

## Memorandum

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To : James Baetge, Executive Director  
State Water Resources Control Board  
901 P Street  
Sacramento, CA 95814

Date: OCT 24 1990

From : Environmental Management Branch  
714 P Street, Room 616  
Sacramento, CA 95814  
445-0498

Subject: Request for Clarification of Beneficial Use Definitions of State Water  
Related to Bacteriological Standards

This responds to your memorandum of March 12, 1990 in which you request clarification of bacteriological standards related to beneficial use definitions for waters of the State. Your letter asks us to comment on the suitability of the definitions and examples specified for Rec-1 and Rec-2 beneficial uses, invites recommendations for changes, and asks what are appropriate bacteriological water quality objectives to be adopted for each of the recreational beneficial use categories to ensure reasonable protection of public health.

It also refers to memoranda from the Department of Health Services regarding sport fishing in agricultural drains in Imperial County, and asks if there are special circumstances relating to agricultural drains that would mitigate the need to establish public health protection standards equal to those established for other waters of the State.

#### DEFINITIONS OF BENEFICIAL USES

The definitions and examples for Water Contact Recreation (REC-1) should be revised to be consistent with the discussion of primary contact recreation presented in the Report of the National Technical Advisory Committee (NTAC) to the Secretary of Interior, published by the Federal Water Pollution Control Administration in 1968, entitled Water Quality Criteria (1).

The NTAC report defines primary contact recreation as activities in which there is prolonged and intimate contact with the water involving considerable likelihood of ingesting water. Examples cited by NTAC are wading and dabbling by children, swimming, diving, water skiing, and surfing.

NTAC did not consider sport fishing as a primary contact recreation. NTAC cited fishing as "secondary contact recreation," with boating and other activity involving limited contact with water incident to shoreline activities.

We recommend that the classification Water Contact Recreation be renamed and revised to read:

Primary Contact Recreation (REC-1)--Recreational uses that involve contact with water with substantial likelihood of ingesting water, such as swimming, wading or dabbling in water by children, water skiing, skin diving, and surfing.

We recommend that the designation REC-2 be assigned to a new classification that reads:

Limited Water-contact Recreation (REC-2)--Recreation uses where limited contact with water is reasonably possible, such as fishing, boating, hunting while standing in water, tidepool and marine life study, and other activity involving limited contact with water incident to shoreline activity. Fishing includes all fishing activities from boats and shore, in-water fishing (e.g., spear fishing, fishing while wading), bait collection, frogging, crayfish fishing, clam harvesting and softshell turtle harvesting.

We recommend that the classification Non-Contact Water Recreation be revised to read:

Non-Contact Water Recreation (REC-3)--Recreational uses which involve proximity of water but do not require contact with water such as picnicking, sunbathing, hiking, beachcombing, camping, pleasure boating, hunting on land, and sightseeing.

NTAC states that criteria for primary contact recreation use should be approached as closely as possible whenever recreation is a designated water use -- especially where recreation use is encouraged by facilities such as boat launching ramps, campgrounds, fishing access points, and shoreline trails.

The definitions of Shellfish Harvesting (SHELL), and Ocean Commercial and Sport Fishing (OFISH) should be revised to make clear that:

- (1) bacteriological criteria for waters used for harvesting filter-feeding bivalve shellfish (clams, oysters, mussels, cockles, scallops) do not apply to abalone and crustacean shellfish (shrimp, crab, lobster); and
- (2) bacteriological criteria for Ocean Commercial and Sport Fishing do not apply to water used for harvesting filter-feeding bivalve shellfish.

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We recommend the following:

Shellfish Harvesting (SHELL) -- The collection of filter-feeding bivalve molluscan shellfish, such as clams, oysters, mussels, cockles, and scallops for commercial or sport purposes.

Ocean Commercial and Sport Fishing (OFISH) -- The commercial collection of various types of fish and shellfish that are not filter-feeding bivalve shellfish, including those taken for bait purposes, and sport fishing in ocean, bays, estuaries, and similar non-freshwater areas. Shellfish that are not filter-feeding bivalve shellfish include abalone, shrimp, crab, and lobster.

#### Background Related to Microbiological Criteria

Studies conducted in the 1940's and early 1950's in eastern waters showed that excess incidence of gastrointestinal illness among swimmers was statistically significant when the geometric mean density of total coliform organisms in water was 2300/100ml--a density later presumed equivalent to 400 fecal coliforms/100 ml (2). Noting in 1968 that those studies were far from definitive, NTAC established a recommended bacteriological criterion for waters used for primary contact recreation by applying a safety factor of two to the log mean density of 400 fecal coliforms/100 ml(1). NTAC recommended that:

- (1) the log mean density of fecal coliform organisms should not exceed 200/100 ml in such waters; and
- (2) not more than 10 percent of samples should exceed 400/100 ml.

The U.S. Environmental Protection Agency (EPA) recommended the same criterion in 1976, noting that a sharp increase in the frequency of detection of Salmonella bacteria has been observed when fecal coliform densities are above 200/ml (3).

More recent studies of eastern waters undertaken by the EPA indicated that where the geometric mean fecal coliform density was 200/100 ml swimming could result in 8 illnesses per 1000 swimmers in fresh waters and 19 illnesses per 1000 in marine waters (2). Those estimates were based on concomitant densities of E. coli in fresh waters and enterococci in fresh waters and marine waters, and correlations between those densities and incidence of swimming-associated gastroenteritis presumed caused by enteric viruses. The correlation between illness and density of fecal coliforms was relatively weak.

Concentrations of E. coli and enterococci in waste constituents in recreational waters presumably can differ substantially, in proportion to concentrations of viruses or other illness-causing organisms, from the proportions that occurred in the waters recently studied by EPA. Thus we recommend that criteria for fecal coliforms be used for recreational

waters, rather than recommending criteria based on E. coli and enterococci from findings now available.

We follow the precedent set by NTAC to establish the highest densities of fecal coliform organisms in water we would consider suitable for primary contact recreation. The geometric mean density of fecal coliform organisms in waters used for primary contact recreation should not exceed half of that which presumably could allow a detectable effect on health of swimmers in fresh water—now 200 fecal coliforms/100 ml; a density twice the geometric mean should not be exceeded in more than 10 percent of samples. Citing a median value as a criterion instead of a log mean will facilitate water quality determinations. Thus:

- (1) the median density of fecal coliform organisms should not exceed 100/100 ml in such waters; and
- (2) the density of fecal coliform organisms should exceed 200/100 ml in no more than 10 percent of samples.

As cited as recommended criteria in the next section below, criteria for density of fecal coliforms and total coliforms in recreational waters are accompanied by citations of levels of treatment of municipal wastewater, to assure that unacceptably high risk of infection with sewage-borne enteric virus is avoided. Those treatment levels were cited in Uniform Guidelines for Wastewater Disinfection, the most recent version of which DHS provided to the State Water Resources Control Board (SWRCB) and the regional water quality control boards in 1987 (5).

A median fecal coliform density of 100/100 ml is the highest median density recommended since 1973 by the Department of Health Services (DHS) for waters used for primary contact recreation. Based on data indicating high quality of waters in coastal streams and mountain streams, the Department has recommended that the median fecal coliform density of waters of coastal streams and mountain streams not exceed 50/100 ml where primary contact recreation occurs (6).

Since 1973, DHS has recommended that the quality of waters used for primary contact recreation be maintained at better quality than allowed by the bacteriological criterion, when better quality is reasonably attainable (6). DHS supports the non-degradation policies of regional water quality control boards as they apply to such waters.

Criteria for total coliform organisms, recommended below for ocean waters and other marine waters used for primary contact recreation, are from Section 7958 of Title 17 of the California Code of Regulations, relating to ocean water-contact sports areas. NTAC recommended that a single set of microbiological criteria be used for fresh, estuarine, and marine waters used for recreation (1). Thus we recommend that the criterion for total coliform organisms be accompanied by the above-cited criterion of 100 fecal coliforms/100 ml in marine waters for primary contact recreation, and recommend the same fecal coliform criterion for estuarine waters. It has been observed that the overall median fecal coliform

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density was 50/100 ml in California waters which met the total coliform criteria cited below for ocean waters and other marine waters (7).

When municipal wastewater is treated to the levels recommended below, recommended criteria for fecal coliform organisms in surface waters are high enough to accommodate the occurrence of substantial densities of fecal coliform bacteria that enter such waters from sources other than human excreta (e.g., animal excreta from storm drains during the water recreation season). Exceedance of the criteria for fecal coliform density in waters not receiving waste constituents originating from human excreta does not per se indicate that the waters are not suitable for recreation. Unlike human excreta, excreta from animals (except primates exposed to infected humans at laboratories or zoos) will not contain enteric viruses infectious to humans.

Agricultural drainage could vary substantially with respect to concentration and type of organisms as well as chemicals that may be present. Accordingly, it is difficult to establish criteria for safe recreational use of agricultural drains.

#### Recommended Criteria for REC-1 Waters

We recommend that the quality of waters not be degraded to the levels represented by criteria recommended below, and that criteria in current basin plans that are more stringent than those recommended below be retained. In that context, we recommend the following bacteriological criteria be adopted for waters designated for Primary Contact Recreation (REC-1):

##### Coastal Streams and Mountain Streams:

As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the median fecal coliform density in waters of coastal streams and mountain streams used for primary contact recreation shall not exceed 50/100 ml, nor shall more than 10 percent of the total samples during any 30-day period exceed 110/100 ml.

##### Estuarine Waters and Fresh Waters Other Than Coastal Streams and Mountain Streams:

As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the median fecal coliform density in estuarine waters and fresh waters, other than coastal streams and mountain streams, used for primary contact recreation shall not exceed 110/100 ml, nor shall more than 10 percent of the total samples during any 30-day period exceed 220/100 ml.

Ocean Waters and Other Marine Waters:

Ocean waters and other marine waters used for primary contact recreation shall have a most probable number of total coliform organisms less than 1000/100 ml (10 per ml) at each sampling station, and not more than 20 percent of the samples of water from each sampling station in any 30-day period shall exceed 1000/100 ml (10 per ml) and no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000/100 ml (100 per ml). As determined by multiple-tube fermentation procedure <sup>a</sup> and based on a minimum of not less than five samples taken over not more than a 30-day period, the median fecal coliform density in such waters shall not exceed 110/100 ml, nor shall more than 10 percent of the total samples during any 30-day period exceed 220/100 ml.

These criteria for water quality are intended by DHS to indicate that water is safe for primary contact recreation only if municipal wastewater effluents, other than discharges from storm drains, discharged thereto have been:

- (1) oxidized, <sup>b</sup> coagulated, <sup>b</sup> clarified, filtered, <sup>b</sup> and disinfected so that the median total coliform density of effluent does not exceed 2.2/100 ml as determined from the bacteriological results of the last seven days for which analyses have been completed and the total coliform density does not exceed 23/100 ml in any sample, when such effluents comprise more than five percent of the volume of surface waters or when they are discharged to a recreational lake or recreational reservoir during the recreational season;
- (2) disinfected so that the median total coliform density of effluent does not exceed 23/100 ml and the total coliform density does not exceed 500/100 ml in any two consecutive samples, when such effluents comprise one to five percent of the volume of surface waters; and
- (3) disinfected so that the median total coliform density of effluent does not exceed 240/100 ml and the total coliform density does not exceed 5000/100 ml in any two consecutive samples, when such effluents comprise less than one percent of the volume of surface waters.

These levels of treatment of municipal wastewater, from the DHS' Uniform Guidelines for Wastewater Disinfection (5), are intended to avoid

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<sup>a</sup> The membrane filter procedure may be used if it is demonstrated that it provides results equivalent to multiple-tube fermentation.

<sup>b</sup> The terms oxidized, coagulated, and filtered are defined in Section 60301 of Title 22 of the California Code of Regulations.

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unacceptably high risk of infection with enteric virus originating from human excreta. Samples of treated wastewater should be collected and tested for total coliform organisms daily where a median of 2.2/100 ml is recommended above, and at least twice a week where a higher median is recommended (5).

Recommended Criteria for REC-2 and REC-3 Waters and Other Waters

For waters designated for Limited Water-contact Recreation (REC-2), and Ocean Commercial and Sport Fishing, we recommend citing bacteria densities five times those cited for primary contact recreation, as did NTAC for waters designated for "recreation uses other than primary contact recreation." Thus we recommend that the criterion for Limited Water-contact Recreation (REC-2) and Ocean Commercial and Sport Fishing be:

As determined by the multiple-tube fermentation procedure for marine water,<sup>a</sup> and multiple-tube fermentation or membrane filter procedures for estuarine water or fresh water, the median fecal coliform density shall not exceed 500/100 ml, nor shall more than 10 percent of samples equal or exceed 1100/100 ml.

For waters designated for Non-contact Water Recreation (REC-3), we recommend citing bacteria densities ten times those cited for primary contact recreation, as did NTAC for waters designated "....for general recreation use of surface waters without reference to specific designation of recreation as a water use....in the absence of local epidemiological experience." Thus we recommend that the criterion for Non-contact Water Recreation (REC-3) be:

As determined by the multiple-tube fermentation procedure for marine water,<sup>a</sup> and multiple-tube fermentation or membrane filter procedures for estuarine water or fresh water, the average fecal coliform density shall not exceed 1100/100 ml and the fecal coliform density shall not exceed 2200/100 ml.

As noted above, NTAC recommends that criteria for primary contact recreation use be approached as closely as possible whenever recreation is a designated water use -- especially where recreation use is encouraged by facilities such as boat launching ramps, campgrounds, fishing access points, and shoreline trails. We concur.

When municipal wastewater--other than discharges from storm drains--comprises more than half the volume of water in a drainage way or stream that is not designated for primary contact recreation and is accessible to the public during weather conducive to visits to the

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<sup>a</sup> The membrane filter procedure may be used if it is demonstrated that it provides results equivalent to multiple-tube fermentation.

drainage way or stream, DHS recommends that such wastewater be treated to at least a level that makes it:

- (1) disinfected so that the median total coliform density of effluent does not exceed 23/100 ml and the total coliform density does not exceed 500/100 ml in any two consecutive samples, when adjacent land downstream from the area of discharge of municipal wastewater has not been developed for residential use, but limited visits to the water are likely;
- (2) oxidized and disinfected so that the median total coliform density of effluent does not exceed 2.2/100 ml and the total coliform density does not exceed 40/100 ml in any two consecutive samples, when land adjacent to the stream or drainage way has been developed for residential use; and
- (3) oxidized, coagulated, clarified, filtered, and disinfected so that the median total coliform density of effluent does not exceed 2.2/100 ml as determined from the bacteriological results of the last seven days for which analyses have been completed and the total coliform density does not exceed 23/100 ml in any sample, when most of the following conditions are met:
  - a. The discharge occurs in or upstream from a residential area.
  - b. There is ready access to the discharged wastewater, and exclusion of the public is not a realistic alternative.
  - c. Historical attempts to post the stream to warn and exclude the public have been unsuccessful.
  - d. The recreation potential in the stream is high and justified because of weather, proximity to other recreation areas, etc.
  - e. There is public interest in recreational use of the water.

These recommended levels of treatment, from the DHS' Uniform Guidelines for Wastewater Disinfection (5), are intended to avoid unacceptably high risk of infection with enteric virus. Samples of treated wastewater should be collected and tested for total coliform organisms daily where a median of 2.2/100 ml or 23/100 ml is recommended above.

Recommended Criteria for Shellfish Harvesting Areas

It is not clear from Attachment 5 of your memorandum that the National Shellfish Sanitation Program criteria for sanitation of shellfish harvesting areas are accurately presented. We recommend the following wording:

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The bacteriological quality of water at an approved shellfish harvesting area shall meet one of the following standards:

- (1) The median or geometric mean MPN density of total coliform organisms shall not exceed 70/100 ml, and not more than 10 percent of the samples shall exceed an MPN of 230/100 ml for a 5-tube decimal dilution test (or an MPN of 330/100 ml for a 3-tube decimal dilution test).
- (2) The median or geometric mean MPN density of fecal coliform organisms shall not exceed 14/100 ml, and not more than 10 percent of the samples shall exceed an MPN of 43/100 ml for a 5-tube decimal dilution test (or an MPN of 49/100 ml for a 3-tube decimal dilution test).

In addition to treatment to avoid exceedance of the above criteria in shellfish harvesting areas, if constituents of municipal wastewater—other than discharge from storm drains—enter a shellfish harvesting area we recommend that such effluents be:

- (1) disinfected so that the median total coliform density of effluent does not exceed 2.2/100 ml and the total coliform density does not exceed 40/100 ml in any two consecutive samples, when the discharge is to a bay and the dilution will not have exceeded 100 to 1 anywhere in a shellfish harvesting area and closing a portion of a shellfish area to harvesting is not practicable;
- (2) disinfected so that the median total coliform density of effluent does not exceed 23/100 ml and the total coliform density does not exceed 500/100 ml in any two consecutive samples, when the discharge is to the ocean and dilution will not have exceeded 100 to 1 in the portion of a shellfish area closed to harvesting and dilution exceeds 100 to 1 only immediately before constituents of wastewater enter an area where shellfish harvesting is allowed; and
- (3) disinfected so that the median total coliform density of effluent does not exceed 23/100 ml and the total coliform density does not exceed 500/100 ml in any two consecutive samples, when the discharge is to the ocean or to a bay and dilution will have exceeded 100 to 1 before constituents of wastewater enter a shellfish area.

Those recommended levels of treatment, from the DHS' Uniform Guidelines for Wastewater Disinfection (5), are intended to avoid unacceptably high risk of infection with enteric virus. Samples of treated wastewater should be collected and tested for total coliform organisms daily where a median of 2.2/100 ml is recommended above, and at least twice a week where a higher median is recommended.

When establishing bacteriological standards, the SWRCB should consult the DHS Office of Drinking Water to obtain criteria for domestic water supply, which may be more stringent than those discussed here. Should your staff need further assistance, they may contact Michael Kiado at (916) 322-1553.

Sincerely,

Don Womeldorf, Chief

cc: John Ladd  
Basin Planning Program Manager

Peter A. Rogers, Chief  
Office of Drinking Water

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REFERENCES

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5. California Department of Health Services, Sanitary Engineering Branch, "Uniform Guidelines for Wastewater Disinfection," in Wastewater Disinfection for Health Protection, February 1987.
6. California State Department of Public Health, Bureau of Sanitary Engineering, Memorandum Report on Fecal Coliform Standards for Freshwater Recreation, April 1973.
7. Sepp, E. and Jopling, W., "California Experience with Fecal Coliform Bacteria" in Proceedings of the Symposium on Fecal Coliform Bacteria in Water and Wastewater, Berkeley and Los Angeles, California, May 1968, sponsored by the Bureau of Sanitary Engineering, California State Department of Public Health.