Appendix D: DWR's Groundwater Bulletin 118

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San Francisco Bay Hydrologic Region

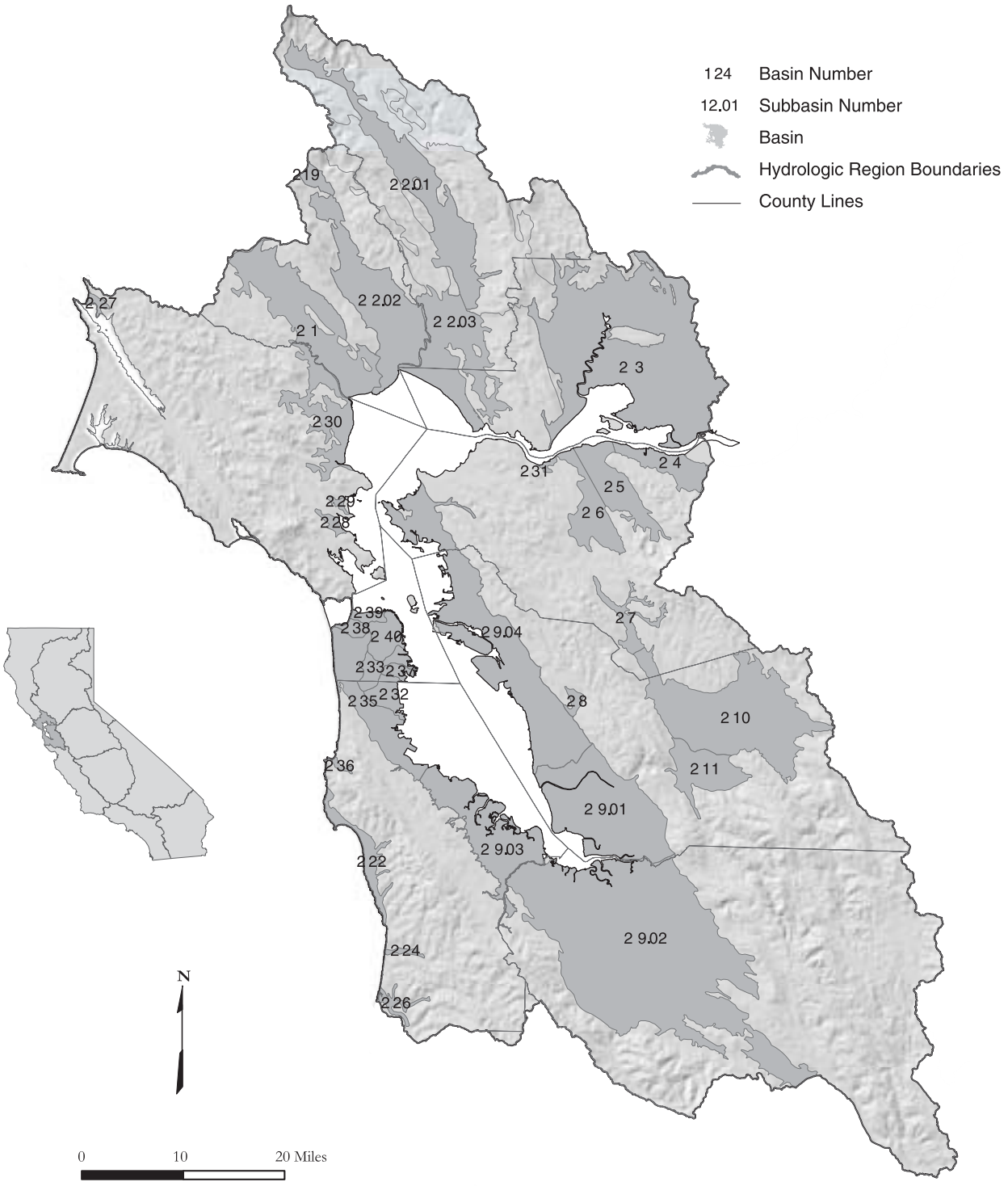

Figure 27 San Francisco Bay Hydrologic Region

Basins and Subbasins of the San Francisco Bay Hydrologic Region

Basin/subbasin	Basin name
2-1	Petaluma Valley
2-2	Napa-Sonoma Valley
2-2.01	Napa Valley
2-2.02	Sonoma Valley
2-2.03	Napa-Sonoma Lowlands
2-3	Suisun-Fairfield Valley
2-4	Pittsburg Plain
2-5	Clayton Valley
2-6	Ygnacio Valley
2-7	San Ramon Valley
2-8	Castro Valley
2-9	Santa Clara Valley
2-9.01	Niles Cone
2-9.02	Santa Clara
2-9.03	San Mateo Plain
2-9.04	East Bay Plain
2-10	Livermore Valley
2-11	Sunol Valley
2-19	Kenwood Valley
2-22	Half Moon Bay Terrace
2-24	San Gregorio Valley
2-26	Pescadero Valley
2-27	Sand Point Area
2-28	Ross Valley
2-29	San Rafael Valley
2-30	Novato Valley
2-31	Arroyo Del Hambre Valley
2-32	Visitacion Valley
2-33	Islais Valley
2-35	Merced Valley
2-36	San Pedro Valley
2-37	South San Francisco
2-38	Lobos
2-39	Marina
2-40	Downtown San Francisco

Description of the Region

The San Francisco Bay HR covers approximately 2.88 million acres (4,500 square miles) and includes all of San Francisco and portions of Marin, Sonoma, Napa, Solano, San Mateo, Santa Clara, Contra Costa, and Alameda counties (Figure 27). The region corresponds to the boundary of RWQCB 2. Significant geographic features include the Santa Clara, Napa, Sonoma, Petaluma, Suisun-Fairfield, and Livermore valleys; the Marin and San Francisco peninsulas; San Francisco, Suisun, and San Pablo bays; and the Santa Cruz Mountains, Diablo Range, Bolinas Ridge, and Vaca Mountains of the Coast Range. While being the smallest in size of the 10 HRs, the region has the second largest population in the State at about 5.8 million in 1995 (DWR 1998). Major population centers include the cities of San Francisco, San Jose and Oakland.

Groundwater Development

The region has 28 identified groundwater basins. Two of those, the Napa-Sonoma Valley and Santa Clara Valley groundwater basins, are further divided into three and four subbasins, respectively. The groundwater basins underlie approximately 896,000 acres (1,400 square miles) or about 30 percent of the entire HR.

Despite the tremendous urban development in the region, groundwater use accounts for only about 5 percent (68,000 acre-feet) of the region's estimated average water supply for agricultural and urban uses, and accounts for less than one percent of statewide groundwater uses.

In general, the freshwater-bearing aquifers are relatively thin in the smaller basins and moderately thick in the more heavily utilized basins. The more heavily utilized basins in this region include the Santa Clara Valley, Napa-Sonoma Valley, and Petaluma Valley groundwater basins. In these basins, the municipal and irrigation wells have average depths ranging from about 200 to 500 feet. Well yields in these basins range from less than 50 gallons per minute (gpm) to approximately 3,000 gpm. In the smaller basins, most municipal and irrigation wells have average well depths in the 100- to 200-foot range. Well yields in the smaller and less utilized basins are typically less than 500 gpm.

Land subsidence has been a significant problem in the Santa Clara Valley Groundwater Basin in the past. An extensive annual monitoring program has been set up within the basin to evaluate changes in an effort to maintain land subsidence at less than 0.01 feet per year (SCVWD 2001). Additionally, groundwater recharge projects have been implemented in the Santa Clara Valley to ensure that groundwater will continue to be a viable water supply in the future.

Groundwater Quality

In general, groundwater quality throughout most of the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, boron, and organic compounds.

The areas of high TDS (and chloride) concentrations are typically found in the region's groundwater basins that are situated close to the San Francisco Bay, such as the northern Santa Clara, southern Sonoma, Petaluma, and Napa valleys. Elevated levels of nitrate have been detected in a large percentage of private wells tested within the Coyote Subbasin and Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin (in the Central Coast HR) located to the south of the Santa Clara Valley (SCVWD 2001). The shallow aquifer zone within the Petaluma Valley also shows persistent nitrate contamination. Groundwater with high TDS, iron, and boron levels is present in the Calistoga area of Napa Valley, and elevated boron levels in other parts of Napa Valley make the water unfit for agricultural uses. Releases of fuel hydrocarbons from leaking underground storage tanks and spills/leaks of organic solvents at industrial sites have caused minor to significant groundwater impacts in many basins throughout the region. Methyl tertiary-butyl ether (MTBE) and chlorinated solvent releases to soil and groundwater continue to be problematic. Environmental oversight for many of these sites is performed either by local city and county enforcement agencies, the RWQCB, the Department of Toxic Substances Control, and/or the U.S. Environmental Protection Agency.

Water Quality in Public Supply Wells

From 1994 through 2000, 485 public supply water wells were sampled in 18 of the 33 basins and subbasins in the San Francisco Bay HR. Analyzed samples indicate that 410 wells, or 85 percent, met the state primary MCLs for drinking water standards. Seventy-five wells, or 15 percent, have constituents that exceed one or more MCL. Figure 28 shows the percentages of each contaminant group that exceeded MCLs in the 75 wells.

Table 16 lists the three most frequently occurring contaminants in each contaminant group and the number of wells in the HR that exceeded the MCL for those contaminants.

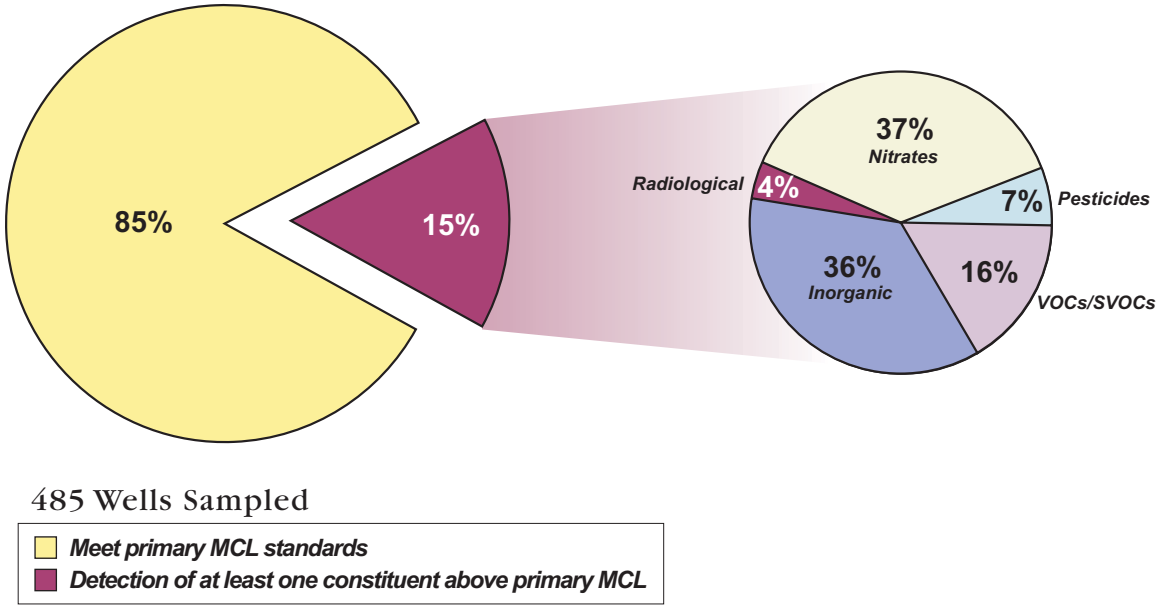

Figure 28 MCL exceedances in public supply wells in the San Francisco Bay Hydrologic Region

Table 16 Most frequently occurring contaminants by contaminant group in the San Francisco Bay Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics	Iron – 57	Manganese – 57	Fluoride – 7
Radiological	Gross Alpha – 2	Radium 226 – 1	
Nitrates	Nitrate (as NO_3) – 27	Nitrate + Nitrite – 3	Nitrite (as N) – 1
Pesticides	Di(2-Ethylhexyl)phthalate – 4	Heptachlor – 1	
VOCs/SVOCs	PCE – 4	Dichloromethane – 3	TCE– 2 Vinyl Chloride – 2

TCE = Trichloroethylene
PCE = Tetrachloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Coumpound

Changes from Bulletin 118-80

Since Bulletin 118-80 was published, RWQCB 2 boundary has been modified. This resulted in several basins being reassigned to RWQCB 1. These are listed in Table 17.

Table 17 Modifications since Bulletin 118-80 of groundwater basins in San Francisco Bay Hydrologic Region

Basin name	New number	Old number
McDowell Valley	1-56	2-12
Knights Valley	1-50	2-13
Potter Valley	1-51	2-14
Ukiah Valley	1-52	2-15
Sanel Valley	1-53	2-16
Alexander Valley	1-54	2-17
Santa Rosa Valley	1-55	2-18
Lower Russian River Valley	1-60	2-20
Bodega Bay Area	1-57	2-21

No additional basins were assigned to the San Francisco Bay HR in this revision. However, the Santa Clara Valley Groundwater Basin (2-9) has been subdivided into four subbasins instead of two, and the Napa-Sonoma Valley Groundwater Basin is now three subbasins instead of two.

There are several deletions of groundwater basins from Bulletin 118-80. The San Francisco Sand Dune Area (2-34) was deleted when the San Francisco groundwater basins were redefined in a USGS report in the early 1990s. The Napa-Sonoma Volcanic Highlands (2-23) is a volcanic aquifer and was not assigned a basin number in this bulletin. This is considered to be a groundwater source area as discussed in Chapter 6. Bulletin 118-80 identified seven groundwater basins that were stated to differ from 118-75: Sonoma County Basin, Napa County Basin, Santa Clara County Basin, San Mateo Basin, Alameda Bay Plain Basin, Niles Cone Basin, and Livermore Basin. They were created primarily by combining several smaller basins and subbasins within individual counties. This report does not consider these seven as basins. There is no change in numbering because the basins were never assigned a basin number.

Table 18 San Francisco Bay Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
2-1	PETALUMA VALLEY	46,100	C	100	-	16	7	24	347	58-650
2-2	NAPA-SONOMA VALLEY									
2-2.01	NAPA VALLEY	45,900	A	3,000	223	19	10	23	272	150-370
2-2.02	SONOMA VALLEY	44,700	C	1,140	516	18	9	35	321	100-550
2-2.03	NAPA-SONOMA LOWLANDS	40,500	C	300	98	0	6	9	185	50-300
2-3	SUISUN-FAIRFIELD VALLEY	133,600	C	500	200	21	17	35	410	160-740
2-4	PITTSBURG PLAIN	11,600	C	-	-	-	-	9	-	-
2-5	CLAYTON VALLEY	17,800	C	-	-	-	-	48	-	-
2-6	YGNACIO VALLEY	15,500	C	-	-	-	-	-	-	-
2-7	SAN RAMON VALLEY	7,060	C	-	-	-	-	-	-	-
2-8	CASTRO VALLEY	1,820	C	-	-	-	-	-	-	-
2-9	SANTA CLARA VALLEY									
2-9.01	NILES CONE	57,900	A	3,000	2,000	350	120	20	-	-
2-9.02	SANTA CLARA	190,000	C	-	-	-	10	234	408	200-931
2-9.03	SAN MATEO PLAIN	48,100	C	-	-	-	2	14	407	300-480
2-9.04	EAST BAY PLAIN	77,400	A	1,000	UNK	29	16	7	638	364-1,420
2-10	LIVERMORE VALLEY	69,500	A	-	-	-	-	36	-	-
2-11	SUNOL VALLEY	16,600	C	-	-	-	-	2	-	-
2-19	KENWOOD VALLEY	3,170	C	-	-	-	-	13	-	-
2-22	HALF MOON BAY TERRACE	9,150	C	-	-	5	-	9	-	-
2-24	SAN GREGORIO VALLEY	1,070	C	-	-	-	-	-	-	-
2-26	PESCADERO VALLEY	2,900	C	-	-	3	-	4	-	-
2-27	SAND POINT AREA	1,400	C	-	-	-	-	6	-	-
2-28	ROSS VALLEY	1,770	C	-	-	-	-	-	-	-
2-29	SAN RAFAEL VALLEY	880	C	-	-	-	-	-	-	-
2-30	NOVATO VALLEY	20,500	C	-	-	-	-	1	-	-
2-31	ARROYO DEL HAMBRE VALLEY	790	C	-	-	-	-	-	-	-
2-32	VISITACION VALLEY	880	C	-	-	-	-	-	-	-
2-33	ISLAIS VALLEY	1,550	C	-	-	-	-	-	-	-
2-35	MERCED VALLEY	10,400	C	-	-	-	-	10	-	-
2-36	SAN PEDRO VALLEY	880	C	-	-	-	-	-	-	-
2-37	SOUTH SAN FRANCISCO	2,170	C	-	-	-	-	-	-	-
2-38	LOBOS	2,400	A	-	-	-	-	-	-	-
2-39	MARINA	220	A	-	-	-	-	-	-	-
2-40	DOWNTOWN SAN FRANCISCO	7,600	C	-	-	-	-	-	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS - total dissolved solids

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Santa Clara Valley Groundwater Basin, San Mateo Subbasin

- Groundwater Basin Number: 2-9.03
- County: San Mateo
- Surface Area: 48,100 acres (75 square miles)

Basin Boundaries and Hydrology

The San Mateo subbasin occupies a structural trough, sub-parallel to the northwest trending Coast Ranges, at the southwest end of San Francisco Bay. San Francisco Bay constitutes its eastern boundary. The Santa Cruz Mountains form the western margin of the San Mateo basin. The Westside basin bounds it on the north and its southern limit is defined by San Francisquito Creek. The basin is composed of alluvial fan deposits formed by tributaries to San Francisco Bay, that drain the basin (CRWQCB 2001). Precipitation ranges from less than 16 inches in the southeast to more than 24 inches in the northwest.

Hydrogeologic Information

Water Bearing Formations

The water bearing formations of the San Mateo subbasin are comprised of two groups: the Santa Clara Formation of Plio-Pleistocene age and the Quaternary age alluvial deposits (DWR 1967). The Quaternary alluvium constitutes the most important water bearing formation of this basin and basically all larger yielding wells acquire their water from it (DWR 1967).

The Santa Clara Formation. The Santa Clara Formation is Plio-Pleistocene age. It underlies the Quaternary alluvium and unconformably overlies non-water bearing formations (DWR 1967). It is composed of gravel, sand, silt and clay with various mixtures of grain sizes. The Santa Clara Formation dips consistently toward the east in the range between 10 and 30 degrees (DWR 1967). Well data indicates that permeability tends to increase from west to east and that beneath the valley proper sediments tend to decrease in grain size and permeability with increasing depth (DWR 1967). This implies that the formation became coarser grained and more permeable with time. The Santa Clara Formation is likely present under the alluvium in most of the San Mateo groundwater basin but lithologic similarities with the Quaternary alluvium makes distinction difficult on the basis of available well log data (DWR 1967).

The Quaternary Alluvium. The Quaternary alluvium is composed of gravel, sand, silt, and clay with various grain size distributions dependent on the depositional environment. Maximum thickness attained by the Quaternary alluvium is approximately 1250 feet (CRWQCB 2001). The proximal edge of the alluvial fans is formed at the margin of the Santa Cruz Mountains. The alluvium is coarse grained and is generally unconfined. It thins out in the upslope areas. A permeable alluvium deposited by the many streams that converge and flow eastward out of the basin underlies the central portion of the valley (DWR 1967). Here the stream channels are typically confined within natural levees. Characteristically, coarser grained channel sediments shift laterally to silty and clay rich material (CRWQCB

2001). Streams have altered course through time, particularly in near proximity to the bay. This has allowed gravel, sand, and clay layers to interfinger and become laterally discontinuous (CRWQCB 2001). A relatively shallow water table aquifer overlies confined and semi-confined aquifers in this lowland area (DWR 1967). Most of the wells in the basin draw water from the deeper confined and semi-confined aquifers (Fio and Leighton 1995).

Recharge Areas

Natural recharge occurs by infiltration of water from streams that enter the valley from the upland areas within the drainage basin and by percolation of precipitation that falls directly on the valley floor.

Groundwater Level Trends

Historically groundwater resources were developed to meet irrigation needs. Atherton, particularly has been a heavily pumped area since the beginning of the 20th century (Rogge 2001). Groundwater pumpage sufficiently affected the hydrology of the region as early as the 1920's enough to reverse artesian conditions along the San Francisco Bay and create an inland water gradient along Willow Road (Killingsworth and Hyde 1932). The City of San Francisco began delivering surface water from Hetch Hetchy Reservoir in 1940 and the State of California began delivering surface water in 1965 to supplement supplies. Maximum groundwater overdrafts generally occurred in 1965 (Fio and Leighton 1995). After 1965 increases in surface water deliveries were used to reduce demand for groundwater restoring water levels to pre-1960 conditions (Fio and Leighton 1995). Imported surface water currently meets approximately 90 % of the demand in San Mateo County (Bawua 1997-1998).

Groundwater Storage

Groundwater Storage Capacity. No published reports addressing groundwater storage capacity were found for the San Mateo groundwater basin.

Groundwater in Storage. No published reports addressing groundwater in storage were found for the San Mateo groundwater basin.

Groundwater Budget (Type C)

Not enough data was found to provide either an estimate of the basin's groundwater budget or the groundwater extraction from the basin.

Groundwater Quality

Characterization. In a study conducted by the US Geological Survey in conjunction with the Town of Atherton in 1997 most well water samples were designated calcium magnesium carbonate bicarbonate waters. The water is slightly alkaline with a mean pH value of 7.3 based on 20 samples. Hardness for the 20 wells sampled averaged 471 milligrams per liter (mg/L) as CaCO3, in excess of the 180 mg/L minimum value for water to be classified as very hard (Metzger and Fio 1997).

Impairments. Some wells produce water that can induce soil problems due to high concentrations of sodium when used for irrigation (Fio and Leighton 1995). One groundwater sample showed a nitrate-nitrogen concentration of 12 mg/L, which exceeds the primary maximum contaminant level, set by the California Department of Health Services and the U.S. Environmental Protection Agency (DWR 1995). Nitrate-Nitrogen concentrations in excess of 10 mg/L are considered hazardous and may result in methemoglobinemia (blue-baby syndrome) for small children (Hem 1985).

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	10	0
Radiological	11	0
Nitrates	10	0
Pesticides	11	0
VOCs and SVOCs	9	0
Inorganics – Secondary	10	2

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Production characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 15 – 50	Average: (Based on 2 Wells)
	Total depths (ft)	
Domestic	Range: 58 - 505	Average: 203 (Based on 13 Wells)
Municipal/Irrigation	Range: 45 - 935	Average: 219 (Based on 72 Wells)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
	Groundwater levels	
DWR	Miscellaneous water quality	2 Wells
Department of Health Services and cooperators	Title 22 water quality	14 Wells

Basin Management

Groundwater management:

Water agencies

Public	Belmont CWD, City of Millbrae WSA, City of Palo Alto Service Area, City of San Bruno WSA, East Palo Alto Co. Waterworks, Estero MID, Menlo Park MWD, Santa Clara Valley WD., County of San Mateo Health Services Division
Private	Burlingame Water Services, California Water Service Co.

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Errata

Changes made to the basin description will be noted here.