

## 4.7 HYDROLOGY AND WATER QUALITY

This section examines impacts associated with the proposed project on local and regional hydrologic characteristics including flooding and drainage, groundwater recharge, surface and groundwater quality, and drinking water quality.

The following comments on hydrology and water quality were received during the public scoping period:

- Describe the existing Bay water quality and identify constituents for which drinking water is not normally tested.
- Analyze the water quality effects of discharging brine to the Bay, including any gradual increase in salinity over time and the ability of the proposed discharge to adequately disperse the brine plume in the surrounding Bay waters.
- Analyze the ability of the desalination process to produce drinking water that meets drinking water standards.

### 4.7.1 Environmental Setting

#### 4.7.1.1 Surface Water Resources

The proposed desalination plant would extract water from San Rafael Bay and discharge a waste stream (brine) to the Bay via the existing CMSA outfall. The proposed intake structure would be at the end of a rebuilt Marin Rod & Gun Club pier (approximately 2,000 feet offshore) and the end of CMSA's existing outfall is approximately 8,000 feet offshore.

San Rafael Bay is the part of San Francisco Bay between Point San Quentin on the south and Point San Pedro on the north. The Bay is very shallow (0 to 6 feet) up to a mile from shore; where it encounters the main channel, the water depths range from 40 to 60 feet. Tides at Point San Quentin have a mean range of 4 feet. Tidal current predictions are available for "Point San Quentin, 0.82 n. mi. east of" which is approximately 3,000 feet south of the diffuser (the portion of the outfall where water is discharged). Maximum flood currents there average 0.7 knots heading 013 degrees (from true North), while maximum ebb currents average 0.8 knots heading 182 degrees.

#### 4.7.1.2 Groundwater Resources

The *Water Quality Control Plan for the San Francisco Bay Basin* (Basin Plan; San Francisco Bay RWQCB ~~2006~~2007) does not identify a groundwater basin at the project site, which is located on fill immediately adjacent to the Bay. There are no significant groundwater resources within the project area.

#### 4.7.1.3 Flooding and Drainage

The proposed desalination plant site is not within the 100-year floodplain as identified by the FEMA Flood Insurance Rate Maps for the San Rafael area (FEMA 1984).

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Global sea level rise during the last century is believed to have been between 0.3 and 0.6 foot. There are eight sea level gauges along the California coast that have at least 50 years of records. The rate of sea level rise measured by all but one of these gauges is fairly consistent with the worldwide trend. Therefore, it is reasonable to expect that changes in the global average sea level through this century will also be experienced by California's coast. The closest of the eight California gauges to Marin County is in San Francisco, located just inside the Golden Gate Bridge on the shore of the Presidio. A trend analysis predicts a sea level rise at this site of 0.7 foot over the next century (California Department of Water Resources [CDWR] 2006).

**Storm Water Drainage.** The project site is unpaved and storm water infiltrates the soil or flows off the site. Much of the site surface is covered with compact soil and gravel that does not allow for significant infiltration. Most storm water runs off of the site. Surface water runoff from the proposed project site generally runs from north to south (off the site toward Pelican Way).

### *4.7.1.4 Surface Water Quality*

San Rafael Bay water quality is important in two ways: as receiving water, it must meet certain water quality objectives (WQOs) established for the Bay in the Basin Plan (San Francisco Bay RWQCB ~~2006~~2007), and, as the water supply for the RO process, it is the source of dissolved constituents in the RO concentrate. San Rafael Bay water quality can be estimated from the San Francisco Estuary Institute Regional Monitoring Program (RMP) data collected from the Red Rock Station between 1994 and 2001. Average, minimum, and maximum concentrations of several dissolved and total constituents are provided in **Table 4.7-1**.

### *4.7.1.5 Groundwater Quality*

The Basin Plan does not identify a groundwater basin at the project site, which is located on fill immediately adjacent to the Bay. There are no significant groundwater resources within the project area.

### *4.7.1.6 Drinking Water Quality*

MMWD drinking water is of high quality and meets all federal and state drinking water standards. MMWD's existing drinking water quality is shown in **Table 4.7-2**.

**Table 4.7-1  
San Rafael Bay Water Quality Data**

| Contaminant                              | Units | Red Rock (1994–2001) |         |        |   |  |        |         |        |   |  |
|--|-------|----------------------|---------|--------|---|--|--------|---------|--------|---|--|
|  |       | Dissolved            |         |        |   |  | Total  |         |        |   |  |
|  |       | Avg                  | Min     | Max    | No. of Samples Used to Calculate Statistics | % of Detects in Samples Used to Calculate Statistics | Avg    | Min     | Max    | No. of Samples Used to Calculate Statistics | % of Detects in Samples Used to Calculate Statistics |
| Silver                                   | µg/l  | 0.0026               | 0.001   | 0.005  | 20  | 100  | 0.0064 | <0.0021 | 0.015  | 17  | 94   |
| Arsenic                                  | µg/l  | 1.66                 | 1.14    | 2.71   | 22  | 100  | 1.82   | 0.94    | 2.64   | 22  | 100  |
| Cadmium                                  | µg/l  | 0.060                | 0.01    | 0.1285 | 22  | 100  | 0.062  | 0.022   | 0.1049 | 20  | 100  |
| Chromium                                 | µg/l  | 0.19                 | 0.11    | 0.48   | 17  | 100  | 2.4    | 0.3     | 5.16   | 17  | 100  |
| Copper                                   | µg/l  | 1.14                 | 0.58    | 2.14   | 22  | 100  | 2.03   | 0.781   | 3.55   | 20  | 100  |
| Mercury                                  | µg/l  | 0.00084              | 0.00016 | 0.0018 | 18  | 100  | 0.0056 | 0.001   | 0.0124 | 20  | 100  |
| Methyl mercury                           | ng/l  | 0.11                 | 0.113   | 0.113  | 1   | 100  | 0.14   | 0.069   | 0.231  | 3   | 100  |
| Nickel                                   | µg/l  | 1.24                 | 0.72    | 2.22   | 22  | 100  | 2.85   | 1.06    | 5.04   | 20  | 100  |
| Lead                                     | µg/l  | 0.016                | 0.0038  | 0.076  | 22  | 100  | 0.39   | 0.1     | 1.06   | 20  | 100  |
| Selenium                                 | µg/l  | 0.15                 | 0.08    | 0.44   | 20  | 100  | 0.15   | 0.05    | 0.37   | 21  | 100  |
| Zinc                                     | µg/l  | 0.53                 | 0.1     | 1.1    | 22  | 100  | 3.1    | 0.822   | 7.8    | 20  | 100  |
| Cyanide <sup>1</sup>                     | µg/l  | <1.0                 | <1.0    | <1.0   | 4   | 0  |        |         |        |   |  |
| Ammonia (as N)                           | mg/l  | 0.075                | 0.01    | 0.15   | 22  | 100  |        |         |        |   |  |
| Dissolved Oxygen                         | mg/l  | 8.62                 | 7       | 14.6   | 21  | 100  |        |         |        |   |  |
| Dissolved Organic Carbon                 | µg/l  | 1646                 | 708.6   | 3856   | 22  | 100  |        |         |        |   |  |
| Conductivity                             | µmho  | 29188                | 800     | 48080  | 21  | 100  |        |         |        |   |  |
| Nitrate (as N)                           | mg/l  | 0.25                 | 0.017   | 0.41   | 21  | 100  |        |         |        |   |  |
| Nitrite (as N)                           | mg/l  | 0.011                | 0.003   | 0.024  | 22  | 100  |        |         |        |   |  |
| Phosphate (as P)                         | mg/l  | 0.067                | 0.01    | 0.16   | 22  | 100  |        |         |        |   |  |
| Salinity (by Salinometer)                | psu   | 21.4                 | 5.4     | 31.6   | 17  | 100  |        |         |        |   |  |
| Salinity (by SCT)                        | ppt   | 21.4                 | 4.8     | 31.4   | 21  | 100  |        |         |        |   |  |
| Endosulfan I                             | pg/l  | 7.4                  | <1      | 45     | 14  | 21   | 8.7    | <1      | 50     | 14  | 43   |
| Endosulfan II                            | pg/l  | 3.2                  | <1      | 8      | 14  | 7  | 4.0    | <1      | 12     | 14  | 29   |
| Endosulfan Sulfate                       | pg/l  | 21                   | <1      | 69     | 16  | 69   | 24     | <1      | 79     | 15  | 73   |
| Chlorpyrifos                             | pg/l  | 74                   | <1      | 310    | 19  | 95   | 69     | 3       | 231    | 18  | 100  |
| Dacthal                                  | pg/l  | 192                  | <1      | 990    | 19  | 79   | 211    | 2.4     | 1020   | 19  | 89   |
| Diazinon                                 | pg/l  | 3379                 | <2.1    | 32000  | 19  | 89   | 3504   | <204    | 32000  | 19  | 95   |
| Oxadiazon                                | pg/l  | 612                  | <1      | 7000   | 17  | 65   | 554    | <1      | 7005   | 19  | 74   |
| Sum of Dichlorodiphenyl-trichloroethanes | pg/l  | 125                  | 37      | 335    | 17  | 100  | 253    | 76      | 754    | 16  | 100  |
| Sum of Chlordanes                        | pg/l  | 70                   | 18      | 302    | 19  | 100  | 98     | 41      | 357    | 17  | 100  |
| cis-Nonachlor                            | pg/l  | 4.9                  | <1      | 22     | 16  | 75   | 7.1    | <1      | 22     | 16  | 88   |
| trans-Nonachlor                          | pg/l  | 11                   | 2       | 38     | 19  | 100  | 15     | 3       | 48     | 17  | 100  |
| Heptachlor                               | pg/l  | 4.3                  | <1      | 21     | 15  | 27   | 4.6    | <1      | 21     | 13  | 23   |
| Heptachlor Epoxide                       | pg/l  | 19                   | <1      | 110    | 19  | 89   | 23     | <1      | 127    | 19  | 89   |
| Oxychlordane                             | pg/l  | 9.2                  | <1      | 53     | 19  | 74   | 11     | <1      | 53     | 18  | 72   |
| Sum of Hexachlorocyclohexanes            | pg/l  | 432                  | 6       | 1118   | 20  | 100  | 460    | 80      | 1123   | 18  | 100  |

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**Table 4.7-1  
San Rafael Bay Water Quality Data**

| Contaminant                              | Units | Red Rock (1994–2001) |      |       |   |  |        |         |        |   |  |
|--|-------|----------------------|------|-------|---|--|--------|---------|--------|---|--|
|  |       | Dissolved            |      |       |   |  | Total  |         |        |   |  |
|  |       | Avg                  | Min  | Max   | No. of Samples Used to Calculate Statistics | % of Detects in Samples Used to Calculate Statistics | Avg    | Min     | Max    | No. of Samples Used to Calculate Statistics | % of Detects in Samples Used to Calculate Statistics |
| Dieldrin                                 | pg/l  | 45                   | <1   | 190   | 19  | 84   | 49     | <1      | 202    | 19  | 89   |
| Endrin                                   | pg/l  | 13                   | <1   | 75    | 14  | 43   | 14     | <1      | 75     | 13  | 38   |
| Hexachlorobenzene                        | pg/l  | 11                   | <1   | 59    | 20  | 90   | 11     | 2       | 27     | 15  | 93   |
| Sum of Polychlorinated Biphenyls         | pg/l  | 106                  | 39.8 | 301.9 | 20  | 100  | 401    | 142.6   | 2451.2 | 18  | 100  |
| Sum of Polynuclear Aromatic Hydrocarbons | ng/l  | 4.3                  | <0.1 | 9.7   | 18  | 94   | 15     | 5.99    | 50     | 18  | 100  |
| Dioxin Toxic Equivalent <sup>2</sup>     | µg/l  |                      |      |       |   |  | 4.7E-8 | 4.2E-10 | 3.4E-7 | 9   | 100  |

**Source:** San Francisco Estuary Institute data, [http:// www.sfei.org/rmp](http://www.sfei.org/rmp)

µg/l = microgram(s) per liter, µmho = micromho(s), mg/l = milligram(s) per liter, ng/l = nanogram(s) per liter, pg/l = picogram(s) per liter, ppt = part(s) per thousand, psu = practical salinity unit(s), SCT = salinity conductivity temperature meter

<sup>1</sup> RMP data are not available for cyanide. Instead, weak acid dissociable cyanide data from the Intake Water Credit Study (URS 2007) are provided here and used in subsequent analyses. Because all samples yielded nondetects, the concentrations are shown as less than the 1.0 µg/l reporting limit. Therefore, the estimated brine concentration is less than twice the reporting limit.

<sup>2</sup> RMP data are not available for dioxin-TEQ (dioxin toxic equivalent). Instead, data from the Intake Water Credit Study (URS 2007) are provided here and used in subsequent analyses.

**Table 4.7-2(a) and (b)  
MMWD Annual Water Quality Report 2007**

| <b>(a) DETECTED CONTAMINANTS WITH PRIMARY MCL, AL, OR TT</b>    |            |                |                   |                 |         |   |
|---|------------|----------------|-------------------|-----------------|---------|---|
| <i>DISTRIBUTION SYSTEM (Blend of Reservoir and SCWA Waters)</i> |            |                |                   |                 |         |   |
| Constituent   | Units      | MCLG [PHG]     | MCL               | Average         | Range   | Source  |
| Coliform Bacteria   | % Presence | 0              | 5                 | 0.1             | 0-0.7   | Naturally present in the environment            |
| Copper <sup>1</sup>   | mg/l       | [0.17]         | 1.32 <sup>2</sup> | 0.1             | ND-0.14 | Internal corrosion of household plumbing system |
| Lead <sup>1</sup>   | µg/l       | [2]            | 15 <sup>2</sup>   | ND <sup>3</sup> | ND-23   | Internal corrosion of household plumbing system |
| Haloacetic Acids  | µg/l       | NA             | 60 <sup>4</sup>   | 15 <sup>5</sup> | 1-26    | By-product of drinking water disinfection       |
| Total Trihalomethanes   | µg/l       | NA             | 80 <sup>4</sup>   | 26 <sup>5</sup> | 8-46    | By-product of drinking water disinfection       |
| Chloramines   | mg/l       | 4 <sup>6</sup> | 4 <sup>6</sup>    | 1.33            | ND-2.4  | Drinking water disinfectant                     |

<sup>1</sup> Copper and lead data are from first-draw 1-liter samples taken at customers' homes for compliance with Lead Copper Rule and are not representative of water delivered to customers.

<sup>2</sup> Action level (AL) for 90th percentile value.

<sup>3</sup> The sixth highest value out of 50 values (90th percentile) is listed. One of these 50 samples exceeded 15 µg/L.

<sup>4</sup> Compliance is based on the four quarter running average of distribution system samples.

<sup>5</sup> Highest of the four running annual averages in 2006.

<sup>6</sup> The data shown are for the Maximum Residual Disinfection Level Goal (MRDLG) and Maximum Residual Disinfection Level (MRDL) rather than the Maximum Contaminant Level Goal (MCLG) and Maximum Contaminant Level (MCL), respectively. MRDL is a term used for disinfectants such as chloramines; in contrast to Maximum Contaminant Level (MCL) used for other parameters. The Maximum Residual Disinfection Level Goal (MRDLG) is the same as the MCLMRDL. Disinfectants provide protection from viruses and bacteria such as *E. coli*.

| <b>(b) OTHER DETECTED CONSTITUENTS (INCLUDING THOSE WITH SECONDARY MCLs (SMCL))</b> |                   |                 |         |           |            |           |  |
|---|-------------------|-----------------|---------|-----------|------------|-----------|--|
| Constituent   | Units             | RESERVOIR WATER |         |           | SCWA WATER |           | Source   |
|   |                   | SMCL            | Average | Range     | Average    | Range     |  |
| Odor  | TON               | 3               | ND      | ND-ND     | ND         | ND-1      | Naturally occurring organic materials                    |
| Chloride  | mg/l              | 500             | 24      | 17-28     | 7          | 7-8       | Runoff/leaching of natural deposits                      |
| Specific Conductance  | µS/cm             | 1,600           | 202     | 169-230   | 288        | 280-294   | Substances that form ions in water                       |
| Sulfate   | mg/l              | 500             | 8       | 4-16      | 12         | 11-13     | Runoff-leaching of natural deposits, treatment chemicals |
| Total Dissolved Solids  | mg/l              | 1,000           | 117     | 88-136    | 175        | 163-192   | Runoff/leaching of natural deposits                      |
| Turbidity   | NTU               | 5               | 0.07    | 0.05-0.10 | 0.11       | 0.09-0.14 | Soil runoff  |
| Zinc  | mg/l              | 5               | 0.44    | 0.32-0.56 | 0.37       | 0.34-0.41 | Corrosion inhibitor                                      |
| Sodium  | mg/l              | NA              | 18      | 14-22     | 20         | 20-21     |  |
| Hardness <sup>1</sup>   | mg/l              | NA              | 55      | 44-64     | 106        | 102-112   |  |
| Hardness  | Grains/gallon gpg | NA              | 3.2     | 2.6-3.7   | 6.2        | 6.0-6.5   |  |
| Alkalinity <sup>1</sup>   | mg/l              | NA              | 52      | 39-61     | 123        | 118-127   |  |
| Radon*  | pCi/l             | NA              | NA      | NA        | 181        | 103-363   | See note below   |

\*Radon is a naturally occurring radioactive gas of geologic origin that is found throughout the United States. It can migrate into indoor air through soil or cracks in foundations. Tapwater contributions to indoor air are small by comparison. Breathing air containing radon can lead to lung cancer. Drinking water containing radon may also cause increased risk of stomach cancer. The radon data in the table above are measured at individual wells operated by SCWA. The radon level in water entering Marin Municipal Water District's system from SCWA's system is lower and averaged 106 pCi/L in 2006. This level is far below the regulatory limit of 300 and 4000 pCi/L once proposed and later withdrawn by the EPA. For additional information, contact the EPA's radon hotline (800-767-7236). EPA data for radon in the North Bay: Average outdoor air is 0.4 pCi/L and average indoor air is 2 pCi/L.

<sup>1</sup> Expressed as Calcium Carbonate or CaCO<sub>3</sub>.

EPA = U.S. Environmental Protection Agency  
 gpg = grains per gallon  
 µg/l = micrograms per liter (equals parts per billion)  
 µS/cm = microSiemens per centimeter  
 mg/l = milligrams per liter (equals parts per million)  
 MRDL = Maximum Residual Disinfection Level  
 MRDLG = Maximum Residual Disinfection Level Goal

NA = not applicable  
 ND = not detected  
 NTU = Nephelometric turbidity unit(s)  
 pCi/L = picoCurie(s) per liter  
 PHG = Public Health Goal  
 SCWA = Sonoma County Water Agency  
 TON = threshold odor number  
 TT = Treatment Technique

NA = not applicable

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### 4.7.1.7 *Tsunami and Seiche*

A tsunami (Japanese word meaning “harbor wave”) is a water wave or a series of waves generated by an impulsive displacement of water in the ocean or other body of water. Tsunamis can travel across oceanic basins and cause damage several thousand miles from their sources. Most tsunamis are caused by a rapid vertical movement along a break in the Earth's crust, i.e., a tectonic fault rupture on the bottom of the ocean resulting in displacement of the column of water directly above it. The majority of tsunamis are triggered by earthquake rupture along subduction zones. The 1964 Alaska earthquake generated a tsunami that caused widespread damage along the west coast of North America and throughout the Pacific. Paleoseismic investigations have also shown that tsunamis resulting from earthquakes on the subduction zone beneath Japan and the Cascadia subduction zone in the Pacific Northwest have also inundated the Pacific coast states (Atwater et al. 1995).

A seiche is a periodic oscillation or “sloshing” of water in an enclosed basin such as the San Francisco Bay. The period of oscillation can range from minutes to hours. The 1898 Mare Island earthquake is reported to have caused a seiche in the northern part of the Bay (Topozada et al. 1992). There are no reports of damage associated with this event.

Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation based on tsunami run-up decreases to 50 percent of its maximum at the Golden Gate by the time it passes the Bay Bridge to the south and the Richmond–San Rafael Bridge to the north. By the time the tsunami reaches the Carquinez Strait to the north or Alviso in the south, the run-up would only be approximately 10 percent of its maximum at the Golden Gate. Tsunami run-up results in inundation and flooding of low-lying areas, and in locations where the waves have sufficient energy to cause significant erosion. According to ABAG mapping, none of the project area is within a tsunami evacuation area (ABAG 1997). Therefore, probability of a tsunami runup-caused flooding and erosion in the project area is very low.

### 4.7.1.8 *Water Quality Regulations*

Water quality objectives for all California waters are established under the Federal CWA and California’s Porter-Cologne Water Quality Control Act. Discharges to surface or groundwater are also covered by regional basin plans. These regulations, as well as regulations applicable to drinking water and reclaimed water use, are described below.

**Clean Water Act.** The CWA is a 1977 amendment to the Federal Water Pollution Control Act of 1972 (United States Code, Title 33). The CWA requires the EPA to establish effluent limitations for municipal sewage plant and industrial facility discharges. The CWA provides for two types of pollution control limits:

- Limits to the quantity of pollutants discharged from a point source such as pipe, ditch, or tunnel into a navigable waterbody. These limits are established through a nationwide assessment of what is technologically and economically feasible for a particular industry.
- Ambient water quality standards for navigable waters that are based on beneficial uses and require more stringent control of discharge if necessary to achieve water quality objectives. For example, the EPA sets water quality limits to control pollution discharged to waters designated by the states for beneficial uses including drinking, fishing, or recreation.

In addition to these point source and ambient water quality control limits, Section 319 of the CWA provides direction for state control of nonpoint source discharges. This section requires states to submit a report that identifies: navigable waters that are expected to achieve applicable water quality standards or goals; categories of nonpoint or specific sources that add significant pollution to contribute to nonattainment of water quality standards or goals; and a process to develop BMPs and measures to control each category of nonpoint or specific sources. The states are then required to develop a management program that proposes to implement the nonpoint source control program.

Section 305(b) of the CWA requires states to perform biennial water quality assessments of navigable waters to describe the nature and extent of nonpoint sources, provide recommendations for control programs, and analyze the success of beneficial use protection and pollution reduction.

Section 303(d) of the CWA requires states to identify waters that are not expected to meet water quality standards after effluent limitations for point sources are implemented, develop a priority ranking, and determine the total maximum daily load of specific pollutants that may be discharged into the water body while still meeting the water quality standards.

The primary method by which the CWA imposes pollutant control limits is the NPDES permit program established under Section 402 of the act. Under the NPDES program, any point source discharge of a pollutant or pollutants into any waters of the United States must be permitted. In California, NPDES permitting authorities are the state's RWQCBs.

Section 402(p) of the CWA requires NPDES permits for storm water discharges from municipal storm water systems, industrial activities, construction activities, and designated dischargers that are considered significant contributors of pollutants to waters of the United States. The Phase I storm water permitting program implemented under these requirements addressed runoff from municipal storm water systems serving populations of 100,000 or more, construction activity disturbing 5 acres of land or more, and various categories of industrial activity.

Section 303(c)(2)(B) of the CWA requires that states adopt numeric criteria for priority pollutants as part of their water quality standards. In 1991, the SWRCB adopted the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan, in part, to comply with the CWA. The SWRCB amended the plans in 1993. In 1994, the SWRCB rescinded the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan in response to a court ruling invalidating the plans. In order to bring California into compliance with the CWA, the SWRCB and the EPA agreed to a two-phased approach. Phase I consisted of the EPA promulgating numeric water quality criteria for priority pollutants for California in accordance with the CWA, and the SWRCB adopting statewide measures to implement those criteria in a statewide policy. In Phase II, the SWRCB will consider the adoption of appropriate statewide water quality objectives for toxic pollutants.

On May 18, 2000, the EPA published the California Toxics Rule in the Federal Register, adding Section 131.38 to Title 40 of the Code of Federal Regulations. On May 22, 2000, the Office of Administrative Law approved, with modifications, the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Phase 1 of the Inland Surface Waters Plan and Enclosed Bays and Estuaries Plan). The Policy establishes implementation procedures for three categories of priority pollutant criteria or water quality

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objectives. These are (1) criteria promulgated by the EPA in the National Toxics Rule that apply in California; (2) criteria proposed by EPA in the California Toxics Rule; and (3) water quality objectives contained in RWQCB water quality control plans (basin plans).

**Porter-Cologne Water Quality Control Act.** The Porter-Cologne Water Quality Control Act of 1969, which became Division 7 of the California Water Code, authorized the SWRCB to provide comprehensive protection for California's waters through water allocation and water quality protection. The SWRCB implements the requirement of CWA Section 303 that water quality standards be set for certain waters by adopting water quality control plans under the Porter-Cologne Act. In addition, the Porter-Cologne Act established the responsibilities and authorities of the nine RWQCBs, which include preparing water quality plans for areas within the region (basin plans), identifying water quality objectives, and issuing NPDES permits and Waste Discharge Requirements (WDRs). Water quality objectives are defined as limits or levels of water quality constituents and characteristics established for reasonable protection of beneficial uses or prevention of nuisance. The Porter-Cologne Act was later amended to provide the authority delegated from EPA to issue NPDES permits.

NPDES permits, issued by RWQCBs pursuant to the CWA, also serve as WDRs issued pursuant to the Porter-Cologne Act. Generally, WDRs are issued for discharges that are exempt from the CWA NPDES permitting program, discharges that may affect waters of the state that are not waters of the United States (i.e., groundwater), and/or wastes that may be discharged in a diffused manner. WDRs are established and implemented to achieve the WQOs for receiving waters as established in the basin plans. Sometimes combined WDRs/NPDES permits are issued.

**2006–2007 San Francisco Bay RWQCB Basin Plan.** The proposed project is within the jurisdiction of the San Francisco Bay RWQCB (Region 2). The San Francisco Bay RWQCB has the authority to implement water quality protection standards through the issuance of permits for discharges to waters at locations within its jurisdiction. The Basin Plan describes the water quality control measures that contribute to the protection of the beneficial uses of the Bay watershed. The Basin Plan identifies beneficial uses for each segment of the Bay and its tributaries, water quality objectives for the reasonable protection of the uses, and an implementation plan for achieving these objectives.

**Drinking Water Regulations.** The Safe Drinking Water Act is the main federal law enacted to protect public health by ensuring that public water systems provide safe drinking water. The act authorizes the EPA to set health-based standards limiting levels of contaminants in drinking water. These primary MCLs are legally enforceable by either EPA or states. Primary MCLs are listed in 22 CCR 64431–64444 (California Department of Health Services). Specific regulations for lead and copper are in 22 CCR 64670, et seq. Secondary MCLs that address the taste, odor, or appearance of drinking water are listed in 22 CCR 64449 (California Department of Health Services 2004). Selected federal and state drinking water maximum contaminant levels and notification levels are shown in **Table 4.7-3**.

**Table 4.7-3  
Selected Federal and State Drinking Water Maximum Contaminant Levels and  
Notification Levels**

| Constituent            | Units     | EPA MCL                             |                       | California Department of Health Services<br>MCL or NL |              |                    |
|------------------------|-----------|-------------------------------------|-----------------------|---|--------------|--------------------|
|                        |           | Primary                             | Secondary             | Primary   | Secondary    | Notification Level |
| Aluminum               | µg/l      |                                     | 50 to 200             | 1,000   | 200          |                    |
| Arsenic                | µg/l      | 10                                  |                       | 50  |              |                    |
| Barium                 | µg/l      | 2,000                               |                       | 1,000   |              |                    |
| Beryllium              | µg/l      | 4                                   |                       | 4   |              |                    |
| Boron                  | µg/l      |                                     |                       |   |              | 1,000              |
| Cadmium                | µg/l      | 5                                   |                       | 5   |              |                    |
| Chloride               | mg/l      |                                     | 250                   |   | 250 to 600   |                    |
| Chromium               | µg/l      | 100                                 |                       | 50  |              |                    |
| Copper                 | µg/l      | 1,300 <sup>2</sup> 300 <sup>1</sup> | 1,000                 | 1,300   | 1,000        |                    |
| Cyanide                | µg/l      | 200                                 |                       | 150   |              |                    |
| Fluoride               | µg/l      | 4,000                               | 2,000                 | 2,000   |              |                    |
| Iron                   | µg/l      |                                     | 300                   |   | 300          |                    |
| Lead                   | µg/l      | 15 <sup>2</sup> 15 <sup>1</sup>     |                       | 15  |              |                    |
| Manganese              | µg/l      |                                     | 50                    |   | 50           | 500                |
| Mercury                | µg/l      | 2                                   |                       | 2   |              |                    |
| Nickel                 | µg/l      |                                     |                       | 100   |              |                    |
| Nitrate                | µg/l as N | 10,000                              |                       | 10,000  |              |                    |
| PCBs                   | µg/l      | 0.5                                 |                       | 0.5   |              |                    |
| pH                     | pH units  |                                     | 6.5 to 8.5            |   |              |                    |
| Selenium               | µg/l      | 50                                  |                       | 50  |              |                    |
| Silver                 | µg/l      |                                     | 100                   |   | 100          |                    |
| Sodium                 | mg/l      |                                     | 30 to 60 <sup>2</sup> |   |              |                    |
| Sulfate                | mg/l      |                                     | 250                   |   | 250 to 600   |                    |
| Total Dissolved Solids | mg/l      |                                     | 500                   |   | 500 to 1,500 |                    |
| Vanadium               | µg/l      |                                     |                       |   |              | 50                 |
| Zinc                   | µg/l      |                                     | 5,000                 |   | 5,000        |                    |

A blank cell indicates that an MCL or NL does not exist for the constituent.

EPA = U.S. Environmental Protection Agency, µg/l = microgram(s) per liter, mg/l = milligram(s) per liter, MCL = maximum contaminant level, NL = notification level

<sup>1</sup> Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.

<sup>2</sup> EPA Drinking Water Advisory Level for taste and odor; not federally enforceable, but is intended as a guideline for States.

In accordance with state and federal requirements, MMWD regularly monitors its domestic water supply. Water quality test results are compiled in an annual report and distributed to the public.

#### 4.7.1.9 Wastewater Discharge Requirements

Discharge of wastewater from CMSA's outfall to San Rafael Bay is regulated through NPDES permit WDRs issued by the RWQCB. CMSA's current NPDES permit limits for analytes that could increase with the addition of RO brine are shown below in **Table 4.7-4**. In addition, CMSA has dilution credits of 10:1 for its existing outfall.

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**Table 4.7-4**  
**CMSA's NPDES Permit Limits**

| Analyte            | Average Monthly Limit             | Maximum Daily Limit               |
|--------------------|-----------------------------------|-----------------------------------|
| Copper             | 13 µg/l                           | 22 µg/l                           |
| Mercury            | 0.021 µg/l                        | 0.040 µg/l                        |
| <u>Cyanide*</u>    | <u>3.3 µg/l</u>                   | <u>6.4 µg/l</u>                   |
| <u>Dioxin-TEQ</u>  | <u>1.4 x 10<sup>-8</sup> µg/l</u> | <u>2.8 x 10<sup>-8</sup> µg/l</u> |
| Un-ionized Ammonia | 0.025 mg/l as N                   | 0.16 mg/l as N                    |

µg/l = microgram(s) per liter, mg/l = milligram(s) per liter, NPDES = National Pollutant Discharge Elimination System

\*The permit limits for cyanide will likely change in response to a Basin Plan amendment adopting a site-specific objective (SSO) for cyanide. Upon the effective date of the SSO, the average monthly limit becomes 21 µg/l and the maximum daily limit becomes 41 µg/l.

### 4.7.2 Impacts and Mitigation Measures

#### 4.7.2.1 Standards of Significance

The following standards of significance are based on Appendix G of the CEQA Guidelines. For the purposes of this EIR, hydrology and water quality impacts are considered significant if implementation of the proposed project would:

- Violate any water quality standards or WDRs;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on site or off site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on-site or off-site;
- Create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff;
- Otherwise substantially degrade water quality;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;

*The proposed project does not involve the placement of housing. Therefore, the proposed project would not place housing within a 100-year flood hazard area.*

- Place within a 100-year flood hazard area structures that would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury, or death involving flooding; or
- Inundation by seiche, tsunami, or mudflow.

#### 4.7.2.2 Analytical Methods

Water quality and dilution of the CMSA effluent/RO brine mixture were modeled to facilitate in the analysis of potential impacts to San Rafael Bay. A brief discussion of these modeling efforts and the results follow. For a more technical discussion see **Appendix F**.

#### **Water Quality Results**

The San Francisco Estuary Institute regularly monitors a multitude of constituents in water at stations throughout the San Francisco Bay as part of the RMP. The closest station to the proposed project site is Red Rock. Average, minimum, and maximum concentrations for the 1994–2001 period were calculated primarily from the RMP data and supplemental data collected by URS (URS 2007), and these These data were used to estimate the concentrations in the brine that would be discharged from the desalination plant. The desalination plant would take in Bay water, remove all suspended solids, and generate a brine that concentrates all the dissolved constituents into half the volume of water.

Two brine disposal methods were evaluated: the brine could be mixed with CMSA effluent and discharged to the Bay through the CMSA outfall, or the brine could be directly discharged into the Bay. RO brine concentrations were compared to water quality criteria, and mass loadings to the Bay were calculated.

Theoretically, the RO brine would concentrate all the dissolved constituents into half the water volume resulting in brine that has twice the dissolved concentration of the Bay water pumped into the plant. ~~This approach assumes that the RO plant is operating at 100 percent capacity and is therefore a conservative assumption. Actual RO brine concentrations are likely to be less than those calculated.~~

Estimated brine concentrations were compared to the lowest of the applicable California Toxics Rule Criteria and the Basin Plan WQOs. Brine concentrations are also compared to the EPA National Recommended Ambient Water Quality Criteria when no California Toxics Rule criteria or Basin Plan WQOs exist.

As the preferred disposal method, the RO brine and CMSA effluent mixture was evaluated with respect to CMSA permit limits and the WQOs and effluent limits for a variety of constituents.

**CMSA/Brine Mixture.** The CMSA wastewater treatment plant generates dry season daily average flows of 2 MGD of effluent and wet season daily average flows of 40 MGD. The RO plant would generate between 2 and 15 MGD of brine if the plant was expanded to 15 MGD capacity and was running at full capacity, and between 1 and 5 MGD of brine ~~during initial operation~~ for operation of the 5 MGD facility (see Section 3.4.4.1). Predicted concentrations were estimated for a range of effluent/brine mixtures that are expected to occur during facility operation. The ratios ranged from a low-brine mixture of 40 parts CMSA effluent to 5 parts brine (which would occur during the wet season months ~~of the first 10 years of operation~~ for the 5 MGD facility during dry and drought years) to the highest brine mixture of 2 parts CMSA effluent to 15 parts brine (which would occur during the dry season during drought years ~~after 10 years of plant operation~~ if the facility was expanded to 15 MGD and running at full capacity). Water quality of CMSA/brine mixtures that contained less than 5 parts brine would fall between the CMSA effluent alone and CMSA/brine 5 parts mixtures.

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Estimated CMSA effluent/brine mixture concentrations were compared to CMSA's permit limits (RWQCB Order No. R2-2007-0007) (**Table 4.7-5**). The estimated concentrations are below the permit limits by an order of magnitude for all permitted constituents except cyanide and ammonia. The CMSA effluent/brine mixture concentrations were also compared to ~~the WQOs water quality criteria and Basin Plan WQOs~~, and similarly, cyanide and ammonia ~~was~~ were the only constituents with an estimated CMSA/RO brine concentration greater than its ~~WQO (water quality criterion for the protection of aquatic life)~~ their respective minimum criterion. However, the high concentrations ~~is~~ are not attributable to the brine because the brine is well below the permit limits and WQO minimum criteria for cyanide and ammonia. Also, the bulk of ~~the ammonia~~ both constituents is contributed by the CMSA effluent at concentrations greater than the permit limits and minimum criteria. The average ammonia concentration in the CMSA effluent is over 200 times greater than that in the RO brine. The CMSA must comply with tasks outlined in its NPDES permit to reduce cyanide, such as implementing source control measures identified in its Infeasibility Report and Basin Plan requirements associated with the cyanide site-specific objective (SSO). The CMSA permit also requires chronic toxicity monitoring for ammonia. If it is demonstrated in initial screening tests that ammonia is the cause of chronic toxicity, ~~the discharger~~ CMSA must demonstrate that the ammonia is not expected to cause toxicity to the receiving waters. This is done by calculating the un-ionized fraction of ammonia from total ammonia concentrations and comparing the un-ionized ammonia to Basin Plan objectives.

The RMP monitors for several constituents that CMSA does not. In order to evaluate the potential impact of RO brine disposal on water quality, particularly for these constituents, a conservative approach was taken and the disposal of RO brine directly to the Bay was also considered. The constituents with estimated RO brine concentrations higher than their WQOs are heptachlor epoxide (maximum concentration), dieldrin (maximum concentration), and total PCBs (maximum and average concentrations). It should be noted that if these constituents occur in the CMSA effluent at lower concentrations than the brine, in-pipe dilution would decrease the concentrations to the environment. For example, if the CMSA effluent contains no heptachlor epoxide PCBs, then the concentrations of the combined discharge would be 12 to 20 percent less depending on the CMSA flow rate. However, the CMSA permit does not allow dilution credits for certain bioaccumulative constituents that have been placed on the Clean Water Act Section 303(d) list. These constituents include PCBs. Despite this limitation, the proposed project would result in a net removal of PCBs regardless of the discharge level of PCBs in the brine. Removal of constituents from the Bay is described below.

Pretreatment of the Bay water would remove the suspended solids and dispose of the resulting sludge in a landfill and therefore reduce the mass of contaminants in the Bay. Substantial quantities of metals would be removed from the Bay on an annual basis through the operation of the RO plant. It is estimated that 4.3 kilograms (kg) of arsenic, 62 kg of chromium, 25 kg of copper, 44 kg of nickel, 10 kg of lead, and 70 kg of zinc would be removed every year the plant is fully operational. In addition, nearly 300 grams of polycyclic aromatic hydrocarbons, 8 grams of PCBs, and smaller quantities of other organics would also be removed from the Bay every year.

**Table 4.7-5  
Estimated CMSA Effluent/Brine Mixture Concentrations**

| Constituent    | Units | CMSA Effluent Concentrations |        |       | Estimated RO Brine Concentrations |                     |                             | 2 Parts CMSA Effluent to 5 Parts RO Brine |      |      | 40 Parts CMSA Effluent to 5 Parts RO Brine |       |       | 2 Parts CMSA Effluent to 10 Parts RO Brine |       |       | 40 Parts CMSA Effluent to 10 Parts RO Brine |       |       | 2 Parts CMSA Effluent to 15 Parts RO Brine |       |       | 40 Parts CMSA Effluent to 15 Parts RO Brine |        |        | CMSA Permit Limit  |                   |        |                   |
|----------------|-------|------------------------------|--------|-------|-----------------------------------|---------------------|-----------------------------|---|------|------|--|-------|-------|--|-------|-------|---|-------|-------|--|-------|-------|---|--------|--------|--------------------|-------------------|--------|-------------------|
|                |       | Avg                          | Min    | Max   | Avg                               | Min                 | Max                         | Avg                                       | Min  | Max  | Avg  | Min   | Max   | Avg  | Min   | Max   | Avg   | Min   | Max   | Avg  | Min   | Max   | Avg   | Min    | Max    | Avg                | Min               | Max    | Avg Monthly Limit |
| Silver         | µg/l  | 0.543                        | 0.2    | 1.2   | 0.0052                            | 0.002               | 0.01                        | 0.16                                      | 0.06 | 0.35 | 0.483                                      | 0.178 | 1.068 | 0.095                                      | 0.035 | 0.208 | 0.435                                       | 0.160 | 0.962 | 0.068                                      | 0.025 | 0.150 | 0.4   | 0.15   | 0.88   |                    |                   |        |                   |
| Arsenic        | µg/l  | 1.7                          | 0.4    | 3.4   | 3.327                             | 2.28                | 5.42                        | 2.9                                       | 1.7  | 4.8  | 1.9  | 0.6   | 3.7   | 3.1  | 2.0   | 5.1   | 2.0   | 0.8   | 3.8   | 3.1  | 2.1   | 5.2   | 2.1   | 0.9    | 4      |                    |                   |        |                   |
| Cadmium        | µg/l  | 0.084                        | 0.03   | 0.1   | 0.121                             | 0.02                | 0.257                       | 0.11                                      | 0.02 | 0.21 | 0.09                                       | 0.03  | 0.12  | 0.11                                       | 0.02  | 0.23  | 0.09  | 0.03  | 0.13  | 0.12                                       | 0.02  | 0.24  | 0.1   | 0.03   | 0.14   |                    |                   |        |                   |
| Chromium       | µg/l  | 0.695                        | 0.4    | 1.4   | 0.39                              | 0.22                | 0.96                        | 0.48                                      | 0.27 | 1.09 | 0.67                                       | 0.38  | 1.36  | 0.44                                       | 0.25  | 1.03  | 0.63  | 0.36  | 1.31  | 0.43                                       | 0.24  | 1.012 | 0.6   | 0.4    | 1.3    |                    |                   |        |                   |
| Copper         | µg/l  | 2.57                         | 1.4    | 3.7   | 2.278                             | 1.16                | 4.28                        | 2.4                                       | 1.2  | 4.1  | 2.6  | 1.4   | 3.8   | 2.3  | 1.2   | 4.2   | 2.5   | 1.4   | 3.8   | 2.3  | 1.2   | 4.212 | 2.5   | 1.3    | 3.9    | 13                 | 22                |        |                   |
| Mercury        | µg/l  | 0.00612                      | 0.0034 | 0.016 | 0.002                             | 0.00032             | 0.0036                      | 0.00                                      | 0.00 | 0.01 | 0.006                                      | 0.003 | 0.015 | 0.002                                      | 0.001 | 0.006 | 0.005                                       | 0.003 | 0.014 | 0.0022                                     | 0.001 | 0.005 | 0.0049                                      | 0.0026 | 0.0126 | 0.021              | 0.04              |        |                   |
| Nickel         | µg/l  | 4                            | 3      | 5     | 2.488                             | 1.44                | 4.44                        | 2.9                                       | 1.9  | 4.6  | 3.9  | 2.8   | 5.0   | 2.7  | 1.7   | 4.5   | 3.7   | 2.7   | 4.9   | 2.7  | 1.624 | 4.506 | 3.6   | 2.6    | 4.8    |                    |                   |        |                   |
| Lead           | µg/l  | 0.308                        | 0.12   | 0.9   | 0.033                             | 0.008               | 0.152                       | 0.11                                      | 0.04 | 0.37 | 0.278                                      | 0.108 | 0.819 | 0.079                                      | 0.027 | 0.277 | 0.253                                       | 0.098 | 0.750 | 0.065                                      | 0.021 | 0.240 | 0.2   | 0.1    | 0.7    |                    |                   |        |                   |
| Selenium       | µg/l  | 1.16                         | 0.5    | 6.4   | 0.31                              | 0.16                | 0.88                        | 0.55                                      | 0.26 | 2.5  | 1.07                                       | 0.46  | 5.80  | 0.45                                       | 0.22  | 1.80  | 0.99  | 0.43  | 5.30  | 0.41                                       | 0.200 | 1.529 | 0.9   | 0.4    | 4.9    |                    |                   |        |                   |
| Zinc           | µg/l  | 34.5                         | 20     | 59    | 1.052                             | 0.2                 | 2.2                         | 11  | 5.9  | 18   | 30.8                                       | 17.8  | 52.7  | 6.6  | 3.5   | 11.7  | 27.8  | 16.0  | 47.6  | 5  | 2.529 | 8.882 | 25.4  | 14.6   | 43.5   |                    |                   |        |                   |
| Cyanide        | µg/l  | 4.2                          | 0.6    | 12    | <2.0                              | <2.0                | <2.0                        | <2.6                                      | <1.6 | <4.9 | <4.0                                       | <0.8  | <11   | <2.4                                       | <1.8  | <3.7  | <3.8  | <0.9  | <10   | <2.3                                       | <1.8  | <3.2  | <3.6  | <1.0   | <9.3   | 3.3 <sup>1</sup>   | 6.4 <sup>1</sup>  |        |                   |
| Dioxin-TEQ     | µg/l  | NA                           | NA     | NA    | <del>4.7E-8</del><br>5.0E-10      | <del>4.2E-100</del> | <del>3.4E-7</del><br>1.8E-9 | NA  | NA   | NA   | NA   | NA    | NA    | NA   | NA    | NA    | NA  | NA    | NA    | NA   | NA    | NA    | NA  | NA     | NA     | NA                 | NA                | 1.4E-8 | 2.8E-8            |
| Ammonia (as N) | mg/l  | 30.2                         | 13.9   | 45    | 0.15                              | 0.02                | 0.3                         | 8.7                                       | 4.0  | 13   | 26.9                                       | 12.4  | 40.0  | 5.2  | 2.3   | 7.8   | 24.2  | 11.1  | 36.1  | 3.7  | 1.7   | 5.6   | 22.0  | 10.1   | 32.8   | 0.79* <sup>2</sup> | 5.0* <sup>2</sup> |        |                   |

CMSA = Central Marin Sanitation Agency, µg/l = microgram(s) per liter, mg/l = milligram(s) per liter, NA = not available, RO = reverse osmosis

<sup>1</sup> The permit limits for cyanide will likely change in response to a Basin Plan amendment adopting SSOs for cyanide. Upon the effective date of the SSOs, the average monthly limit becomes 21 µg/L and the maximum daily limit becomes 41 µg/L.

<sup>2</sup>\* Actual CMSA permit limits for ammonia are consistent with Basin Plan water quality objectives and are in terms of un-ionized ammonia nitrogen: an annual median of 0.025 mg/l as N and a maximum of 0.16 mg/l as N. Conversion to total ammonia nitrogen is pH- and temperature-dependent. A pH of 8 and a temperature of 20°C were assumed to convert the un-ionized ammonia nitrogen limits to the total ammonia nitrogen values shown. First, both un-ionized ammonia “as N” limits were converted to total un-ionized ammonia concentrations. Each un-ionized ammonia limit was divided by the ratio of nitrogen (molecular weight = 14 g/mol) to ammonia (molecular weight = 17 g/mol), or 0.8235. Thus, the permitted annual median limit of 0.025 mg/L un-ionized ammonia as N became 0.025 / 0.8235 = 0.030 mg/L un-ionized ammonia. Likewise, the permitted maximum limit of 0.16 mg/L un-ionized ammonia as N became 0.16 / 0.8235 = 0.19 mg/L un-ionized ammonia. Next, the pH- and temperature-dependent conversion factor was determined from a conversion table (<http://www.awqa.org/pubs/waterqual/calcnh3.pdf>). Using the previous assumptions for pH and temperature, the resulting conversion factor was 0.0381. Finally, the un-ionized ammonia concentrations were divided by the conversion factor to determine the permit limits in terms of total ammonia nitrogen. The annual median limit, or equivalent average monthly limit, was calculated as 0.030 / 0.0381 = 0.79 mg/L total ammonia nitrogen. The maximum limit, or equivalent maximum daily limit, was calculated as 0.19 / 0.0381 = 5.0 mg/L total ammonia nitrogen.

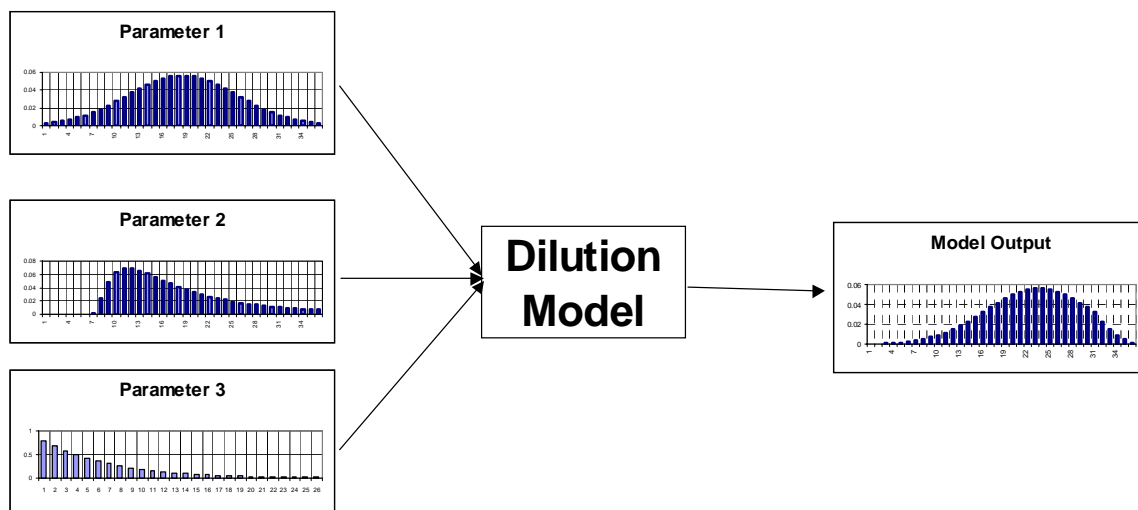


### **Dilution Modeling Results**

**CMSA Outfall Modeling.** The dilution of the combined MMWD-CMSA discharge was modeled using EPA’s Visual Plumes mixing zone model. Visual Plumes is a Windows-based mixing zone modeling platform that simulates both single and multiple port discharges. Model predictions include dilution, plume diameter, plume elevation, and other plume variables.

There is a large variability in the range of ambient and effluent conditions that could occur for the combined CMSA-MMWD discharge, and not enough synoptic data (“time-series” data collected at the same time) are available for all parameters for a period of time sufficient to cover the range of potential conditions that could occur. ~~In other words, insufficient data are available to perform hourly dilution modeling for a whole year.~~ For this reason, a statistical approach using the Monte Carlo method was chosen as the modeling approach~~preferred methodology~~.

The Monte Carlo method uses statistical descriptions of the model input parameters that affect dilution instead of selecting discrete model scenarios~~measurements~~. This statistical description consists of defining ~~is performed through~~ probability density functions for each parameter. The actual input to the model is randomly generated from the probability density functions. The model output is a statistical description of the discharge’s dilution, the dilution probability density function. **Figure 4.7-1** is a schematic of the Monte Carlo method.



**Figure 4.7-1 Schematic of the Monte Carlo Method**

~~Depending upon the~~One year of detailed ambient data (tides, currents and salinity) and three years of effluent data (flow) were available. ~~The one year of ambient data was repeated to generate three years of ambient data. From this data~~ For each desalination plant case, a total of between 5,000 and 10,000 ~~4,280~~ synoptic datasets were generated for each desalination plant case. ~~different scenarios were run with Visual Plumes.~~ Results presented in this section consider the average dilution that is achieved in the near-field, defined where the plume hits the bottom of the Bay floor or reaches the surface of the water. The plume would continue to dilute from ambient turbulence beyond this point, i.e., in the far-field. The CMSA “fresh” wastewater and the MMWD desalination plant brine are assumed to mix in the diffuser pipe, and the model results presented below are for the combined final discharge.

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**Table 4.7-6** shows the statistics for the dilution at the edge of the mixing zone for the case of a 15 MGD, 10 MGD, ~~and 5 MGD,~~ and 0 MGD discharge of brine into the CMSA outfall. The edge of the mixing zone is defined as the location where the plume reaches the surface or hits the bottom of the Bay.

**Table 4.7-6**  
**Statistics for Dilution at Edge of Mixing Zone**

| Parameter | Average Dilution<br>(15 MGD plant) | Average Dilution<br>(10 MGD plant) | Average Dilution<br>(5 MGD plant) |
|-----------|------------------------------------|------------------------------------|-----------------------------------|
| Mean      | 191                                | 468                                | 975                               |
| Median    | 200                                | 355                                | 908                               |
| Minimum   | 8.7                                | 5.5                                | 19                                |
| Maximum   | 721                                | 9593                               | 7490                              |

| RO Flow Rate<br>MGD | Mean<br>Dilution | Median<br>Dilution | Minimum<br>Dilution | Maximum<br>Dilution | Standard<br>Deviation of<br>Dilution |
|---------------------|------------------|--------------------|---------------------|---------------------|--------------------------------------|
| 0                   | 716              | 622                | 21                  | 4279                | 541                                  |
| 5                   | 484              | 466                | 16                  | 2894                | 306                                  |
| 10                  | 344              | 331                | 9                   | 3709                | 221                                  |
| 15                  | 211              | 212                | 6                   | 3586                | 145                                  |

MGD = million gallons per day

The discharge plume sinks and hit the bottom when ~~its salinity is higher than that of the surrounding Bay water. This occurs when~~ the brine flow is larger than CMSA's fresh water flow, since the brine is considered to be twice as saline as the intake Bay water. The discharge plume was found to hit the bottom about ~~80-74~~ 80-74 percent of the time for the 15 MGD discharge, ~~65-27~~ 65-27 percent of the time for the 10 MGD discharge, ~~and less than 20-6~~ and less than 20-6 percent of the time for the 5 MGD discharge, and rose to the surface the rest of the time (which occurs when the brine flow is less than the CMSA discharge).

The SIP (CEPA 2005) requires that NPDES dischargers complete an independent mixing zone study and demonstrate that a dilution credit is appropriate during the NPDES application process. In the current modeling study, there were ~~nine~~ four scenarios out of the approximately ~~13,000~~ 12,840 (3 multiplied by 4,280 runs) scenarios modeled, or 0.031 percent, that showed initial dilution less than 10:1 ~~at the edge of the near-field. When the plume either surfaced or hit the bottom.~~ Of these cases, the 15 MGD brine discharge had ~~one~~ three scenarios with low dilution less than 10:1 (0.070 percent) and the 10 MGD discharge had ~~8-1~~ 1 scenario (0.023 percent)s. The 5 MGD and 0 MGD discharges did not have any cases show any scenario with low initial near-field dilution less than 10:1. It is possible that there could be an additional, but small, number of cases where the initial dilution is less than 10:1 if the temperatures of the combined effluent and the ambient water are different and the salinities are similar. The 5 MGD brine discharge had no low dilution values less than 10:1 because the discharge remains positively buoyant for most discharges, whereas for larger brine flows the discharge is often negatively buoyant. The smallest dilutions would occur when ambient current speeds are low, total effluent flow rates (brine plus CMSA discharge) are low, and the effluent is slightly negatively buoyant (i.e., the effluent has a density similar

but greater than the ambient water). This situation occurs when the CMSA discharge is about equal to the brine discharge. In this case the brine is diluted back to Bay salinity by the CMSA discharge. Therefore, a small dilution value does not necessarily mean that high salinity occurs at the edge of the mixing zone as a result of the discharge. In addition, the low dilution values (on the order of 10 or less) are limited to an area very near the diffuser, generally within 2 meters and usually within 1 meter. Dilutions would increase quickly farther away from the diffuser. In general, most mixing zones require that initial dilution always exceed a value of 10:1; however, the physical boundaries where that limit needs to be met is often negotiated after consideration of various site-specific factors. The initial dilution limit of 10:1 would be met within an area of several meters around the diffuser (less than 2 to 3 meters). Therefore, there is no significant impact. Additionally, the above dilution numbers do not account for dilution that takes place within the pipe. For example, if the brine discharge is 10 MGD and the CMSA effluent flow rate is also 10 MGD, then the CMSA effluent is diluted by 2:1 in the pipe in addition to the dilution from the diffuser. Since dilutions are multiplicative, if the diffuser resulted in a dilution of 8:1 of the combined discharge, the total dilution of the CMSA effluent would be 16 (8:1 times 2:1) in the above example.

As proposed, the ~~first phase of the project~~ would construct a 5 MGD facility. If necessary, and subsequent phases could increase capacity to 15 MGD. ~~Although~~ If the ultimate desalination plant was expanded to 15 MGD it could produce 15 MGD of product water and 15 MGD of brine; however, the plant would operate under much lower flows under normal conditions. As stated in Section 3.4.1, based on current projections, the potential operation scenarios for the desalination plant would be as follows:

- Initial Operation
  - In normal rainfall years: 4 MGD from May through November; 1 MGD from December through April.
 

(Dilution results would be similar to the results for the 5 MGD case. The plume would be positively buoyant over 90 percent of the time for the 4 MGD case and over 99 percent of the time for the 1 MGD case).
  - In dry years and drought years: 5 MGD year-round.
- Estimated at approximately 10 years from initial operation, if necessary
  - In normal rainfall years: 8 MGD from May through November; 1 MGD from December through April.
 

~~(The CMSA flow rate is between about 7 and 12 MGD about 50 percent of the time. A brine discharge of 8 MGD would therefore be about equal to the CMSA flow frequently. This would result in an increased probability of having a dilution of the combined effluent of about 10 or less more often than for smaller or larger flows).~~
  - In dry years: 12 MGD from April through November; 8 MGD from December through March.

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~~(Increasing the brine flow rate decreases the probability that a low dilution on the order of 10 would occur.)~~

- In drought years: 15 MGD year-round.

(See above for dilution effects with 15 MGD.)

- Estimated at approximately 15 years from initial operation, if necessary

- In normal rainfall years: 12 MGD from May through November; 2 MGD from December through April.

(The average CMSA flow rate is about 14 MGD. A brine discharge of 14 MGD would therefore frequently be about equal to the CMSA flow. This would result in an increased probability of having a dilution of the combined effluent of about 10 or less more often than for smaller or larger flows.)

- In dry years: 15 MGD from April through November; 12 MGD from December through March.

(Increasing the brine flow rate above 14 MGD decreases the probability that a low dilution on the order of 10 would occur.)

- In drought years: 15 MGD year-round.

(See above for dilution results.)

**RO Plant Intake Modeling.** The amount that the combined MMWD-CMSA discharge from the outfall would be diluted by the time it reached the MMWD intake pipe at the end of the Marin Rod & Gun Club pier was modeled using MIKE 21. MIKE 21 is a two-dimensional, free-surface flow modeling system developed by DHI Water & Environment. It is used to simulate hydraulics and hydraulics-related phenomena in estuaries, coastal waters, and seas. It consists of a hydrodynamic module to which other modules can be added to address different phenomena.

Inputs to the model include bathymetry, bed resistance, wind velocities, hydrographic boundary conditions (e.g., tides and inflows), and dispersion coefficients. The bathymetry covered the entire San Francisco Bay. NOAA tide station data at Point Reyes were used at the boundary west of the Golden Gate. Data from the CDWR DAYFLOW program were used to specify the Delta outflow at the eastern boundary. Other freshwater sources included daily averaged flows for Napa River, Petaluma River, Alameda Creek, Coyote Creek, and Guadalupe River from USGS gaging stations. South Bay wastewater treatment plant flows were also included. The MMWD-CMSA discharge was input as a constant inflow to the model of 23 MGD. The MMWD intake was input as a constant outflow from the model of 30 MGD.

The simulation period was May through August 1993. At the end of the simulation period, the 14-day running average of hourly concentrations at the MMWD intake showed that the MMWD-CMSA discharge would be diluted by a factor of approximately 1,250 by the time it reached the intake pipe. This means that 1 part of every 1,250 parts discharged by the treatment plant would reach the intake.

### Toxicity Testing Results

Toxicity tests were performed on brine/CMSA effluent blends that were collected during pilot plant operations to assess the potential for toxic effects due to brine disposal. Two brine/CMSA

effluent blends were chosen that approximate average and high brine proportions relative to the CMSA effluent: 4:11 (27 percent brine) and 15:4 (79 percent brine), respectively.

### ***Acute Toxicity***

An invertebrate (mysid shrimp; *Mysidopsis bahia*), a vertebrate (topsmelt; *Atherinops affinis*), and a marine alga (*Thalassiosira pseudonana*) were exposed to both average and high brine blends during three acute episodes. Each test was performed as a screening tool using whole effluent, without dilution. Two to four replicates were used for each test as specified in the appropriate protocol.

All tests were run with both controls and reference toxicants. All controls had acceptable survival or growth rates, while the reference toxicant LC<sub>50</sub> was slightly below control limits for the second episode of *Thalassiosira* testing. However, no adverse effects were detected in the associated tests, therefore this discrepancy is deemed of no consequence.

The results are summarized in the **Table 4.7-7**.

In summary, no significant effects on survival or growth were observed among the acute toxicity tests conducted during any of the three episodes, with any of the selected species.

### ***Chronic Toxicity***

Chronic toxicity testing was performed in two phases. In the first phase, five species (marine algae, *Thalassiosira pseudonana*; giant kelp, *Macrocystis pyrifera*; Bay mussel, *Mytilus edulis*; mysid shrimp, *Mysidopsis bahia*; and inland silverside, *Menidia beryllina*) were exposed to both average and high brine blends in a dilution series (5, 10, 25, 50, 75, and 100 percent solutions). Effluent blends were tested in both a salinity-adjusted state and an unadjusted state. The three most sensitive species were chosen for the second phase. Four to eight replicates were used for each test as specified in the appropriate protocol.

All tests were run with both controls and reference toxicants. All controls had acceptable survival or growth rates, and reference toxicant responses. All test acceptability criteria were met for both Phases I and II.

Phase I results are summarized in **Table 4.7-8**.

**Table 4.7-7  
Acute Toxicity Results Summary**

| Species   | Test Episode | Sample           | Mean Survival (%)                       |
|---|--------------|------------------|---|
| Mysid shrimp<br><i>(Mysidopsis bahia)</i>         | Episode 1    | Lab Control      | 95                                      |
|   |              | Salinity Control | 100                                     |
|   |              | Average Blend    | 95                                      |
|   |              | High Blend       | 100                                     |
|   | Episode 2    | Lab Control      | 100                                     |
|   |              | Salinity Control | 100                                     |
|   |              | Average Blend    | 95                                      |
|   |              | High Blend       | 100                                     |
|   | Episode 3    | Lab Control      | 100                                     |
|   |              | Salinity Control | 100                                     |
|   |              | Average Blend    | 95                                      |
|   |              | High Blend       | 95                                      |
| Species   | Test Episode | Sample           | Mean Survival (%)                       |
| Topsmelt<br><i>(Atherinops affinis)</i>           | Episode 1    | Lab Control      | 90                                      |
|   |              | Salinity Control | 75                                      |
|   |              | Average Blend    | 65                                      |
|   |              | High Blend       | 95                                      |
|   | Episode 2    | Lab Control      | 100                                     |
|   |              | Salinity Control | 100                                     |
|   |              | Average Blend    | 95                                      |
|   |              | High Blend       | 100                                     |
|   | Episode 3    | Lab Control      | 95                                      |
|   |              | Salinity Control | 100                                     |
|   |              | Average Blend    | 85                                      |
|   |              | High Blend       | 100                                     |
| Species   | Test Episode | Sample           | Cell Density (10 <sup>5</sup> cells/ml) |
| Marine algae<br><i>(Thalassiosira pseudonana)</i> | Episode 1    | Lab Control      | 1.47                                    |
|   |              | Salinity Control | 1.02                                    |
|   |              | Average Blend    | 2.64                                    |
|   |              | High Blend       | 1.82                                    |
|   | Episode 2    | Lab Control      | 1.20                                    |
|   |              | Salinity Control | 0.93                                    |
|   |              | Average Blend    | 1.52                                    |
|   |              | High Blend       | 2.40                                    |
|   | Episode 3    | Lab Control      | 4.59                                    |
|   |              | Salinity Control | 6.40                                    |
|   |              | Average Blend    | 8.42                                    |
|   |              | High Blend       | 13.6                                    |

Average Blend treatment results statistically compared to Lab Control results ( $\alpha = 0.05$ ). High Blend treatment results statistically compared to Salinity Control results ( $\alpha = 0.05$ ).

**Table 4.7-8**  
**Phase I Chronic Toxicity Results Summary**

(all concentrations given as % whole solution)

| Species   |              | Average Blend       |      | Unadjusted Average Blend |      | High Blend          |      | Unadjusted High Blend |      |
|---|--------------|---------------------|------|--------------------------|------|---------------------|------|-----------------------|------|
|   |              | LC/IC <sub>50</sub> | NOEC | LC/IC <sub>50</sub>      | NOEC | LC/IC <sub>50</sub> | NOEC | LC/IC <sub>50</sub>   | NOEC |
| Mysid shrimp<br>( <i>Mysidopsis bahia</i> )         | Survival     | >100                | 100  | NA                       | 100  | >100                | 100  | >100                  | 100  |
|   | Growth       | >100                | 100  | NA                       | 100  | >100                | 100  | >100                  | 75   |
| Inland silverside<br>( <i>Menidia beryllina</i> )   | Survival     | >100                | 100  | NA                       | 100  | >100                | 100  | 68.8                  | 10   |
|   | Growth       | >100                | 100  | NA                       | 100  | >100                | 100  | 87.3                  | 25   |
| Marine algae<br>( <i>Thalassiosira pseudonana</i> ) | Cell density | >100                | 100  | NA                       | 100  | >100                | 100  | >100                  | 100  |
| Bay mussel<br>( <i>Mytilus edulis</i> )             | Normal       | 61.3                | 25   | NA                       | NT   | >100                | 100  | >100                  | 100  |
|   | Survival     | >100                | 100  | NA                       | NT   | >100                | 100  | >100                  | 100  |
| Giant kelp<br>( <i>Macrocystis pyrifera</i> )       | Germination  | >100                | 100  | NA                       | NT   | >100                | 100  | >100                  | 75   |
|   | Growth       | >100                | 5    | NA                       | NT   | >100                | 50   | >100                  | 50   |

LC/IC<sub>50</sub> = lethal concentration/inhibition concentration, NA = not applicable, NOEC = no-observed-effect concentration, NT = not tested

Significant effects were observed for the following tests:

- *M. bahia* growth in the unadjusted high blend
- *M. beryllina* survival and growth in the unadjusted high blend
- *M. edulis* development in the average blend
- *M. pyrifera* germination in the unadjusted high blend and growth in the average, high, and unadjusted high blends

Phase II tests were intended to provide confirmation of Phase I observations. Phase II results are summarized in **Table 4.7-9**. Phase I results for the Phase II test species are included for comparative purposes.

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**Table 4.7-9  
Phase II Chronic Toxicity Results Summary**

(all concentrations given as % whole solution)

| Bioassay Phase and Test Dates               | Bioassay Endpoint  | Giant Kelp<br>( <i>Macrocystis pyrifera</i> )<br>Sporophyte Germination /<br>Gametophyte Growth <sup>(c)</sup> |                    |                   | Bay Mussel<br>( <i>Mytilus edulis</i> ) Laval<br>Development |                    |                   | Inland Silverside<br>( <i>Menidia beryllina</i> )<br>Survival / Growth <sup>(c)</sup> |            |                   |                    |
|---|--|--|--------------------|-------------------|--|--------------------|-------------------|---|------------|-------------------|--------------------|
|   |  | Avg. Blend   | High Blend         | Unadj. High Blend | Avg. Blend   | High Blend         | Unadj. High Blend | Avg. Blend  | High Blend | Unadj. High Blend |                    |
| Phase I<br>(20-28 Feb 2006)                 | NOEC   | Germination/<br>Survival   | 100                | 100               | 75   | 100                | 100               | 100   | 100        | 100               | 10                 |
|   |  | Growth/<br>Development   | 5                  | 50                | 50   | 25                 | 100               | 100   | 100        | 100               | 25                 |
|   | LC <sub>25</sub> or<br>EC <sub>25</sub> or<br>IC <sub>25</sub> | Germination/<br>Survival   | >100               | >100              | >100   | >100               | >100              | >100  | >100       | >100              | 17.5               |
|   |  | Growth/<br>Development   | 73                 | >100              | 96.4   | 56.7               | >100              | >100  | >100       | >100              | 23.2               |
|   | TUc<br>(100 /<br>NOEC)   | Germination/<br>Survival   | 1.0                | 1.0               | 1.3  | 1.0                | 1.0               | 1.0   | 1.0        | 1.0               | 5.7 <sup>(b)</sup> |
|   |  | Growth/<br>Development   | 1.4 <sup>(a)</sup> | 2.0               | 1.04 <sup>(a)</sup>  | 1.8 <sup>(a)</sup> | 1.0               | 1.0   | 1.0        | 1.0               | 4.3 <sup>(a)</sup> |
| Phase II,<br>Episode 1<br>(21-28 Mar 2006)  | NOEC   | Germination/<br>Survival   | 100                | 100               | 100  | 100                | 100               | 100   | 100        | 100               | 25                 |
|   |  | Growth/<br>Development   | 25                 | 100               | 75   | <5                 | 25                | <5  | 100        | 100               | 75                 |
|   | LC <sub>25</sub> or<br>EC <sub>25</sub> or<br>IC <sub>25</sub> | Germination/<br>Survival   | >100               | >100              | >100   | >100               | >100              | >100  | >100       | >100              | 43.6               |
|   |  | Growth/<br>Development   | >100               | >100              | >100   | 20.9               | >100              | 49.4  | >100       | >100              | 40.2               |
|   | TUc<br>(100 /<br>NOEC)   | Germination/<br>Survival   | 1.0                | 1.0               | 1.0  | 1.0                | 1.0               | 1.0   | 1.0        | 1.0               | 2.3 <sup>(b)</sup> |
|   |  | Growth/<br>Development   | 4.0                | 1.0               | 1.3  | 4.8 <sup>(a)</sup> | 4.0               | 2.0 <sup>(a)</sup>  | 1.0        | 1.0               | 2.5 <sup>(a)</sup> |
| Phase II,<br>Episode 2<br>(5-14 April 2006) | NOEC   | Germination/<br>Survival   | 100                | 100               | 75   | 100                | 100               | 100   | 100        | 100               | 100                |
|   |  | Growth/<br>Development   | 25                 | 75                | 50   | 50                 | 100               | 50  | 50         | 100               | 100                |
|   | LC <sub>25</sub> or<br>EC <sub>25</sub> or<br>IC <sub>25</sub> | Germination/<br>Survival   | >100               | >100              | >100   | >100               | >100              | >100  | >100       | >100              | >100               |
|   |  | Growth/<br>Development   | 83.0               | >100              | 92.8   | 85.7               | >100              | >100  | >100       | >100              | >100               |
|   | TUc<br>(100 /<br>NOEC)   | Germination/<br>Survival   | 1.0                | 1.0               | 1.3  | 1.0                | 1.0               | 1.0   | 1.0        | 1.0               | 1.0                |
|   |  | Growth/<br>Development   | 1.2 <sup>(a)</sup> | 1.3               | 1.1 <sup>(a)</sup>   | 1.2 <sup>(a)</sup> | 1.0               | 2.0   | 2.0        | 1.0               | 1.0                |

NOEC – "No Observable Effect Concentration" is the highest concentration of toxicant (CMSA effluent or Brine/Effluent blend) to which organisms are exposed in a full life-cycle or partial life-cycle (short-term) test, that causes no observable adverse effects on the test organisms (i.e., the highest concentration of toxicant concentration of toxicant in which the values for the observed responses are not statistically significantly different from the controls).

EC<sub>25</sub> – "Effect Concentration 25%" is the concentration of toxicant having an effect on 25% of the population, compared to the control.

IC<sub>25</sub> – "Inhibition Concentration 25%" is a calculated percentage of toxicant at which the test organism exhibits a 25% reduction in a biological function such as reproduction or growth.

LC<sub>25</sub> – "Lethal Concentration 25%" is the concentration of toxicant at which 25% of the test population is killed.

TUc – Chronic toxicity unit. U.S. Environmental Protection Agency recommends using a TUc of 1.0 as the limit to indicate that no toxics are present in toxic amounts.

(a) TU value calculated as 100 / IC<sub>25</sub>.

(b) TU value calculated as 100 / EC<sub>25</sub>.

(c) Species are listed as identified by Weston Solutions. When a species within the same genus was used in a CMSA effluent bioassay, results are shown under the species in the same genus, even though the specific species may be different.

The following conclusions may be reached:

- Exposure to the average-brine whole effluent blend did not cause statistically significant mortality to any of the five species tested across all three episodes.
- The average-brine whole effluent blend did not elicit any statistically significant sublethal effects in two of the five species tested. The growth and development effects observed on giant kelp spore germ-tube growth in all three episodes; inland silverside growth during Phase II, episode 2; and Bay mussel embryo development during Phase I and Phase II, episode 2 are considered to be nominal because there were only minor variations from the control treatments. These observed effects are expected to be eliminated with minimal receiving-water dilution.
- The average brine whole effluent blend effect on bivalve development during Phase II, episode 1 was the most substantial effect observed throughout the entire study based on statistical significance and a low  $IC_{50}$ . A dilution of 5.7:1 will reduce toxicity to levels indistinguishable from the controls. Dilutions of 10:1 and greater are expected within 2 to 3 meters of the outfall. Therefore, the observed toxicity will be eliminated within the receiving water mixing zone, i.e., within 2 to 3 meters of the outfall.
- Exposure to the high-brine whole effluent blend did not cause statistically significant mortality to any of the five species tested across all three episodes.
- The high-brine whole effluent blend did not elicit any statistically significant sublethal effects in three of the five species tested. The growth and development effects observed on giant kelp spore germ-tube growth (Phase I and Phase II, episode 2) and Bay mussel embryo development (Phase II, episode 1) were less significant than those observed from the average-brine blend exposures. As such, they are also considered nominal under the same reasoning discussed previously for the average-brine blend results.
- As expected, exposure to the unadjusted high-brine whole effluent blend caused statistically significant but minor effects on mortality to all Phase II species tested, except the Bay mussel embryos. The only substantial effects (i.e.,  $LC_{50}$ - $LC_{25}$ , below 100 percent) were observed with inland silverside (Phase I and Phase II, Episode 1), an estuarine fish and likely the most susceptible to higher salinities of all five test species.
- The unadjusted high-brine whole effluent blend elicited statistically significant sublethal effects during at least one episode in all species tested, except the Marine Algae. As with the observed effects on mortality, the only substantial sublethal effects (i.e.,  $IC_{50}$  below 100 percent) were observed to the Inland Silverside (Phase I and Phase II, Episode 1).

None of the species tested have consistently high TUC values over the three testing episodes for any blend. This, in conjunction with the fact that there would be immediate dilution in the mixing zone of 10:1 or greater, indicates that the brine effluent would not have any significant toxic effect on local aquatic life.

## 4.7 HYDROLOGY AND WATER QUALITY

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### 4.7.2.3 *Project Impacts and Mitigation*

**Impact 4.7-1:** Construction activities associated with implementation of the proposed project would not contribute substantial loads of sediment or other pollutants in storm water runoff that could degrade receiving water quality.

**Significance:** Less than significant

**Mitigation:** No mitigation required

**Discussion:**

Development of the proposed desalination project would require construction activities such as site clearing and grading, trenching, and excavation, which could potentially cause temporary increases in erosion during storm events. Although the desalination plant site is relatively flat, the tanks would be located on hills and pipelines would traverse the hills, which would require earthwork on slopes. MMWD will comply with the NPDES statewide General Permit for Discharge of Storm Water Associated with Construction Activity by implementing control measures and BMPs required by project-specific Storm Water Pollution Prevention Plans to eliminate or reduce nonstorm and storm water discharges to receiving waters. Compliance with the statewide General NPDES permit would make this impact less than significant.

\* \* \*

**Impact 4.7-2:** Construction activities associated with implementation of the proposed project could temporarily disturb bottom sediments in the Bay, increasing turbidity.

**Significance:** Less than significant

**Mitigation:** No mitigation required

**Discussion:**

Reconstruction of the Marin Rod & Gun Club Pier would require driving 175 14-inch concrete piles in the Bay. Initial placement and subsequent driving of the piles could temporarily disturb bottom sediments and create a localized increase in turbidity. Total suspended sediment concentrations naturally range from 10 mg/l to around 1,000 mg/l. Turbidity caused by this project from pile removal, pile installation, and general construction activities is expected to be minor, local, and short-term.

\* \* \*

**Impact 4.7-3:** Development of the proposed project would increase the amount of impervious surface on the proposed project site and could alter drainage patterns, thereby increasing runoff and potentially increasing loads of pollutants in storm water, which could affect water quality.

**Significance:** Less than significant

**Mitigation:** No mitigation required

**Discussion:**

**Groundwater.** The Basin Plan does not identify a groundwater basin at the project site, which is located on fill immediately adjacent to the Bay. There are no significant groundwater resources within the project area. Therefore, construction of the proposed project would not adversely affect groundwater resources.

**Surface Water.** Construction of the desalination facility would increase the amount of impervious surface at the proposed project site, thereby increasing runoff and loads of pollutants in storm water. The estimated amount of impervious surface associated with the desalination plant is 88,600 square feet (approximately 2 acres). Runoff would be directed to the existing storm drain system in Pelican Way. Between the paved surface of the project site and the storm drain at Pelican Way, vegetative swales would be constructed to intercept the runoff and reduce its pollutant load prior to entering the storm drain. In addition, the following BMPs would be conducted as part of the proposed project:

- Absorbent materials would be used to clean up automotive fluids on the parking lot and would be disposed of properly.
- Litter would be controlled and dumpster lids would be kept closed.
- Storm drain inlets would be stenciled with “No dumping, Drains to Bay” message.

Because these storm water quality BMPs would be conducted as part of the proposed project, impacts to surface water quality from storm water runoff would be less than significant.

\* \* \*

**Impact 4.7-4:** Implementation of the proposed project could alter drainage patterns in the project area and increase impervious surfaces, which would not exceed the capacity of storm water drainage systems and result in localized flooding and contribution to off-site flooding.

**Significance:** Less than significant

**Mitigation:** No mitigation required

**Discussion:**

Currently the site is undeveloped and storm water either infiltrates the ground or flows off the site. The site is presently covered with hard-packed soil and gravel, and much of the storm water presently runs off the site to Pelican Way. Paving the site would slightly increase the amount of storm water runoff from the site. Drainage systems would be designed and sized to meet to current County standards. Storm water runoff would be directed to a grassy swale between the end of pavement and Pelican Way, which would allow for some infiltration. The net increase in storm water runoff to the storm drain system would not significantly increase.

\* \* \*

**Impact 4.7-5:** Discharge of brine through CMSA’s outfall into San Rafael Bay could affect the water quality of the Bay.

**Significance:** Less than significant

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**Mitigation:** No mitigation required

**Discussion:**

The CMSA NPDES permit requires that dilution always exceed a value of 10. Although ~~the combined-estimated~~ RO brine concentrations would be above WQOs for dieldrin, heptachlor epoxide, and total PCBs, San Rafael Bay water quality would not be significantly adversely affected. The ambient concentrations of these constituents in the Bay are already above ~~WQOs water quality criteria~~, and the desalination plant would not add to that amount. It is expected that the maximum concentrations of the constituents would be only slightly higher than ambient after initial dilution at the outfall diffuser. While the maximum concentrations of dieldrin ~~and~~ heptachlor epoxide, ~~and total PCBs~~, would be higher than ambient Bay water, the total mass of these constituents would be reduced through removal of the particulate fraction. In addition, the mixture of the saline RO brine with the fresh CMSA effluent would reduce the salinity differential between the ambient Bay water and the discharge at the diffuser.

Available water quality data show that the ammonia concentration in the CMSA effluent is already above the permit limit for ammonia and would remain so even if the effluent is mixed with RO brine. However, the concentration of ammonia in the brine is much lower than that in the CMSA effluent and well below the ~~WQO minimum criterion~~. Thus, the discharge of brine through CMSA's outfall would dilute the total concentration of ammonia discharged into the Bay lessening the existing effect of the CMSA effluent on Bay water quality.

There are also benefits to San Rafael Bay water quality from the proposed project. Pretreatment of the Bay water would remove the suspended solids and therefore reduce the mass of contaminants in the Bay. Substantial quantities of metals would be removed from the Bay on an annual basis through the operation of the RO plant. It is estimated that 4.3 kg of arsenic, 62 kg of chromium, 25 kg of copper, 44 kg of nickel, 10 kg of lead, and 70 kg of zinc would be removed every year the plant is fully operational. In addition, nearly 300 grams of polycyclic aromatic hydrocarbons, 8 grams of PCBs, and smaller quantities of other organics would also be removed from the Bay every year.

Acute toxicity was not observed in a battery of tests run on a range of brine/CMSA effluents. While some chronic toxicity was observed in testing, the toxicity observed was, in general, relatively slight and in all cases inconsistent among three rounds of testing with three species each. Chronic toxicity tests are designed to simulate long-term exposure to effluents. The most toxicity observed in the chronic toxicity tests would be reduced to levels indistinguishable from the controls with a maximum dilution of 5.7:1. Dilutions of 10:1 and higher are expected within 2 to 3 meters of the outfall. Therefore, toxicity in the brine/CMSA effluent blend would be eliminated in the mixing zone.

Operation of the MMWD desalination plant would withdraw saltwater from the Bay and return about half of that water to the Bay as brine. The volume of water in the Bay would be unaffected, however, since the ocean would replace the volume of water removed from the Bay during each flood tide. ~~Since the salinity of the ocean water that replaces the fresh water removed is greater, there would be a slight increase in the total salt in the Bay. On average the salt level in the Bay would increase above existing average background levels until the additional mass of salt leaving the Bay during each tide cycle equals the additional mass of salt that entered the Bay due to the removal of freshwater. The fraction change in salinity in the Bay on average is proportional to the change in total Bay outflow (i.e., tidal flow plus freshwater inflow).~~ The average tidal flow at

the Golden Gate is about 2,3000,000 cubic feet per second, the average freshwater inflow from the Delta is about 29,000 cubic feet per second, and the average net withdrawal rate by the proposed desalination plant would be about 23 cubic feet per second (i.e., for a 15 MGD capacity plant). This would result in an insignificant change in the average salinity in the Bay, far below a level that of about  $1 \times 10^{-5}$  (0.00001) percent, which is much smaller than can be measured.

The water quality impact to San Rafael Bay from brine disposal would be less than significant.

\* \* \*

**Impact 4.7-6:** Liquid wastes, sanitary wastes and process area washdown wastes would be discharged to the sanitary sewer system for treatment and ultimate disposal to the Bay, which would not exceed WDRs and degrade receiving water quality.

**Significance:** Less than significant

**Mitigation:** No mitigation required

**Discussion:**

Liquid wastes, sanitary wastes and process area washdown wastes would be discharged to the sanitary sewer system for treatment at the CMSA wastewater treatment plant prior to discharge to the Bay. This wastewater would be treated to comply with CMSA's existing permit limits and would not exceed any discharge limits designed to protect Bay water quality. This impact is less than significant.

\* \* \*

**Impact 4.7-7:** The proposed project would not expose people or structures to a significant risk of loss, injury, or death involving flooding.

**Significance:** No impact

**Mitigation:** No mitigation required

**Discussion:**

The project site is not within the 100-year floodplain as identified by the FEMA Flood Insurance Rate Maps for the San Rafael area (FEMA 1984). Global sea level rise during the last century is believed to have been between 0.3 and 0.6 foot. There are eight sea level gauges along the California coast that have at least 50 years of records. The rate of sea level rise measured by all but one of these gauges is fairly consistent with the worldwide trend. Therefore, it is reasonable to expect that changes in the global average sea level through this century will also be experienced by California's coast. The closest of the eight California gauges to Marin County is in San Francisco, located just inside the Golden Gate Bridge on the shore of the Presidio. A trend analysis predicts a sea level rise at this site of 0.7 foot over the next century (CDWR 2006). The Marin Countywide Plan states that the sea level is likely to rise 1.8 feet along the West Coast by the year 2100 (Marin County 2007a). The elevation of the desalination facility would be determined during final design and would take into account existing and predicted future flood hazards. The predicted rise in sea level is not expected to result in a flooding hazard to the desalination facility.

\* \* \*

## 4.7 HYDROLOGY AND WATER QUALITY

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**Impact 4.7-8:** Tsunami- and seiche-generated waves have the potential to inundate the shoreline and damage the desalination facilities.

**Significance:** Potentially significant.

**Mitigation 4.7-8:** The impacts of future tsunamis can be lessened or mitigated completely by the application of appropriate engineering design. Detailed hydrodynamic modeling may be necessary for coastal locations in order to determine the likely extent of potential inundation. The behavior of tsunami waves is dependent on local bathymetry. Optimal siting and design of shoreline facilities would lessen the impact of incoming waves. MMWD would design and construct the facility to minimize the risk of damage from a tsunami or seiche-generated wave.

**Residual Significance:** Less than significant

### **Discussion:**

Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation based on tsunami run-up decreases to 50 percent of its maximum at the Golden Gate by the time it passes the Bay Bridge to the south and the Richmond–San Rafael Bridge to the north. By the time the tsunami reaches the Carquinez Strait to the north or Alviso in the south, the run-up would only be approximately 10 percent of its maximum at the Golden Gate. This model was used to assess hazards related to tsunamis and seiche in San Francisco Bay.

Tsunami-generated waves have the potential to inundate low-lying coastal areas and cause extensive erosion and/or deposition of sediment. Poorly constructed facilities can also be damaged by both the incoming and outgoing waves. As stated above, by the time a tsunami enters the Bay, its impacts would be dramatically reduced compared to a tsunami on the open coast. Therefore, the impact of a tsunami to facilities along the Bay shoreline would be minimal, possibly involving a meter or so of potential inundation. Optimal siting and design of the desalination facility would reduce this potential impact to less than significant.

\* \* \*

**Impact 4.7-9:** Introduction of a new water supply source could affect the water quality of the domestic water supply.

**Significance:** Less than significant

**Mitigation:** No mitigation required

### **Discussion:**

Raw water from the Bay would be pretreated prior to going through the RO treatment system. Pretreatment may consist of conventional water treatment using filtration or may use membrane technology. In either, case pretreatment would remove essentially all solids and many dissolved substances from the Bay water prior to RO treatment. Product water quality from RO systems is of high quality and is expected to meet all California and federal drinking water quality MCLs. Testing of product water from the pilot desalination facility operated by MMWD from March 2005 to April 2006 showed product water could meet all primary and secondary MCLs that were evaluated. **Table 4.7-10** shows the predicted single-pass RO product water quality. These values

are based on the average of three manufacturers’ membrane performance models (verified during the testing from the pilot plant program) or from laboratory testing conducted during the pilot plant program (Kennedy/Jenks Consultants 2007). Concentrations shown as “less than” (<) are based on laboratory analysis conducted during the pilot plant testing program. Concentration ranges shown for some parameters are for average and drought conditions, which can influence the source water quality. Membrane and RO systems have also been show to be effective in removing pathogens (bacteria, *Giardia lamblia*, *Cryptosporidium*) from drinking water sources (EPA 2003a; Kennedy/Jenks Consultants 2007).

**Table 4.7-10  
Comparison of Predicted Product Water Quality with Selected Federal and State Drinking Water Maximum Contaminant Levels and Notification Levels**

| Constituent               | Units     | EPA MCL            |                       | Cal DHS MCL or NL |              |                    | Pilot Plant Single Pass RO Permeate |
|---------------------------|-----------|--------------------|-----------------------|-------------------|--------------|--------------------|-------------------------------------|
|                           |           | Primary            | Secondary             | Primary           | Secondary    | Notification Level |                                     |
| Aluminum                  | µg/l      |                    | 50 to 200             | 1,000             | 200          |                    | <2                                  |
| Arsenic                   | µg/l      | 10                 |                       | 50                |              |                    | <2                                  |
| Barium                    | µg/l      | 2,000              |                       | 1,000             |              |                    | <2                                  |
| Beryllium                 | µg/l      | 4                  |                       | 4                 |              |                    | <0.3                                |
| Boron                     | µg/l      |                    |                       |                   |              | 1,000              | 500 to 1,000 <sup>1</sup>           |
| Cadmium                   | µg/l      | 5                  |                       | 5                 |              |                    | <1                                  |
| Chloride                  | mg/l      |                    | 250                   |                   | 250 to 600   |                    | 56 to 100                           |
| Chromium                  | µg/l      | 100                |                       | 50                |              |                    | <2                                  |
| Copper                    | µg/l      | 1,300 <sup>2</sup> | 1,000                 | 1,300             | 1,000        |                    | <1                                  |
| Cyanide                   | µg/l      | 200                |                       | 150               |              |                    | <20                                 |
| Fluoride                  | µg/l      | 4,000              | 2,000                 | 2,000             |              |                    | <100                                |
| Iron                      | µg/l      |                    | 300                   |                   | 300          |                    | <20                                 |
| Lead                      | µg/l      | 15 <sup>2</sup>    |                       | 15                |              |                    | <1                                  |
| Manganese                 | µg/l      |                    | 50                    |                   | 50           | 500                | <2                                  |
| Mercury                   | µg/l      | 2                  |                       | 2                 |              |                    | <0.1                                |
| Nickel                    | µg/l      |                    |                       | 100               |              |                    | <1                                  |
| Nitrate                   | µg/l as N | 10,000             |                       | 10,000            |              |                    | <100                                |
| Polychlorinated Biphenyls | µg/l      | 0.5                |                       | 0.5               |              |                    | <0.08                               |
| pH                        | pH units  |                    | 6.5 to 8.5            |                   |              |                    | 7.9                                 |
| Selenium                  | µg/l      | 50                 |                       | 50                |              |                    | <2                                  |
| Silver                    | µg/l      |                    | 100                   |                   | 100          |                    | <2                                  |
| Sodium                    | mg/l      |                    | 30 to 60 <sup>3</sup> |                   |              |                    | 35-60                               |
| Sulfate                   | mg/l      |                    | 250                   |                   | 250 to 600   |                    | 0.7 to 1.11                         |
| Total Dissolved Solids    | mg/l      |                    | 500                   |                   | 500 to 1,500 |                    | 100 to 170                          |
| Vanadium                  | µg/l      |                    |                       |                   |              | 50                 | <2                                  |
| Zinc                      | µg/l      |                    | 5,000                 |                   | 5,000        |                    | <5                                  |

DHS = Department of Health and Safety, EPA = U.S.Environmental Protection Agency, µg/l = microgram(s) per liter, mg/l = milligram(s) per liter, MCL = maximum contaminant level, NL = notification level, RO = reverse osmosis

<sup>1</sup> Boron concentrations shown are worst case and would be 50-80 percent lower using pH adjustment.

<sup>2</sup> Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.

<sup>3</sup> EPA Drinking Water Advisory Level for taste and odor; not federally enforceable, but is intended as a guideline for States.

## 4.7 HYDROLOGY AND WATER QUALITY

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Customers sensitive to sodium, such as those on a sodium-restricted diet, might be concerned about the consumption of desalinated water. Sodium removal from Bay water is expected to be very high using membrane technology (99.9 percent). Results from the pilot plant indicated the sodium concentration in product water was 35 to 60 mg/l, which is higher than currently delivered to MMWD customers (average of 15 to 20 mg/l). No MCLs exist for sodium; however, EPA published a drinking water advisory document that listed a sodium taste and odor threshold that ranged from 30 to 60 mg/l (EPA 2003b). EPA advises persons on a sodium-restricted diet to drink water with sodium concentrations less than 20 mg/l. Because the desalination facility would not be operating on a year-round basis and not be the sole supply to any given water users, the effects of drinking this water on customers with a sodium-restricted diet would be less than significant. For these same reasons, taste and odor would not be noticeable if the product water maintained a blend with existing supply of at least 1:1.