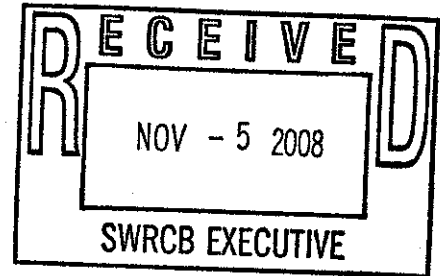


**Stormwater Quality Standards Task Force**

Santa Ana Region  
c/o Santa Ana Watershed Project Authority  
P.O. Box 7729  
Riverside, California 92513-7729

November 5, 2008

Jeanine Townsend  
Clerk to the Board  
State Water Resources Control Board  
1001 I Street, 24<sup>th</sup> Floor  
Sacramento, CA 95814



**Re: Comment Letter – Bacterial Standards for REC-1 Waters**

Dear Ms. Townsend:

Thank you for the opportunity to present scoping comments at your Southern California workshop on October 22, 2008, in Anaheim. This letter memorializes and augments the comments that you heard orally at that workshop from the Santa Ana Region Stormwater Quality Standards Task Force. We appreciate the indulgence of your staff in allowing a planned series of speakers from our Task Force. The Task Force is constituted by the Counties of Orange, Riverside, and San Bernardino, the Orange County Sanitation Districts, the Santa Ana Watershed Project Authority, and the Regional Water Quality Control Board, Santa Ana Region (Santa Ana Regional Board), and conducts regular meetings attended by numerous public and private stakeholders representing local government, the US Environmental Protection Agency (EPA), landowners, industry, and environmental interest groups. We felt that, not only did we have a long list of issues to raise, but that our presentation should illustrate the breadth of participation we have had in the Task Force. This letter generally follows the format of the speakers at the workshop in order to facilitate coordination with staff's notes.

It is important to note that these comments do not represent a Task Force position or recommendation. Rather, this being scoping, this is a broad set of ideas that our Task Force members suggest as being appropriate for State Board staff to investigate and consider. We understand that some members of the Task Force intend to submit separate comments as well.

The Importance of Regionalism. It is important for the State Board to recognize and encourage local and regional approaches to watershed and water quality protection and not discourage them. The Santa Ana Regional Board has made extensive and successful use of cost-shared task forces of stakeholders to accomplish meaningful reviews of standards and proposed updates to standards that would otherwise be infeasible for the Regional Board to undertake with its own resources. One such effort is an ongoing review of the REC-1 freshwater standards that has been underway with a large stakeholder group for almost six years.

In light of this experience, and given the existence of Regional Boards made up of representatives of diverse viewpoints who are charged with setting appropriate standards for their regions, the State Board should consider in this instance the

alternative of not setting a statewide standard for REC-1 at all, but letting Regions do it. Regional Boards are legally obligated periodically to review their own basin plans. The consideration of the particular circumstances in each region – including existing water quality, priority pollutants, economic considerations, preferred treatment approaches and management practices – is a key part of what makes the water quality program workable in a State as geographically diverse as California. While there are certainly aspects of water quality regulation that would benefit from consistent statewide approaches, with regard to REC-1 uses and pathogen indicator bacteria, regional flexibility may be more appropriate. For example, the difference across the State just with regard to temperature and how that affects both the indicators and the uses is significant.

In any event, our Santa Ana experience of grappling with the practicalities of setting and implementing REC-1 standards has brought to light a number of issues that you will also need to consider at the State level.

Environmental Effects of Compliance. It is very unlikely that source control can be relied upon to meet REC-1 standards based on pathogen indicator bacteria. The sources are too pervasive and the potential for growth of bacteria in the environment too high. Runoff from most land uses has been found to contain fecal coliform and *E. coli*. Thus, compliance is being driven toward treatment alternatives, and these have their own potential environmental impacts, or unintended consequences. Treating runoff to reduce pathogen indicator bacteria consumes energy to run pumps, ultraviolet light arrays, and so forth. To treat runoff, it usually has to be diverted from its normal course, whether that is natural or designed, and the diversion itself can have consequences including effects of any barriers used for the diversion and the direct effects on the stream of reducing flows, particularly in dry weather when the water course may be completely diverted. If the method of treatment is chemical, including chlorination or ozonation, there may be disinfection by-products, which may affect the recipients of the treated water, wherever it is subsequently discharged. If chemical additives are to be used, there will need to be chemical storage or transportation, which could have environmental effects. Perhaps most significantly, the practice of treating and disinfecting water using any of the methods currently in wide use results in broad spectrum mortality of microorganisms other than pathogen indicator bacteria. We do not know whether treatment kills environmentally beneficial organisms. Ultimately, careful evaluation of the impacts of treatment requirements is warranted in order to ensure that the cure is not worse than the disease.

What is Within Our Control? Water quality standards should be achievable. Compliance does not have to be easy, but it should at least be physically possible. Thus, we need to account for natural sources. Bacteria water quality objectives are imperfect indicators of human health risk. Unfortunately, direct measurements of human health threats are currently unproven, costly, or both. Problems with bacterial indicators include that they are able to live, die and reproduce in stream systems, unlike the pathogenic organisms they represent. Further, most bacteria are not harmful to humans. *E. coli* and other forms of bacteria can be generated from the gut of any mammal, including native species that naturally inhabit lakes, rivers and streams. Bacteria produced from these mammals are not normally considered pathogenic to humans and thus might not impair recreational beneficial uses. In any case, it is not desirable, even if it were feasible, to remove these animals and thereby impair wildlife-related uses in the interest of protecting REC-1 uses.

1. Natural bacteria loadings from mammals and birds can be significant. Magnification of these loads via colonization and regrowth is also possible. Several studies have documented undeveloped stream systems that regularly exceed existing recreation water quality standards. Natural sources are not considered controllable and the annual or day-to-day loadings from these sources are not predictable. Requirements mandating control or elimination of natural source of bacteria may inadvertently impair natural stream functions and/or impair other designated beneficial uses. It is therefore important that any proposed statewide Recreation Water Quality Objective address natural background sources of bacteria.

2. The State Board must specifically consider the impacts of bacteria regrowth and recovery. Several studies, such as those conducted in south Orange County have documented that the benefits of effective treatment technologies such as UV irradiation are defeated by rapid bacterial regrowth and/or recovery a mere few hundred feet downstream of the BMP.

3. The combined effects of unpredictable natural source inputs and bacteria die-off, regrowth and recovery call into question the very viability of load-based TMDL models for addressing REC-1 use impairments. Bacteria are not conservative pollutants such as metals, pesticides or even nutrients. Therefore, the State must also consider the potential environmental impacts of methods to address impairments in setting the water quality objective.

4. To evaluate the environmental effects of implementation, the State Board must consider how, or more specifically where, compliance with the recreational water quality objectives will be determined. Selection of points of compliance can significantly impact the costs of compliance and environmental outcomes. The Task Force would recommend that the most practical and effective approach would be to determine compliance at representative locations where recreational use occurs in receiving waters, especially by small children.

5. In establishing an appropriate water quality objective for REC-1, seasonality of the objective must be considered. Recreational uses may not only be limited by seasonal low flow conditions, but also by stream configuration and wet weather high flow conditions. Swimming or wading in high velocity flood waters is not safe and not considered recreation. Further, recreational usage of streams and rivers in California is highly specific to the varied stream configuration, flow conditions, and climate conditions that exist in California. If the REC-1 water quality objective does not recognize these conditions appropriately, limited public resources could be misappropriated. Moreover, the conditions that lead to whether or not a recreation use exists are so unique to an individual water body, the Task Force believes that establishing the seasonality of use must be a procedure left to the local Regional Water Quality Control Boards to develop and administer.

The Program Must Focus on Risk. The establishment of an appropriate body contact recreation standard must start with the determination of an acceptable risk level. The EPA guidance provides that the State has the obligation and the discretion to set this level. EPA does not "recommend" a specific level of acceptable risk. EPA does suggest that an *E. coli* standard of 126 is approximately equivalent to the risk protection level provided by the existing fecal coliform objective. For the State to adopt a new objective, however, it must start with consideration of the acceptable risk level.

The true range of acceptable risk levels extends from zero illnesses per 1000 swimmers to 19 illnesses per 1000 swimmers (the current marine standard). The current fecal coliform objective for freshwater is based on an anticipated illness rate of 8 per thousand swimmers. In many instances, our existing inland waterways in Southern California are stormwater channels, often fenced and posted because they represent a hazard, especially during rain. A key question the State Board must answer is why the people entering stormwater channels – even illegally – are entitled to a higher level of protection than the swimmers at the coastal beaches? There are 30 million beach days per year in Orange County and 50 million beach days per year in Los Angeles County. Therefore, the current marine bacteria standards anticipate up to 1.5 million illnesses per year as acceptable. That is many orders of magnitude higher than the total number of people even entering the stormwater channels. At a minimum, this suggests that, in considering a new REC-1 standard, the State should consider the alternative of using the risk level currently applied to marine waters. In order realistically to consider socioeconomic impacts, the State Board should relate the potential cost of compliance with a new standard with the incremental change in expected illness rates based on the likely numbers of people exposed.

Not all exceedances should be treated equally. A sound policy should ensure that available resources will flow to the areas where we can achieve the greatest improvement in public health protection (e.g. actual reductions in the absolute number of illnesses). There is a very wide range of regulatory options available that have been approved by EPA throughout the 50 states. The Task Force has compiled a summary of these alternatives that is attached, or you can download the file from the following website:

[www.sawpa.org/projects/planning/State%20Rec%20Uses%20TM.pdf](http://www.sawpa.org/projects/planning/State%20Rec%20Uses%20TM.pdf)

We urge you to pay particular attention to the approved rules in Kansas and Idaho. For background information, you might also consider the attached summary of how EPA's bacteria criteria were developed and the key underlying assumptions associated with using these criteria to adopt water quality objectives in California. It can be found at the following web address:

[www.sawpa.org/projects/planning/Scientific%20Basis%20for%20EPA%20Recommendations%20WQ%20Objectives%20for%20Bacteria%20-%20Final.pdf](http://www.sawpa.org/projects/planning/Scientific%20Basis%20for%20EPA%20Recommendations%20WQ%20Objectives%20for%20Bacteria%20-%20Final.pdf)

It is critically important for the State Board to bear in mind the assumptions under which the pathogen indicators were originally developed. These included full contact, swimming with full immersion for approximately ten minutes, creating a situation where ingestion of at least 100 ml of water was likely. This kind of evaluation is difficult to translate to ephemeral western streams, much less designed storm channels. In general, this suggests that the State Board cannot fully evaluate alternative objectives without bearing in mind—and potentially reconsidering—the beneficial use definitions. In particular, the State Board should note that the *E. coli* criteria suggested by US EPA were not intended to be used to protect wading and fishing, since those are not primary contact uses in the EPA's way of defining uses.

Science is Producing Alternatives. Even as the State Board is considering moving forward with new REC-1 objectives, US EPA is in the midst of conducting research to support the development of new pathogen indicator criteria by 2012. New indicators

may be very different from any that are currently being used. Other organisms (e.g. bacteroides) and molecular technologies may provide a better surrogate measure of risk to humans. If we continue on our course of using indicators of the presence of human sewage as a proxy for potential pathogenicity, we may find that chemical surrogates such as pharmaceutical residuals are more suitable indicators than any of the bacteria currently being used or considered. In considering objectives based on indicators, rather than direct measurement of pathogens, the State Board should consider whether implementation of the standards will simply amount to removing the canary from the coal mine, without addressing the poison gas.

One alternative approach that the State Board should consider would be to concentrate efforts directly on reducing sources of human sewage. The State could fashion a narrative objective for controlling sources of human sewage and use pathogen indicator bacteria monitoring to direct or trigger investigation, rather than as an enforceable standard.

The State Board will need to consider, for any new objective, whether and how to apply single sample maximum (SSM) numeric standards. For REC-1 objectives, SSMs were never intended to be applied as independent water quality objectives when there are sufficient data to calculate geometric means. Using indicators inappropriately as SSMs severely limits the available alternatives for implementation, favoring extensive treatment, with its potential harmful side effects. Moreover, the State Board should extend the Ocean Plan precedent to limit the use of SSMs when making 303(d) listing decisions.

Application of the 13241 Factors. The State Board is obligated, in considering new objectives, also to consider the factors listed in Water Code Section 13241. In general, we urge the State to apply the Porter Cologne Water Quality Control Act's overarching principles of reasonableness in crafting REC-1 protections that balance actual risk against potentially significant costs. To address actual risk with the minimum environmental impact and to be most consistent with the 13241 factors, the State Board should encourage regions to consider developing a "limited REC" use with objectives tailored to the lower exposure. Finally, it may be that the complex balancing of concerns, from acceptable risk, to matching monitoring points and implementation to places of actual exposure, to consideration of the 13241 factors, can only be effectively achieved at a more local or regional level, rather than statewide.

Thank you for considering these scoping comments regarding the State Board's consideration of potential new bacterial standards. We look forward to continuing dialogue on this issue if the State Board decides to continue toward setting new objectives.

Sincerely,



Larry B. McKenney  
Chair, Stormwater Quality Standards Task Force  
Santa Ana Region



## Memorandum

To: *Stormwater Quality Standards Study Task Force*

From: *CDM*

Date: *April 10, 2006*

Subject: *Scientific Basis for EPA Recommended Water Quality Objectives for Bacteria*

### Introduction

At the direction of the Stormwater Quality Standards Study Task Force, CDM researched the technical or scientific basis used to establish the recommended bacteria water quality objectives contained in the draft Environmental Protection Agency (EPA) guidance document, *Implementation Guidance for Ambient Water Quality Criteria for Bacteria*, (November 2003), including any assumptions, "safety factors" and other information relative to "acceptable" vs. "unacceptable" risks used in determining recommendations. This information was to be gathered to provide an assessment of the applicability of the assumptions, conditions and safety factors in EPA guidance relative to conditions within the Santa Ana River watershed.

### Methodology

The requested research was conducted by following three general steps:

- CDM reviewed the history of EPA recommendations for the establishment of bacteria water quality objectives to protect recreational uses published in guidance documents dating back to 1968.
- Key documents cited in the EPA guidance documents were obtained (if available) and subsequently reviewed to gather additional information that provided a more complete understanding of the information contained in the EPA documents.
- Related documents that addressed the subject of the establishment of appropriate objectives for the protection of recreational uses were reviewed. This source list was initially generated by reviewing the citations in the recent National Academy of Sciences report, *Indicators for Waterborne Pathogens*, (National Research Council 2004).

While information was gathered on both freshwater and marine studies, the majority of the information presented in this technical memorandum focuses on the freshwater studies.

However, where potentially relevant, information from marine studies also has been included.

## Summary of Findings

The federally recommended bacteria objectives are, to a degree, somewhat subjective; however, this does not discount or minimize the fact that increased pathogens have been shown to be related to increased illness. This has been demonstrated in numerous studies conducted around the world, especially in marine waters. However, while there should be no disagreement that this relationship exists, what can be debated and considered is how the federal recommended objectives be applied to different types of waters.

Following is a summary of findings that provides some understanding regarding how the federal objectives were derived. With this understanding in mind, the applicability of the federally recommended bacteria objectives to waterbodies with varying qualities may be considered. More detailed information follows this section.

- The bacteria objectives recommended by EPA are based on two epidemiological studies conducted during summer months generally from 1979 to 1982 at Keystone Reservoir in Oklahoma and Lake Erie in Pennsylvania.
- Bacteria objectives are intended to protect swimmers or primary contact activity where there is a high risk of ingestion of water. McKee (1980), which provides part of the basis for EPA's recommended freshwater primary contact objectives (i.e., the studies involving Keystone Reservoir), provides a clear distinction between swimmers and non-swimmers:
  - Non-swimmers were those who either did not go in the water (non-bathers) or went in the water but did not get their head or face wet (waders). *Persons who reported that they were in the water for less than ten minutes were classified as non-swimmers regardless of whether they got their head or face wet, in view of their short water exposure time.* No explanation was offered for why ten minutes was selected as this threshold.
  - Swimmers were those who did swim or otherwise get their head or face wet.

Although the specifics of the Lake Erie study were not available (as they were for Keystone Reservoir), Dufour (1984) states that "swimming activity was rigidly defined" in the context of studies at both locations; thus, we have no reason to believe that the swimmer definition provided by McKee (1980) was any different than that which was used at Lake Erie.

With the exception of a few waters in the Santa Ana River basin, e.g., portions of the mainstem Santa Ana River and Big Bear Lake, "swimming" as defined above is not likely to occur - especially given that the study classified short exposure swimming (less than 10 minutes) as non-swimming.

- Although there is a pattern of higher illness rates in swimmers, the rates for swimmers and non-swimmers were often not significantly different. In fact, for the symptom category "Highly credible gastrointestinal symptoms" only 2 of the 9 comparisons found a significantly higher illness rate for swimmers (see Tables 2 and 3).
- Children are noted as potentially being more susceptible to illness than adults (e.g., see Federal Water Pollution Control Administration 1968; EPA 2003). However, children were included in the freshwater and marine epidemiological studies, and thus the recommended objectives already consider any potential for increased illness rates in children.
- Fleisher et al. (1993) discusses how easily risk may have been over or underestimated in the epidemiological studies conducted by EPA ; in addition, Fleisher (1991) demonstrates how easy data may be manipulated to achieve different interpretations. Ultimately, Fleisher et al. (1993) argues that the problem is best dealt with thorough risk management decisions.
- The acceptable risk used to establish recommended bacteria objectives is arbitrary. From the EPA Gold Book (EPA 1986):

"The levels displayed in Table 1 [Gold Book, 1986] depend not only on the assumed standard deviation of log densities, but also on the chosen level of acceptable risk. While this level was based on the historically accepted risk, it is still arbitrary insofar as the historical risk was itself arbitrary" (the basis for the historical risk is described in Federal Water Pollution Control Administration 1968).
- The single sample maximum values published in EPA (1986) for beaches ranging from "designated beach area" to "infrequently used" were intended to apply to swimmable areas or areas where primary contact recreation is possible.
- Cabelli's (1983) comments on the recommended bacteria objectives for marine waters included recommendations on how these objectives can best be used:
  - The recommended objective provides a relatively reliable generalization which is amenable to risk analysis, allows a wider choice of options at both the federal and local levels, and can be defended on the basis of epidemiological data.
  - A cost-benefit or cost-effectiveness type model should be developed for determining the acceptable risk or incidence of illness in the context of general and local factors.
  - The "most resource responsible use" of the proposed objectives is for translation into effluent guidelines governing the design of sewage treatment facilities, the location of their outfalls and the decisions to be made relative to the degree of treatment and disinfection required.
- EPA (2003) recognizes the need for a risk-based approach. This recognition makes sense given the basis for the objectives, the potential bias in the approach, the wide range of waterbody types to which these objectives could be applicable to, and the range of



recreational activities that may occur in these waters. Recently, the EPA illustrated how it accepts states using a risk-based thought process in establishing bacteria objectives to protect different levels of recreational activity (see EPA Kansas approval letter in Appendix B of "*Review of State Recreational Uses and Bacteria Objectives*" in CDM Stormwater Quality Standards Study Task Force Technical Memorandum, December 12, 2005).

## Supporting Documentation

The following sections provide a summary of the findings from documents reviewed to date. Complete references are provided at the end of this document.

### History of EPA Recommended Bacteria Water Quality Objectives for the Protection of Recreational Uses

Between 1968 and 1986, the EPA published five guidance documents addressing the establishment of bacteria water quality objectives:

- Report of the National Technical Advisory Committee ("Green Book"), Federal Water Pollution Control Administration (1968)
- Report of the Committee on Water Quality Criteria ("Blue Book"), National Academy of Sciences - National Academy of Engineering (1973)
- Quality Criteria for Water, 1976 ("Red Book"), U.S. EPA (1976)
- Ambient Water Quality Criteria for Bacteria - 1986, U.S. EPA (1986)
- Quality Criteria for Water, 1986 ("Gold Book"), U.S. EPA (1986)

A sixth document, *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* (November 2003 Draft), provides additional guidance with regards to how EPA recommends the 1986 criteria be implemented.

### Overview

In general, the typically accepted primary contact fecal coliform objectives in use by states today date back to the 1968 Green Book recommendations. These recommendations were based on limited epidemiological data from three studies conducted by the United States Public Health Service (USPHS) on Midwestern waters (Great Lakes in Michigan, Inland River and Ohio River [Ohio]) from 1948-1950. In addition, the concept of a secondary contact use having objectives that are 10 times the primary contact objectives also has its root in the 1968 recommendations.

The only significant change from the 1968 recommended bacteria objectives occurred with the publication *Ambient Water Quality Criteria for Bacteria* (EPA 1986). This publication based on studies conducted on freshwater beaches in Oklahoma and Pennsylvania and marine beaches in New York, Massachusetts and Louisiana resulted in EPA recommending that states adopt

*E. coli* and enterococci as the recommended pathogen indicators for the protection of recreational uses in freshwater and marine waters, respectively.

The 1986 recommendations provided a risk-based approach for establishing criteria with a geometric mean based on an acceptable risk level and single sample criteria based on consideration of the frequency of use of the beach. The 2003 draft guidance did not change the 1986 recommended objectives, but instead provided guidelines on how bacteria objectives may be implemented. The following sections provide a brief summary of the recommendations contained within each document referenced above and the basis for those recommendations.

### **Green Book**

The Green Book recommended bacteria water quality objectives for three types of recreational uses. These uses, their definitions and associated criteria are as follows:

- Criteria for Primary Contact Recreation - The Green Book recommended that primary contact recreation be applied to

“... activities in which there is prolonged intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard. Examples are wading and dabbling by children, swimming, water skiing and surfing.”

The recommended fecal coliform objectives were as follows:

“... based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation waters shall not exceed a log mean of 200/100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 ml.”

The basis for the recommended objectives was USPHS epidemiological studies that showed an epidemiologically detectable health effect at levels of 2,300 – 2,400 total coliforms per 100 ml. Subsequent work indicated that fecal coliforms represented 18% of the total coliforms. This relationship suggested that detectable health effects may occur at a fecal coliform level of about 400 per 100 ml. The addition of a 2X safety factor resulted in the recommendation of 200 per 100 ml.

- Criteria for General Recreational Use of Surface Waters - General recreational use is discussed in the context of a “secondary contact” type of use, where there is no significant risk of ingestion. Applicable criteria for this use was recommended as follows:

“In the absence of local epidemiological experience, the Subcommittee recommends an average not exceeding 2,000 fecal coliform per 100 ml and a maximum of 4,000 per 100 ml except in specified mixing zones adjacent to outfalls.”

The basis for this recommendation was as follows:

"risk [is] considered to be one-tenth that for primary contact recreation...Further research will be necessary to arrive at precise criteria for secondary contact recreation activities."

- Criteria for the Enhancement of Recreation Value of Waters Designated for Recreation Uses Other Than Primary Contact Recreation - The Green Book states that the recommendations for this category:

"are intended to apply where recreation is a designated use for water quality management purposes (but not in cases where primary contact recreation is involved)."

The recommended criteria are as follows:

"In waters designated for recreation uses other than primary contact recreation, the Subcommittee recommends that the fecal coliform content...should not exceed a log mean of 1,000/100 ml, nor equal or exceed 2,000/100 ml in more than 10 percent of the samples."

### **Blue Book**

The Blue Book, published in 1972, did not support the 1968 recommendations stating that "current epidemiological data are not materially more refined or definitive than those that were available in 1935." The authors noted:

"When used to supplement other evaluative measurements, the fecal coliform index [criteria recommended in the Green Book] may be of value in determining the sanitary quality of recreational water intended for bathing and swimming. The index is a measure of the "sanitary cleanliness" of the water and may denote the possible presence of untreated or inadequately treated human wastes. But it is an index that should be used only in conjunction with other evaluative parameters of water quality such as sanitary surveys, other biological indices of pollution, and chemical analyses of water. To use the fecal coliform index as the sole measure of "sanitary cleanliness," it would be necessary to know the maximum "acceptable" concentration of organism; but there is no agreed-upon value that divides "acceptability" from "unacceptability." Thus, as a measure of "sanitary cleanliness," an increasing value in the fecal coliform index denotes simply a decrease in the level of cleanliness of the water."

The Committee that authored the Blue Book ultimately concluded that no recommendations should be made concerning bacteria concentrations in "bathing water" "because of the paucity of valid epidemiological data." However, the Committee footnoted its findings stating that:

"if an arbitrary value for the fecal coliform index is desired, consideration may be given to a density value expressed as a geometric mean of a series of samples collected during periods of normal seasonal flow. A maximum value of 1000 fecal coliform per 100 ml could be considered."

### **Red Book**

The Red Book, published in 1976, reversed the 1972 position and reinstated the Green Book recommendations for primary contact or "bathing waters":

"Based on a minimum of not less than five samples taken over a 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 during any 30-day period exceed 400 per 100 ml."

No definition is provided for "bathing waters," and there is no discussion of bacteria objectives for recreational uses other than primary contact.

### **Gold Book and Ambient Water Quality Criteria for Bacteria**

The Gold Book, published in May 1986, includes the bacteria objective recommendations published in *Ambient Water Quality Criteria for Bacteria* (EPA 1986) ("bacteria guidance") - the document that changed the recommended bacteria objectives for freshwater from fecal coliform to *E. coli*. The Gold Book summarizes the findings of several documents that were used to generate the bacteria guidance document. These key documents: Cabelli (1983), Dufour (1984), and McKee (1980) provide more detailed information and are discussed below. However, some of the key points are summarized here:

- The 1986 guidelines established the risk-based approach that considers an acceptable number of illnesses. For the 1986 document, the acceptable illness rate for freshwater was 8 illnesses/1000.
- No studies were done to determine what is an "acceptable illness rate." Instead, the "acceptable illness rate" was established by back-calculating the risk associated with the 200 fecal coliforms/100 ml objective already in use (see above for basis of the fecal coliform objectives).
- The Gold Book states that the recommended objectives depend on the chosen level of acceptable risk and admits, that "while this level was based on the historically accepted risk, it is still arbitrary insofar as the historical risk was itself arbitrary."
- The 1986 bacteria guidance was focused on designated beaches: The situation needing the most rigorous monitoring is the designated swimming beach. Such areas are frequently lifeguard protected, provide parking and other public access and are heavily used by the

public. *Public beaches of this type were used by EPA in developing the relationship described in this document*" (emphasis added).

- The EPA document notes that the equations used to calculate geometric mean indicator densities for *E. coli* and enterococci corresponding to the accepted gastrointestinal illness rates are for "steady state dry weather conditions."
- The basis and purpose for the single sample maximum values is as follows:

"To set the single sample maximum, it is necessary to specify the desired chance that the beach will be left open when the protection is adequate. This chance, or confidence level, was based on Agency judgment. For the simple decision rule considered here, a smaller confidence level corresponds to a more stringent (i.e. lower) single sample maximum. Conversely, a greater confidence level corresponds to less stringent (i.e., higher) maximum values. This technique reduces the chances of single samples inappropriately indicating violations of the recommended criteria. By using a control chart analogy and the actual log standard deviations from the EPA studies, single sample maximum densities for various confidence levels were calculated. EPA then assigned qualitative use intensities to those confidence levels. A low confidence level (75%) was assigned to designated beach areas because a high degree of caution should be used to evaluate water quality for heavily used areas. Less intensively used areas would allow less restrictive single sample limits. Thus, 95% confidence might be appropriate for swimmable water in remote areas. "

Note: Table 4 in the in EPA (1986) bacteria guidance clearly states that the single sample maximums based on confidence levels are applicable to waters for *full body contact recreation*. However, while the text of EPA 2003 clearly states that different objectives may apply to waters that are not designated primary contact recreations, Table 1-1 in EPA (2003), which summarizes the Table 4 objectives from EPA (1986), does not explicitly state that the single sample maximums are for full body contact recreation. Unless the full text is read, the intended applicability of Table 1-1 may be misunderstood.

### **2003 Draft Implementation Guidance**

The 2003 draft guidance does not change the 1986 objective recommendations, but instead provides guidance on how these objectives may be implemented and provides alternatives to directly establishing the 1986 recommendations, especially where primary contact recreation is not an existing use or primary contact use is not attainable because of high flows, temperature or non-human sources of bacteria.

### ***Recreational Categories***

With regards to primary and secondary contact, this document provides additional guidance regarding where these uses may apply:

- "States... should assure that primary contact recreation uses are designated for waterbodies where people engage, or are likely to engage, in activities that could result in ingestion of water or immersion. These activities include swimming, water skiing, kayaking, and any other activity where contact and immersion in the water are likely. Certain conditions, such as the location of a waterbody, high or low flows, safety concerns, or other physical conditions of the waterbody may make it unlikely that these activities would occur. However, states...should take into consideration that there will be individuals, particularly children, who may be more likely to swim or make other use of the waterbody such that ingestion may occur. States...should take those populations into account when making designated use determinations."
- "For waterbodies where a state...demonstrates through a use attainability analysis that "swimmable" standards are not attainable, adoption of secondary contact uses and the associated water quality criteria may be appropriate. EPA defines secondary contact uses as including activities where most participants would have very little direct contact with the water and where ingestion of water is unlikely. Secondary contact activities may include wading, canoeing, motor boating, fishing, etc."

For waters designated with a secondary contact use, the EPA notes and recommends the following with regards to the establishment of water quality objectives:

- "EPA is unable to derive a national criterion for secondary contact recreation based upon existing data, because secondary contact activities involve far less contact with water than primary contact activities. During the development of this guidance document, EPA explored the feasibility of deriving criteria for secondary contact waters and found it infeasible for several reasons. In reviewing the data generated in the epidemiological studies conducted by EPA that formed the basis for its 1986 criteria recommendations, EPA found that the data would be unsuitable for the development of a secondary contact criterion. The data collected were associated with swimming related activities involving immersion. Secondary contact recreation activities generally do not involve immersion in the water, unless it is incidental."
- "Despite the lack of epidemiological studies/data necessary to develop a risk-based secondary contact recreation criterion, EPA believes that waters designated for secondary contact recreation should have an accompanying numeric criterion...Accordingly, states...may wish to adopt a secondary contact criterion which is five times their primary contact criterion. EPA recommends that secondary contact criteria be geometric mean values using a 30 day, seasonal, or annual averaging period. Clearly identifying the averaging period is very important to support attainment and permitting decisions. Another approach would be the adoption of a secondary contact criterion as a maximum, not to be exceeded value. EPA feels that this would also be an appropriate approach, particularly for states...that are unable to collect sufficient monitoring data to calculate a geometric mean value. States...may also pursue other approaches for secondary contact

waters, and EPA will work with the state...to ensure the approach is protective of the designated use and meets the above objectives."

***Single Sample Maximum Versus Geometric Mean for Measuring Compliance***

With regards to the use of a single sample maximum in addition to a geometric mean for measuring compliance, this document provides additional guidance. EPA recommends adopting both a geometric mean and an "upper percentile value". The term "upper percentile value" is used in place of "single sample maximum" to more accurately reflect their derivation and more adequately reflect the range of recommended usage of this aspect of EPA's criteria. Although the upper percentile value is intended primarily for beach monitoring and notification programs, including it in water quality standards provides the flexibility to determine the circumstances in which either the geometric mean or the upper percentile value (or both) would be most appropriate when determining attainment. Per the 2003 Draft Implementation Guidance, the "single sample maximum" was never intended to be a value not to be exceeded when referring to attainment decisions and National Pollutant Discharge Elimination System (NPDES) permitting under the Clean Water Act. Therefore, EPA proposed dropping the use of the term in favor of the more statistically correct term "upper percentile value."

EPA encourages using only one bacteria indicator. Once a state adopts *E. coli* and/or enterococci as indicators to replace fecal coliform, the EPA recommends removing fecal coliform criteria from recreational waters, as retaining it may result in unnecessary additional permitting and monitoring requirements. To facilitate a period of transition, EPA states that both fecal coliform and *E. coli*/enterococci may be included in water quality standards for a limited period of time, generally one triennial review cycle. Temporarily using both *E. coli* / enterococci and fecal coliform criteria could prove useful for enabling regulatory decisions and actions to continue while collecting data for newly adopted *E. coli*/enterococci criteria. EPA stresses that with this option available, lack of data should not delay adoption of *E. coli* and/or enterococci criteria.

***Non-Human Sources of Bacteria***

According to the guidance, in many circumstances waterbodies are impacted by not only human sources of fecal contamination, but also domesticated animals and wildlife. Available data suggest there is some risk posed to humans as a result of exposure to microorganisms resulting from non-human fecal contamination, particularly those animal sources with which humans regularly come into contact, i.e., livestock and other domestic animals. Accordingly, EPA believes it is inappropriate to conclude that these sources present no risk to human health from waterborne pathogens. Accordingly, states should account for bacteria from all non-wildlife sources in water quality standards.

EPA guidance states that broad exemptions from bacteriological criteria should not be used based on the presumption that high levels of bacteria originating from non-human fecal

contamination present no risk to human health. Rather, limited exemptions should be used only when high levels of bacteria are shown to be from wildlife sources. This revises EPA's previous policy as stated in its 1994 Water Quality Standards Handbook, which allowed states and authorized tribes to justify a decision not to apply the bacteriological criteria to particular recreational waters when high concentrations of bacteria were found to be of animal origin.

A recent study performed in Mission Bay in San Diego, California may be an example of a study that could be used as support for a "limited exemption" as described by EPA. The study included an investigation of potential human sources of indicator bacteria into Mission Bay, and an investigation into non-human sources using emerging molecular source tracking techniques. Bacteria transport and sediment source evaluations were also a part of the study.

The Mission Bay study concluded that the large majority of enteric bacteria in Mission Bay originates from birds, and contributions from human sources are insignificant. Avian sources amounted to 67% of the bacteria contained within study samples; human sources amounted to 5%. The report states that because little can be done about the number of birds in Mission Bay, management solutions should focus on areas that contribute to the initial bacteria load from birds (San Diego, Mission Bay Clean Beaches Initiative Final Report, 2004).

## **Methods and Basis for Establishment of EPA Recommended Bacteria Objectives**

The review of the scientific basis used by the EPA to establish water quality objectives to protect recreational uses is found in three key documents:

- Cabelli, V.J. 1983. *Health Effects Criteria for Marine Recreational Waters* - Although the emphasis is on the establishment of bacteria objectives for marine waters, some interesting recommendations are contained in this document.
- Dufour, A.P. 1984. *Health Effects Criteria for Fresh Recreational Waters* - This EPA document provides the basis for the *E. coli* criteria for freshwaters. The document's content is based in part on the research conducted by McKee (1980).
- McKee, G.L. 1980. *Development of Health Effects Criteria for Fresh Water Bathing Beaches by Use of Microbial Indicators* - One of the study sites used to develop the *E. coli* freshwater objectives was in Oklahoma and the studies conducted at this site were done as part of a Ph.D. dissertation at the University of Oklahoma.

Following is a summary of the key findings from each of the above documents.

### **Health Effects Criteria for Marine Recreational Waters (Cabelli 1983)**

Per this document, the objective of the program was to produce criteria defined as:



"a mathematical relationship of some untoward effect from swimming in sewage polluted water to the quality of that water as measured by any of a number of potential microbial or chemical indicators; thus, they were to be amenable to risk analysis."

In Cabelli's summary of why these studies were needed, the author notes:

- Without exception, existing guidelines suffer from two major deficiencies: (1) paucity or lack of epidemiological data to support guidelines; and (2) a consequence of the first deficiency, officials responsible for making decisions are given a "number," and this inherently limits the options available in decision-making for compliance or noncompliance.
- To resolve the deficiencies, an alternative approach is needed that takes into account risk:  
"This approach then permits a decision as to 'acceptable risk' based upon social, economic, medical, public health, and even political considerations (some form of cost-benefit or cost-effectiveness analysis). The acceptable risk of illness or its incidence can then be extrapolated from the criterion to yield a water quality limit (guideline), and the guideline can then be fixed in law to provide a standard."

The result of this study was a recommendation to replace fecal coliform objectives with enterococci objectives in marine waters. Since the focus of this document is on freshwaters, the specifics of these recommendations will not be discussed further in this document. However, in preparing the recommendations, the author also noted the following regarding the implementation of the proposed objectives:

- The recommended objective provides a relatively reliable generalization which is amenable to risk analysis, allows a wider choice of options at both the federal and local levels, and can be defended on the basis of epidemiological data.
- A cost-benefit or cost-effectiveness type model should be developed for determining the acceptable risk or incidence of illness in the context of general and local factors.
- The "most resource responsible use" of the proposed objectives is for translation into effluent guidelines governing the design of sewage treatment facilities, the location of their outfalls and the decisions to be made relative to the degree of treatment and disinfection required.

#### **Health Effects Criteria for Fresh Recreational Waters (Dufour 1984)**

Dufour (1984) used the findings from epidemiological studies at two fresh waterbodies to develop the current *E. coli* objectives recommended by EPA for the protection of primary contact recreation. These two locations are Keystone Reservoir on the Arkansas River near Tulsa, Oklahoma and Lake Erie in Pennsylvania. Dufour summarizes the study sites, methodology used and findings, but cites McKee (1980) for a more detailed presentation of the methodology (see below).

### *Study Sites*

#### Keystone Reservoir

- Beach Sites - (1) first beach set was less than three miles from the point of discharge of a wastewater treatment facility (Beach W) (Note: McKee (1980) explains that Beach W actually consists of two separate beaches, one less than a mile, and the other almost three miles from the point of discharge. Dufour (1984) combines the data from these beaches), and (2) the second beach site was located about five miles from the treatment outfall (Beach E).
- Wastewater Facility - In 1979 the sewage treatment system was two "full retention" lagoons, which discharged an average of 120,000 gallons per day of unchlorinated sewage. The following year the practice of releasing non-disinfected sewage into the lake was discontinued. After April of 1980, approximately 60,000 gallons per day of sewage was passed through one of the lagoons, then through an aeration basin after which it was adequately treated with chlorine before being discharged.

#### Lake Erie

- Beach Sites - Two sites located in a State Park, situated on a peninsula just north of the City of Erie: (1) Beach B is approximately three-quarters of a mile northwest of a wastewater treatment facility outfall which discharges the treated sewage of a large urban population. (2) Beach A, which is located on the opposite side of the peninsula from the wastewater effluent outfall, does not receive pollutants from a point source and the quality of the water is "usually good."
- Wastewater Facility - An activated sludge process is used to treat an average of 45 million gallons per day of sewage. The secondary treatment effluent was chlorinated before being discharged into the lake.

It should be noted that the Lake Erie and Lake Keystone studies were performed during non-stormwater conditions. What may be attainable based on these studies versus what may be attainable under a stormwater scenario has not been studied.

### *Methodology*

- The beach surveys or trials were conducted only on weekends to take advantage of the large populations using the bathing beaches and to permit more intensive monitoring of water quality during the time of swimming activity.
- Swimming activity was rigidly defined as having all upper body orifices exposed to the water. Interviewers were instructed to observe the individuals they were interviewing for signs of complete body immersion, such as wet hair. This was not always possible and reliance was then placed in the responses to questions about swimming activity.
- The nonswimming control group was selected from beachgoers who did not meet the definition of a swimmer.

- The beach interviews were conducted in two phases:
  - In the first phase, trained interviewers approached beachgoers who were about to leave the beach area and solicited their cooperation in the study. The following procedure was followed:
    - Whenever possible, family units were sought because information on multiple individuals could be obtained from one person, usually an adult member of a family.
    - During this initial contact, the following information was obtained on each participant: sex, age, race and ethnicity, if the person swam and got their head and face wet, length of time and time of day in the water, the illness symptoms they may have had in the previous week, and for those who did not swim, the reason for not going into the water.
    - An address and telephone number were requested so that follow-up information could be obtained.
    - If an individual had gone swimming in the previous five days, they were not asked to participate in the study.
  - In the second phase, telephone interviews were conducted 8 to 10 days after the swimming experience. The eligibility of each participant was confirmed, i.e., they had not swam in the week following the initial contact, before they were queried about the onset of any symptoms of illness that might have occurred during the time interval between the swimming experience and the follow-up telephone call.

#### *Analysis of Results & Findings*

- Unlike marine beaches, where wading and sunning are more popular than swimming, the beach goers at freshwater beaches had a tendency to go into the water for extended periods and to immerse their bodies totally in the water.
- Greater water activity results in a much smaller nonswimming population from which a control group can be chosen. To overcome this limitation of the freshwater studies, it was necessary to pool the nonswimming control groups from each beach within a single swimming season to form a single control population.
- Pooling of nonswimming control groups for each year increased the probability of detecting a difference in the incidence of illness between swimmers and non-swimmers if it does exist.
- The variables used to examine the relationship between swimmers and non-swimmers were (1) the differences in symptomatic illness rates between swimmers and non-swimmers, and (2) the density of bacterial indicators in the water at the time of swimming activity.
- Symptoms of interviewees were classified into five categories (Table 1).

Symptom Category	Definition
<b>Gastrointestinal</b>	Positive response for any of the following individual symptoms vomiting, diarrhea stomachache or nausea
<b>Respiratory</b>	Individual symptoms included sore throat, bad cough or a chest cold
<b>Other</b>	Individual symptoms included fever (greater than 100°F), headache for more than three hours, and backache
<b>Disabling Gastrointestinal Symptoms</b>	Any one gastrointestinal symptom plus any one of the following characteristics: stayed home due to symptoms, stayed in bed due to symptoms or sought medical help due to symptoms.
<b>Highly Credible Gastrointestinal Symptoms</b>	Combination of unmistakably recognized individual symptoms used to establish the credibility of the gastrointestinal illness; defined as any one of the following: (1) vomiting, (2) diarrhea with a fever or disabling condition (remained home, remained in bed or sought medical advice due to symptoms) and (3) stomachache or nausea accompanied by a fever.

- In general, the symptom rates for swimmers were higher than those for non-swimmers, in all the categories (see Tables 2 and 3).

Symptom Category (Table 1)	1979				1980			
	Beach W <sup>1</sup>		Beach E		Beach W <sup>1</sup>		Beach E	
	S	NS	S	NS	S	NS	S	NS
<b>Gastrointestinal</b>	61	52	57	52	36.7*	19	37.9*	19
<b>Respiratory</b>	94	84	70	84	47*	32.2	51.1	32.2
<b>Other</b>	71*	53	55	53	29.3*	21.5	32*	21.5
<b>Disabling Gastrointestinal Symptoms</b>	20.6	17.5	15.6	17.5	11.7	9.1	10.1	9.1
<b>Highly Credible Gastrointestinal Symptoms</b>	20.6	15.5	16	15.5	13.5	8.3	11.2	8.3
<b>N-Value</b>	3059	970	2440	970	5121	1211	3562	1211

<sup>1</sup> Beach W comprised of two separate beaches (see McKee 1980)

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\* Swimmer illness rate significantly different from non-swimmer illness rate at the  $p < 0.05$  level

† Non-swimmer illness rate significantly different from swimmer illness rate at the  $p < 0.05$  level

Symptom Category (Table 1)	1979				1980				1982	
	Beach A		Beach B		Beach A		Beach B		Beach B	
	S	NS	S	NS	S	NS	S	NS	S	NS
Gastrointestinal	54.6	44.7	56.4	44.7	55*	45.4	75.4*	45.4	58.3	46.7
Respiratory	50	42.6	55.4	42.6	36.8	53.4†	68.8	53.4	67.9	50.3
Other	30.1	25.5	40.4*	25.5	32	36.1	52.7	36.1	49.6	59.4
Disabling Gastrointestinal Symptoms	12.3	10.2	18.5	10.2	8.9	8.3	16.9*	8.3	19.7	11.5
Highly Credible Gastrointestinal Symptoms	17.2	14.9	19.5	14.9	16.5	11.7	26.4*	11.7	24.9*	13.9
N-Value	3020	2349	2056	2349	2907	2944	2427	2944	4374	1650

\* Swimmer illness rate significantly different from non-swimmer illness rate at the  $p < 0.05$  level

† Non-swimmer illness rate significantly different from swimmer illness rate at the  $p < 0.05$  level

- Most of the symptom rates, especially those unrelated to enteric illness, were not statistically significant ( $p < 0.05$ ). This finding was similar to that observed in the early USPHS studies (4) conducted in the 1950s and in the marine recreational water studies conducted by the USEPA in the 1970s.
- Most of the statistically significant differences between swimmer and non-swimmer illness rates, with one exception, occurred in those symptomatic illness categories associated with enteric disease.
- The significant swimming related illness rates also had a tendency to occur at the beach with poorer quality water, Beach B (see Table 4 for water quality results).
- "These data clearly show that there is a swimming-associated health effect and that the effect appears to be related to the microbiological quality of the bathing water. The illness rates by age showed a pattern similar to that observed in the marine bathing beach studies, wherein the highest rates for gastrointestinal illness occurred in children under 10 years old."

**Table 4. Bacteria densities at Keystone Lake and Lake Erie Bathing Beaches (Reported in Dufour 1984)**

Keystone Reservoir					
Year	Beach	<i>E. coli</i>		Fecal Coliform	
1979	W <sup>1</sup>	138	30-300	436	200 - 920
	E	19	1 - 44	51	NA
1980	W <sup>1</sup>	52	14 - 200	230	58 - 1300
	E	71	12 - 215	234	47 - 1600
Lake Erie					
1979	A	23	7 - 268		
	B	47	16 - 413		
1980	A	137	66 - 536	37	1 - 191
	B	236	110 - 950	104	8 - 279
1982	B	146	23 - 524	60	27 - 107

<sup>1</sup> Beach W consists of two separate beaches (see McKee 1980)

#### Development of Health Effects Criteria for Fresh Water Bathing Beaches by Use of Microbial Indicators (McKee 1980)

The freshwater studies conducted at Keystone Reservoir were actually carried by McKee as a Ph.D. dissertation. The summary provided by Dufour (1984) comes directly from this dissertation. McKee offers this statement as his conclusion regarding the study findings:

“When the data from the...beaches was examined, the symptom rates categorized as gastrointestinal, respiratory and “other” were higher among swimmers than non-swimmers. Although the data was not statistically significant, definite trends could be shown in that direction. Good agreement was obtained between geometric means of *Escherichia coli* and *enterococcus* densities and the differential (swimmers minus non-swimmers) rate of gastrointestinal symptoms.”

McKee provides a little more detail regarding the characteristics of the study site and the beaches used for the study:

“The city of Mannford, Oklahoma has a population of approximately 2,300 people. The sewage system for this community was two ‘full retention’ lagoons. These lagoons were located near the Keystone Reservoir in Creek County...The lagoons were within one mile of the Salt Creek North bathing area and within 3 miles of the Keystone Ramp bathing beach area. These two beaches were used as the ‘barely acceptable’ test beaches. The lagoons were too small to retain all of the sewage effluent that the City of Mannford discharged. This sewage effluent was 120,000 gallons per day on the average throughout the summer of 1979...The test beaches had fecal coliform counts that usually exceeded 100 organisms/100 ml of

sample...Pre-test bacterial sampling using *E. coli* and enterococci was done in the summer of 1978 and these organisms were consistently high at the test beaches. A "control" beach on the other side of the reservoir was selected. This beach was Washington Irving South, located on the Arkansas River arm of the Keystone reservoir. The fecal coliform counts were relatively low at this site and pre-testing of *E. coli* and enterococci showed it to be unpolluted."

McKee provides a detailed summary of the field procedures, particularly how it was decided whether or not to include people in the analysis and, if included, how they were categorized as swimmers or non-swimmers:

■ Selection of interviewees:

- Interviews conducted on weekends with family group members
- Interviewing was planned for every "good" weekend day, i.e., every Saturday and Sunday in June, July and August for which the "probability of fair weather indicated a large number of beach-goers"
- Interviewers were told to approach as many groups on the beaches as possible and to be attentive to groups who appeared to be near the point of leaving for the day
- Persons who swam between Monday and Friday of the previous week were not interviewed

■ Follow-up telephone calls:

- Follow-up phone calls to obtain information on health status of original interviews were conducted 9 to 11 days after the swimming event - 83% success rate in follow-up interviews)
- Persons who swam between Monday and Friday after the initial beach interview were eliminated to avoid possibility of incubation of symptoms from a weekday swimming experience
- Persons who swam on the weekend following the initial interview were retained in the study
- Persons who were encountered on two successive weekends were not interviewed for the second weekend
- Persons encountered a second time who had a least one intervening weekend but no mid-week swimming were retained for both occasions
- Person who swam on both Saturday and Sunday of one weekend were included as swimming on the day with the highest microbial count

■ Link to water quality:

- Microbial counts on the day of swimming were linked to the interview data of each respondent retained in the sample
- Water samples were collected according to the following procedure:
  - Collected periodically during time of maximum swimming activity on each interviewing day
  - Samples collected at approximately 1, 3 and 5 pm
  - Samples taken at chest depth approximately 4 inches below the surface
  - Mannford Sewer Plant also conducted water chemistry testing for a variety of constituents, e.g., BOD, nutrients, TOC, temperature, DO

■ Classification of swimmers and non-swimmers:

- Respondents were grouped into two categories according to their stated bathing activities:
  - Non-swimmers who either did not go in the water (non-bathers) or went in the water but did not get their head or face wet (waders)
  - Swimmers who did swim or otherwise got their head or face wet
- Persons who reported that they were in the water for less than ten minutes were classified as non-swimmers regardless of whether they got their head or face wet. Any water contact for 10-minutes or less was considered "short water exposure time".

McKee provides the following summary of findings:

"There were no significant differences between swimmers and non-swimmers using chi-square 2 x 2 tables. However, 12 out of the 18 reported symptom rates showed a greater attack rate among swimmers and non-swimmers. It therefore appears that swimmers are at a greater risk than non-swimmers in general. The relative risk reflects that this trend was also true. The difference between the relative risk at the two beaches show that the barely acceptable beach I & II [combined data from two beaches = Beach W in Dufour (1984)] was higher than the control beach III. Except for the other category, this indicates a trend in favor of swimmers being at a greater relative risk in the categories of gastrointestinal and respiratory symptoms at the polluted beach. Reported symptoms were low in number and therefore this small sample size may not be large enough to detect the small differences between swimmers and non-swimmers or between the barely acceptable and the relatively unpolluted beach symptom rates."



## Other Information Sources

A review of the literature identified numerous other sources of information that are relevant to the scientific basis for bacteria water quality objectives. These studies do not dispute the need for objectives to protect primary contact recreation; in fact, there have been a number of studies to show that there is a relationship between gastrointestinal illness and increased pathogens. However, there are differences of opinion regarding appropriate objectives, the epidemiological methodology, and how objectives should be implemented. The following sections provide a summary of some of these ideas.

### Alternatives to EPA Recommendations

- Ferley et al. (1989) - This study presents results from an epidemiological study conducted on a freshwater river in France during July and August of 1986. Over 5,700 people were interviewed from eight vacation camps along the river. Results showed that swimmers became ill substantially more often than non-swimmers. Results support use of fecal coliform objectives, but do not well support recommended *E. coli* objectives.
- Kueh et al. (1995) - Results from this Hong Kong study show a better correlation between turbidity and swimming associated illness than *E. coli* and such illness. This result could be site-specific, as sewage was a probable cause for the turbidity and a study performed a few years prior indicated a better correlation with *E. coli*. This study recommended a beach water quality objective of 15 NTU turbidity to correspond to 10 cases of gastrointestinal illness symptoms per 1000 swimmers.
- Seyfried et al. (1985) - This paper presents the results from an Ontario, Canada study performed to test several different bacterial indicators and their correlation with human illness. Water and sediment sampling was performed. Concentrations of bacteria in sampled beach sediments were significantly higher (10 times higher) than in beach water. Total staphylococci appeared to be a more consistent indicator for predicting total illness rates among swimmers than fecal coliform.
- Lopez-Pila, J.M., and R. Szewzyk. (2000) - This study suggests that due to the variability in epidemiological study results among varying regions, microbiological standards should be reexamined from time to time in order to update them with respect to acceptable risk encountered locally. The study offers a more cost effective way to perform epidemiological studies, an alternative way of obtaining health-related standards which are easier to carry out and more affordable than epidemiological studies. The study introduces a model for estimating infectious risk in bathing water from the distribution of fecal indicators, the dose/response relationship of an enteric pathogen and its ratio to fecal indicators.

### **Critique of EPA Methodology and Implementation Approach**

Fleisher in association with various authors have written a number of papers that identify concerns regarding EPA's epidemiological methodology, e.g., sources of bias, and approach for developing objectives:

#### *Fleisher et al. (1993) - Setting Recreational Water Quality Criteria*

This paper focuses on the substantial amounts of potential bias present in the methodology used to develop recreational water quality objectives:

"Although there have been four published epidemiological studies reporting mathematical relationships between increasing levels of sewage pollution and increased risk of gastroenteritis among bathers...all have incorporated within them substantial amounts of bias that question the validity of the reported mathematical relationships. These sources of bias are firmly grounded in basic epidemiological theory. Since recreational water quality criteria are frequently based on one or more of the mathematical relationships reported in the literature, the amount of bias present in these epidemiological studies will affect the validity of such criteria. It is the purpose of this paper to discuss several basic epidemiological principles that have been violated in previously published epidemiological studies, and to explore the effect of the resulting bias on the study outcome."

Although Fleisher et al. (1993) are critical of the epidemiological methodology, they do not argue against the need for objectives, for example:

"Evidence is indeed accumulating that bathers exposed to recreational waters contaminated with domestic sewage are at increased risk of acquiring gastroenteritis...What remains to be established is at what levels of domestic sewage pollution are bathers at increased risk of acquiring gastroenteritis. This issue is critical to establishing recreational water quality criteria."

Four sources of bias are identified in the epidemiological studies. Considerable detail is provided because the discussion illustrates how the existing data can underestimate or overestimate the true risk:

- Failure to control for the effect of the limited precision inherent in current techniques of indicator density enumeration almost always leads to an underestimation of the true risk. For example, if the Multiple Tube Fermentation Technique yields an estimate of 3,000 indicator organisms/100 mL of sample, the associated 95% confidence interval will range from 990 to 9,080 organisms/100 mL. Similarly, for the Membrane Filtration Technique method, the 95% confidence interval around a point estimate of 3,000 organisms/100 mL is 1,848 to 4,668 organisms/100 mL. Precision may be increased by averaging replicate

determinations made on individual samples. The precision more than doubles by just taking three or four replicate measures regardless of the method used.

- Failure to address the fact that substantial amounts of temporal and spatial variation in indicator pathogens occurs at almost all bathing water locations. Fleisher et al. (1993) noted that this source of bias could be a major reason for the differences in findings among epidemiological studies, both in the terms of the diseases or ailments reported to be associated with swimmers in waters contaminated with domestic sewage, as well as the associated estimates of risk.

The water quality sampling design used in previous epidemiological studies (e.g., McKee 1980) typically consisted of taking 2-4 samples at two or three sites along the length of a study location on each trial day. Studies have shown that pathogen indicator densities at a site can vary widely in just a few hours. With respect to spatial variation, a study demonstrated that even when temporal variation was controlled for in the analysis, pathogen densities changed by more than two orders of magnitude at six sampling locations spaced equidistantly along a 100-meter beach.

A geometric mean is a measure of central tendency, but one should not be interested in using a measure of central tendency to assign exposure since, by definition, this would control or eliminate the effect of the substantial amount of spatial and temporal variation that affect the pathogen densities that swimmers are actually exposed to at most beaches. Instead, one should be more interested in the range of pathogen densities an individual is exposed to. Since the designs of most previous epidemiological studies allowed swimmers to enter the water over the course of an entire trial day, one should be interested in the maximum pathogen density the individual was exposed to, and not the average observed on the day of exposure. Some individuals are exposed to concentrations less than the mean, some are exposed to concentrations above the mean. Yet all individuals are assumed to be exposed to an average. The effect of this bias cannot be estimated but can result in either an under or overestimation of risk.

- Failure to relate pathogen indicator densities directly to the individual bather. To address this source of bias, the study design needs to be modified. Fleisher et al. (1993) discuss an example of how this can be done by more intensive water quality sampling and much closer observation of swimmers so that the water quality results can be tied to individuals. Failure to do so can lead to an under or overestimation of risk.
- Failure to control for non-water related risk factors for the illness under study. The following quotes from Fleisher et al. (1993) illustrate the importance of this issue:

"Suppose an epidemiological study of bathing-associated illness is being conducted. The exposure of interest is whether an individual has entered the water while the disease outcome of interest is gastroenteritis. Now, further suppose that those who enter the water (the bather group) were more likely to stay at the beach for longer periods of time than

those who chose not to enter the water (the non-bather group). Because the bather group is hypothesized to stay on the beach longer, they also may be more likely to bring along food from home that will remain unrefrigerated or poorly refrigerated until eaten. Now further suppose the results of this...study show a two-fold increase in the risk of acquiring gastroenteritis among the bather group relative to the non-bather group. The question then becomes how much of this two-fold increase in risk can be attributed to exposure to bathing waters...the possibility exists that some of the two-fold increase in the risk of acquiring gastroenteritis we observe among the bathers has nothing to do with exposure to bathing waters, but is instead due to the consumption of poorly refrigerated foods. "

"The importance of identifying and controlling for possible confounding factors cannot be overstressed, especially when studying diseases that have many mechanisms of transmission. Since there are so many non-bathing-water-related risk factors for gastroenteritis (e.g., consumption of poorly refrigerated foods; having an underlying medical condition that predisposes to symptoms of gastroenteritis; side effects of prescription or non-prescription drugs; and consumption of excessive amounts of alcohol)..., it becomes extremely important to rule out possible bias caused by such factors...To date, no previously published epidemiological study that reported association between gastroenteritis and bathing in waters contaminated with sewage had adequately addressed the possible role of the many known non-bathing water related causes of gastroenteritis in the results reported."

"One could argue that there is no intrinsic reason why the distribution of non-related water risk factors for gastroenteritis should differ between bathers vs. non-bathers. It is, however, quite possible that the underlying reasons that determine whether a person will choose to enter the water could be related to their risk of acquiring gastroenteritis (e.g., non-bathers may be in poorer health than bathers, or conversely, non-bathers might pay more attention to their health and thus be less likely to expose themselves to other risk factors for gastroenteritis such as the consumption of poorly refrigerated foods; the consumption of improperly prepared foods; the consumption of excessive amounts of alcohol, etc.)."

Taking into consideration these sources of bias in existing epidemiological studies, Fleisher et al., (1993) conclude:

"This paper has sought to describe several important sources of bias that are, in all probability, incorporated in the results reported by previous epidemiological studies, and thus in current recreational water quality criteria. All the sources of bias discussed in this paper can be minimized through innovative approaches to the design of future epidemiological studies. Until new epidemiological studies are undertaken which are specifically designed to address the issues raised in this paper, the data base upon which current recreational water quality criteria are based will

remain a composite of previous epidemiological studies that reported diverse estimates of risks and ailments associated with bathing in waters contaminated with sewage. The need for future epidemiological studies is critical if we are to formulate recreational water quality criteria that are based on solid scientific and epidemiological principles. Until this is accomplished, the validity of current recreational water quality criteria should continue to be questioned."

*Fleisher, J.M. 1991. A Reanalysis of Data Supporting the US Federal Bacteriological Water Quality Criteria Governing Marine Recreational Waters*

Fleisher (1991) provides a reanalysis of the EPA data used to generate the marine bacteria water quality objectives (reported by Cabelli 1983). Although this paper emphasized marine criteria rather than freshwater criteria, Fleisher (1991) illustrates how differences in methodology can influence the data interpretation. Specifically, he disagrees with EPA's data analysis approach and conducts his own reanalysis. He states that even if others disagree with his approach to reanalyze the data, his study illustrates how differences in the analysis methodology will influence the interpretation. He then offers an opinion regarding how this concern should be addressed. Following are a few highlights from the paper:

■ Methodology Concerns

Three sites were used for the EPA study: marine water locations in Boston and New York City and a brackish water location in Lake Pontchartrain. Salinity varied from an average of 3 ppt at Lake Pontchartrain to 32 ppt and 30 ppt at Boston and New York City, respectively. Studies have shown indicator organism survival for fecal coliform to be inversely correlated with salinity; other evidence is available that this correlation exists for enterococci as well (citations in Fleisher (1991)). Even with these differences in salinity, results from these three sites were pooled in the final data analysis. This pooling of data has "serious consequences with regard to the validity of the reported findings."

■ Analysis Concerns

- Total gastrointestinal symptoms were more closely related (statistically) to swimming associated illness than "highly credible symptoms." Yet highly credible symptoms were considered a more reliable measure of swimming-associated illness than total gastrointestinal symptoms (Note; the  $R^2$  values are not that different: Total gastrointestinal symptoms = 0.67; highly credible symptoms = 0.56).
- The analysis clustered sample results collected from groups of days rather than using the actual data from each site for each day.
- Analysis left out three data points - "Two of the three data points that were omitted corresponded to trial clusters that had no reported gastrointestinal symptoms among non-swimmers (The third was omitted due to an unusually low non-swimmer rate)." Fleisher (1991) uses the original data and then conducts his own analysis incorporating

"average GI symptom rates for non-swimmers for the year and location" rather than dropping the datapoints. Using this approach and reanalyzing the regression relationship results in the highly credible symptoms relationship no longer being significant.

■ Study Findings

"Although it can be argued that the methods used to derive the analyses [i.e., Fleisher's approach] are also arbitrary [vs. EPA's arbitrary approach of just dropping the data points], the striking differences between this analysis and that reported by the EPA study highlight the enormous effect that can be caused by minor manipulation of the data. This phenomena could have considerable relevance to the outcome reported by the EPA study, specifically, the potential effect of clustering sample dates before the analysis."

"Based on the serious methodological and analytical weaknesses incorporated in the EPA study as shown by this report, it would be premature to conclude that health effects can be quantified sufficiently to support the continued uses of current federal bacteriological criteria governing marine recreational waters. The practical significance of this finding cannot be overstressed. Currently, most local health departments use recreational water quality standards based on the use of the coliform organism. To require a change of indicator organism at this point would be inappropriate. This is especially true in light of the fact that the current "acceptable" level of risk to the swimmer remains the same under previous federal criteria that used fecal coliforms as the indicator organism of choice. Perhaps of more importance is the fact that the reanalysis presented in this report questions the appropriateness of the use of a single maximum allowable mean enterococci density to govern all marine recreational locations in the U.S."

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## Memorandum

*To: Stormwater Quality Standards Study Task Force*

*From: CDM*

*Date: December 12, 2005*

*Subject: Review of State Recreational Uses and Bacteria Objectives*

### Introduction

A comprehensive review of state water quality standards was conducted to characterize freshwater recreational beneficial uses and associated water quality objectives for bacteria. This review was conducted to identify the following:

- The range of approved recreational uses and their associated bacteria objectives
- How water quality standards for states compare with recommended U.S. Environmental Protection Agency (EPA) federal water quality standards for bacteria
- Alternative approaches to implement bacteria water quality objectives or assess compliance

### Methodology

For each state, two general pieces of information were sought from the state's adopted water quality standards:

- Approach for designating freshwaters with recreational uses
- Objectives associated with each recreational use category

In a couple of instances information regarding proposed standards is provided if the proposed changes substantively change the existing standards. In addition, any language contained in the water quality standards regarding implementation, e.g., seasonal applicability and flow exemptions, was documented - but only if the information was contained in the water quality standards regulations. State implementation documents were not reviewed; thus, to fully understand the nuances of how a particular provision is implemented in practice would require further investigation.

All 50 states were included in the analysis. For the most part, water quality standards information was gathered from the websites of the state agencies responsible for the development and implementation of water quality standards. In several instances, primarily



at the direction of the Task Force, the state agency was contacted directly to gather additional information.

## Results and Discussion

State by state summaries of recreational uses and objectives are provided in Appendix A.

Table 1 provides a guide to the state-by-state summaries per EPA regions.

**Table 1 Location of State-by-State Summaries in Appendix A**

EPA Region	State	Page No.	EPA Region	State	Page No.
Region 1	Connecticut	11	Region 7	Iowa	37
	Maine	11		Kansas	38
	Massachusetts	12		Missouri	42
	New Hampshire	13		Nebraska	42
	Rhode Island	13	Region 8	Colorado	43
	Vermont	14		Montana	44
Region 2	New Jersey	15		North Dakota	45
	New York	15		South Dakota	45
Region 3	Delaware	16		Utah	46
	Maryland	16	Wyoming	46	
	Pennsylvania	17	Region 9	Arizona	47
	Virginia	17		California	48
	West Virginia	18		California - North Coast (1)	49
Region 4	Alabama	19		California - San Francisco Bay (2)	49
	Florida	21		California - Central Coast (3)	51
	Georgia	21		California - Los Angeles (4)	51
	Kentucky	22		California - Central Valley (5)	52
	Mississippi	22		California - Lahontan (6)	53
	North Carolina	24		California - Colorado River (7)	53
	South Carolina	24		California - Santa Ana (8)	54
	Tennessee	25		California - San Diego (9)	54
Region 5	Illinois	25		Hawaii	55
	Indiana	26		Nevada	56
	Michigan	26	Region 10	Alaska	57
	Minnesota	28		Idaho	57
	Ohio	30		Oregon	58
	Wisconsin	32		Washington	59
Region 6	Arkansas	33			
	Louisiana	34			
	New Mexico	34			
	Oklahoma	35			
	Texas	36			

The following sections provide a summary of the commonalities among states as well as the unique and interesting approaches used by states to establish water quality standards regulations to protect recreational activities.

## Recreational Use Categories

States are using two basic approaches for establishing recreational uses in freshwaters:

- Use-based - Establishing the recreational uses and then applying them to specific waterbodies, e.g., application of a REC-1 use to the Santa Ana River.
- Class-based - Establishing "classes" of waters and then assigning combinations of uses, including recreational uses, to the established classes. For example, Class A or Class 1 is typically used to identify waters with the best expectations for water quality and have uses with the most restrictive objectives.

Interestingly, the class-based approach seems to be more common in the east than in the west where the use-based approach appeared to be more common (western exceptions are Montana and Wyoming). While fundamentally different, the alternative approaches have little bearing on the water quality objectives established. However, for states using a class-based approach it was often unclear how the state assigns a waterbody to a particular class.

Overall, it appeared that there was more similarity among states within EPA regions in their approach for protecting recreational uses than between states in different EPA regions. This observation is not particularly surprising since states within the same EPA region would likely receive similar guidance on how to develop approvable water quality standards.

States use various terminologies to recognize two basic types of recreational uses. These types and examples of alternative terminology include: primary contact (full-body contact, immersion recreation) and secondary contact (partial-body contact, incidental contact). Without exception the former refers to situations where water ingestion or submergence is likely as a result of recreational activity; the latter refers to situations where ingestion or submergence is unlikely.

All states have established some form of primary contact use. In addition, it is fairly common for states to have also established a secondary contact use, e.g., Massachusetts, Rhode Island, Kentucky, Mississippi, Ohio, Iowa, Kansas, Missouri, Oklahoma, Louisiana, Arkansas, New Mexico, Texas, Colorado, Montana, South Dakota, Utah, Wyoming, Arizona, Nevada, and Idaho.

Some states have not established a separate use for secondary contact, but instead established a seasonal exemption, which for all practical purposes serves the same purpose as establishing a secondary contact use. Examples include: Indiana, Maine, Vermont, Georgia, and North Dakota.

## Water Quality Objectives

Considerable variation was found from state to state regarding the objectives applicable to recreational uses. The following text provides some general observations, but the details can be important and should be reviewed for each state (see Table 1, Appendix A).

### Type of Bacteria Objectives

Although EPA guidance has recommended since 1986 that states use *E. coli* as the primary freshwater pathogen indicator applicable to recreational uses, many states still rely on fecal coliform as the primary pathogen indicator. Some states still rely on both fecal coliform and *E. coli*; and, interestingly, a few eastern states still use both fecal and total coliform objectives (e.g., see New York, Rhode Island, Pennsylvania, and Florida). Two states rely on only *Enterococcus* for both fresh and marine waters: Delaware and Hawaii.

### Water Quality Objectives

States typically adopt numeric objectives for pathogen indicators. However, some examples of narrative objectives were identified. Accordingly, narrative and numeric objectives are discussed separately.

#### *Narrative Objectives*

Several states rely on a narrative objective rather than numeric objective for situations where a secondary contact type use is applicable - either because the waterbody is designated as such or because of a seasonal exemption, i.e., primary contact recreation does not apply. Examples of states with narrative objectives include:

- Oklahoma - Waters so designated [secondary body contact recreation] shall be maintained to be free from human pathogens in numbers that may produce adverse health effects in humans. The water quality requirements for secondary body contact recreation are usually not as stringent as for primary body contact recreation.
- Rhode Island, for Class C waters - none [bacteria] in such concentrations that would impair any usages specifically assigned to this class.
- Mississippi, for ephemeral waters - bacteria objectives are assigned where the "probability of a public health hazard or other circumstances so warrant."

To fully understand how these narrative objectives are implemented in practice would require further investigation.

#### *Numeric Objectives*

The most commonly observed objectives for primary contact recreation were derived from EPA guidance either for fecal coliform or *E. coli* (Note: A few states have more stringent objectives for primary contact for certain classes of waters, e.g., see Maine, New Hampshire, Rhode Island, and Vermont):

## Recreational Uses and Bacteria Objectives

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- Fecal coliform - 200 colony forming units (cfu)/100 mL (geometric mean) and 400 cfu/100 mL (single sample maximum or 10 percent of observations)
- *E. coli* - 126 cfu/100 mL (geometric mean) and 235 cfu/100 mL (single sample maximum or 10 percent of observations)

EPA has not provided clear guidance on the establishment of secondary contact recreation objectives for *E. coli*, but does indicate that objectives that are five times higher than the primary contact objectives may be acceptable. This "five times" approach is often used with fecal coliform, where states use 1,000 (geometric mean) and 2,000 cfu/100 mL (single sample or 10 percent of samples) for secondary contact instead of the 200 and 400 cfu/100 mL used for primary contact. A review of the state's objectives found that states have a variety of objectives for secondary contact recreation ranging from only slightly less stringent than primary contact objectives to substantially different. Following are some examples of secondary contact objectives adopted by states to illustrate the range of approved approaches:

- Massachusetts - Class C waters shall not exceed a geometric mean of 1,000 cfu/100 mL, nor shall 10 percent of the samples exceed 2,000 cfu/100 mL.
- Delaware - Geometric mean of *Enterococcus* shall not exceed 500 cfu/100 mL; single sample shall not exceed 925 cfu/100 mL.
- Kentucky - Fecal coliform shall not exceed 1,000 cfu/100 mL as a 30-day geometric mean based on not less than five samples; not exceed 2,000 cfu/100 mL in 20 percent or more of all samples taken during a 30-day period.
- Ohio - Fecal coliform shall not exceed 5,000 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period; *E. coli* shall not exceed 576 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.
- Iowa - March 15 to November 15 - *E. coli* 630 cfu/100 mL geometric mean; 2,880 cfu/100 mL single sample maximum; remainder of the year the bacteria objectives do not apply.
- Kansas - For stream segments, geometric mean objectives, Class A - *E. coli* 2,358 cfu/100 mL; Class B - 3,843 cfu/100 mL; lake/reservoir/pond geometric mean objectives slightly more stringent.
- Louisiana - No more than 25 percent of the total samples collected on a monthly or near monthly basis shall exceed a fecal coliform density of 2,000 cfu/100 mL.
- Arkansas - Fecal coliform shall not exceed a geometric mean of 1,000 cfu/100 mL, or a monthly maximum of 2,000 cfu/100 mL. *E. coli* values shall not exceed the geometric mean of 630 cfu/100 mL or a monthly maximum of 1,490 cfu/100 mL for lakes, reservoirs and Extraordinary Resource Waters, and 2,050 cfu/100 mL for other rivers and streams.

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- New Mexico - New Mexico uses an acceptable illness rate of 14 in 1,000 to establish its geometric mean for secondary contact (548 cfu/100 mL). The single sample objective of 2,507 cfu/100 mL is based on the 95 percent confidence level of infrequently used waters.
- Texas - The geometric mean of *E. coli* should not exceed 605 cfu/100 mL.
- Colorado - *E. coli*, 630 cfu/100 mL, geometric mean; fecal coliform, 2,000 cfu/100 mL, geometric mean.
- South Dakota - Applicable only from May 1 to September 30; fecal coliform  $\leq$  1,000 cfu/100 mL geometric mean based on a minimum of five samples obtained during separate 24-hour periods for any 30-day period, and they may not exceed this value in more than 20 percent of the samples in this same 30-day period. No single sample may exceed 2,000 cfu/100 mL.
- Utah - *E. coli*, 576 cfu/100 mL, 30-day geometric mean; 940 cfu/100 mL single sample maximum.
- Arizona (Idaho has similar objectives) - Geometric mean (four-sample minimum) 126 cfu/100 mL; single sample maximum of 576 cfu/100 mL.
- California - The secondary contact objectives (REC-2) applicable to California's waters vary across the nine state regions. Region 6 applies the most stringent criteria, using the same criteria to protect both REC-1 and REC-2. However, two regions have no REC-2 objectives (Regions 1, 5) and two regions have qualifiers indicating that the REC-2 criteria only apply if the waterbody is not designated REC-1 (Regions 4, 9).

### Use of Seasonal Exemptions

EPA guidance allows the establishment of seasonal exemptions for application of bacteria objectives to surface waters. Establishing this exemption recognizes that when water temperatures are too cold, the likelihood of recreational activity taking place in a manner that ingestion or body submersion occur decreases substantially. Two common approaches for using seasonal exemptions were observed:

- The exemption is total, such that no bacteria objectives apply during the season in which the exemption has been established, e.g., Maine, Illinois, Indiana, Ohio, Iowa, Missouri, South Dakota, and North Dakota.
- The primary contact objectives are replaced with less restrictive or secondary contact objectives during the seasonal exemption, e.g., Pennsylvania, Georgia, Oklahoma, Arkansas, Louisiana, Kansas, Montana, and Wyoming.

Some variations of the above exist:

- Vermont allows a provisional seasonal exemption, which is implemented as a waiver under an NPDES permit.

- Kentucky replaces the primary contact single sample maximum objective with the secondary contact objective from November through April. However, it appears that the geometric mean objective is applicable year-round.
- Minnesota has different seasonal exemption periods depending on whether the waterbody is protected for primary or secondary contact recreation. For the former the exemption exists between November 1 and March 31. For waters protected only for secondary contact, the exemption exists from November 1 to April 30.

For the most part, the seasonal exemption exists for the months November 1 through March 31. However, a few states, e.g., North and South Dakota and Wyoming, have longer exemptions lasting from October 1 through April 30.

### Unique and Interesting Elements

A number of interesting elements incorporated into specific state water quality standards were noted. Most of these elements are generally implementation related and can affect how permits are implemented or how bacteria objectives are assessed. Some of the more interesting examples are highlighted below:

- Georgia, Washington, and New Hampshire have rule language that indicates recognition that non-human sources of bacteria may impact compliance with a water quality objective. Only Georgia has established alternative objectives where a non-human component has been identified (see italicized language); however, the state is considering removing these alternative objectives in a future standards revision. The current language is as follows:

For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 cfu/100 mL based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. *Should water quality and sanitary studies show fecal coliform levels from nonhuman sources exceed 200 cfu/100 mL (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 mL in lakes and reservoirs and 500 per 100 mL in free flowing freshwater streams.*

- Several states have statements in their water quality standards relating to the need to disinfect wastewater only during recreational periods. For example:
  - Connecticut states that "recreational uses in Class B waters do not apply when disinfection of effluent is not required consistent with Standard 23" (Note: Standard 23 allows for seasonal disinfection in certain parts of the state).
  - New York's standards state that "the total and fecal coliform standards for Classes B, C, and D shall be met during all periods when disinfection is practiced." It was not clear from the standards when this rule would be applied, but it suggests that disinfection is not required during certain times of the year.

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- Arkansas has a unique method for deciding where primary or secondary contact applies. If a watershed is greater than 10 mi<sup>2</sup> in area, then primary contact applies. For smaller watersheds, primary contact is applied only after "site verification."
- Florida exempts "secondary and tertiary canals" from recreational standards.
- Arizona has agricultural and public water supply uses established on many canals (so-called Phoenix area and Yuma area canals), but no recreational uses.
- Most states have geometric means as part of their bacteria objectives and apply them on a 30-day basis. Three notable exceptions were observed:
  - Louisiana applies no geometric mean. For example, the primary contact objective states: "No more than 25 percent of the total samples collected on a monthly or near monthly basis shall exceed a fecal coliform density of 400 cfu/100 mL."
  - New Hampshire uses a 60-day geometric mean.
  - Nevada applies an annual geometric mean for many of its waters that have *E. coli* geometric mean objectives established.
- Kansas has the most number of recreation use subcategories of any state. Uses have been separated for lakes and streams, and the state has recognized public access potential as part of its basis for classifying waters. In its approval letter (Appendix B), EPA notes that access may not be used as a basis for establishing uses and objectives; however, because the objectives associated with the access-based subcategories were appropriately derived using a risk management approach (consistent with EPA guidance), EPA approved the Kansas regulations.
- Kansas and California Region 4 appear to be the only jurisdictions reviewed that have established a high flow exemption.
- Illinois water quality standards include a statement that provides an off-ramp from application of bacteria water quality objectives if certain conditions exist: "Waters unsuited to support primary contact uses because of physical, hydrologic, or geographic configuration and are located in areas unlikely to be frequented by the public on a routine basis as determined by the Agency are exempt from this standard." It is unknown how this narrative statement is implemented in practice.
- Wisconsin has established a substantial variance in the "Southeast District" of the state that includes a heavily urbanized area. For a number of waters, the applicable objectives for fecal coliform shall not exceed 1,000 cfu/100 mL as a monthly geometric mean based on not less than five samples per month nor exceed 2,000 cfu/100 mL in more than 10 percent of all samples during any month.
- Iowa recognizes a use subcategory for children recreational activity; however, the objectives are the same as the objectives for adult primary contact.

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- In Idaho a single water sample exceeding an *E. coli* standard does not in itself constitute a violation of water quality standards, additional samples shall be taken for the purpose of comparing the results to the geometric mean objectives.
- Idaho has successfully conducted use attainability analyses (UAAs) that recognize safety as a factor for reclassifying waters from primary to secondary contact.



## Appendix A - Summary of State Water Quality Standards for Protection of Recreational Uses

Table 1 provides a guide to the page number where each state's summary may be found.

Table 1 Location of State-by-State Summaries in Appendix A

EPA Region	State	Page No.	EPA Region	State	Page No.
Region 1	Connecticut	11	Region 7	Iowa	37
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	Rhode Island	13	Region 8	Colorado	43
Vermont	14	Montana		44	
Region 2	New Jersey	15		North Dakota	45
	New York	15		South Dakota	45
Region 3	Delaware	16		Utah	46
	Maryland	16	Wyoming	46	
	Pennsylvania	17	Region 9	Arizona	47
	Virginia	17		California	48
West Virginia	18	California - North Coast (1)		49	
Region 4	Alabama	19		California - San Francisco Bay (2)	49
	Florida	21		California - Central Coast (3)	51
	Georgia	21		California - Los Angeles (4)	51
	Kentucky	22		California - Central Valley (5)	52
	Mississippi	22		California - Lahonton (6)	53
	North Carolina	24		California - Colorado River (7)	53
	South Carolina	24		California - Santa Ana (8)	54
Tennessee	25	California - San Diego (9)	54		
Region 5	Illinois	25	Hawaii	55	
	Indiana	26	Nevada	56	
	Michigan	26	Region 10	Alaska	57
	Minnesota	28		Idaho	57
	Ohio	30		Oregon	58
Wisconsin	32	Washington		59	
Region 6	Arkansas	33			
	Louisiana	34			
	New Mexico	34			
	Oklahoma	35			
	Texas	36			

## **EPA Region 1**

### **Connecticut**

#### *Recreational Use Categories*

The state has adopted a general definition for recreational use - active or passive water-related leisure activities such as fishing, swimming, boating, and aesthetic appreciation.

#### *Numeric Objectives*

Connecticut's bacteria objectives for freshwaters are as follows (Note: it is not clear how these categories and classes are applied to specific waters):

- Designated Swimming; Classes AA, A, or B - *E. coli*, geometric mean less than 126 cfu/100 mL; single sample maximum 235/100 mL
- Non-designated Swimming AA, A, or B - *E. coli*, geometric mean less than 126/100 mL; single sample maximum 410 cfu/100 mL
- All Other Recreational Uses AA, A, B - *E. coli*, geometric mean less than 126/100 mL; single sample maximum 576 cfu/100 mL

Standards note that recreational uses in Class B waters do not apply when disinfection of effluent is not required consistent with "Standard 23" (allows for seasonal disinfection only in certain parts of the state).

### **Maine**

#### *Recreational Use Categories*

No specific recreational uses have been defined; instead, surface waters are organized by classes (AA, A, B, and C). Each class has specific bacteria objectives.

#### *Numeric Objectives*

Bacteria objectives dependent on the waterbody class:

- Class AA and A - Bacteria of waters shall be as naturally occurs
- Class B - Between May 15 and September 30, the number of *E. coli* bacteria of human origin in these waters may not exceed a geometric mean of 64 cfu/100 mL or an instantaneous level of 427 cfu/100 mL
- Class C - Between May 15 and September 30, the number of *E. coli* bacteria of human origin in these waters may not exceed a geometric mean of 142 cfu/100 mL or an instantaneous level of 949 cfu/100 mL

At the request of the Task Force, to better understand how Maine implements the provision regarding bacteria "of human origin," Susan Davies of the Maine Department of Environmental Protection was contacted. Her response was as follows:

"We have been interested in the microbial source tracking library for New England but it has had limited success. We don't have any sophisticated diagnostic methods of our own. Our management approach is more based on logical and reasonable expectations. We make some assumptions that *E. coli* and *Enterococci* are indicative of 'human origin'. Recreational uses are managed by only applying the bacterial standards during 'reasonable' swimming seasons for Maine. If there are not any sources of human activity in minimally disturbed watersheds (a very common circumstance in northern and Downeast Maine), we generally assume that bacteria are caused by wildlife, and are not of human origin, and therefore not a water quality problem that can be reasonably addressed by state management. We are interested in the recent bacterial DNA research that Jack Parr at [the] EPA Regional Lab in Chelmsford, MA has reported on, but it is not ready for use in monitoring yet. Unfortunately we don't have any other tricks to diagnose 'of human and domestic origin'."

## Massachusetts

### *Recreational Use Categories*

- Primary Contact Recreation - 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. These include, but are not limited to, wading, swimming, diving, surfing, and water skiing.
- Secondary Contact Recreation - Any recreation or other water use in which the contact with the water is either incidental or accidental. These include but are not limited to fishing, boating, and limited contact incident to shoreline activities.

Inland waters divided into Classes A, B, and C. Primary and Secondary Contact Recreation apply to both Classes A and B; only Secondary Contact Recreation applies to Class C.

### *Numeric Objectives*

The following fecal coliform objectives apply to each of the waterbody classes:

- Class A - Shall not exceed an arithmetic mean of 20 cfu/100 mL in any representative set of samples, nor shall 10 percent of the samples exceed 100 cfu/100 mL. More stringent regulations may apply for specific waters.
- Class B - Shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples nor shall more than 10 percent of the samples exceed 400 cfu/100 mL. This criterion may be applied on a seasonal basis at the discretion of the Department.
- Class C - Shall not exceed a geometric mean of 1,000 cfu/100 mL, nor shall 10 percent of the samples exceed 2,000 cfu/100 mL.

## **New Hampshire**

### ***Recreational Use Categories***

Waters divided into Class A ("highest quality") and B ("second highest quality"). It was not apparent how waters are classified as A or B.

### ***Numeric Objectives***

- Class A - shall contain not more than either a geometric mean based on at least three samples obtained over a 60-day period of 47 *E. coli*/100 mL, or > 153 *E. coli*/100 mL in any one sample; and for designated beach areas shall contain not more than a geometric mean based on at least three samples obtained over a 60-day period of 47 *E. coli*/100 mL, or 88 *E. coli*/100 mL in any one sample; unless naturally occurring. There shall be no discharge of any sewage or wastes into waters of this classification.
- Class B - shall contain not more than either a geometric mean based on at least three samples obtained over a 60-day period of 126 *E. coli*/100 mL, or > 406 *E. coli*/100 mL in any one sample; and for designated beach areas shall contain not more than a geometric mean based on at least three samples obtained over a 60-day period of 47 *E. coli*/100 mL, or 88 *E. coli*/100 mL in any one sample; unless naturally occurring.

## **Rhode Island**

### ***Recreational Use Categories***

- Primary Contact Recreation - any recreational activities in which there is prolonged and intimate contact by the human body with the water, involving considerable risk of ingesting waters, such as swimming, diving, water skiing, and surfing.
- Secondary Contact Recreation - any recreational activities in which there is minimal contact by the human body with the water, and the probability of ingestion of the water is minimal, such as boating and fishing.

Classification of waters dictates which uses apply:

- Class A, B, B1 - protected for both primary and secondary contact recreational activities
- Class C - protected only for secondary contact recreation

### ***Numeric Objectives***

- Class A Waters
  - Total Coliform - Not to exceed a geometric mean value of 100 and not more than 10 percent of the samples shall exceed a value of 500.
  - Fecal Coliform - Not to exceed a geometric mean value of 20 and not more than 10 percent of the samples shall exceed a value of 200.
- Class B Waters

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- Total Coliform - Not to exceed a geometric mean value of 1,000 and not more than 20 percent of the samples shall exceed a value of 2,400.
- Fecal Coliform - Not to exceed a geometric mean value of 200 and not more than 20 percent of the samples shall exceed a value of 500.
- Class C Waters
  - None in such concentrations that would impair any usages specifically assigned to this class.

### Vermont

#### *Recreational Use Categories*

Waters divided into Class A(1) Ecological Waters (high quality waters), Class A(2) Public Water Supplies and Class B Waters . All classes protected for "Swimming and other Primary Contact Recreation."

The definitions for "Swimming and other Primary Contact Recreation" vary depending on the class:

- Class A(1) - highest quality in waters, in their natural condition with negligible risk of illness or injury from conditions that are a result of human activities.
- Class A(2) - in waters that pose negligible risk of illness due to conditions that are a result of human activities but managed as necessary for consistency with use as a public water supply.
- Class B - waters suitable for swimming and other forms of water based recreation where sustained direct contact with the water occurs and, where attainable, suitable for these uses at very low risk of illness based on Water Management Type designation.

#### *Numeric Objectives*

- Class A(1) and A(2) - *E. coli* - Not to exceed a geometric mean based on at least three samples obtained over a 30 day period of 18 cfu/100 mL, no single sample above 33 cfu/100 mL. No bacteria attributable to the discharge of wastes.
- Class B - *E. coli* not to exceed 77 cfu/100mL. The Secretary may, by permit condition, waive compliance with this criterion during all or any portion of the period between October 31 and April 1, provided that a health hazard is not created. The Secretary shall provide written notice to the Vermont Department of Health prior to issuing a permit waiving compliance with the *E. coli* criterion.

## **EPA Region 2**

### **New Jersey**

#### *Recreational Use Categories*

The primary and secondary contact recreation uses generally apply to all freshwaters.

- **Primary Contact Recreation** - water related recreational activities that involve significant ingestion risks and includes, but is not limited to, wading, swimming, diving, surfing, and water skiing.
- **Secondary Contact Recreation** - recreational activities where the probability of water ingestion is minimal and includes, but is not limited to, boating and fishing.

#### *Numeric Objectives*

The following objectives apply to all freshwaters:

- Fecal coliform levels shall not exceed a geometric average of 200 cfu/100 mL nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 cfu/100 mL.
- *Enterococci* levels shall not exceed a geometric mean of 33 cfu/100 mL, nor shall any single sample exceed 61 cfu/100 mL.
- Samples shall be obtained at sufficient frequencies and at locations during periods that will permit valid interpretation of laboratory analyses. As a guideline and for the purpose of these regulations, a minimum of five samples as equally spaced over a 30-day period, as feasible, should be collected; however, the number of samples, frequencies, and locations will be determined by the Department or other appropriate agency in any particular case.

### **New York**

#### *Recreational Use Categories*

Both recreational uses appear to be applicable to all classes of freshwaters.

- **Primary Contact Recreation** - recreational activities where the human body may come in direct contact with raw water to the point of complete body submergence. Primary contact recreation includes, but is not limited to swimming, diving, water skiing, skin diving, and surfing.
- **Secondary Contact Recreation Mentioned** - recreational activities where contact with the water is minimal and where ingestion of the water is not probable. Secondary contact recreation includes, but is not limited to, fishing and boating.

**Numeric Objectives**

■ **Total Coliform**

- Class AA - The monthly median value and more than 20 percent of the samples, from a minimum of five examinations, shall not exceed 50 and 240 cfu/100 mL, respectively.
- Class A, B, C, D - The monthly median value and more than 20 percent of the samples, from a minimum of five examinations, shall not exceed 2,400 and 5,000 cfu/100 mL, respectively.
- Class A-Special - The geometric mean, of not less than five samples, taken over not more than a 30-day period shall not exceed 1,000 cfu/100 mL.

■ **Fecal Coliform**

- Class A, B, C, and D - The monthly geometric mean, from a minimum of five examinations, shall not exceed 200 cfu/100 mL.
- Class A-Special - The geometric mean, of not less than five samples, taken over not more than a 30-day period shall not exceed 200 cfu/100 mL.

Standards include following note: The total and fecal coliform standards for Classes B, C, and D shall be met during all periods when disinfection is practiced. Not clear how this might affect application of objectives.

**EPA Region 3**

**Delaware**

**Recreational Use Categories**

- **Primary Contact Recreation** - Any water-based form of recreation, the practice of which has a high probability for total body immersion or ingestion of water (examples include but are not limited to swimming and water skiing).
- **Secondary Contact Recreation** - A water-based form of recreation, the practice of which has a low probability for total body immersion or ingestion of water (examples include but are not limited to wading, boating, and fishing).

**Numeric Objectives**

- **Primary Contact Recreation (Freshwater)** - Geometric mean of *Enterococcus* shall not exceed 100 cfu/100 mL; single sample shall not exceed 185 cfu/100 mL.
- **Secondary Contact Recreation (Freshwater)** - Geometric mean of *Enterococcus* shall not exceed 500 cfu/100 mL; single sample shall not exceed 925 cfu/100 mL.

**Maryland**

**Recreational Use Categories**

General Recreational Use classification, "Water Contact Recreation" is applicable to all surface waters.

**Numeric Objectives**

Maryland applies both *E. coli* and *Enterococcus* to freshwaters (cfu/100 mL):

Indicator	Geometric Mean (All Areas)	Single Sample Maximum Allowable Density			
		Frequent Full Body Contact Recreation (Upper 75% CL)	Moderately Frequent Full Body Contact Recreation (Upper 82% CL)	Occasional Full Body Contact Recreation (Upper 90% CL)	Infrequent Full Body Contact Recreation (Upper 95% CL)
<i>Enterococci</i>	33	61	78	107	151
<i>E. coli</i>	126	235	298	410	576

**Pennsylvania**

**Recreational Use Categories**

Recreational uses are subdivided into four categories - Boating, Fishing, Water Contact Sports, and Esthetics. Although it could not be confirmed, it appears that all four uses apply to all waterbodies unless it has been demonstrated that the existing use is less restrictive.

**Numeric Objectives**

- Fecal coliform - During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 cfu/100 mL based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10 percent of the total samples taken during a 30-day period may exceed 400/100 mL. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 cfu/100 mL based on a minimum of five consecutive samples collected on different days during a 30-day period.
- Total coliform - Maximum of 5,000 cfu/100 ml as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000 cfu/100 mL in more than 5 percent of the samples.

**Virginia**

**Recreational Use Categories**

- Primary Contact Recreation - any water-based form of recreation, the practice of which has a high probability for total body immersion or ingestion of water (examples include but are not limited to swimming, water skiing, canoeing, and kayaking).
- Secondary Contact Recreation - a water-based form of recreation, the practice of which has a low probability for total body immersion or ingestion of waters (examples include but are not limited to wading, boating, and fishing).

**Numeric Objectives**

Fecal coliform bacteria shall not exceed a geometric mean of 200 cfu/100 mL for two or more samples over a calendar month nor shall more than 10 percent of the total samples taken during any calendar month exceed 400 cfu/100 mL. This criterion shall not apply for a



sampling station after the bacterial indicators described for *E. coli* have a minimum of 12 data points or after June 30, 2008, whichever comes first. The applicable *E. coli* objectives include a geometric mean of 126 cfu/100 mL and a single sample maximum of 235 cfu/100 mL:

## **West Virginia**

### ***Recreational Use Categories***

West Virginia uses a class system for establishing beneficial uses. Only one recreational use class has been established - Category C, Water Contact Recreation. This category, which includes swimming, fishing, water skiing, and certain types of pleasure boating such as sailing in very small craft and outboard motor boats, is applied as follows:

"Unless otherwise designated by these rules, at a minimum all waters of the State are designated for...Water Contact Recreation (Category C) consistent with Federal Act goals. Incidental utilization for whatever purpose may or may not constitute a justification for assignment of a water use category to a particular stream segment."

It is not clear what this statement means with regards to application. Elsewhere in the water quality standards, the text state: "See Appendix D for a representative list of category C waters." A review of Appendix D shows that this list includes only a portion of the state's waters. It is not clear how the state evaluates the applicability of water contact recreation to waters not on the list.

### ***Numeric Objectives***

With the exception of a seasonal exemption for the mainstem Ohio River, the following water quality objectives apply to all waters categorized as Category C or Category A (Public Water Supply):

- Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN or MF) shall not exceed 200 cfu/100 mL as a monthly geometric mean based on not less than five samples per month; nor to exceed 400 cfu/100 mL in more than 10 percent of all samples taken during the month.
- Ohio River mainstem seasonal exemption - During the non-recreational season (November through April only) the maximum allowable level of fecal coliform for the Ohio River (either MPN or MF) shall not exceed 2,000 cfu/100 mL as a monthly geometric mean based on not less than five samples per month.

## **EPA Region 4**

### **Alabama**

#### *Recreational Use Categories*

Under the "General Conditions" section, the regulations state:

"All waters, where attainable, shall be suitable for recreation in and on the waters during the months of June through September except that recreational use is not recommended in the vicinity of discharges or other conditions which the Department or the Department of Public Health does not control."

In assigning classifications to waters (choices include Public Water Supply, Outstanding Alabama Water, Swimming and Other Whole Body Water-Contact Sports ["Swimming"], Shellfish Harvesting, Fish and Wildlife, Limited Warmwater Fishery, Agricultural and Industrial Water Supply), the state applies the best use(s) to the water. The state's list of waters and their use classifications typically limits each designated waterbody to one or two classifications and many are not specifically listed for Swimming. However, per the "General Condition" listed above, Swimming is likely presumed to be attainable from June through September.

When specifically designating a waterbody for swimming, the following note, which is included in the water quality standards, applies:

"In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wastes and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing."

#### *Numeric Objectives*

If waterbodies are designated with "Swimming" as the "best use" the following objectives apply:

- (i) Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes are not acceptable for swimming or other whole body water-contact sports.
- (ii) In all other areas, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not

exceed 200 cfu/100 mL in non-coastal waters. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. 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 following note applies to (i) above: In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wastes and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing.

If a waterbody is not classified with "Swimming" as the "best use," it still has applicable bacteria water quality objectives. These vary depending on the best use classification. For the period from June through September, the objectives are generally similar to the objectives established for "Swimming"; however, for the remainder of the year less stringent objectives may apply. For example, the bacteria objectives applicable to waters classified with Fish and Wildlife as the best use are as follows:

- (i) In non-coastal waters, bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000 cfu/100 mL; nor exceed a maximum of 2,000 cfu/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.
- (ii) For incidental water contact and recreation during June through September, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 200 cfu/100 mL in non-coastal waters. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric bacterial coliform 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. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

## **Florida**

### *Recreational Use Categories*

No specific recreational use definitions found in state water quality standards. Instead, waters are designated by class and the bacteria water quality objectives are established for each class. Florida designates all waters as Class III - Recreation, Propagation, and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife, unless the waters are "secondary and tertiary canals wholly within agricultural areas."

### *Numeric Objectives*

Class III freshwaters have the following applicable water quality objectives:

- Fecal coliform (MPN) shall not exceed a monthly geometric mean (10 sample minimum over a 30-day period) of 200, nor exceed 400 in 10 percent of the samples, not exceed 800 on any one day.
- Total coliform  $\leq 1,000$  as a monthly geometric mean (10 sample minimum over a 30-day period); not exceed 1,000 in more than 20 percent of the samples examined during any month;  $\leq 2,400$  at any time.

## **Georgia**

### *Recreational Use Categories*

General Recreational Use classification is applicable to all surface waters. Recreation generally defined as activities such as water skiing, boating, and swimming, or for any other use requiring water of a lower quality, such as recreational fishing.

### *Numeric Objectives*

For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 cfu/100 mL based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from nonhuman sources exceed 200 cfu/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams.

For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 mL based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 mL for any sample.

Objectives section includes following statement: The state does not encourage swimming in surface waters since a number of factors which are beyond the control of any State regulatory agency contribute to elevated levels of fecal coliform.

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At the request of the Task Force, to better understand how Georgia implements the "nonhuman source" provision of its bacteria water quality objectives, David Word of the Georgia Environmental Protection Division was contacted. He indicated that the provision has never been officially adopted even though it is in the water quality standards regulations. It appears that he meant that the provision has not been approved by EPA. Regardless, Mr. Word indicated that Georgia will likely remove the "nonhuman source" language from the standards next year - at the same time that the state moves forward with a proposal to replace fecal coliform objectives with *E. coli* objectives.

### Kentucky

#### *Recreational Use Categories*

Primary and Secondary Contact Recreation uses established, but they appear to apply to all surface waters. No specific definition for either was found. Both uses appear to be applicable to all surface waters.

#### *Numeric Objectives*

- Primary Contact Recreation - The following objectives shall apply to waters designated as primary contact recreation use:
  - Fecal coliform or *E. coli* shall not exceed 200 cfu/100 mL or 130 cfu/100 mL, respectively, as a geometric mean based on not less than five samples taken during a 30-day period.
  - Concentration also shall not exceed 400 cfu/100 mL in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 cfu/100 mL for *E. coli*. These limits shall be applicable during the recreation season of May 1 through October 31. Fecal coliform objectives for Secondary Contact Recreation shall apply during the remainder of the year.
- Secondary Contact Recreation - These objectives apply year-round. Fecal coliform shall not exceed 1,000 cfu/100 mL as a 30-day geometric mean based on not less than five samples; not exceed 2,000 cfu/100 mL in 20 percent or more of all samples taken during a 30-day period.

### Mississippi

#### *Recreational Use Categories*

Recreation is defined as water suitable for recreational purposes, including such water contact activities as swimming and water skiing. It is not clear how waterbodies are classified. Some are not classified for Recreation, but still may have recreation-related bacteria objectives applied because of their applicability to other classifications, e.g., Fish and Wildlife, Public Water Supply, and Ephemeral. Some of the bacteria objectives refer to an "incidental recreational contact," but this "classification" does not appear to be formally recognized.

*Numeric Objectives*

Bacteria objectives for freshwater-related classifications other than Recreation are provided below because it appears that the state uses recreational use objectives to protect recreational potential regardless of the classification:

- Recreation - Fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL based on a minimum of five samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 cfu/100 mL more than 10 percent of the time.
- Public Water Supply - For the months of May through October, when water contact recreation activities may be expected to occur, fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL based on a minimum of five samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 cfu/100 mL more than 10 percent of the time.

For the months of November through April, when incidental recreational contact is not likely, fecal coliform shall not exceed 2,000 cfu/100 mL as a geometric mean based on at least five samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4,000 cfu/100 mL more than 10 percent of the time.

- Fish and Wildlife - For the months of May through October, when water contact recreation activities may be expected to occur, fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL based on a minimum of five samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 cfu/100 mL more than 10 percent of the time.

For the months of November through April, when incidental recreational contact is not likely, fecal coliform shall not exceed a geometric mean of 2,000 cfu/100 mL based on a minimum of five samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4,000 cfu/100 mL more than 10 percent of the time.

- Ephemeral - Bacteria objectives are assigned where the "probability of a public health hazard or other circumstances so warrant."

## North Carolina

### *Recreational Use Categories*

- Primary Recreation - includes swimming, skin diving, skiing, and similar uses involving body contact with water where such activities take place in an organized or on a frequent basis.
- Secondary Recreation - includes wading, boating, other uses not involving body contact with water and activities involving human body contact with water where such activities take place on an infrequent, unorganized, or incidental basis

### *Numeric Objectives*

Waters are classified as according to their best use. Bacteria objectives depend on the waterbodies assigned.

- Class B - Fecal coliform shall not to exceed geometric mean of 200 cfu/100 mL based on at least five consecutive samples examined during any 30-day period and not to exceed 400 cfu/100 mL in more than 20 percent of the samples examined during such period.
- Class C - Fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL based upon at least five consecutive samples examined during any 30-day period, nor exceed 400 cfu/100 mL in more than 20 percent of the samples examined during such a period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution.

## South Carolina

### *Recreational Use Categories*

Primary Contact Recreation - means any activity with the intended purpose of direct water contact by the human body to the point of complete submergence, including but not limited to swimming, water skiing, and skin diving.

Secondary Contact Recreation - means any activity occurring on or near the water that does not have an intended purpose of direct water contact by the human body to the point of complete submergence, including but not limited to fishing, boating, canoeing, and wading.

### *Numeric Objectives*

No distinction in the objectives between primary and secondary contact. If a waterbody is classified as "Freshwater," both primary and secondary contact recreational uses apply. The bacteria objectives for this use are as follows:

- Fecal coliform - Not to exceed a geometric mean of 200 cfu/100 mL, based on five consecutive samples during any 30-day period; nor shall more than 10 percent of the total samples during any 30-day period exceed 400 cfu/100mL.

## **Tennessee**

### ***Recreational Use Categories***

A General Recreational Use appears to be applicable to all surface waters. No definition was found.

### ***Numeric Objectives***

The concentration of the *E. coli* group shall not exceed 126 cfu/100 mL, as a geometric mean based on a minimum of five samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purposes of determining the geometric mean, individual samples having an *E. coli* concentration of less than 1 per 100 mL shall be considered as having a concentration of 1 per 100 mL.

Additionally, the concentration of the *E. coli* group in any individual sample taken from a lake, reservoir, State Scenic River, or Tier II or III stream shall not exceed 487 cfu/100 mL. The concentration of the *E. coli* group in any individual sample taken from any other waterbody shall not exceed 941 cfu/100 mL.

## **EPA Region 5**

### **Illinois**

#### ***Recreational Use Categories***

Illinois waters may be classified as Primary Contact (e.g., swimming, water skiing) or Secondary Contact (e.g., boating, fishing).

#### ***Numeric Objectives***

From May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL, nor shall more than 10 percent of the samples during any 30-day period exceed 400 cfu/100 mL in protected waters. Protected waters are defined as waters that, due to natural characteristics, aesthetic value, or environmental significance are deserving of protection from pathogenic organisms. Protected waters will meet one or both of the following conditions:

- Presently support or have the physical characteristics to support primary contact
- Flow through or adjacent to parks or residential areas

Waters unsuited to support primary contact uses because of physical, hydrologic, or geographic configuration and are located in areas unlikely to be frequented by the public on a routine basis as determined by the Agency are exempt from this standard.

At the direction of the Task Force, the Illinois Environmental Protection Agency (IEPA) was contacted to better understand the approach used by the agency to determine whether a



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waterbody was unsuited for primary contact and met the criteria for exemption. IEPA indicated the following:

- All proposed exemptions are public noticed and recreational "use testimonies" are requested
- Recreational uses are assumed to not occur during wet weather events due to the safety risk
- Exemption regularly applied to waters receiving wastewater discharges that sought disinfection exemptions
- Criteria used by the agency to evaluate potential for exemption include:
  - Waterbody must have 2 feet or less average depth
  - Informal/anecdotal recreational use survey conducted to evaluate "unlikely to be used routinely" criterion in exemption language; however, no formal definition for terms such as "routinely" have been adopted
  - Waterbody must not flow through or be adjacent to a park or residential area
  - Waterbody must not be a public water supply

### Indiana

#### *Recreational Use Categories*

- Full Body Contact - direct contact with the water to the point of complete submergence

#### *Numeric Objectives*

The objectives in this subsection are to be used to evaluate waters for full body contact recreational uses, to establish wastewater treatment requirements, and to establish effluent limits during the recreational season, which is defined as the months of April through October, inclusive:

- *E. coli* bacteria shall not exceed:
  - 125 cfu/100 mL as a geometric mean based on not less than five samples equally spaced over a 30-day period.
  - 235 cfu/100 mL in any one sample in a 30-day period. If a geometric mean cannot be calculated because five equally spaced samples are not available, then the single sample objective must be met.

### Michigan

#### *Recreational Use Categories*

Michigan recognizes two recreational use subcategories:

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- Total Body Contact Recreation - any activities normally involving direct contact with water to the point of complete submergence, particularly immersion of the head, with considerable risk of ingesting water, including swimming.
- Partial Body Contact Recreation - any activities normally involving direct contact of some part of the body with water, but not normally involving immersion of the head or ingesting water, including fishing, wading, hunting, and dry boating.

At a minimum, all surface waters of the state are designated to be protected for the following uses: (a) agriculture; (b) navigation; (c) industrial water supply; (d) public water supply at the point of water intake; (e) warmwater fishery; (f) other indigenous aquatic life and wildlife; and (g) partial body contact recreation. In addition, all surface waters of the state are protected for Total Body Contact Recreation from May 1 to October 31. However, "Total Body Contact Recreation immediately downstream of wastewater discharges, areas of significant urban runoff, combined sewer overflows, and areas influenced by certain agricultural practices is contrary to prudent public health and safety practices, even though water quality standards may be met."

### *Numeric Objectives*

The following objectives, which take into account season, are applicable:

- (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli*/100 mL, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli*/100 mL. Compliance shall be based on the geometric mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area.
- (2) All waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 *E. coli*/100 mL. Compliance shall be based on the geometric mean of three or more samples, taken during the same sampling event, at representative locations within a defined sampling area.
- (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform/100 mL, based on the geometric mean of all of five or more samples taken over a 30-day period, nor more than 400 fecal coliform/100 mL, based on the geometric mean of all of three or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.

- (4) The department may suspend the provisions of subrule (3) of this rule, for the purpose of discharge permit issuance, from November 1 to April 30, upon an adequate demonstration by the applicant that designated uses will be protected. At a minimum, the provisions of subrule (2) of this rule shall be met.

## **Minnesota**

### ***Recreational Use Categories***

Minnesota has a class system for its waters. Two of these classes include protections for recreation. Class 2 waters are protected for drinking water, aquatic life, and primary contact recreation. Class 7 waters or Limited Resource Value Waters are protected for secondary contact recreation. Five Class 2 subcategories have been established. Within these five Class 2 subcategories, three recreational subcategories have been established:

- 2A (coldwater), Bd (cool/ warmwater; waterbody is a drinking water source), B (cool/ warmwater; waterbody is not a drinking water source) - class varies depending on type of aquatic life. All of these classes are suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable.
- 2C - suitable for boating and other forms of aquatic recreation for which the waters may be usable.
- 2D - suitable for boating and other forms of aquatic recreation for which the wetland may be usable.

### ***Numeric Objectives***

Class 2 Waters - Current bacteria water quality objectives are as follows:

- 2A - Not to exceed 200 cfu/100 mL as a geometric mean of not less than five samples in any calendar month, nor shall more than 10 percent of all samples taken during any calendar month individually exceed 400 cfu/100 mL. The standard applies only between April 1 and October 31.
- 2Bd, 2B, 2C, 2D - Not to exceed 200 cfu/100 mL as a geometric mean of not less than five samples in any calendar month, nor shall more than 10 percent of all samples taken during any calendar month individually exceed 2,000 cfu/100 mL. The standard applies only between April 1 and October 31.

Class 7 Waters - Not to exceed 1,000 cfu/100 mL in any calendar month as determined by a geometric mean of a minimum of five samples, nor shall more than 10 percent of all samples taken during any calendar month individually exceed 2,000 cfu/100 mL. The standard applies only between May 1 and October 31.

Proposed Revision: Minnesota is currently proposing revisions to its water quality objectives for bacteria. The following text has been included verbatim to summarize the proposed objectives and the basis for the changes:

"The MPCA [Minnesota Pollution Control Agency] is proposing to replace the current fecal coliform standard with an *E. coli* standard, based on an EPA criterion. MPCA's goal is to adopt the *E. coli* standard with as little disruption as possible to ongoing programs, specifically to:

1. Keep the protection level for swimmers the same.
2. Keep the number of waters considered impaired for swimming about the same.
3. Retain current assessment methods for determination of impairment.
4. Minimize impact on ongoing bacteriological total maximum daily load studies.
5. Not impact the BEACH program on Lake Superior beaches.

"The MPCA is recommending the *E. coli* standards shown in the table below. The current fecal coliform standard is included for comparison."

**Proposed *E. coli* Standards Shown with the Current Fecal Coliform Standard for Class 2 and Class 7 Waters**

Use	Water Type	30-Day Geometric Mean cfu/100 mL		10% of Values not to Exceed cfu/100 mL	
		<i>E. coli</i>	Fecal coliform	<i>E. coli</i>	Fecal coliform
Primary Body Contact (swimming)	Class 2A Trout waters	126*	200	1260	400
	Class 2B, C, D Warm waters	126	200	1260	2000
Secondary Body Contact (wading)	Class 7 Limited Resource Value Waters	630	1000	1260	2000

\*126 *E. coli* cfu/100 mL is the 30-day geometric mean EPA criterion (1986).

"In order to understand the relationship between fecal coliform and *E. coli* levels, for several years the MPCA analyzed for both indicators from the same sample as part of the MPCA routine river and stream monitoring program. The analysis of these paired fecal coliform and *E. coli* measurements suggests that the recommended *E. coli* 30-day geometric mean standard may be slightly more stringent than the current fecal coliform standard. However, because of the variability in bacteriological data, the analysis does not support proposing a geometric mean standard different from the EPA criterion of 126 colony forming units (cfu) per 100 mL.

"EPA allows some flexibility to states to determine the appropriate maximum standard. The MPCA is proposing a maximum standard of 1,260 cfu/100 mL. Again, the analysis of the paired fecal coliform/*E. coli* data indicates this value may be slightly more stringent than the current maximum fecal coliform standard of 2,000 cfu/100 mL, but well within the variability of the data.

"The MPCA is proposing to do away with the more stringent 10 percent maximum standard currently applicable to trout waters (400 cfu/100 mL), and make the maximum standard the same for all waters (see table above). The MPCA believes that the more stringent standard for trout waters is not needed, and that swimmers in any category of Class 2 waters should receive the same level of protection.

"The bacteriological standard applicable to limited resource value (Class 7) waters is designed to protect types of water recreation where emersion in the water is unlikely, such as wading and boating. The MPCA proposes to replace the current Class 7 standard with an *E. coli* standard that provides the same level of protection (see table above).

"It is important to emphasize that the standards proposed for change are the ambient standards applicable to lakes, rivers, and streams in Minnesota. The current fecal coliform effluent limit of 200 fecal coliform cfu/100 mL as a monthly mean that appears in discharge permits is not proposed for change (Minn. R. 7050.0211)."

## Ohio

### *Recreational Use Categories*

These use designations are in effect only during the recreation season, which is the period from May 1 to October 15, for all water bodies except those designated seasonal salmonid habitat. The recreation season for streams designated seasonal salmonid habitat is June 1 to September 30:

- **Bathing Waters** - these are waters that, during the recreation season, are suitable for swimming where a lifeguard and/or bathhouse facilities are present, and include any additional such areas where the water quality is approved by the director. Water bodies assigned the bathing waters use designation are not necessarily indicated in rules 3745-1-08 to 3745-1-30 of the Administrative Code but include local areas of those water bodies meeting this definition.
- **Primary Contact** - these are waters that, during the recreation season, are suitable for full-body contact recreation such as, but not limited to, swimming, canoeing, and scuba diving with minimal threat to public health as a result of water quality. In addition to those water body segments designated in rules 3745-1-08 to 3745-1-32 of the Administrative Code, all

lakes and reservoirs, except upground storage reservoirs and those lakes and reservoirs meeting the definition of bathing waters, are designated primary contact recreation.

- Secondary Contact - these are waters that, during the recreation season, are suitable for partial body contact recreation such as, but not limited to, wading with minimal threat to public health as a result of water quality.

#### *Numeric Objectives*

- Bathing Waters

- Fecal coliform - geometric mean fecal coliform content, based on not less than five samples within a 30-day period, shall not exceed 200 cfu/100 mL and fecal coliform content shall not exceed 400 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.
- *E. coli* - geometric mean *E. coli* content, based on not less than five samples within a 30-day period, shall not exceed 126 cfu/100 mL and *E. coli* content shall not exceed 235 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.

- Primary Contact

- Fecal coliform - geometric mean fecal coliform content, based on not less than five samples within a 30-day period, shall not exceed 1,000 cfu/100 mL and fecal coliform content shall not exceed 2,000 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.
- *E. coli* - geometric mean *E. coli* content, based on not less than five samples within a 30-day period, shall not exceed 126 cfu/100 mL and *E. coli* content shall not exceed 298 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.

- Secondary Contact

- Fecal coliform - shall not exceed 5,000 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.
- *E. coli* - shall not exceed 576 cfu/100 mL in more than 10 percent of the samples taken during any 30-day period.

Per the direction of the Task Force, Bob Heitzman of the Ohio Environmental Protection Agency was asked if the state was transitioning from fecal coliform to *E. coli* as the pathogen indicator or did the state plan to use both indicators for the long term. Mr. Heitzman responded:

"When Ohio was considering adopting USEPA's recommended *E. coli* criteria several years ago, people raised concerns about possible increased costs to meet the criteria and about the analytical methods to measure *E. coli*. We, therefore, kept the fecal coliform criteria on the books while those concerns were addressed. We plan to

propose rule revisions in summer 2006, eliminating the fecal coliform criteria and, perhaps, revising the *E. coli* criteria we currently have."

### Wisconsin

Wisconsin does not appear to have an explicit class or use system. A separate section in the state's water quality standards addresses recreational use protection:

Standards for Recreational Use - A sanitary survey and/or evaluation to assure protection from fecal contamination is the chief criterion in determining the suitability of a surface water for recreational use.

- (a) Bacteriological guidelines - The membrane filter fecal coliform count may not exceed 200 cfu/100 mL as a geometric mean based on not less than five samples per month, nor exceed 400 cfu/100 mL in more than 10 percent of all samples during any month.
- (b) Exceptions - Whenever the department determines, in accordance with the procedures specified in s. NR 210.06, that wastewater disinfection is not required to protect recreational uses, the recreational use criteria and classifications as established in this subsection and in chapters NR 103 and 104 do not apply.

Although this section applies to all waters, a review of the use designation portion of the state's standards found that a substantial variance has been established in the "Southeast District" of Wisconsin, which includes the most urbanized portion of the state. This variance states:

- (a) The following surface waters in the southeast district shall meet the standards for fish and aquatic life except that the dissolved oxygen shall not be lowered to less than 2 mg/L at any time, nor shall the membrane filter fecal coliform count exceed 1,000 cfu/100 mL as a monthly geometric mean based on not less than five samples per month nor exceed 2,000 cfu/100 mL in more than 10 percent of all samples during any month:
  - 1. Underwood Creek in Milwaukee and Waukesha counties below Juneau Boulevard
  - 2. Barnes Creek in Kenosha County
  - 3. Pike Creek, a tributary of Pike River, in Kenosha County
  - 4. Pike River in Racine County
  - 5. Indian Creek in Milwaukee County
  - 6. Honey Creek in Milwaukee County

7. Menomonee River in Milwaukee County below the confluence with Honey Creek
  8. Kinnickinnic River in Milwaukee County
  9. Lincoln Creek in Milwaukee County
- (b) The following surface waters in the southeast district shall meet the standards for fish and aquatic life except that the dissolved oxygen may not be lowered to less than 2 mg/L at any time, nor may the membrane filter fecal coliform count exceed 1,000 cfu/100 mL as a monthly geometric mean based on not less than five samples per month nor exceed 89 degrees F at any time at the edge of the mixing zones established by the department under s. NR 102.05 (3):
1. Milwaukee River in Milwaukee County downstream from the North Avenue dam
  2. South Menomonee Canal and Burnham Canal in Milwaukee County

## **EPA Region 6**

### **Arkansas**

#### *Recreational Use Categories*

- **Primary Contact Recreation** - This beneficial use designates waters where full body contact is involved. Any streams with watersheds of greater than 10 mi<sup>2</sup> are designated for full body contact. All streams with watersheds less than 10 mi<sup>2</sup> may be designated for primary contact recreation after site verification.
- **Secondary Contact Recreation** - This beneficial use designates waters where secondary activities like boating, fishing, or wading are involved.

#### *Numeric Objectives*

- **Primary Contact Waters** - Between May 1 and September 30, fecal coliform shall not exceed a geometric mean of 200 cfu/100 mL, nor a monthly maximum of 400 cfu/100 mL. Alternatively, in these waters, *E. coli* colony counts shall not exceed a geometric mean of more than 126 cfu/100 mL, or a monthly maximum value of not more than 298 cfu/100 mL in lakes, reservoirs, and Extraordinary Resource Waters or 410 cfu/100 mL in other rivers and streams. During the remainder of the calendar year, these objectives may be exceeded, but at no time shall these counts exceed the level necessary to support secondary contact recreation.
- **Secondary Contact Waters** - Fecal coliform shall not exceed a geometric mean of 1,000 cfu/100 mL, nor a monthly maximum of 2,000 cfu/100 mL. *E. coli* values shall not exceed the geometric mean of 630 cfu/100 mL or a monthly maximum of 1,490 cfu/100 mL for lakes, reservoirs, and Extraordinary Resource Waters and 2,050 cfu/100 mL for other rivers and streams.



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For assessment of ambient waters as impaired by bacteria, the above listed applicable values shall not be exceeded in more than 25 percent of samples in no less than eight samples taken during the primary contact season or during the secondary contact season.

### Louisiana

#### *Recreational Use Categories*

- Primary Contact Recreation - any recreational or other water contact use involving prolonged or regular full-body contact with the water and in which the probability of ingesting appreciable amounts of water is considerable. Examples of this type of water use include swimming, skiing, and diving.
- Secondary Contact Recreation - any recreational or other water contact use in which body contact with the water is either incidental or accidental and the probability of ingesting appreciable amounts of water is minimal. Examples of this type of water use include fishing, wading, and boating.

#### *Numeric Objectives*

- Primary Contact Recreation - No more than 25 percent of the total samples collected on a monthly or near monthly basis shall exceed a fecal coliform density of 400 cfu/100 mL. This primary contact recreation criterion shall apply only during the defined recreational period of May 1 through October 31. During the non-recreational period of November 1 through April 30, the objectives for secondary contact recreation shall apply.
- Secondary Contact Recreation - No more than 25 percent of the total samples collected on a monthly or near monthly basis shall exceed a fecal coliform density of 2,000 cfu/100 mL. This secondary contact recreation criterion shall apply year round.

### New Mexico

#### *Recreational Use Categories*

- Primary Contact Recreation - means any recreational or other water use in which there is prolonged and intimate human contact with the water, such as swimming and water skiing, involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard. Primary contact also means any use of surface waters of the state for cultural, religious, or ceremonial purposes in which there is intimate human contact with the water, including but not limited to ingestion or immersion that could pose a significant health hazard.
- Secondary Contact Recreation - any recreational or other water use in which human contact with the water may occur and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, commercial, and recreational boating and any limited seasonal contact.

**Numeric Objectives**

Numeric bacteria objectives are listed by basin or waterbody type. Objectives are typically one of the following combinations with the more stringent objectives associated with primary contact and the less stringent objectives associated with secondary contact:

- The monthly geometric mean of *E. coli* bacteria 126 cfu/100 mL or less; single sample 235 cfu/100 mL or less
- The monthly geometric mean of *E. coli* bacteria 548 cfu/100 mL or less, single sample 2,507 cfu/100 mL or less (some waters have a single sample objective of 2,880 cfu/100 mL)

Note: The above objectives are generally the rule. However, variations exist where a waterbody designated secondary contact has more stringent objectives. Some waters also have different single sample limits.

Per the state's 2003 rule proposal, the basis for the New Mexico secondary contact geometric mean objective of 548 cfu/100 mL is the use of an accepted illness rate of 14/1,000. The single sample objective of 2,507 cfu/100 mL is based on the 95 percent confidence level of infrequently used waters. No explanation is provided for the higher objective of 2,880 cfu/100 mL.

**Oklahoma**

**Recreational Use Categories**

- Primary Body Contact Recreation involves direct body contact with the water where a possibility of ingestion exists. In these cases the water shall not contain chemical, physical, or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings.
- Secondary Body Contact Recreation - A UAA is required to designate a water with Secondary Body Contact Recreation. The Secondary Body Contact Recreation beneficial use is designated where ingestion of water is not anticipated; associated activities may include boating, fishing or wading.

**Numeric Objectives**

Objectives for Primary Contact Recreation apply only during the recreation period of May 1 to September 30. The objectives for Secondary Body Contact Recreation apply during the remainder of the year.

- Primary Contact Recreation - Compliance shall be based upon meeting the requirements of one of the three options specified below for bacteria. Upon selection of one group or test method, said method shall be used exclusively over that 30-day period. Provided, where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, no objectives exceedances shall be allowed for any indicator group:

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- Fecal coliform shall not exceed a monthly geometric mean of 200 cfu/100 mL, as determined by multiple-tube fermentation or membrane filter procedures based on a minimum of not less than five samples collected over a period of not more than 30 days. Further, in no more than 10 percent of the total samples during any 30-day period shall fecal coliform exceed 400 cfu/100 mL.
- *E. coli* shall not exceed a monthly geometric mean of 126 cfu/100 mL based upon a minimum of not less than five samples collected over a period of not more than 30 days. No sample shall exceed a 75 percent one-sided confidence level of 235 cfu/100 mL in lakes and high use waterbodies and the 90 percent one-sided confidence level of 406 cfu/100 mL in all other Primary Body Contact Recreation beneficial use areas.
- *Enterococci* shall not exceed a monthly geometric mean of 33 cfu/100 mL based upon a minimum of not less than five samples collected over a period of not more than 30 days. No sample shall exceed a 75 percent one-sided confidence level of 61 cfu/100 mL in lakes and high use waterbodies and the 90 percent one-sided confidence level of 108 cfu/100 mL in all other Primary Body Contact Recreation beneficial use areas.
- Secondary Contact Recreation - Waters so designated shall be maintained to be free from human pathogens in numbers that may produce adverse health effects in humans. The water quality requirements for Secondary Body Contact Recreation are usually not as stringent as for Primary Body Contact Recreation

### Texas

#### *Recreational Use Categories*

- Contact Recreation - Recreational activities involving a significant risk of ingestion of water, including wading by children, swimming, water skiing, diving, and surfing.
- Noncontact Recreation - Aquatic recreational pursuits not involving a significant risk of water ingestion; including fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity.

Texas water quality standards state: Classified segments are designated for contact recreation unless elevated concentrations of indicator bacteria frequently occur due to sources of pollution which cannot be reasonably controlled by existing regulations or contact recreation is considered unsafe for other reasons such as ship or barge traffic. In a classified segment where contact recreation is considered unsafe for reasons unrelated to water quality, a designated use of noncontact recreation may be assigned objectives normally associated with contact recreation. A designation of contact recreation is not a guarantee that the water so designated is completely free of disease-causing organisms. Indicator bacteria, although not generally pathogenic, are indicative of potential contamination by feces of warm blooded animals. The objectives for contact recreation are based on these indicator bacteria, rather than direct measurements of pathogens.

**Numeric Objectives**

■ *E. coli*:

– Contact Recreation – The geometric mean of *E. coli* should not exceed 126 cfu/100 mL. In addition, single samples of *E. coli* should not exceed 394 cfu/100 mL.

– Noncontact Recreation – The geometric mean of *E. coli* should not exceed 605 cfu/100 mL.

■ Fecal coliform – Fecal coliform bacteria can be used as an alternative instream indicator of recreational suitability until sufficient data are available for *E. coli* or *Enterococci*. Fecal coliform can also continue to be used as a surrogate indicator in effluent limits for wastewater discharges. Fecal coliform objectives are as follows:

– Contact Recreation – The geometric mean of fecal coliform should not exceed 200 cfu/100 mL. In addition, single samples of fecal coliform should not exceed 400 cfu/100 mL.

– Noncontact Recreation – Fecal coliform shall not exceed 2,000 cfu/100 mL as a geometric mean. In addition, single samples of fecal coliform should not exceed 4,000 cfu/100 mL.

**EPA Region 7**

**Iowa**

**Recreational Use Categories**

■ Primary Contact Recreational Use (Class "A1") – Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

■ Secondary Contact Recreational Use (Class "A2") – Waters in which recreational or other uses may result in contact with the water that is either incidental or accidental. During the recreational use, the probability of ingesting appreciable quantities of water is minimal. Class A2 uses include fishing, commercial and recreational boating, any limited contact incidental to shoreline activities and activities in which users do not swim or float in the water body while on a boating activity.

■ Children's Recreational Use (Class "A3") – Waters in which recreational uses by children are common. Class A3 waters are water bodies having definite banks and bed with visible evidence of the flow or occurrence of water. This type of use would primarily occur in urban or residential areas.

**Numeric Objectives**

The applicable water quality objectives are dependent on the waterbody's classification:

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- Class A1, March 15 - November 15 - *E. coli* 126 cfu/100 mL geometric mean; 235 cfu/100 mL single sample maximum; remainder of the year the bacteria objectives do not apply.
- Class A2, March 15 - November 15 - *E. coli* 630 cfu/100 mL geometric mean; 2,880 cfu/100 mL single sample maximum; remainder of the year the bacteria objectives do not apply.
- Class A3, March 15 - November 15 - *E. coli* 126 cfu/100 mL geometric mean; 235 cfu/100 mL single sample maximum; remainder of the year the bacteria objectives do not apply.
- Class A2 and Aquatic Life (cold or warmwater) or a waterbody designated as a "high quality" water - *E. coli* 630 cfu/100 mL geometric mean; 2,880 cfu/100 mL single sample maximum; year-round.

At the request of the Task Force, information was requested from the Iowa Department of Natural Resources regarding how the agency makes a determination that a waterbody is Class A3. Adam Schnieders provided the following information:

- Iowa has no formal protocol for the classification of recreational uses. The state collects data on waters, e.g., depth, flow, bank characteristics, location (e.g., urban, near parks, residential areas), and then uses a general weight of evidence approach for assigning recreational uses.
- Only a few waters are classified as A3 and these are all urban streams in populated areas.
- The state has no plans to establish more stringent bacteria objectives for the Class A3 use.

### Kansas

#### *Recreational Use Categories*

Kansas has numerous definitions related to the establishment of recreational use subcategories:

- Primary Contact Recreation - Primary contact recreational use is evaluated differently for each of two main categories of waters: 1) classified surface waters other than classified stream segments, and 2) classified stream segments. For each category, the determining factor for primary contact recreation is body immersion in the water to the extent that some inadvertent ingestion of water is probable. The primary contact recreation season is from April 1 through October 31 of each year.
  - Classified Surface Waters Other Than Classified Stream Segments - Uses supported in this category include boating, mussel harvesting, swimming, skin diving, water skiing, and wind surfing. The three subcategories of primary contact recreational use for classified surface waters other than classified streams segments are:

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- Primary Contact Recreational Use: Swimming Beach - applies to those classified surface waters other than classified stream segments that have posted public swimming areas. During the non-recreational season, the secondary contact recreational use: public access objectives will apply.
  - Primary Contact Recreational Use: Public Access - applies to those classified surface waters other than classified stream segments where full body contact may occur and is by law or written permission of the landowner open to and accessible by the public. During the non-recreational season, the secondary contact recreational use: public access objectives will apply.
  - Primary Contact Recreational Use: Restricted Access - applies to those classified surface waters other than classified stream segments where full body contact may occur and is not open to and accessible by the public under Kansas law. During the non-recreational season, the secondary contact recreational use: restricted access objectives will apply.
- Classified Stream Segments - The three subcategories of primary contact recreational use for classified stream segments are:
- Primary Contact Recreational Use: Class A - applies to those classified stream segments that have been designated as public swimming areas. Uses supported in this category include activities such as; kayaking, mussel harvesting, swimming, skin diving, water skiing, and wind surfing. During the non-recreational season, the secondary contact recreational use Class A objectives will apply.
  - Primary Contact Recreational Use: Class B - applies to classified stream segments where moderate full body contact from activities that include kayaking, mussel harvesting, swimming, skin diving, water skiing, and wind surfing shall occur. A classified stream segment under this classification must be by law or written permission of the landowner open to and accessible by the public. During the non-recreational season, the secondary contact recreational use Class A objectives will apply.
  - Primary Contact Recreational Use: Class C - applies to classified stream segments supporting boating, mussel harvesting, swimming, skin diving, water skiing, wind surfing, wading, or fishing and has infrequent full body contact under Kansas' law, a classified stream segment in this classification is not open to and accessible by the public. During the non-recreational season, the secondary contact recreational use Class B objectives will apply.
- Secondary Contact Recreational Use - There are two categories for secondary contact recreational use: 1) classified surface waters other than classified stream segments and 2) classified stream segments. The determining factor for secondary contact recreational use is a lack of body immersion to the extent ingestion of surface water is not probable. The

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secondary contact recreational use standards apply year round to surface waters designated for secondary contact recreational use.

- Classified Surface Waters Other Than Classified Stream Segments - This use shall include wading, fishing, trapping, and hunting. The two subcategories of secondary contact recreational use for classified surface waters other than classified stream segments are:
  - Secondary Contact Recreational Use: Public Access - applies to classified surface waters other than classified stream segments that are by law or written permission of the landowner open to and accessible by the public.
  - Secondary Contact Recreational Use: Restricted Access - applies to classified surface waters other than a classified stream segments that by law are not open to and accessible by the public.
- Classified Stream Segments - Secondary contact recreational uses for classified stream segments are capable of supporting the recreational activities of wading, fishing, canoeing, motor boating, rafting, or other types of boating. There two classes of secondary contact recreational use for classified stream segments are:
  - Secondary Contact Recreational Use: Class A - applies to classified stream segments that are by law or written permission of the landowner open to and accessible by the public.
  - Secondary Contact Recreational Use: Class B - applies to classified stream segments that by law are not open to and accessible by the public.

If opposite sides of a classified stream segment have differing public access status, the designated use of the entire classified stream segment will be the assigned the highest attainable recreational use. Assignment of the higher use, however, does not grant de facto public access to both sides of such segment.

Neither primary nor secondary contact recreational use designations will apply to stream segments where the natural, ephemeral, intermittent, or low flow conditions or water levels prevent primary or secondary recreational activities.

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*Numeric Objectives*

Kansas has established the following *E. coli* for classified stream segment:

Use	Colony Forming Units (cfu)/100mL	
	Geometric Mean April 1 - Oct. 31	Geometric Mean Nov. 1 - March 31
<b>Primary Contact Recreation</b>		
Class A	160	2,358
Class B	262	2,358
Class C	427	3,843
<b>Secondary Contact Recreation</b>	Geometric Mean Jan. 1 - Dec. 31	
Class A	2,358	
Class B	3,843	

Kansas has also adopted *E. coli* objectives specific to classified surface waters other than stream segments, e.g., lakes, reservoirs, wetlands, ponds, etc.:

Use	Colony Forming Units (cfu)/100 mL			
	Geometric Mean Apr 1 - Oct 31	Geometric Mean Nov 1 - Mar 31	Single Sample Maximum Apr 1 - Oct 31	Single Sample Maximum Nov 1 - Mar 31
<b>Primary Contact Recreation</b>				
Swimming Beach	160	800	732	3,655
Public Access	262	1,310	1,198	6,580
Restricted Access	427	2,135	1,950	9,760
<b>Secondary Contact Recreation</b>	Geometric Mean Jan 1 - Dec 31		Single Sample Maximum Jan 1 - Dec 31	
Public Access	2,135		9,760	
Restricted Access	2,135		9,760	

High Flow Exemption - Kansas has a high flow exemption for *E. coli* objectives if any of the following conditions are met:

- The flow is equal to or greater than the flow that is exceeded 10 percent of the time for any classified stream segment with a mean flow of less than 30 cubic feet per second.
- The flow is equal to or greater than 50 percent of the 2-year flood flow for any classified stream segment that has a mean flow of 30 or more cubic feet per second but less than 900 cubic feet per second.
- The flow is equal to or greater than the 2-year flood flow for any classified stream segment that has a mean flow greater than 900 cubic feet per second.

Because of the uniqueness of Kansas' water quality standards, the state was contacted for more information. The state provided the following:

- Portion of the EPA letter that approved the above recreational subcategorizations and water quality objectives (see Appendix B). EPA notes that Kansas used an appropriate risk management approach, consistent with EPA guidance, for establishing uses and objectives.



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- Kansas has established UAA guidance for evaluating recreational uses ([www.kdhe.state.ks.us/befs/uaas/UAAGuidance.pdf](http://www.kdhe.state.ks.us/befs/uaas/UAAGuidance.pdf)). As a result of this guidance, Kansas has completed over 1600 recreational UAAs

### Missouri

#### *Recreational Use Categories*

- Whole-Body Contact Recreation – Activities in which there is direct human contact with the raw surface water to the point of complete body submergence. The raw water may be ingested accidentally and certain sensitive body organs, such as the eyes, ears, and the nose, will be exposed to the water. Although the water may be ingested accidentally, it is not intended to be used as a potable supply unless acceptable treatment is applied. Water so designated is intended to be used for swimming, water skiing, or skin diving.
- Secondary Contact Recreation – Applies where incidental contact occurs and ingestion unlikely

State's water quality standards are currently being updated to recognize where whole-body and secondary contact uses should apply. UAAs have been done where appropriate to demonstrate secondary contact. UAA protocol was developed by the state; it uses simple observations to make decisions regarding whether whole body contact is an existing use. State appears to use the following depth objectives for whole body: depth of at least 1 meter or average of 0.5 meter.

#### *Numeric Objectives*

- Protection of whole-body-contact recreation is limited to classified waters designated for that use. For periods when the stream or lake is not affected by stormwater runoff, the fecal coliform count shall not exceed 200 cfu/100 mL during the recreational season in waters designated for whole-body-contact recreation or at any time in losing streams. The recreational season is from April 1 to October 31.
- No objectives have been adopted for waters designated with secondary contact recreation.

### Nebraska

#### *Recreational Use Categories*

Nebraska has only one recreational use: Primary Contact Recreation. Per the state regulations, this use applies to surface waters which are used, or have a high potential to be used, for primary contact recreational activities. Primary contact recreation includes activities where the body may come into prolonged or intimate contact with the water, such that water may be accidentally ingested and sensitive body organs (e.g., eyes, ears, nose, etc.) may be exposed. Although the water may be accidentally ingested, it is not intended to be used as a potable water supply unless acceptable treatment is applied. These waters may be used for swimming, water skiing, canoeing, and similar activities. Any of the following objectives may be used to determine support of this use.

**Numeric Objectives**

- Fecal Coliform - Bacteria of the fecal coliform group shall not exceed a geometric mean of 200 cfu/100 mL, nor equal or exceed 400 cfu/100 mL, in more than 10 percent of the samples. These objectives are based on a minimum of five samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines. These objectives apply during the recreational period of May 1 through September 30.
- *E. coli* - *E. coli* bacteria shall not exceed a geometric mean of 126 cfu/100 mL. For increased confidence of the objectives, the geometric mean should be based on a minimum of five samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines. Single sample maximum allowable densities shall not exceed the following objectives:
  - 235 cfu/100 mL at designated bathing beaches
  - 298 cfu/100 mL at moderately used recreational waters
  - 406 cfu/100 mL at lightly use recreational waters
  - 576 cfu/100 mL at infrequently used recreational waters

Note: Appears to be no seasonal basis for *E. coli* objectives.

**EPA Region 8**

**Colorado**

**Recreational Use Categories**

- Class 1, Primary Contact - These surface waters are suitable or intended to become suitable for recreational activities in or on the water when the ingestion of small quantities of water is likely to occur. Such waters include but are not limited to those used for swimming, rafting, kayaking, tubing, windsurfing, and water-skiing. Waters shall be presumed to be suitable for Class 1 uses and shall be assigned a class 1a or class 1b classification unless a UAA demonstrates that there is not a reasonable potential for primary contact uses to occur in the water segment(s) in question within the next 20-year period:
  - Class 1a, Existing Primary Contact - Class 1a waters are those in which primary contact uses have been documented or are presumed to be present. Waters for which no UAA has been performed demonstrating that a recreation class 2 classification is appropriate shall be assigned a class 1a classification, unless a reasonable level of inquiry has failed to identify any existing class 1 uses of the water segment.
  - Class 1b, Potential Primary Contact - This classification shall be assigned to water segments for which no UAA has been performed demonstrating that a recreation class 2 classification is appropriate, if a reasonable level of inquiry has failed to identify any existing class 1 uses of the water segment.

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- **Class 2, Secondary Contact** - These surface waters are not suitable or intended to become suitable for primary contact recreation uses, but are suitable or intended to become suitable for recreational uses on or about the water that are not included in the primary contact subcategory, including but not limited to wading, fishing, and other streamside or lakeside recreation.

### *Numeric Objectives*

- **Primary Contact Recreation** (Where data from both indicators are available for a site, the *E. coli* indicator takes precedent for assessment purposes):
  - *E. coli*
    - Class 1a - 126 cfu/100 mL, geometric mean
    - Class 1b - 205 cfu/100 mL, geometric mean
  - **Fecal coliform**
    - Class 1a - 200 cfu/100 mL, geometric mean
    - Class 1b - 325 cfu/100 mL, geometric mean
  - **Secondary Contact**
    - *E. coli*, 630 cfu/100 mL, geometric mean
    - Fecal coliform, 2,000 cfu/100 mL, geometric mean

Regulations include a statement regarding why no single sample maximum objectives have been adopted:

The Commission has declined to adopt such objectives at this time, due in part to uncertainty regarding the significance of and the appropriate response to elevated single sample test results. An important aspect of this concern is the substantial variability that can be common in individual bacteriological samples, because bacteria are not uniformly distributed in water samples, since they behave more like suspended particles, rather than dissolved constituents. Repeat testing on such samples can yield results which vary substantially.

## **Montana**

### *Recreational Use Categories*

Waters are classified with groupings of uses. Classified waters are either protected for "bathing, swimming, and recreation" or "secondary contact recreation." Only the latter is defined (the other likely being considered self-explanatory): Secondary contact recreation - activities in or on the water where the potential for immersion or ingestion of water is low, such as wading or boating.

**Numeric Objectives**

Instead of assigning several beneficial uses to a given water body, a single use category is assigned. Each use category is composed of different combinations of beneficial uses. There are a total of approximately 16 categories with the following names: A-Closed, A-1, B-1, B-2, B-3, ..., F-1, G-1. For categories from D-1 thru G-1, the applicable use is secondary contact recreation. All other categories are protected for "swimming" type recreation. The following table shows the numeric objectives for bacteria in each of the Montana beneficial use categories.

Use Category	Colony Forming Unit (cfu)/100 mL	
	Geometric Mean April 1 - Oct 31	Geometric Mean Nov 1 - Mar 31
A-1 through A-Closed	32	32
B-1 through C-2	126	630
C3	252	630
D-1 through G-1	630	630

**North Dakota**

Waters identified by class with types or groupings of applicable uses. It appears that all waters regardless of class have the following fecal coliform criterion: not to exceed 200 cfu/100 mL in any sample, but only during the "recreation season" from May 1 through September 30. However, a separate rule section requires that any wastewater discharge meet a 200 cfu/100 mL criterion prior to discharge.

**South Dakota**

**Recreational Use Categories**

- Immersion Recreation - a beneficial use assigned to surface waters of the state that are suitable for uses where the human body may come in direct contact with the water, to the point of complete submersion and where water may be accidentally ingested or where certain sensitive organs such as the eyes, ears, and nose may be exposed to water
- Limited-Contact Recreation - a beneficial use assigned to surface waters of the state that are suitable for boating, fishing, and other water-related recreation other than immersion recreation where a person's water contact would be limited to the extent that infections of eyes, ears, respiratory or digestive systems, or urogenital areas would normally be avoided

**Numeric Objectives**

- Immersion Recreation - Applicable only from May 1 to September 30; Fecal coliform  $\leq 200$  cfu/100 mL geometric mean based on a minimum of five samples obtained during separate 24-hour periods for any 30-day period, and they may not exceed this value in more than 20 percent of the samples in this same 30-day period. No single sample may exceed 400 cfu/100 mL.

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- Limited Contact Recreation - Applicable only from May 1 to September 30; Fecal coliform  $\leq 1,000$  cfu/100 mL geometric mean based on a minimum of five samples obtained during separate 24-hour periods for any 30-day period, and they may not exceed this value in more than 20 percent of the samples in this same 30-day period. No single sample may exceed 2,000 cfu/100 mL.

Note: Appears that waters have no objectives from October 1 through April 30; however, this has not been confirmed.

### Utah

#### *Recreational Use Categories*

Utah categorizes use types (e.g., recreation, aquatic life) into classes. Class 2 and its two subclasses establish protection categories for recreation:

- Class 2 - Protected for recreational use and aesthetics
  - Class 2A - Protected for primary contact recreation such as swimming
  - Class 2B - Protected for secondary contact recreation, e.g., boating, wading, or similar uses

#### *Numeric Objectives*

- *E. coli*
  - Class 2A - 126 cfu/100 mL, 30-day geometric mean; 206 cfu/100 mL single sample maximum
  - Class 2B - 576 cfu/100 mL, 30-day geometric mean; 940 cfu/100 mL single sample maximum

At the request of the Task Force, information was requested from the Utah Department of Environmental Quality regarding the basis for the use of the 940 cfu/100 mL single sample maximum objective. No response was received from the state.

### Wyoming

#### *Recreational Use Categories*

- Primary Contact Recreation - any recreational or other surface water use in which there is contact with the water sufficient to pose a significant health hazard (i.e., water skiing, swimming).
- Secondary Contact Recreation - any recreational or other surface water use in which contact with water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, hunting and commercial and recreational boating.

### *Numeric Objectives*

The following objectives are currently proposed to replace existing fecal coliform objectives:

■ **Geometric mean objectives:**

- **Primary Contact Recreation** - In all waters designated for primary contact recreation, during the summer recreation season (May 1 through September 30), concentrations of *E. coli* bacteria shall not exceed a geometric mean of 126 cfu/100 mL based on a minimum of not less than five samples obtained during separate 24 hour periods for any 30-day period. During the period October 1 through April 30, all waters are protected for secondary contact recreation only.
- **Secondary Contact Recreation** - In all waters designated for secondary contact recreation, and in waters designated for primary contact recreation during the winter recreation season (October 1 through April 30), concentrations of *E. coli* bacteria shall not exceed a geometric mean of 630 organisms per 100 milliliters based on a minimum of not less than five samples obtained during separate 24 hour periods for any 30-day period.

■ **Single-Sample Maximum Concentrations** - During the recreation season, on all waters designated for primary contact recreation, the following single-sample maximum concentrations of *E. coli* bacteria shall apply:

- High use swimming areas - 235 organisms per 100 milliliters
- Moderate full body contact - 298 organisms per 100 milliliters
- Lightly used full body contact - 410 organisms per 100 milliliters
- Infrequently used full body contact - 576 organisms per 100 milliliters

Additional information provided regarding use of objectives: Single-sample maximum values may be used to post recreational use advisories in public recreation areas and to derive single-sample maximum effluent limitations on point source discharges. Exceedances of the single-sample maxima shall not be cause for the listing of a waterbody on the State 303(d) list or development of a TMDL or watershed plan. The appropriate recreational use category (i through iv above) shall be determined by the administrator as needed, on a case by case basis. In making such a determination, the administrator may consider such site-specific circumstances as type and frequency of use, time of year, public access, proximity to populated areas and local interests.

## **EPA Region 9**

### **Arizona**

#### *Recreational Use Categories*

- **Full-Body Contact** - use of a surface water for swimming or other recreational activity that causes the human body to come into direct contact with the water to the point of complete

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submergence. The use is such that ingestion of the water is likely and sensitive body organs, such as the eyes, ears, or nose, may be exposed to direct contact with the water.

- Partial-Body Contact - use of a surface water that may cause the human body to come into direct contact with the water, but normally not to the point of complete submergence (for example, wading or boating). The use is such that ingestion of the water is not likely and sensitive body organs, such as the eyes, ears, or nose, will not normally be exposed to direct contact with the water.

### *Numeric Objectives*

Both full and partial body contact use objectives are based on *E. coli*:

- Full Body Contact - Geometric mean (four-sample minimum) 126 cfu/100 mL; single sample maximum of 235 cfu/100 mL.
- Partial Body Contact - Geometric mean (four-sample minimum) 126 cfu/100 mL; single sample maximum of 575 cfu/100 mL.

Arizona recently published draft rules as part of its current triennial review of water quality standards. Arizona is proposing to establish separate single sample maximum criteria for designated beaches/swimming areas and other waters with a Full Body Contact use. The revised criteria would be as follows:

- Single sample maximum (designated bathing beaches and swimming areas) - 235 cfu/100 mL
- Single sample maximum (all other surface waters designated Full Body Contact) - 575 cfu/100 mL)

Arizona does not apply any recreational uses or objectives to waterbodies that are canals. This includes the following canals that have classified uses: "Phoenix Area Canals" and "Yuma Area Canals."

## **California**

### *Recreational Use Categories*

All nine California Regional Water Quality Boards have two recreational uses that are defined as follows:

- REC-1, Water Contact Recreation - waters are used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and use of natural hot springs.
- REC-2, Non-contact Water Recreation - waters are used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water would be reasonably possible. These uses may include, but are not limited to,

picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.

Region 8 (Santa Ana) has added the following footnote to these definitions:

"The REC1 and REC2 beneficial use designations assigned to surface waterbodies in this Region should not be construed as encouraging recreational activities. In some cases, such as Lake Mathews and certain reaches of the Santa Ana River, access to the waterbodies is prohibited because of potentially hazardous conditions and/or because of the need to protect other uses, such as municipal supply or sensitive wildlife habitat. Where REC1 or REC2 is indicated as a beneficial use in Table 3-1, the designations are intended to indicate that the uses exist or that the water quality of the waterbody could support recreational uses."

#### *Numeric Objectives*

The applicable numeric objectives do vary somewhat across regions and the regions are at different stages with addressing EPA's recommendation to change from the traditional fecal coliform objectives to *E. coli* and *Enterococci* objectives. Following is a region-by-region summary of bacteria objectives and, where information was available, the status of efforts to modify these objectives:

#### Region 1 - North Coast

- REC-1 Objectives - In waters designated for contact recreation (REC-1), the median fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed 50/100 mL, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 mL.
- REC-2 Objectives - Region 1 has not established any REC-2 bacteria objectives.

Region 1's 2004 triennial review workplan includes the following: Regional Update to the Water Quality Objectives for Bacteria (to include the Russian River) for FY '05-'06 - purpose is to consider adopting *E. coli* and *Enterococci* objectives and add a single sample maximum that "could give guidance for posting areas when the bacteria levels are considered unhealthy for the REC-1 (primary water contact) use."

#### Region 2 - San Francisco Bay

Basin Plan (Table 3-1) provides the following objectives:

- REC-1 - Fecal coliform geometric mean < 200 cfu/100mL (based on five samples equally spaced over a 30-day period) and 90th percentile < 400 cfu/100 mL; Total coliform median < 240 cfu/100 mL and no sample > 10,000 cfu/100 mL.
- REC-2 - Fecal coliform mean < 2000 cfu/100 mL and 90th percentile < 4000 cfu/100 mL.



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Region 2's Basin Plan also includes a table (Table 3-2) that summarizes EPA's water quality criteria for water contact recreation based on the frequency of use a particular area receives. These criteria are identical to the EPA 1986 recommendations (see following table). According to the Basin Plan, "these criteria will be used to differentiate between pollution sources or to supplement objectives for water contact recreation."

TABLE 3-2 U.S. EPA BACTERIOLOGICAL CRITERIA FOR WATER CONTACT RECREATION (IN COLIFORMS PER 100 mL)			
	FRESH WATER ENTEROCOCCI	FRESH WATER E. COLI	SALT WATER ENTEROCOCCI
Steady State (all areas)	33	126	35
Maximum at:			
- designated beach	61	235	104
- moderately used area	89	298	124
- lightly used area	108	406	276
- infrequently used area	151	576	500

**NOTES:**

- The criteria were published in the Federal Register, Vol. 51, No. 45 / Friday, March 7, 1986 / 8012 - 8016. The Criteria are based on:
  - Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. U.S. EPA, EPA 600/1-80-031, Cincinnati, Ohio, and
  - Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. EPA, EPA 600/1-84-004, Cincinnati, Ohio.
- The U.S. EPA criteria apply to water contact recreation only. The criteria provide for a level of protection based on the frequency of usage of a given water contact recreation area. The criteria may be employed in special studies within this region to differentiate between pollution sources or to supplement the current coliform objectives for water contact recreation.

Region 2's November 2004 staff report prioritizing triennial review issues, rated modification of bacteria water quality objectives as a low priority for the following reasons:

"In 1986, the Water Board included the then-newly adopted U.S. EPA bacteriological criteria for reference (Table 3-2), but not as water quality objectives. U.S. EPA has requested that the Water Board take the next step of adopting them as State water quality objectives, as has been done in some other Regional Water Board jurisdictions. Table 3-1 contains bacteriological water quality objectives. Some bacteriological criteria are currently cited in Table 3-2 of the Basin Plan as U.S. EPA criteria, not water quality objectives. In their comment letter, U.S. EPA requested that Water Board

adoption of bacteriological criteria as water quality objectives precede U.S. EPA's promulgation of these criteria in the State's coastal waters. U.S. EPA is encouraging all Regional Water Boards to adopt the 1986 criteria as State water quality objectives for their non-coastal waters. This issue is under active discussion at the Basin Plan roundtable as a statewide planning priority, in order to make Regional Water Board planning resources available for other priorities. U.S. EPA noted that such promulgation would only affect coastal waters in our region, and requests that this Water Board adopt the objectives for inland surface waters. Table 3-1 of the Basin Plan already contains bacteriological objectives (fecal coliform) to protect these waters, and our experience has shown that the U.S. EPA objectives are not significantly different from Basin Plan objectives based on analyses from the Section 303d impaired waterbodies listings in 2002. For example, an analysis of compliance with Table 3-1 (objectives) and 3-2 (U.S. EPA criteria) yielded the identical conclusions of percent exceedances and impairment at every beach analyzed in the 2002 303d process, as documented in the administrative record for that action."

#### Region 3 - Central Coast

- REC-1 - Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 cfu/100 mL, nor shall more than 10 percent of total samples during any 30-day period exceed 400 cfu/100 mL.
- REC-2 - Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 2,000 cfu/100 mL, nor shall more than 10 percent of samples collected during any 30-day period exceed 4,000 cfu/100 mL.

Revised bacteria water quality objectives were a triennial review priority for 2001-2004, but no changes were made. The bacteria objectives are now on the 2005 priority list. The Regional Board plans to incorporate an *Enterococcus* objective for water contact recreation in ocean waters, an *E. coli* objective for water contact recreation in surface waters, and a fecal coliform objective for shellfish harvesting.

#### Region 4 - Los Angeles

- REC-1 (freshwater) - Geometric mean for *E. coli* shall not exceed 126 cfu/100 mL; fecal coliform shall not exceed 200 cfu/100 mL. Single sample maximum for *E. coli* shall not exceed 235 cfu/100 mL and fecal coliform shall not exceed 400 cfu/100 mL.

Region 4 has also adopted the following implementation provisions for REC-1 bacteria objectives - The geometric mean values should be calculated based on a statistically sufficient number of samples (generally not less than five samples equally spaced over a 30-day period). If any of the single sample limits are exceeded, the Regional Board may require repeat sampling on a daily basis until the sample falls below the single sample limit in order to determine the persistence of the exceedance. When repeat sampling is required

because of an exceedance of any one single sample limit, values from all samples collected during that 30-day period shall be used to calculate the geometric mean.

In addition, Region 4 has adopted and EPA has approved a high flow suspension for selected waters:

"The High Flow Suspension shall apply to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (ad) footnote appears in Table 2-1a. The High Flow Suspension shall apply on days with rainfall greater than or equal to 1/2-inch and the 24 hours following the end of the 1/2-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods. The High Flow Suspension only applies to engineered channels, defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or bottom with concrete. The water bodies to which the High Flow Suspension applies are identified in Table 2-1a in the column labeled 'High Flow Suspension'."

- REC-2 - In waters designated for non-water contact recreation (REC-1) and not designated for water contact recreation (REC-1), the fecal coliform concentration shall not exceed a log mean of 2,000 cfu/100 mL (based on a minimum of not less than four samples for any 30-day period), nor shall more than 10 percent of the samples collected during any 30-day period exceed 4,000 cfu/100 mL.

Note: Region 4 is the only region to have formally adopted *E. coli* objectives. In changing from fecal coliform to *E. coli*, the Regional Board's staff report included the following regarding water quality objectives for the REC-2 use:

"Staff recommends that the fecal coliform objectives for non-contact recreation (REC-2) remain unchanged at the current time, since no epidemiological studies or research have been conducted focusing on accidental/incidental contact."

#### Region 5 - Central Valley

- REC-1 - The Basin Plan was amended in 2002 to replace the REC-1 fecal coliform objectives with *E. coli* objectives and provide some implementation language:

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"...the *E. coli* concentration, based on a minimum of not less than five samples equally spaced over a 30-day period, shall not exceed a geometric mean of 126 cfu/100 mL and shall not exceed 235 cfu/100 mL in any single sample.

If any single sample limits are exceeded for *E. coli*, the Regional Water Board may require repeat sampling on a daily basis until the sample falls below the single sample limit or for 5 days, whichever is less, in order to determine the persistence of the exceedance.

When repeat sampling is required because of an exceedance of any one single sample limit, values from all samples collected during that 30-day period will be used to calculate the geometric mean. "

The Regional Board website notes that EPA approval is needed prior to the above language becoming effective. Betty Yee of the Regional Board was contacted to determine status. She indicated that the bacteria objectives were not submitted to the State Water Board for approval because there is now a statewide process that is scheduled to present statewide criteria to the State Water Board for adoption in June 2006.

- REC-2 - No water quality objectives have been adopted for the REC-2 use.

Region 6 - Lahonton

The bacteria water quality objectives for Region 6 apply to all surface waters and are not REC use specific:

- The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20 cfu/100 mL, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40 cfu/100 mL. The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log mean concentration exceeding 20 cfu/100 mL for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected.

Region 7 - Colorado River Basin

REC-1 & REC-2 - Based on a statistically sufficient number of samples (generally not less than five samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following:

	REC-1	REC-2
<i>E. coli</i>	126 cfu/100 mL	630 cfu/100 mL
<i>Enterococci</i>	33 cfu/100 mL	165 cfu/100 mL

Nor shall any sample exceed the following maximums:

	REC-1	REC-2
<i>E. coli</i>	400 cfu/100 mL	2000 cfu/100 mL
<i>Enterococci</i>	100 cfu/100 mL	500 cfu/100 mL

Except that for the Colorado River, the following maximum shall apply:

	REC-1	REC-2
<i>E. coli</i>	235 cfu/100 mL	1175 cfu/100 mL
<i>Enterococci</i>	61 cfu/100 mL	305 cfu/100 mL

In addition to the objectives above, in waters designated REC-1, the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 cfu/100 mL, nor shall more than 10 percent of total samples during any 30-day period exceed 400 cfu/100 mL.

#### Region 8 - Santa Ana

- REC-1 - Fecal coliform: log mean less than 200 cfu/100 mL based on five or more samples/ 30-day period, and not more than 10 percent of the samples exceed 400 cfu/100 mL for any 30-day period.
- REC-2 - Fecal coliform: average less than 2,000 cfu/100 mL and not more than 10 percent of samples exceed 4,000 cfu/100 mL for any 30-day period.

#### Region 9 - San Diego

- REC-1 - Fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 cfu/100 mL, nor shall more than 10 percent of total samples during any 30-day period exceed 400 cfu/100 mL.
- REC-2 - In water designated for REC-2 and not designated for REC-1, the average fecal coliform concentrations for any 30-day period, shall not exceed 2,000 cfu/100 mL nor shall more than 10 percent of samples collected during any 30-day period exceed 4,000 cfu/100 mL.

This Regional Board's 2004 triennial review priority list included two "high" priority elements involving recreational uses and bacteria water quality objectives:

- Update and clarify existing water quality objectives for bacteria indicators. Include language in Basin Plan Chapter 3 clarifying how objectives should be interpreted and

implemented (e.g., applicability of *E. coli* and *Enterococcus* for use in NPDES permitting). Additionally, develop implementation provisions for bacteria objectives for REC-1 beneficial use. Implementation provisions would not replace water quality objectives but would discuss provisions under which exceedances of water quality objectives would be allowed during wet weather conditions. Implementation provisions may include but are not be limited to incorporation of a reference watershed, or a watershed that is minimally impacted by anthropogenic activities, or such other approaches as may be found appropriate, useful and compatible with EPA guidelines. Such a watershed has a certain amount of exceedances of the water quality objectives during rain events, and these exceedances are due to input from natural sources (wildlife). TMDLs for bacteria would incorporate these implementation provisions as an alternative to using the water quality objectives as written in the Basin Plan.

- Adopt a subcategory of REC-1 called "Wildlife Impacted Recreation" for waterbodies designated with REC-1 beneficial use, which also support an abundance of wildlife (e.g., Children's Pool, La Jolla). In wildlife-impacted areas achieving REC-1 standards for bacteria is difficult. Adoption of the subcategory "Wildlife Impacted Recreation" would reflect the natural levels of bacteria while providing protection to the noncontact recreation beneficial use (REC-2). Consider sub-category for contact recreation (REC-1) in flood control areas and reservoirs where public access is restricted. Revise designated beneficial uses to recognize flood control and its incompatibility with beneficial uses on a case-by-case basis, such as Forrester Creek and Chollas Creek.

## Hawaii

### *Recreational Use Categories*

Waters are classified by type and location, e.g., inland vs. marine. There appears to be no specific use designations established, e.g., primary or secondary contact.

### *Numeric Objectives*

For inland waters:

- *Enterococcus* content shall not exceed a geometric mean of 33 cfu/100 mL in not less than five samples that shall be spaced to cover a period between 25 and 30 days. No single sample shall exceed the single sample maximum of 89 cfu/100 mL or the site-specific one-sided 82 percent confidence limit.
- Inland recreational waters in which *Enterococcus* does not exceed the standard shall not be lowered in quality.
- At locations where sampling is less frequent than five samples per 25 to 30 days, no single sample shall exceed the single sample maximum nor shall the geometric mean of these samples taken during the 30-day period exceed 33 cfu/100 mL.

## Nevada

### *Recreational Use Categories*

Waters are categorized into Classes A, B, C, or D; the applicable recreational use varies. Class A, B, and C are designated with both REC-1 and REC-2; Class D is designated with REC 2 only. Definitions of REC-1 and REC-2 include:

- REC-1 applies to waters where recreation involving contact with the water may occur
- REC-2 applies to waters where recreation not involving contact with the water may occur

Class D waters, where only REC-2 applies are defined as follows: waters or portions of waters located in areas of urban development, highly industrialized or intensively used for agriculture or a combination of the above and where effluent sources include a multiplicity of waste discharges from the highly altered watershed. Very few waters have been categorized as Class D; not clear whether a UAA was required.

### *Numeric Objectives*

Numeric objectives applicable to waterbodies depend on the class of water:

- Class A and B: The fecal coliform concentration, based on a minimum of five samples during any 30-day period, must not exceed a geometric mean of 200 cfu/100 mL nor may more than 10 percent of total samples during any 30-day period exceed 400 cfu/100 mL.
- Class C: The more stringent of the following apply:
  - The fecal coliform concentration must not exceed a geometric mean of 1,000 cfu/100 mL nor may more than 20 percent of total samples exceed 2,400 cfu/100 mL.
  - The annual geometric mean of fecal coliform concentration must not exceed that characteristic of natural conditions by more than 200 cfu/100 mL nor may the number of fecal coliform in a single sample exceed that characteristic of natural conditions by more than 400 cfu/100 mL.
  - The fecal coliform concentration, based on a minimum of five samples during any 30-day period, must not exceed a geometric mean of 200 cfu/100 mL, nor may more than 10 percent of total samples during any 30-day period exceed 400 cfu/100 mL. This is applicable only to those waters used for primary contact recreation.
- Class D: No numeric objectives apply.

In addition to these statewide standards, Nevada has also established site-specific bacteria standards on many of its major waters. These site-specific objectives are based on *E. coli* rather than fecal coliform. Tributaries to Lake Tahoe have a 126 cfu/100 mL single sample maximum standard. Most of the other state waters with *E. coli* objectives use the 126 cfu/100 mL geometric mean as the standard, but the geometric mean is based on an annual calculation. Waters with a 126 cfu/100 mL annual geometric mean also have a single sample maximum of

either 235 or 410 cfu/100 mL. A few waters have either only an annual geometric mean objective of 630 cfu/100 mL or only a single sample maximum of 630 cfu/100 mL.

## EPA Region 10

### Alaska

Alaska is currently undergoing its triennial review to adopt revised *E. coli* objectives. One of the issues to be addressed is whether to adopt seasonal-based objectives.

#### *Recreational Use Categories*

No definitions found. It appears that contact and secondary contact uses apply to all state freshwaters.

#### *Numeric Objectives*

- Contact Recreation - In a 30-day period, the geometric mean of fecal coliform samples may not exceed 100 cfu/100 mL, and not more than one sample, or more than 10 percent of the samples if there are more than 10 samples, may exceed 200 cfu/100 mL.
- Secondary Recreation - In a 30-day period, the geometric mean of fecal coliform samples may not exceed 200 cfu/100 mL, and not more than 10 percent of the total samples may exceed 400 cfu/100 mL.

### Idaho

#### *Recreational Use Categories*

- Primary Contact Recreation - water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, those used for swimming, water skiing, or skin diving.
- Secondary Contact Recreation - water quality appropriate for recreational uses on or about the water and that are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

#### *Numeric Objectives*

- Primary Contact Recreation - Waters designated for primary contact recreation are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding:
  - For areas within waters designated for primary contact recreation that are additionally specified as public swimming beaches, a single sample of 235 cfu/100 mL. For the purpose of this subsection, "specified public swimming beaches" are considered to be indicated by features such as signs, swimming docks, diving boards, slides, or the like, boater exclusion zones, map legends, collection of a fee for beach use, or any other unambiguous invitation to public swimming. Privately owned swimming docks or the like which are not open to the general public are not included in this definition.



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- For all other waters designated for primary contact recreation, a single sample of 406 cfu/100 mL
- A geometric mean of 126 cfu/100 mL based on a minimum of five samples taken every 3 to 5 days over a 30-day period.
- Secondary Contact Recreation - Waters designated for secondary contact recreation are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding:
  - A single sample of 576 cfu/100 mL
  - A geometric mean of 126 cfu/100 mL based on a minimum of five samples taken every 3 to 5 days over a 30-day period.

In addition to the above objectives, the following statements are included in the Idaho water quality standards:

- Numeric water quality standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation, optimum flow is equal to or greater than 5 cfs. In Idaho, intermittent waters are defined as: A stream, reach, or water body which has a period of 0 flow for at least 1 week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than 0.1 cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent.
- The designated use of a waterbody does not imply any rights to access or ability to conduct any activity related to the use designation, nor does it imply that an activity is safe. For example, a designation of primary or secondary contact recreation may occur in areas where it is unsafe to enter the water due to water flows, depth, or other hazardous conditions.
- A single water sample exceeding an *E. coli* standard does not in itself constitute a violation of water quality standards; however, additional samples shall be taken for the purpose of comparing the results to the geometric mean objectives:
  - Any discharger responsible for providing samples for *E. coli* shall take five additional samples. The Department shall take five additional samples for ambient *E. coli* samples unrelated to dischargers' monitoring responsibilities.
- Idaho has also successfully conducted UAAs to change the primary contact recreation use to secondary contact primarily based on safety concerns.

## Oregon

### *Recreational Use Categories*

Oregon has a single recreational use: water contact recreation, which is applicable to all state waters except Bull Run River and its tributaries (may be a water supply source protection issue).

**Numeric Objectives**

*E. coli* - 30-day log mean of 126 cfu/100 mL, based on a minimum of five samples; no single sample may exceed 406 *E. coli*/100 mL

**Washington**

**Recreational Use Categories**

- Extraordinary Primary Contact - waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas
- Primary Contact Recreation - activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing.
- Secondary Contact Recreation - activities where a person's water contact would be limited (e.g., wading or fishing) to the extent that bacterial infections of eyes, ears, respiratory or digestive systems, or urogenital areas would normally be avoided.

**Numeric Objectives**

- Extraordinary Primary Contact - Fecal coliform organism levels must not exceed a geometric mean value of 50 cfu/100 mL, with not more than 10 percent of all samples (or any single sample when less than 10 sample points exist) obtained for calculating the geometric mean value exceeding 100 cfu/100 mL.
- Primary Contact Recreation - Fecal coliform organism levels must not exceed a geometric mean value of 100 cfu/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 cfu/100 mL.
- Secondary Contact Recreation - Fecal coliform organism levels must not exceed a geometric mean value of 200 cfu/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 400 cfu/100 mL.

Washington's water quality standards also include the following implementation statements:

- When averaging bacteria sample data for comparison to the geometric mean objectives, it is preferable to average by season and includes five or more data collection events within each period. Averaging of data collected beyond a 30-day period, or beyond a specific discharge event under investigation, is not permitted when such averaging would skew the data set so as to mask noncompliance periods. The period of averaging should not exceed twelve months, and should have sample collection dates well distributed throughout the reporting period.

## Recreational Uses and Bacteria Objectives

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- When determining compliance with the bacteria objectives in or around small sensitive areas, such as swimming beaches, it is recommended that multiple samples are taken throughout the area during each visit. Such multiple samples should be arithmetically averaged together (to reduce concerns with low bias when the data is later used in calculating a geometric mean) to reduce sample variability and to create a single representative data point.
- As determined necessary by the department, more stringent bacteria objectives may be established for rivers and streams that cause, or significantly contribute to, the de-certification or conditional certification of commercial or recreational shellfish harvest areas, even when the pre-assigned bacteria objectives for the river or stream are being met.
- Where information suggests that sample results are due primarily to sources other than warm-blooded animals (e.g., wood waste), alternative indicator objectives may be established on a site-specific basis by the department.

Recreational Uses and Bacteria Objectives  
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## **Appendix B**

Portion of EPA letter approving adoption of recreational uses and associated objectives.



## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII  
901 NORTH 5TH STREET  
KANSAS CITY, KANSAS 66101

03 NOV 2003

Mr. Roderrick L. Bremby, Secretary  
Kansas Department of Health and Environment  
Office of the Secretary  
1000 SW Jackson, Suite 540  
Topeka, Kansas 66612-1368

Dear Mr. Bremby:

This letter addresses new and revised water quality standards provisions submitted by the Kansas Department of Health and Environment (KDHE) concerning provisions of KSA 2002 Supp. 82a-2001, as amended by Senate Substitute for Substitute House Bill 2219, and regulations adopted by KDHE to implement those provisions. Under Section 303(c) of the Clean Water Act (CWA), 33 U.S.C. § 1313(c), states are to review their water quality standards no less frequently than every three years and submit revised or new water quality standards to the U.S. Environmental Protection Agency (EPA) for review and approval. Federal regulations at 40 C.F.R. §§ 131.20, 131.21, and 131.22 implement these requirements.

By letter dated September 26, 2003, KDHE submitted new and revised water quality standards provisions to EPA for review and approval pursuant to Section 303(c) of the Clean Water Act (CWA), 33 U.S.C. § 1313(c), and federal regulations at 40 C.F.R. § 131.20. The submission includes revisions to the Kansas Administrative Regulations (K.A.R.), Title 28, Article 16, which, after review and approval by the Attorney General of Kansas, were adopted by the State on September 25, 2003. Submitted along with these revised water quality standards was the Kansas Implementation Procedures: Surface Water Quality Standards (dated May 1, 2003). EPA received this submission on October 1, 2003.

These 2003 revisions were adopted by the State during a review of water quality standards conducted by the KDHE. As part of the revision process, KDHE posted the proposed rules on the KDHE Internet web site, and held a public hearing on August 28, 2003. Based upon our review, Kansas' procedures for adoption of these new and revised water quality standards are consistent with and satisfy the procedural requirements of 40 C.F.R. § 131.20.

On December 10, 2002, KDHE submitted new and revised water quality standards that – among other things – implemented new statutory water quality provisions at K.S.A. 2002 Supp. 82a-2001, *et seq.* In actions dated June 24 and August 4, 2003, EPA took action on portions of the State's December 2002 submittal. Today's decision resolves all outstanding items from the December 2002 submittal.

RECYCLE A small graphic of a recycling symbol consisting of three chasing arrows forming a triangle.

By letter dated June 16, 2003, KDHE submitted Senate Substitute for Substitute for House Bill No. 2219 (hereafter H.B. 2219), which repealed and amended K.S.A. 2002 Supp. 82a-2001. EPA informed the State in a July 23, 2003, letter that it would take action on HB 2219 and the portions of the State's December 2002 submission that refer to K.S.A. 2002 Supp. 82a-2001 when the State submitted rules and regulations adopted to incorporate provisions of HB 2219. The State's September 26, 2003, submittal included the awaited rules and regulations. Therefore, EPA's decision concerning the provisions of K.S.A. 2002 Supp. 82a-2001, as amended by HB 2219, is also included within today's action.

### TODAY'S DECISION

As Director of the Water, Wetlands and Pesticides Division, I am charged with the responsibility of reviewing and approving or disapproving new or revised state water quality standards under Section 303(c) of the CWA. I am hereby approving the following provisions of the new or revised water quality standards.

- K.S.A. 2002 Supp. 82a-2001, as amended by Senate Substitute for Substitute House Bill 2219, except as noted below
- Revisions to KAR 28-16-28d and KAR 28-16-28e
- Revisions to the Kansas Implementation Procedures - Surface Water Quality Standards dated May 1, 2003, except as noted below
- Decision That No Aquatic Life Use Is Attainable for 2 Waters
- Decision That No Recreation Use Is Attainable for 1 Water

In addition, I am hereby disapproving the following provisions of the new and revised water quality standards for Kansas.

- K.S.A. 2002 Supp. 82a-2001(a)(D)(ii) - disapproving the use of a cost/benefit analysis before classifying waters with flow less than 1 cfs for protection of aquatic life.
- Revisions to the Kansas Implementation Procedures - Surface Water Quality Standards dated May 1, 2003 - disapproving implementation of the use of a cost/benefit analysis before classifying waters with flow less than 1 cfs for protection of aquatic life.
- Frontier Ditch - disapproving the removal of the special aquatic life use designation without the support of an assessment and the removal of primary contact recreation use designation based on EPA's waterbody assessment under 40 CFR § 131.10(g)
- Great Eastern Ditch - disapproving the removal of the expected aquatic life use designation without the support of an assessment under 40 CFR § 131.10(g)

The enclosure to this letter provides a more detailed description of EPA's review and the basis for the approval and disapproval actions regarding these new and revised water quality standards.

Pursuant to 40 CFR § 131.21(c), the approved provisions of the Kansas water quality standards are applicable water quality standards for purposes of the CWA. The disapproved provisions of the Kansas water quality standards, however, are not applicable for purposes of the CWA. No further federal action is necessary with respect to the cost/benefit provisions of K.S.A. 2002 Supp. §2a-2001(a)(D)(ii) and the Implementation Procedures, although the State may wish to remove these provisions for purposes of clarity. The State may correct the deficiencies for Frontier Ditch and the Great Eastern Ditch by either restoring the recreation and/or aquatic life use designations – as appropriate – to the Kansas Surface Water Register, or by conducting UAAs for the recreation and/or aquatic life uses – as appropriate – and adopting the designations those UAAs support. The State has ninety days to submit new or revised water quality standards for these waters consistent with this action to EPA. If the State does not correct the deficiencies for Frontier Ditch and the Great Eastern Ditch identified in this action in a manner consistent with the CWA and its implementing regulations, EPA will promptly propose new or revised water quality standards for these waters.

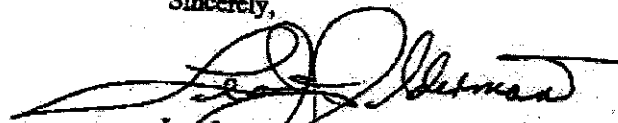
### CONSULTATION

EPA's approval of Kansas water quality standards is considered a Federal Action for purposes of compliance with the consultation requirements of Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536. On October 3, 2003, EPA initiated consultation with the U.S. Fish and Wildlife Service (Service) under Section 7(a)(2) of the ESA, as required, to determine whether or not this federal action is likely to adversely affect threatened and endangered species in Kansas. Section 7(a)(2) of the ESA requires that federal agencies, in consultation with the Service, insure that their actions are not likely to jeopardize the existence of federally listed species or result in the adverse modification of designated critical habitat for such species.

As of today, the Service has not provided EPA with a response. Therefore, EPA is approving the Kansas water quality standards pending completion of ESA Section 7(a)(2) consultation with the Service.

If you have any questions regarding these comments or the actions taken by EPA, please contact Cheryl A. Crisler, Water Resources Protection Branch Chief, at (913) 551-7820.

Sincerely,

  
Leo J. Alderman  
Director  
Water, Wetlands, and Pesticides Division

Enclosure

**K. Approved - K.S.A. 2002 Supp. 82a-2001(c)(7)(A) and KAR 28-16-28e(c)(7):  
Definition of primary and secondary contact recreation designated uses and water  
quality criteria to protect those uses**

**(A) "Recreation Use" means:**

**(i) Primary contact recreational use is use of a classified stream segment for recreation during the period from April 1 through October 31 of each year, provided such classified stream segment is capable of supporting the recreational activities of swimming, skin diving, water skiing, wind surfing, kayaking or mussel harvesting where the body is intended to be immersed in surface water to the extent that some inadvertent ingestion of water is probable.**

**(a) Primary contact recreational use-Class A:**

**(b) Primary contact recreational use-Class B:**

**(c) Primary contact recreational use-Class C:**

**(ii) Secondary contact recreation use is use of a classified stream segment for recreation, provided such classified stream segment is capable of supporting recreational activities of wading, fishing, canoeing, motor boating, rafting or other types of boating where the body is not intended to be immersed and where ingestion of surface water is not probable.**

**(a) Secondary contact recreational use-Class A:**

**(b) Secondary contact recreational use-Class B:**

This new statutory provision sets forth the circumstances under which a stream segment will be designated for either primary or secondary contact recreation use and describes the level of protection to be adopted by KDHE into their regulations for each category of recreational use. EPA's regulations at 40 CFR § 131.10(g) indicate the conditions that allow a state to designate a use other than the CWA § 101(a) goal uses or to designate subcategories of uses.

These Kansas statutory provisions include definitions for primary and secondary contact recreation use designations for stream segments, subcategories of each of those uses depending upon the level of recreation expected, the bacteria criteria illness rate levels upon which KDHE is to adopt criteria for each subcategory, seasonal use criteria for primary contact recreation uses, and the methodology for determining whether the stream segment is impaired for the designated use.

In addition to these statutory provisions addressing water quality standards for waters designated for recreation, Kansas submitted new and revised provisions of K.A.R. 28-16-28e(c)(7)(D) and (E) as part of its September 2003 submittal. These provisions are based on new State water quality standards codified in K.S.A. 2002 Supp. 82a-2001, *et seq.* as part of legislation passed in May 2003, and submitted to EPA by letter dated June 16, 2003. These regulations implement the requirements contained in 2002 Supp. 82a-2001(c)(7)(A), and therefore, EPA considered the statutory and regulatory provisions together in arriving at its approval decision. Each issue is reviewed below.

*Definitions of primary contact recreation designated uses, subcategories of that use, illness rate protection levels, and seasonal recreation uses.*



K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(i) identifies primary contact recreation for stream segments as activities "... where the body is intended to be immersed in surface water to the extent that some inadvertent ingestion of water is probable." This provision also includes three subcategories of primary contact recreation depending on the likelihood of usage of such waters for whole-body recreation. The first subcategory - Class A - applies where a stream segment is a designated public swimming area; the second - Class B - is where moderate full body contact recreation is expected and the stream segment is "by law or written permission of the landowner open to and accessible to the public"; and the third - Class C - is where full body recreation is infrequent, and the segment is not open to and accessible by the public under Kansas law and "is capable of supporting the recreational activities of swimming, skin diving, water-skiing, wind surfing, boating, mussel harvesting, wading or fishing."

Designation of a waterbody for primary contact recreation is consistent with the goal uses of Section 101(a) of the CWA. EPA's regulations at 40 CFR § 131.10(c) authorize states to adopt sub-categories of a designated use. EPA believes this type of risk management discretion is appropriate so long as the resultant water quality criteria assure protection of the designated use and such a designation to an individual water body assures the attainment and maintenance of downstream water quality standards. While UAAs are required to justify a lower use designation below Section 101(a) goal uses, no supporting analysis is required to support adoption of sub-categories of primary contact recreation uses so long as the adopted criteria are sufficient to protect primary contact recreation.

In addition to the primary contact recreation use categories described in K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(i), the statute also provides guidelines based on illness rates for adoption of specific criteria protective of the uses within each primary contact recreation use category. New regulations at K.A.R. 28-16-28c(c)(7)(D) specify the criteria applicable to these primary contact recreation use categories. The provisions within K.A.R. 28-16-28c(c)(7)(D) establish the criteria for stream segments with a primary contact recreation use designation of Classes A, B and C. Compliance with the criteria is based on five samples collected during separate 24-hour periods within a 30 day period. The criteria - all based on the concentration of *Escherichia coli* (*E. coli*) bacteria - include numeric criteria for both the recreation period from April 1 through October 31 each year and the non-recreation period from November 1 through March 31 each year.

This is the first use in Kansas of bacteria water quality criteria based on *E. coli*; previously, the bacteria criteria have been based on fecal coliform. Use of *E. coli* as the indicator bacteria has been recommended since 1986 by EPA as being a better indicator of fecal contamination which may cause illnesses in humans. The specific *E. coli* criteria adopted by Kansas in this provision for protection of primary contact recreation during the recreation season from April 1 through October 31 are as follows:

Primary Contact Recreational Use - Class A - not to exceed a geometric mean of 160 colony forming units (cfu) per 100 mL.

Primary Contact Recreational Use - Class B - not to exceed a geometric mean of 262 cfu/100 mL.

Primary Contact Recreational Use - Class C - not to exceed a geometric mean of 427 cfu/100 mL.

EPA has evaluated the water quality criteria for Primary Contact Recreational Use Classes A, B, and C finds them to be protective of primary contact recreation. In the cases of the criteria associated with Primary Contact Recreational Use - Classes A and B, the water quality criteria correlate to approximately 10 or fewer illnesses per 1000 swimmers, alternatively expressed as an illness rate of approximately 1%.

In the case of the water quality criteria associated with the Primary Contact Recreational Use - Class C, EPA evaluated information contained in Health Effects Criteria for Fresh Recreational Waters (EPA, 1984) and Water Quality Criteria for Bacteria - 1986 (EPA, 1986) to help inform its analysis of the level of protection provided by Kansas's adopted water quality criteria for bacteria. Under the best case assumption that the linear relationship between average bacterial densities and illness rates and its associated confidence limits continue to apply at bacterial densities of approximately 400 cfu per 100 mL, the associated illness rate at the upper and lower 95% confidence limit ranges from 8 to 18 illnesses per 1000 swimmers. This is consistent with estimates of national historically acceptable risk levels for primary contact recreation uses (i.e., the criteria values recommended by EPA in 1986 for fresh marine recreational waters were associated with illness rates that ranged from 8 to 19). Therefore, for waters that may be designated for Primary Contact Recreational Use - Class C, where the use is expected to be infrequent and access is severely limited, this expression of risk management discretion is consistent with the Clean Water Act and the federal regulations. For these reasons, the three sub-categories of primary contact recreation use designations and corresponding levels of protection are approved.

These new State provisions also include seasonal recreational use criteria for the three categories of primary contact recreation uses during the non-recreation period of November 1 through March 31 each year. EPA's regulations at 40 CFR § 131.10(f) allow seasonal uses as an alternative to reclassifying a water body. If seasonal uses are adopted, the corresponding criteria

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The State's definitions for primary contact recreation Class B and C stream segment use designations contain language regarding whether the stream is open and accessible to the public by law or written permission of the land owner. EPA's regulations and guidance do not include "permission" as a basis upon which primary contact recreation might be determined. EPA's regulations at 40 CFR § 131.10(g) identify factors that would allow removing a designated use. These factors include physical as well as natural conditions that may limit attainment of a use.

Because the State's criteria levels for both Class B and Class C primary contact recreation waters are based on EPA's CWA §304(a) water quality criteria recommendations, they are approved. While "landowner permission" may serve as an indicator of whether access to a waterbody is probable, EPA does not endorse the presence or absence of "landowner permission" as an indicator of whether primary contact recreation is an appropriate use designation for a waterbody. State law regarding the protection of private property is a separate issue from - and is unaffected by - a determination under the CWA as to the level of protection appropriate for a waterbody. Likewise, the level of recreational protection afforded a waterbody under the CWA neither grants nor restricts permission to use that water for recreation.

should be protective of the seasonal use as well as any downstream uses. 40 CFR § 131.10(f). EPA's regulation does not require a formal UAA to support adoption of seasonal recreation uses. EPA believes that the adoption and application of the criteria associated with the protection of secondary contact recreation uses during the non-recreation period will assure protection of the seasonal use as well as any downstream uses. Therefore, the provisions within K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(i) and KAR 28-16-28e(c)(7)(D) for protection of primary contact recreation use waters during the non-recreation season are consistent with the CWA and 40 CFR § 131.10(f) and are approved.

*Definitions of secondary contact recreation designated uses, subcategories of that use, and illness rate protection levels.*

K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(ii) indicates that secondary contact recreation is use of a stream segment for "... wading, fishing, canoeing, motor boating rafting and other types of boating where the body is not intended to be immersed and where ingestion of surface water is not probable." This provision includes two subcategories of secondary contact recreation. The first subcategory - Class A - applies where a stream segment is capable of supporting wading or fishing and the stream segment "... is by law or written permission of the landowner open and accessible to the public"; and the second - Class B - applies where the stream segment is capable of supporting fishing or swimming, but it is not accessible to the public under Kansas law. Under this provision, Class A secondary contact recreation use stream segments receive a level of protection for bacteria indicator organisms at nine times the level applicable to primary contact recreation use Class B waters. Class B secondary contact recreation use stream segments receive a level of protection for bacteria indicator organisms at nine times the level applicable to primary contact recreation use Class C waters.

As previously indicated, EPA's regulations allow states to adopt sub-categories of uses. Because secondary contact recreation is not protective of CWA § 101(a) uses, a UAA must be performed to demonstrate that secondary contact recreation is the appropriate use designation. 40 CFR § 131.10(g). This determination may be based on a number of factors, including an evaluation of whether natural, ephemeral, intermittent or low flow and the lack of pooling preclude attainment of primary contact recreation.

In addition to the secondary contact recreation use categories described in K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(ii), KAR 28-16-28e(c)(7)(E) adds regulations to specify the criteria applicable to these secondary contact recreation use categories. The regulations require compliance with a concentration of *E. coli* not to exceed a geometric mean of 2,358 cfu per 100 mL beyond the mixing zone Secondary Contact Recreational Use - Class A and compliance with a concentration of *E. coli* not to exceed a geometric mean of 3,843 cfu per 100 mL beyond the mixing zone for Secondary Contact Recreational Use - Classes B and C. While EPA's recommended water quality criteria for bacteria are designed to protect the public from gastrointestinal illnesses associated with accidental ingestion of water, there has been no guidance developed to protect the public from such illnesses from other types of exposure that may occur during secondary contact activities, such as dermal contact. Thus, EPA does not currently provide specific recommended criteria values for protection of secondary contact recreation for other than accidental ingestion.

The criteria adopted by Kansas to protect the Class A and B secondary contact recreational uses are nine times the levels of protection adopted for the Class B and C primary contact recreational uses, respectively. These levels of protection are not inconsistent with EPA's preference for States to adopt numeric water quality criteria for bacteria to protect public health for secondary contact recreation uses.

During the non-recreation period from November 1 through March 31, the criteria for Class A and B primary contact recreation use stream segments are set at a level of E. coli not to exceed a geometric mean of 2,358 cfu per 100 mL, and the criterion for Class C stream segments is set at a level of E. coli not to exceed a geometric mean density of 3,843 cfu per 100 mL. The criterion for Class A and B primary contact recreation waters during the non-recreation period is the same as the criterion for Class A secondary contact recreation waters, and the criterion for Class C primary contact recreation waters during the non-recreation period is the same as the criterion for Class C secondary contact recreation waters.

The State will need to perform a UAA consistent with the requirements of 40 CFR § 131.10(g) to justify the adoption of a secondary contact recreation use designation under K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(ii) for each stream segment so designated. Thereafter, these provisions will protect wading and fishing uses for waters that are identified as secondary contact recreation Class A and B stream segments by applying specific numeric criteria to each sub-category of use.<sup>2</sup> The provisions of K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(ii) are consistent with the CWA and its implementing regulations and are approved.

EPA notes that this provision does not specifically address protection of downstream uses, as required by 40 CFR § 131.10(b). When submitting new and revised stream segment use designations for secondary contact recreation to EPA for review and approval, the State must take into consideration the protection of downstream uses to ensure that the new or revised secondary contact recreation use designation will provide for the attainment and maintenance of the water quality standards of downstream waters. 40 CFR § 131.10(b). Any new or revised use designation that is inconsistent with the CWA and EPA's regulations will be subject to disapproval by EPA.

#### *Monitoring Waters to Determine Attainment of WQS*

Each sub-category of primary and secondary contact recreation use under K.S.A. 2002 Supp. 82a-2001(c)(7)(A) includes a provision stating that a water within that sub-category will only be considered impaired for that use, "... if the calculated geometric mean of at least five samples collected in separate 24-hour periods within a 30-day period exceeds the corresponding

<sup>2</sup> As indicated in *Footnote 1*, written permission by the landowner for public access is not a characteristic identified in 40 CFR § 131.10(g) as the basis for determining the appropriate level of protection for a waterbody. Accessibility to the water by the public, however, may be one of an number of factors considered in determining the appropriate use designation.

water quality criterion." EPA encourages state to implement a methodology that calculates a geometric mean value from samples taken over a period of time – such as a thirty day period. Such an approach is appropriate for assuring attainment of the primary and secondary contact recreation use.

The provisions of K.S.A. 2002 Supp. 82a-2001(c)(7)(A)(i) and (ii) concerning determinations of impairment for each of the primary and secondary contact recreation sub-categories are consistent with the CWA and its implementing regulations and are approved.

**L. Approved - K.S.A. 2002 Supp. 82a-2001(c)(7)(B): Recreational use designations on opposite sides of a stream segment – protection to higher level of recreational use.**

*(B) If opposite sides of the stream segment would have different designated recreational uses due to differences in public access, the designated use of the entire classified stream segment may be the higher attainable use, notwithstanding that such designation does not grant the public access to both sides of such segment.*

This provision allows for a higher level of protection for recreational use designation purposes when opposite sides of a stream segment would otherwise be assigned different use designation or sub-category use designation levels based upon accessibility to the stream by the public. EPA's regulations at 40 CFR § 131.10(a) require states to take into consideration the use and value of the water for, among other things, recreation in and on the water. This Kansas provision allows for – although it does not mandate – protection within a stream segment to the highest level of use. As has been discussed previously, a designated use – which is not an existing use – may only be lowered from the level of protection afforded under Section 101(a) of the CWA upon a demonstration that the higher use is not attainable. See 40 CFR § 131.10(g). Therefore, the State would need to perform a UAA before adopting a use designation other than primary contact recreation under the provisions of K.S.A. 2002 Supp. 82a-2001(c)(7)(B). EPA would review the State's resulting use designation and supporting UAA for consistency with the CWA. The provisions of K.S.A. 2002 Supp. 82a-2001(c)(7)(B) are consistent with the CWA and implementing regulations, and are approved.

**M. Approved - K.S.A. 2002 Supp. 82a-2001(c)(7)(C): Flow and water levels preventing recreation.**

*(C) Recreational Use designations shall not apply to stream segments where the natural, ephemeral, intermediate or low flow conditions or water levels prevent recreational activities.*

Federal regulations at 40 CFR § 131.10(a) requires the states to specify appropriate water uses to be achieved and protected, taking into consideration the value of those waters for, among other things, recreation in and on the water. Additionally, 40 CFR § 131.10(g) specifies the process by which a state can remove or lower a use that is not an existing use based on the results of a UAA. Under this regulation, states may consider whether natural, ephemeral, intermittent or low flow conditions or water levels prevent attainment of a use.