

**Final Staff Report on Recommended
Changes to California's Clean Water Act
Section 303(d) List**

Appendix A

Numeric Criteria Fact Sheets

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A Appendix - Numeric Criteria Fact Sheets

Regional Board staff developed “Fact Sheets” to describe the criteria used to interpret data for certain categories of pollutants. The Numeric Criteria Fact Sheets were developed for pollutants for which the Regional Board had a significant amount of information. For a category of pollutant, the Numeric Criteria Fact Sheets identify the beneficial uses that are likely impacted, the water quality objectives that are relevant to that pollutant, the criteria used to assess attainment of the water quality objectives, and a general description of how data were interpreted. Numeric Criteria Fact Sheets were developed for mercury, metals, pathogens, and pesticides.

A.1 Mercury Numeric Criteria Fact Sheet

A.1.1 Introduction

This fact sheet describes the basis for the Regional Board staff's evaluation of mercury information available for surface waters within the Central Valley region. The applicable beneficial uses and water quality objectives are described (as identified in the Regional Board's Basin Plan), the criteria used to interpret narrative water quality objectives are identified, and a summary of how data are generally evaluated relative to those criteria is provided.

A.1.2 Applicable Beneficial Uses

The following beneficial uses will most often apply in the evaluation of potential mercury impacts in surface waters (from pages II-1 and II-2 of the Basin Plan).

Cold Freshwater Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Commercial and Sport Fishing (COMM) – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Warm Freshwater Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

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Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Wildlife Habitat (WILD) – Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

A.1.3 Applicable Water Quality Objectives

The following narrative objectives potentially apply in the evaluation of mercury impacts in surface waters under the heading of toxicity from Section III of the Basin Plan:

Under the heading of **Chemical Constituents**:

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Under the heading of **Toxicity**:

The narrative water quality objective for toxicity in the Basin Plan states, in part, “All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.” The narrative toxicity objective further states that “The Regional Water Board will also consider ... numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the USEPA, and other appropriate organizations to evaluate compliance with this objective.” (CRWQCB-CVR, 1998)

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The USEPA promulgated numeric water quality standards for mercury as part of the California Toxic Rule (CTR) in April 2000 (USEPA, 2000a). The CTR criterion of 0.05 µg/L (50 ng/L) total recoverable mercury protects humans from exposure to mercury in drinking water and contaminated fish. The standard is enforceable for all waters with a MUN, REC-1, or COMM beneficial use designation. The federal rule did not specify duration or frequency terms; however, Regional Board staff has previously employed a 30-day averaging interval with an allowable exceedance frequency of once every three years for protection of human health, which is recommended for this effort.

A.1.4 Numeric Criteria Used

Various government entities have developed numeric criteria for mercury in fish tissue and water for both human health and wildlife protection. The following describes some of the criteria that could be used to interpret the Regional Board's narrative toxicity water quality objective. Applicable numeric water quality objectives and federal water quality standards are also described.

Mercury in Fish Tissue

The National Academy of Sciences (NAS) numeric total mercury guideline of 0.5 µg/g (parts per million [ppm]) (NAS, 1973) applies to whole, freshwater fish and marine shellfish. The NAS criterion was developed for the purpose of wildlife protection. The USEPA has also established wildlife criteria for the Great Lakes Water Quality Initiative (USEPA, 1995) and the Mercury Study Report to Congress (USEPA, 1997a). These USEPA criteria suggest that a range of mercury in fish tissue of 0.08 ppm (trophic level 3 [TL3] fish) to 0.35 ppm (trophic level 4 [TL4] fish) should be protective of wildlife. Because wildlife generally consume lower trophic level (and smaller) fish, the human health and wildlife criteria are not directly comparable.

The United States Food and Drug Administration (USFDA) action level for methylmercury in fish tissue of 1.0 ppm (USFDA, 1995) applies to the edible portion of commercially caught freshwater and marine fish for the protection of human health. Action levels are health-based advisory levels for chemicals for which primary maximum contaminant levels (MCLs) have not been adopted.

The USEPA recently established a criterion of 0.3 ppm methylmercury in the edible portions of fish for protection of human health (USEPA, 2001b). For 303(d) fact sheet development, USEPA's criterion of 0.3 ppm is applied. This criterion is the most conservative and the most recently established.

Mercury in Surface Water

The USEPA and the California Department of Health Services determined that a MCL of 2.0 micrograms per liter (µg/L) (2,000 ng/L) be established for mercury in drinking water (Marshack, 2000). The CTR criterion, which also applies to mercury in surface waters, is discussed above.

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All available criteria are summarized in Table A-1.

Table A-1. Mercury Criteria		
Agency	Hg in fish tissue (mg/kg)	Hg in Surface Water (µg/L)
USEPA Recommended Criterion for Human Consumption - methylmercury	0.3	
USEPA Recommended Aquatic Life Criteria- inorganic Hg		0.77 (4-day average) 1.4 (1-hour average)
USEPA IRIS Reference Dose, - (Drinking Water) – methylmercury		0.07
NAS Guideline for Wildlife Protection – Total Hg	0.5	
USFDA Action Level for Human Consumption – methylmercury	1.0	
CDHS & USEPA Primary MCL-inorganic Hg – Total Hg		2
USEPA CTR Human Health – (Drinking Water & Aquatic Organism Consumption- inorganic Hg) – Total Hg		0.05

A.1.5 Data Interpretation

Mercury in Fish Tissue

The mercury criterion for fish tissue derived by USEPA is based on an average allowable intake of mercury by humans per day and an average consumption rate. The criterion is based on human consumption and accumulation of mercury over time. Mercury tends to accumulate in fish that are at top trophic levels and concentrations typically increase with fish age and size. When evaluating mercury fish tissue data, staff compared the average mercury concentrations in fish tissue samples of top trophic level fish (trophic level 4 fish – including mostly bass and catfish) to the USEPA human health criterion of 0.3 mg/kg (ppm). Average concentrations of mercury in trophic level 3 fish (e.g., trout, suckers, carp, and pikeminnow) were evaluated when there were limited data for trophic level 4 fish.

This approach may be conservative because people may eat a mix of trophic level 3 and 4 fish. In contrast to the potentially conservative approach of considering only trophic

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level 4 fish, the USEPA default consumption rate may not be representative of fishing populations in Central Valley waters (i.e consumption rates may be higher in the Central Valley). Staff calculated a weighted average based on the number of fish in the composite sample analyzed.

Exceptions to the general approach for evaluating mercury in fish tissue are described in the specific fact sheets.

Mercury in Surface Water

In contrast to fish tissue data, data from water samples are location and time specific. An initial screening of available water quality data was performed by determining whether a minimum of ten water samples was available and whether there was a minimum of two exceedances of the CTR criterion of 0.05 µg/L. If the minimum amount of data were available, staff then performed a more intensive review of the available data to determine whether the CTR criterion was being attained. Staff considered the CTR exceedance frequency of once every three years when evaluating the data.

A.2 Metals Numeric Criteria Fact Sheet

A.2.1 Introduction

This fact sheet describes the Regional Board staff's evaluation of metals information available for surface waters within the Central Valley Region. The applicable beneficial uses and water quality objectives are described (as identified in the Regional Board's Basin Plan), the criteria used to interpret narrative water quality objectives are identified, and a summary of how data are generally evaluated relative to those criteria given.

A.2.2 Applicable Beneficial Uses

The following beneficial uses will most often apply in the evaluation of potential metals impact in surface waters (from pages II-1 and II-2 of the Basin Plan).

Agricultural Supply (AGR) - Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.

Cold Freshwater Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Commercial and Sport Fishing (COMM) – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not

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limited to, uses involving organisms intended for human consumption or bait purposes.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Warm Freshwater Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Wildlife Habitat (WILD) – Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

A.2.3 Applicable Water Quality Objectives

The following narrative objectives potentially apply in the evaluation of metals impact in surface waters under the heading of toxicity from Section III of the Basin Plan:

Under the heading of **Chemical Constituents**:

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Under the heading of **Toxicity**:

The narrative water quality objective for toxicity in the Basin Plan states, in part, “All waters shall be maintained free of toxic substances in concentrations that

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produce detrimental physiological responses in human, plant, animal, or aquatic life.” The narrative toxicity objective further states that “The Regional Water Board will also consider ... numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the USEPA, and other appropriate organizations to evaluate compliance with this objective.” (CRWQCB-CVR, 1998)

The USEPA promulgated numeric water quality standards for some metals as part of the California Toxic Rule (CTR) in April 2000 (USEPA, 2000b). The applicable CTR criteria are described in Table A-2 below.

A.2.4 Numeric Criteria Used

Several numeric criteria have been developed by state and federal agencies to assess surface water impairment by metals toxicity. The following describes some of the criteria that could be used to interpret the Regional Board's narrative water quality objectives. Applicable numeric water quality objectives and federal water quality standards are also described. For waters with both drinking water and aquatic life beneficial uses, the most stringent criterion was applied.

California Department of Health Services (CDHS) and United States Environmental Protection Agency (USEPA) develop Maximum Contaminant Levels (MCLs) as part of their drinking water standards. Primary MCLs are derived from health-based criteria (e.g., cancer risk) and secondary MCLs are derived from human welfare considerations (e.g., taste, odor, and laundry staining).

The Food and Agriculture Organization of the United Nations published *Water Quality for Agriculture* in 1985, which contains criteria protective of agricultural uses of water. This publication includes water quality goals for agricultural uses of water that can be used to interpret the narrative toxicity objective.

Metals objectives provided in the Basin Plan for cadmium, copper, and zinc are based on a water hardness of 40 mg/L (as CaCO₃). The Basin Plan also contains equations to derive objectives for hardness other than 40 mg/L.

The California Toxics Rule (CTR) was promulgated in April 2000 when USEPA developed water quality criteria for priority toxic pollutants in California's inland surface waters (USEPA, 2000a). Together the CTR criteria and the Basin Plan beneficial uses are water quality standards. All CTR metals criteria presented in Table A-2 are based on 40 mg/L hardness (as CaCO₃). Since the continuous and maximum criteria vary with hardness, the CTR provides equations to derive the adjusted criteria for water samples with a hardness other than 40 mg/L. In addition to promulgated CTR criteria, USEPA

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publishes recommended water quality criteria for use by states in developing water quality standards and interpreting narrative standards.

Regional Board staff did not use the aluminum 4-day average recommended criterion published by USEPA. In a recent document that included corrections to a number of criteria developed by USEPA (USEPA, 1999), the following footnote was included for the aluminum 4-day average criterion:

“There are three major reasons why the use of Water-Effect Ratios might be appropriate. (1) The value of 87 µg/l is based on a toxicity test with the striped bass in water with pH= 6.5-6.6 and hardness <10 mg/L. Data in “Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia” (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time. (2) In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide. (3) EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 µg aluminum/L, when either total recoverable or dissolved is measured.”

Based on the significant qualifications associated with the aluminum 4-day average criteria, Regional Board staff believes that site specific evaluation of potential chronic effects of aluminum are necessary prior to making a determination to add waters to the 303(d) list based on chronic aluminum impairment. Central Valley waters in general do not have the combination of low pH and hardness that the toxicity test, upon which the criterion was based, had. Additionally, a portion of the aluminum observed in Central Valley waters is likely to be associated with clay particles, which, as stated by USEPA, may be less toxic than aluminum associated with aluminum hydroxide. Regional Board staff did apply the acute aluminum criterion, because USEPA did not make a similar qualification regarding the applicability of the acute criterion.

Regional Board staff did not apply the secondary MCL for aluminum, copper, iron, manganese, and zinc in its evaluation of water quality data for those parameters. In a number of cases, the natural background levels for these metals may be consistently above the secondary MCL for many Central Valley waters. Regional Board staff believes that it would be necessary to access natural background levels of these metals in order to determine whether the water quality objective is being met. Since such information is not readily available, an evaluation of attainment of the secondary MCL for these metals is beyond the scope of the current 303(d) list update effort.

All applicable water quality objectives and numeric criteria are summarized in Table A-2.

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Table A-2. Metals Criteria (µg/L)								
Metal	Chemical Constituents Objective			Other	Toxicity Objective	CTR Criteria		
	Primary MCL	Secondary MCL	Numeric Objective (Basin Plan) (Dissolved)	Ag Water Quality Goals	Human Health Criteria	Freshwater Aquatic Life 4-Day Avg Concentration (Dissolved)	Freshwater Aquatic Life 1-Hr Avg Concentration (Dissolved)	Human Health – (Drinking Water & Aquatic Organism Consumption)
Al	1000 ^a	200 ^a		5000	600 ^j	87 ^{h,m}	750 ⁱ	
As	50 ^a		10 ^c	100	0.02 ^k , 2.1 ^l	150	340	0.018 ^f
Cd	5 ^{a,b}		0.22 ^{d,m}	10	0.07 ^j	1.1 ^m	1.6 ^{g,m}	
Cu	1300 ^{a,b}	1000 ^{a,b}	5.6 ^{d,m} , 10 ^{c,g}	200		4.1 ^m	5.7 ^{g,m}	1300
Fe		300 ^{a,b,i}	300 ^c	5000				
Pb	15 ^{a,b}			5000	2 ^j	0.92 ^m	24 ^m	
Mn		50 ^{a,b}	50 ^c	200				
Ni	100 ^a			200		24 ^m	220 ^m	610
Zn		5000 ^{a,b}	100 ^{c,g} , 16 ^{d,m}	2000		54 ^m	54 ^{g,m}	9100 ^t
pH		6.5-8.5 ^b	6.5-8.5 ^c					

- a California Department of Health Services criterion
- b USEPA criterion
- c Applies to Sacramento River from Keswick Dam to the I Street Bridge at City of Sacramento; American River from Folsom Dam to the Sacramento River; Folsom Lake; and the Sacramento-San Joaquin Delta.
- d Applies only to Sacramento River and its tributaries above State Hwy 32 bridge at Hamilton City
- e Or a change of 0.5; Goose Lake criteria range 7.5-9.5
- f Total recoverable concentration. USEPA National Recommended Ambient Water Quality Criteria; CTR and NTR values have not been promulgated.
- g Does not apply to Sacramento River above State Hwy 32 bridge at Hamilton City.
- h Not used in evaluation of aluminum data. See discussion in main text above.
- i Not used in evaluation of iron data.
- j OEHHA Public Health Goal (PHG) for drinking water.
- k OEHHA and USEPA 10⁻⁶ cancer risk level in drinking water.
- l USEPA IRIS Reference Dose for drinking water, non-cancer health effects.
- m Based on a hardness of 40 mg/L.

A.2.5 Data Interpretation

Data from water samples are both location and time specific. In recognition of the discrete nature of water quality sample results, Regional Board staff considered the following factors in reviewing available data: 1) total number of samples collected; 2) total number of exceedances of criteria; 3) magnitude of exceedances of criteria; and 4) frequency of exceedance of criteria. An initial screening of available water quality data was performed by determining whether a minimum of ten water samples was available and whether there was a minimum of two exceedances. If the minimum amount of data were available, staff then performed a more intensive review of the available data to determine whether the applicable criteria were being attained. Staff considered the CTR exceedance frequency of once every three years when evaluating the data.

If exceedances appeared to occur infrequently (e.g., less than once every three years), then no recommendation for listing was made. In evaluating exceedances of chronic water quality criteria (often expressed as a four-day average), data over consecutive days were often not available. Regional Board staff evaluated the available data to determine

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whether exceedance of the chronic criteria could be inferred based on the magnitude of the exceedance or based on data collected prior to and after the data point being evaluated. A significant exceedance of a chronic criterion on a single day (e.g. by a factor of 4) would imply exceedance of the 4-day average criterion. Exceedance of the chronic criteria over successive (although non-consecutive) sampling events would also imply exceedance of the criteria.

In general, waters were listed as impaired due to a particular metal when the available information indicated that the criteria would likely be exceeded on a periodic basis (i.e., the exceedance is not a unique event). A few data points with consistent (and/or substantial) exceedances could provide evidence of impairment in one case, whereas, more data points would be needed in another instance in which infrequent exceedances occurred. A specific description of how data were interpreted is contained in the fact sheets for each 303(d) list recommendation.

If available water quality data did not indicate exceedances of criteria, if few data points were available (e.g., less than 10 sampling events), or if an exceedance appeared to be a unique event, no recommendation for adding the water and pollutant to the 303(d) list was made. In some cases, the information available indicated that there may be an impairment, but not enough data were available to indicate that the exceedances occurred on a periodic basis. For those waters, a recommendation for further assessment is made.

The extent of impairment is based on the location of samples and evidence of relevant metal sources. The extent of impairment would be minimally defined as the distance between sampling points at which exceedances of criteria were found. Land use information, and the relative location of potential dilution flows were also considered in identifying the extent of impairment.

A.3 Pathogen Numeric Criteria Fact Sheet

A.3.1 Introduction

This fact sheet describes the basis for the Regional Board's evaluation of pathogen information available for surface waters within the Central Valley Region. The applicable beneficial uses and water quality objectives are described (as identified in the Regional Board's Basin Plan), the criteria used to interpret narrative water quality objectives are identified, and a summary of how data is generally evaluated relative to those criteria is given.

A.3.2 Applicable Beneficial Uses

The following beneficial uses will most often apply in the evaluation of potential pathogen impacts in surface waters (from pages II-1 and II-2 of the Basin Plan):

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Agricultural Supply (AGR) - Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Shellfish Harvesting (SHELL) - Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

A.3.3 Applicable Water Quality Objectives

The most sensitive beneficial use for pathogen impairment is contact recreation. The Basin Plan contains a specific objective for fecal coliform bacteria. (CRWQCB-CVR, 1998; <http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf>). The Basin Plan states, “In waters designated for contact recreation (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 geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml.

For Folsom Lake (50), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 100/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 200/100 ml.”

In addition to the specific Basin Plan objective for bacteria the narrative toxicity objective also is applicable. The narrative toxicity objective in the Basin Plan states, in part, “All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.” The narrative toxicity objective further states the “ the Regional Water Board will also consider...numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services...the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.”

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A.3.4 Numeric Criteria Used

Pathogen guidelines and criteria have been developed for the protection of human health by the California Department of Health Services (CDHS) (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines for posting/closure of freshwater beaches CDHS, July 2000 <http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm>. USEPA has also issued criteria for bacteria (*Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a)). USEPA has requested that states adopt *E. coli* and enterococci indicators, rather than total or fecal coliforms by federal fiscal year 2003. The recommendation is based on studies that indicate that *E. coli* and enterococci show a strong correlation between swimming-associated illness and the microbiological quality of the waters used by recreational bathers (USEPA, 1986a).

Table A-3. Bacteria Water Quality Standards

California Department of Health Services Standards					
Criteria are expressed as Most Probable Number (MPN) per 100 milliliters					
	Total Coliform	Fecal Coliform	enterococcus		<i>E. coli</i>
30 day log mean¹	1,000	200	35		126 ²
Single Sample	10,000	400	104	61 ²	235 ²
USEPA Standards					
Criteria are expressed as Most Probable Number (MPN) per 100 milliliters					
	Total Coliform	Fecal Coliform	enterococcus		<i>E. coli</i>
30 day geometric mean¹			33		126
Single Sample³			61		235
CVRWQCB Basin Plan Criteria					
Criteria are expressed as Most Probable Number (MPN) per 100 milliliters					
30 day		200			
10% of the samples shall not exceed		400			

1. The geometric mean and the log mean statistical methods are equivalent for non-zero, positive data sets.
2. Draft guidelines for posting/closure of freshwater beaches (CDHS, 2000).
3. Single sample values for posting/closing beaches are statistically derived. The values presented in the tables are for “designated bathing beach” areas. Less restrictive numbers may be calculated for areas with lower frequency of contact recreational use. (USEPA, 1986a)

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A.3.5 Data Interpretation

Pathogen criteria differ from other pollutant types in that the pollutant is not measured directly but uses indicator organisms to assess the likelihood of a water body being impaired. The criteria, adopted by USEPA, used a risk level value of no more than eight illnesses per 1,000 swimmers for fresh waters, and no more than 19 illnesses per 1,000 swimmers for marine waters (USEPA, 2001a). The numerical values are “steady state” geometric mean values. USEPA recommends a sampling protocol of a minimum of not less than five samples taken over not more than a 30-day period (USEPA, 1986a). CDHS standards and recommended criteria are similar to USEPA’s and are also based on a statistically significant sample sizes. The primary difference between CDHS and USEPA is the statistical methods used to derive the steady state number. USEPA uses a geometric mean calculation and CDHS uses a log-mean calculation. The statistical methods are equivalent with non-zero positive data sets.

Monitoring studies of the indicator organisms for pathogens outside of designated swimming areas are variable in scope and frequently contain a limited number of samples. Data sets that include multiple sampling events per month (weekly or bi-weekly for example) and that span multiple months were statistically evaluated and compared to the USEPA standards (i.e., the geometric mean or log mean was calculated). If the geometric means exceed the criteria a recommendation for listing for impairment by pathogens will be made. Single samples that exceed the recommendations for beach closure may not, in the absence of additional monitoring, be evidence of an ongoing, or seasonal, problem that would justify the listing of the water body.

A.4 Pesticide Numeric Criteria Fact Sheet

A.4.1 Introduction

This fact sheet describes the basis for the Regional Board’s evaluation of pesticide information available for surface waters within the Central Valley Region. The applicable beneficial uses and water quality objectives are described (as identified in the Regional Board’s Basin Plan), the criteria used to interpret narrative water quality objectives are identified, and a summary of how data is generally evaluated relative to those criteria is given.

A.4.2 Applicable Beneficial Uses

The following beneficial uses will most often apply in the evaluation of potential pesticide impacts in surface waters (from pages II-1 and II-2 of the Basin Plan):

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-

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skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Warm Freshwater Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

A.4.3 Applicable Water Quality Objectives

The following narrative objectives potentially apply in the evaluation of potential pesticide impacts in surface waters (from Section III of the Basin Plan).

Under the heading of **Chemical Constituents**:

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Tables 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Under the heading of **Pesticides**:

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.
- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.
- Total identifiable persistent chlorinated hydrocarbon pesticides shall not be present in the water column at concentrations detectable within the accuracy of analytical methods approved by the Environmental Protection Agency or the Executive Officer.

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- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies(see State Water Resources Control Board Resolution No. 68-16 and 40 C.F.R. Section 131.12.).
- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.
- Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of pesticides in excess of the Maximum Contaminant Levels set forth in California Code of Regulations, Title 22, Division 4, Chapter 15.
- Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of thiobencarb in excess of 1.0 µg/l.

Where more than one objective may be applicable, the most stringent objective applies. For the purposes of this objective, the term pesticide shall include: (1) any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, which may infest or be detrimental to vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment whatsoever, or (2) any spray adjuvant, or (3) any breakdown products of these materials that threaten beneficial uses. Note that discharges of "inert" ingredients included in pesticide formulations must comply with all applicable water quality objectives.

Under the heading of **Toxicity**:

All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board. The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge, or, when necessary, for

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other control water that is consistent with the requirements for "experimental water" as described in *Standard Methods for the Examination of Water and Wastewater*, latest edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay.

Further explanation of the interpretation of surface water monitoring information can be found in section IV (Implementation) of the Basin Plan, as follows:

Under Policy for Application of Water Quality Objectives

Where multiple toxic pollutants exist together in water, the potential for toxicologic interactions exists. On a case by case basis, the Regional Water Board will evaluate available receiving water and effluent data to determine whether there is a reasonable potential for interactive toxicity. Pollutants which are carcinogens or which manifest their toxic effects on the same organ systems or through similar mechanisms will generally be considered to have potentially additive toxicity. The following formula will be used to assist the Regional Water Board in making determinations:

$$\sum_{i=1}^n \frac{\text{Concentration of Toxic Substance}_i}{\text{Toxicologic Limit for Substance in Water}_i} < 1.0$$

The concentration of each toxic substance is divided by its toxicologic limit. The resulting ratios are added for substances having similar toxicologic effects and, separately, for carcinogens. If such a sum of ratios is less than one, an additive toxicity problem is assumed not to exist. If the summation is equal to or greater than one, the combination of chemicals is assumed to present an unacceptable level of toxicologic risk.

Under the heading of Pesticide Discharges from Nonpoint Sources

In conducting a review of pesticide monitoring data, the Board will consider the cumulative impact if more than one pesticide is present in the water body. This will be done by initially assuming that the toxicities of pesticides are additive. This will be evaluated separately for each beneficial use using the following formula:

$$\frac{C_1}{O_1} + \frac{C_2}{O_2} + \dots + \frac{C_i}{O_i} = S$$

Where:

C = The concentration of each pesticide.

O = The water quality objective or criterion for the specific beneficial use for each pesticide present, based on the best available information. Note that the

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numbers must be acceptable to the Board and performance goals are not to be used in this equation.

S = The sum. A sum exceeding one (1.0) indicates that the beneficial use may be impacted.

For most pesticides, numerical water quality objectives have not been adopted. USEPA criteria and other guidance are also extremely limited. Since this situation is not likely to change in the near future, the Board will use the best available technical information to evaluate compliance with the narrative objectives. Where valid testing has developed 96 hour LC50 values for aquatic organisms (the concentration that kills one half of the test organisms in 96 hours), the Board will consider one tenth of this value for the most sensitive species tested as the upper limit (daily maximum) for the protection of aquatic life. Other available technical information on the pesticide (such as Lowest Observed Effect Concentrations and No Observed Effect Levels), the water bodies and the organisms involved will be evaluated to determine if lower concentrations are required to meet the narrative objectives.

The USEPA promulgated numeric water quality standards as part of the California Toxic Rule (CTR) in April 2000 (USEPA, 2000a). The applicable CTR criteria are described in Table A-5 below.

A.4.4 Numeric Criteria Used

Regional Board staff used the following hierarchy to determine the applicable criteria for use in evaluating potential impacts on aquatic life: 1) the most recently developed California Department of Fish and Game or USEPA criteria; and 2) Canadian water quality guidelines.

Regional Board staff used the following hierarchy to determine the applicable criteria for use in evaluating potential drinking water impacts: 1) Regional Board adopted water quality objectives (a numeric water quality objective for thiobencarb has been established for MUN uses); 2) the most recently developed California Department of Health Services, California Office of Health Hazard Assessment, or USEPA criteria; and 3) Canadian drinking water quality guidelines.

For waters with both drinking water and aquatic life beneficial uses, the most stringent criterion was applied.

The table below describes some of the criteria that could be used to interpret the Regional Board's narrative water quality objectives. The numbers in **bold** are the criteria used to evaluate available data on pesticide levels in surface waters for the purpose of providing recommendations to the State Board on changes to the 303(d) list. The DDT and DDE criteria were adopted by the USEPA as part of the California Toxics Rule and therefore

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are the applicable standards where fishing (i.e., REC 1) is a beneficial use of water. The thiobencarb water quality objective is identified in the Regional Board's Basin Plan for use where drinking water (i.e., MUN) is a designated use.

In general, the criteria presented are contained in the report and associated database *A Compilation of Water Quality Goals* (Marshack, 2000). The report includes criteria developed by the USEPA, California Department of Fish and Game, California Department of Health Services, and California Office of Environmental Health Hazard Assessment. In general, the criteria were developed either to protect human health through consumption of drinking water or to protect aquatic life. The criteria for DDT and DDE, although water column criteria, were derived in part to protect humans from consumption of contaminated fish.

Regional Board staff also used water quality guidelines from the Canadian Council of Environmental Ministers, the Canadian national environmental agency, when criteria derived in the United States were not available. The Canadian protocol for derivation of water quality guidelines to protect aquatic life includes a minimum toxicological data set for fish, invertebrates, and plants (CCME, 1991). The guideline for a given pollutant is preferably derived based on the lowest-observable-effect level (LOEL) of the most sensitive stage of the most sensitive organism. The LOEL is multiplied by a safety factor of 0.1 to derive the guideline value. Alternatively, the guideline can be derived from studies of acute toxicity. In this case, the acute/chronic (i.e. LC50/ no-observed-effect concentration) ratio is applied by dividing the most sensitive LC50 by the acute to chronic ratio (ACR). If an ACR is not available universal application factors are applied for non persistent (0.05) vs. persistent (0.01) pollutants. The Canadian protocol is comparable to the methodology employed by the USEPA and California Department of Fish and Game.

Regional Board staff also considered criteria derived by the Pesticide Action Network of North America from the AQUIRE database (PANNA, 2000). The AQUIRE database is managed by USEPA and provides results from tens of thousands of toxicity tests. From the AQUIRE database, PANNA derived an acute value by calculating the average LC50 (lethal concentration to 50% of the organisms) for the most sensitive species. PANNA derived a chronic value by calculating the average concentration of the most sensitive non-lethal endpoint for the most sensitive species. For example, if reproduction for a particular invertebrate species was most sensitive to a pesticide, PANNA averaged the toxicity endpoints of all the studies for that particular species and effect.

Regional Board staff is not recommending the use of the PANNA criteria. The quality control and quality assurance (QA/QC) procedures for studies contained in the AQUIRE database are not consistent. The experimental conditions of the various studies may also vary. It is beyond the scope of the update of the 303(d) list to make a determination as to adequacy of the studies upon which the PANNA criteria are based. The PANNA criteria are displayed for comparative purposes only.

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Pesticide	USEPA Criteria	CDFG Criteria	Canadian	PANNA
2,4-D				1.0
Alachlor	76^a			5.0
Atrazine	12 ^b		1.8	2.0
Azinphos-methyl	0.01			0.024
Bromacil			5	97
Carbaryl	0.02 ^d	2.53 (CCC^e & CMC^f)	0.20	1.0
Carbofuran		0.5 (max)	1.8	2.0
Chlorpyrifos	0.041/0.083 (CCC/CMC)	0.014/0.020 (CCC/CMC)	0.0035	0.003
Cyanazine			2.0	0.1
DDE				0.0018
DDT	0.01/1.1^c (CCC/CMC)			0.0055
Diazinon	0.09 (draft CMC)	0.05/0.08 (CCC/CMC)		0.0018
Diazoxon				8.9
Dicamba	200 ^d		0.06 (Irrigation water)	
Dieldrin	0.056/0.24^c (CCC/CMC)			0.01
Dimethoate			6.2	1.0
Diuron				7.03
Endosulfan II Beta	0.056/0.22^c (CCC/CMC)		0.02	0.1
Endosulfan Sulfate	0.056 (CCC)		0.02	212
Fonofos				0.08
Malathion	0.1^a	0.43 (CMC)		0.001
MCPA, dimethylamine salt			2.6	6.0
Methidathion				0.3
Methyl Parathion		0.08 (max)		0.0003
Molinate		13 (max)		3.0
Parathion	0.013/0.065 (CCC/CMC)			0.0006
Prometryn				0.75
Propanil				0.5
Simazine	10^b		10	0.6140

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Pesticide	USEPA Criteria	CDFG Criteria	Canadian	PANNA
Thiobencarb		3.1 (max)		6.2

Bold – are the criteria used to evaluate available data on pesticide levels in surface waters for the purpose of providing recommendations to the State Board on changes to the 303(d) list.

USEPA Criteria – Criteria are from criteria documents published by the U.S. Environmental Protection Agency as described in Marshack, 2000.

CDFG Criteria – Criteria are from hazard assessment criteria documents published by the California Department of Fish and Game (Harrington, 1990; Menconi and Gray, 1992; Menconi and Harrington, 1992; Siepmann and Slater, 1998; Siepmann and Jones, 1998; Siepmann and Finlayson, 2000)

Canadian - Criteria are from guidelines published by the Canadian Council of Ministers of the Environment (CCME, 1991).

PANNA – Criteria are contained in the Pesticide Action Network's 303(d) list submittal to the Central Valley Regional Board (PANNA, 2000).

^a USEPA Water Quality Advisory

^b Draft criterion

^c California Toxics Rule (CTR) or National Toxics Rule (NTR) criterion

^d Criteria published in *Water Quality Criteria, 1972* (NAS, 1973)

^e CCC = Criterion Chronic Concentration

^f CMC = Criterion Maximum Concentration

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Table A-5. Drinking Water Protection - Criteria are in µg/L				
Pesticide	USEPA Criteria	Regional Board	OEHHA/CDHS	Canadian
2,4-D	70 (MCL), 100 ^a		70 (MCL)	
Alachlor	2 (MCL)		2 (MCL)/ 4(PHG)	
Atrazine	3 (MCL)		0.15 (OEHHA)/ 3 (MCL)	0.005
Azinphos-methyl	87.5 (NAS)			0.02
Bromacil	90 (HA)			
Carbaryl	700 (IRIS)		700 (CDHS AL)	
Carbofuran	40 (MCL)/ 35 (IRIS)		18 (MCL)/ 1.7 (PHG)	
Chlorpyrifos	21 (IRIS)			
Cyanazine	1 (HA)			
DDE	0.00059 ^b (drinking water/ consumption)		0.1 (OEHHA)	
DDT	0.00059 ^b (drinking water/ consumption)		0.1 (OEHHA)	
Diazinon	0.6 (HA)		6 (CDHS AL)	
Diazoxon				
Dicamba	210 (IRIS)			
Dieldrin	0.00014 ^p (drinking water/ consumption)		0.002 (CDHS AL)	
Dimethoate	1.4 (IRIS)		1.0 (CDHS AL)	
Diuron	14 (IRIS)			
Endosulfan II Beta	110 ^b (drinking water/ consumption)			
Endosulfan Sulfate	110 ^b (drinking water/ consumption)			
Fonofos	14 (IRIS)			
Malathion	160 (IRIS)		160 (CDHS AL)	
MCPA, dimethylamine salt	11 (IRIS)			
Methidathion	0.7 (IRIS)			
Methyl Parathion	1.8 (IRIS)		2 (CDHS AL)	
Molinate	14 (IRIS)		20 (MCL)	
Parathion	4.2 (IRIS)		40 (CDHS AL)	
Prometryn	28 (IRIS)			
Propanil	35 (IRIS)			
Simazine	3.5 (IRIS)		0.4 (OEHHA)	

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Table A-5. Drinking Water Protection - Criteria are in µg/L				
Pesticide	USEPA Criteria	Regional Board	OEHHA/CDHS	Canadian
			PHG)/ 4 (MCL)	
Thiobencarb	1 (secondary MCL)/ 70 (primary MCL)	1.0		

Bold – are the criteria used to evaluate available data on pesticide levels in surface waters for the purpose of providing recommendations to the State Board on changes to the 303(d) list.

CDHS AL – California Department of Health Services Action Level for drinking water.

USEPA Criteria – Criteria are from criteria documents published by the U.S.

Environmental Protection Agency as described in Marshack, 2000.

HA – Health Advisory for drinking water.

IRIS – USEPA Integrated Risk Information System.

NAS – National Academy of Sciences recommended level for protection of health for drinking water.

OEHHA/CDHS – Criteria are from guidelines and criteria published by the California Office of Environmental Health Hazard Assessment and California Department of Health Services as described in Marshack, 2000.

Canadian - Criteria are from guidelines published by the Canadian Council of Ministers of the Environment (CCME, 1991).

PHG – Public Health Goal for drinking water (OEHHA).

^a USEPA National Recommended Ambient Water Quality criterion to protect human health from water and fish/shellfish consumption.

^b California Toxics Rule criterion for protection for drinking water and consumption of fish/shellfish.

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A.4.5 Data Interpretation

Data from water samples are both location and time specific. In recognition of the discrete nature of water quality sample results, Regional Board staff considered the following factors in reviewing available data: 1) total number of samples collected; 2) total number of exceedances of criteria; 3) magnitude of exceedance of criteria; and 4) frequency of exceedance of criteria. An initial screening of available water quality data was performed by determining whether a minimum of ten water samples was available and whether there was a minimum of two exceedances. If the minimum amount of data were available, staff then performed a more intensive review of the available data to determine whether the applicable criteria were being attained.

In addition, Regional Board staff also considered factors such as the season of sample collection, the likely pesticide use patterns, and when the studies were conducted (e.g. comparisons were made between past studies and recent studies). When data were evaluated, sampling events conducted at different sites for the same water body were considered together.

In evaluating exceedance of chronic water quality criteria (often expressed as a four-day average), data over consecutive days was often not available. Regional Board staff evaluated the available data to determine whether exceedance of the chronic criteria could be inferred based on the magnitude of the exceedance or based on data collected prior to and after the data point being evaluated.

Exceedance of the chronic criteria was determined based on one of the following methods: 1) The four-day average concentration was calculated based on the concentration found on a given sampling date and the concentrations found on the previous three days. If no sample was collected on one or more of the previous three days, the concentration on those days was assumed to be zero for purposes of calculating the four-day average. 2) A significant exceedance of a chronic criteria on a single day (e.g. by a factor of 4) would imply exceedance of the 4-day average criteria. 3) Exceedance of the chronic criteria over successive (although non-consecutive) sampling events that were greater than 4 days apart would also imply exceedance of the criteria.

In general, waters were listed as impaired due to a particular pesticide when the available information indicated that the criteria would likely be exceeded on a periodic basis (i.e. the exceedance is not a unique event). Few data with consistent (and/or significant) exceedances could provide evidence of impairment in one case, whereas, more data would be needed in another instance in which infrequent exceedances occurred.

If available water quality data did not indicate exceedances of criteria, if little data were available (e.g. less than 10 sampling events), or if the exceedance appeared to be a unique event, no recommendation for adding the water and pollutant to the 303(d) list was made.

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In some cases, the information available indicated that there may be an impairment, but not enough data were available to indicate that the exceedances occurred on a periodic basis. For those waters, a recommendation for further assessment is made.

The extent of impairment is based on the location of samples and evidence of relevant sources. The extent of impairment would be minimally defined as the distance between sampling points at which exceedances of criteria were found. Land use information, as well as the relative location of potential dilution flows, was also considered in identifying the extent of impairment.

A specific description of how data were interpreted is contained in the fact sheets for each 303(d) list recommendation.