DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
U.S. BUREAU OF RECLAMATION

OPEN-FILE REPORT 86-72

Redding Basin

Honey Lake Basin

Sacramento Valley

Livermore Valley

San Joaquin Valley

Southern California Desert Basins

Santa Barbara and Ventura Counties

San Diego County

INTRODUCTION

Reported high concentrations of selenium in shallow ground water of western San Joaquin Valley, California (Deverel and others, 1984) has caused concern that selenium may be present at unacceptable levels in ground water in other areas of the State. Ground water provides 39 percent of the State's annual water supply (U.S. Geological Survey, 1985, p. 147) and provides a significant part of the State's drinking water.

This report documents some of the presently available data on the distribution of dissolved selenium in California. This information can be used to assess the need for additional studies in areas not covered by existing data and areas requiring additional studies because of high selenium concentrations.

DESCRIPTION OF DATA

All available data for selenium concentrations in samples from wells were retrieved from the U.S. Geological Survey water-data storage system (WATSTORE). Uniformity in sample-collection and analytical methods, and quality control were assured by limiting the review to U.S. Geological Survey data. Data from WATSTORE prior to 1975 were not included because a different method of chemical analysis was used that produced inconsistent results (U.S. Geological Survey, Quality of Water Branch Technical Memorandum 81.12). The only U.S. Geological Survey data omitted for 1975-85 were for samples collected from shallow wells in tile-drained areas of the western San Joaquin Valley and previously reported by Deverel and others (1984). These samples were omitted because they are not representative of aquifers used for water supply.

The data in this report were collected for a number of different projects, resulting in differences among wells in the frequency of sample collection. Of the 230 wells for which there were selenium analyses, 21 were sampled more than once, but none were sampled more than seven times. The laboratory detection limit for most samples was less than 1 ug/L of selenium. Seven wells had analyses reported as less than 10 ug/L and six wells had values reported as less than 8 ug/L.

CONCENTRATIONS IN GROUND WATER

The wells were concentrated in eight areas of the State (table 1). Statewide, dissolved selenium was detected in 84 of the 230 wells. The U.S. Environmental Protection Agency (1977) standard for dissolved selenium in drinking water is 10 ug/L. Only six wells had concentrations greater than 10 ug/L; and of these, three had concentrations greater than 20 ug/L (table 2). Two of these wells are in the Davis-Woodland area of the Sacramento Valley (60 ug/L--well 8N/2E-13P3M and 27 ug/L--well 9N/2E-22Q1M), and the other is in Santa Barbara County (35 ug/L--well 6N/35W-30R1S). Data for all 230 wells are summarized by area in table 3.

Although selenium was detected in ground water of all the areas of the State for which there were data, it was almost always less than the drinking-water standard of 10 ug/L. The detection of selenium was common only in Santa Barbara County and the Davis-Woodland areas of the Sacramento Valley.

REFERENCES CITED

Deverel, S.J., Gilliom, R.J., Fujii, Roger, Izbicki, J.A., and Fields, J.C., 1984, Areal distribution of selenium and other inorganic constituents in shallow ground water of the San Luis Drain service area, San Joaquin Valley, California: A Preliminary Study: U.S. Geological Survey Water-Resources Investigations Report 84-4319, 67 p.

U.S. Environmental Protection Agency, 1977, National interim primary drinking water regulations: Environmental Protection Agency, Office of Water Supply, EPA 570/9-76-003, 159 p.

U.S. Geological Survey, 1985, National water summary 1984--Hydrologic events and issues: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

WELL-NUMBERING SYSTEM

Wells are identified according to their location in the rectangular system for the subdivision of public lands. Their identification consists of the township number, north or south; the range number, east or west; and the section numbers. Each section is further divided into sixteen 40-acre tracts lettered consecutively (except I and O), beginning with A in the northeast corner of the section and progressing in a sinusoidal manner to R in the southeast corner. Within the 40-acre tract, wells are sequentially numbered in the order they are inventoried. The final letter in a well identification number refers to the base line and meridian. All wells in the study area are either referenced to the Mount Diablo base line and meridian (M) or the San Bernardino base line and meridian (S). The illustration below shows how the well number 30N/3W-12E1M is derived.

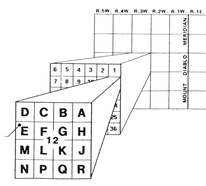

TABLE 1. Distribution of wells with selenium-concentration data

Area	Well distribution
San Diego County	24
Santa Barbara and Ventura Counties	32
Southern California Desert Basins	15
San Joaquin Valley	20
Livermore Valley	6
Sacramento Valley	93
Honey Lake basin	22
Redding Basin	18

TABLE 2. Summary of selenium concentrations

[For wells with multiple samples, the sample with the highest concentration was used in this compilation. Not detected: The detection limit for all but 13 samples from 13 wells was 1 ug/L. For 7 samples, the dection limit was 10 ug/L, and for 6 samples the detection limit was 8 ug/L]

Area	Number of wells with selenium concentrations: Not detected	1 to 10 ug/L	Greater than 10 ug/L
San Diego County	14	10	0
Santa Barbara and Ventura Counties	13	16	3
Southern California Desert Basins	11	4	0
San Joaquin Valley	15	5	0
Livermore Valley	5	1	0
Sacramento Valley	54	36	3
Honey Lake basin	18	4	0
Redding Basin	16	2	0

TABLE 3.--Selenium concentrations in wells of California

[Values that are preceded by a less than symbol (<) represent the detection limit for selenium at the time of analysis]

Well No.	Date of sample	Dissolved selenium (ug/L)
SAN DIEGO COUNTY		
19S/2W- 1N5S	11-15-82	<1
4D5S	11-16-82	2
16S/6E- 2N1S	11-10-75	<1
16S/7E-13N1S	11-10-75	<1
15S/1E-18C1S	12- 1-82	3
15S/1W-29L1S	12- 1-82	5
14S/1W- 8D1S	3-19-85	1
17B2S	3-19-85	<1
21H1S	3-19-85	<1
14S/2W-19K1S	3-20-85	<1
22C1S	3-19-85	2
25M1S	3-19-85	2
14S/2W-26J1S	3-19-85	5
14S/3W-20F1S	3-20-85	<1
20G1S	3- 2-85	1
20L1S	3-20-85	<1
24R1S	3-20-85	<1
11S/2W- 1F2S	3-18-85	<1
1Q2S	3-21-85	<1
5J1S	3-21-85	<1
6G2S	3-18-85	<1
10N1S	3-18-85	2
11S/4W- 4Q2S	11-17-82	1
18C9S	11-17-82	<1

TABLE 3.--Selenium concentrations in wells of California--Continued

Well No.	Date of sample	Dissolved selenium (ug/L)
SANTA BARBARA AND VENTURA COUNTIES		
1N/22W- 3F1S	5- 2-78	<10
		7N/35W- 1M2S 1-22-85 2
		5- 9-85 1
4N/27W-1AR1S	6-13-77	<10
15J2S	6- 6-77	<10
15Q1S	6- 6-77	<10
22B6S	6- 6-77	<10
22C1S	6- 6-77	<10
		7N/35W-13N2S 6-18-80 11
		7- 8-81 10
		6-23-82 2
		9-17-84 12
		11-19-84 9
6N/35W- 5F2S	11- 7-84	1
	2- 6-85	<1
	4-30-85	<1
		15M1S 11- 8-84 <1
		1- 5-85 <1
5F3S	11-07-84	<1
	4-29-85	<1
	8- 7-85	<1
30R1S	7- 8-82	35
		32N1S 3-29-84 <1
		7- 5-84 <1
		11- 7-84 <1
6N/36W- 1K1S	2- 7-85	<1
	4-30-85	<1
		2- 5-85 <1
		4-30-85 <1
1J1S	3-30-84	<1
	7- 5-84	1
	11- 7-84	1
	2- 7-85	2
	4-30-85	1
	8- 7-85	<1
		8N/34W-16G4S 10-30-75 <10
		8N/35W-35K1S 9-18-84 1
		1-23-85 1
		7- 9-85 <1
		35Q1S 6-18-80 <1
		7- 7-81 <1
24D1S	7- 9-82	1
26G1S	8- 8-82	1
26G1S	6-20-82	4
		6-21-83 <1
		8-17-83 1
		9-16-84 <1
7N/34W-19Q2S	4-16-84	2
	1-14-85	2
	7-25-85	<1
	9- 4-85	1
		10N/33W- 7B2S 9-29-75 <1
		21F6S 9-29-75 1
19CAS	4-17-84	3
		10N/34W- 3H3S 9-28-75 3
7N/35W- 1M1S	6-19-80	2
	7- 7-81	1
		4L1S 9-28-75 2
		12H1S 9-29-75 1
		13G1S 9-28-75 1
1M2S	8-18-83	2
	9-17-84	<1
	11-20-84	<1
		11N/34W-33J1S 9-29-75 12
		34K1S 9-28-75 <1
SOUTHERN CALIFORNIA DESERT BASINS		
3N/7E-28R1S	8-25-78	<1
29R1S	8-15-78	1
32J1S	9-16-78	<1
		26S/40E-30K1M 6- -75 <8
		30K2M 6- -75 <8
30S/37E-36H1M	4-19-76	<1
		30K3M 6- 4-75 <8
		33P4M 6- -75 <8
30S/38E-30P1M	4-19-76	<1
32D2M	4-19-76	<1
32D3M	4-19-76	1
		15S/44E-36J5M 10-28-83 4
		10-29-83 5
		3- 9-84 4
27S/40E- 4Q2M	6- -75	<8
4C1M	6- -75	<8
		36J6M 10-28-83 1
		10-29-83 1
SAN JOAQUIN VALLEY		
18S/18E-27N1M	7-19-79	<1
33N1M	7-19-79	5
		7S/10E-23K3M 7-28-83 2
		6-27-85 3
17S/19E-15P2M	7-18-79	<1
16S/20E- 2P1M	7-17-79	<1
		1N/7E-16M1M 6-29-78 <1
		2N/7E-11F1M 6-20-78 1
		11M1M 6-18-79 1
15S/21E-21P1M	7-18-79	<1
34J1M	7-17-79	<1
		3N/5E-19B2M 5-30-78 <1
		3N/6E-36H6M 5-30-78 1
14S/22E- 1F1M	7-16-79	<1
3B2M	7-16-79	<1
7S/9E-12H1M	7-28-83	<1
		4N/3E-26G1M 9-17-82 <1
		7R2M 6- 6-79 <1
		4N/7E-13N3M 5-22-78 <1
7S/10E-19G1M	7-28-83	<1
		24B2M 5-22-78 <1
LIVERMORE VALLEY		
3S/1E- 9L2M	10-12-76	5
	4- 7-77	10
		3S/1E-29E3M 10-12-76 <1
		4- 7-77 <1
11J1M	10-12-76	<1
	4- 7-77	<1
		32K2M 10-12-76 <1
		4- 7-77 <1
12F1M	10-13-76	<1
	4- 8-77	<1
		3S/2E-17G1M 4- 8-77 <1
SACRAMENTO VALLEY		
5N/3E-13G1M	9-20-82	<1
5N/5E- 3P1M	9-28-82	<1
		32N6M 8-13-81 1
		33P2M 8-13-81 <1
5N/6E-22Q2M	9-22-82	<1
29G4M	9-15-82	3
		10N/1W- 2P1M 9- 3-81 <1
		2Q1M 9- 3-81 <1
5N/7E-10P1M	9- 9-82	<1
		4E1M 6- 6-79 <1
		7R2M 6- 6-79 <1
6N/1E-18C2M	9- 4-80	6
1B1M	9- 4-80	3
		14F1M 7-25-79 4
		28C1M 6- 6-79 1
		7-26-79 2
6N/1W-36E2M	9-16-80	2
6N/6E- 7Q1M	9-14-82	<1
		10N/2E-15A1M 6- 5-79 5
		10N/2W-15Q1M 9- 3-81 <1
7N/1W-34R1M	9-12-80	<1
34R2M	9-12-80	<1
		10N/3E-36N1M 9-10-82 <1
		10N/5E-21K1M 9-22-82 <1
7N/6E-29C1M	9-14-82	<1
		10N/6E- 2K1M 9-24-82 <1
		22L1M 9-17-82 <1
8N/1E- 6B1M	7-31-79	3
12R5M	7-31-79	2
17C1M	7-26-79	1
22B1M	7-26-79	1
		11N/1E- 8K1M 6- 7-79 <1
		26Q1M 7-25-79 7
		11N/1W- 1D1M 7-25-79 1
		18F1M 6- 7-79 1
8N/2E-13P3M	6- 4-79	60
20B1M	8-25-81	9
21B2M	8-26-81	1
27C2M	6- 4-79	4
		11N/3W- 4J1M 8-17-81 <1
		4L1M 8-17-81 1
8N/3E- 5N4M	8- 1-79	3
6M1M	8- 1-79	10
		11N/5E-16Q1M 9-14-82 <1
8N/4E-15G2M	8-27-81	<1
		34P1M 9-14-82 <1
8N/5E- 1C2M	9-23-82	<1
29Q1M	9-28-82	<1
35Q1M	9-28-82	<1
		11N/7E-15A1M 9-15-82 <1
		12N/1E-24P1M 8- 6-81 <1
		2N1M 8- 6-81 <1
9N/1E-19E1M	8-24-81	<1
20C2M	8-24-81	1
31D2M	8-20-81	2
35H2M	6- 5-79	1
	7-31-79	1
		12N/2E-20P1M 9-11-75 <1
		12N/3E- 2Q1M 4-17-80 <1
		12N/6E-14C1M 9- 8-82 <1
9N/1W-11E1M	6- 6-79	<1
25M1M	7-31-79	2
31M1M	6- 6-79	1
36E1M	8-20-81	2
		13N/5E-22Q1M 8- 9-76 <1
		14N/1W- 1P2M 9-17-75 1
		14N/4E- 9F2M 8-12-76 <1
9N/2E- 3B1M	6- 5-79	2
9K1M	6- 5-79	17
18N1M	6- 5-79	1
21L2M	7-31-79	9
22Q1M	6- 4-79	27
29L1M	7-31-79	2
32J1M	6- 4-79	4
		15N/1W- 9Q1M 9-18-75 <1
		15N/3E- 3N2M 8-18-76 <1
		16N/2E- 3B2M 8-24-76 <1
		17N/5E-16K1M 8-26-76 1
		18N/2E-14K1M 9- 1-76 <1
		19N/1W-32G1M 4-18-80 <1
		19N/3E-12E1M 9- 7-76 <1
9N/3E-31L1M	8- 1-79	<1
9N/5E-23L2M	9-29-82	<1
9N/6E- 5B1M	9-16-82	1
9N/7E- 4M2M	9-27-82	<1
		20N/2E-35A2M 9- 8-76 <1
		22N/1E-26Q1M 10- 9-75 <1
		22N/1W-11M2M 10- 8-75 <1
		22N/2E-31Q1M 9- 9-76 <1
10N/1E- 1H1M	6- 7-79	2
		23N/1W-30K1M 10-20-75 <1
HONEY LAKE BASIN		
25N/17E- 4N1M	9-29-80	<1
		29N/12E- 3Q1M 10- 1-80 <1
		12C3M 10- 1-80 <1
26N/16E-16Q1M	9-29-80	<1
		14A1M 10- 2-80 <1
		16M2M 10- 2-80 <1
27N/14E- 6B1M	9-30-80	<1
6H1M	9-30-80	<1
22A1M	9-30-80	<1
		29N/13E- 4J1M 10- 1-80 <1
		12P1M 10- 1-80 <1
		16M2M 10- 1-80 1
27N/16E-36Q5M	9-29-80	2
		29N/15E- 8B2M 10- 1-80 3
28N/13E- 5A1M	10- 2-80	<1
25B1M	10- 2-80	<1
		21Q1M 9-30-80 <1
		23Q1M 10- 1-80 <1
28N/14E- 2Q2M	9-30-80	<1
8J1M	10- 2-80	<1
		29N/16E-19J1M 9-30-80 1
		30N/12E-30A2M 10- 2-80 <1
REDDING BASIN		
29N/5W-21R1M	10-17-79	<1
36J1M	10-17-79	<1
		30N/4W-26P1M 10-10-79 1
		30N/5W-28G1M 10-10-79 <1
29N/3W- 6L1M	10-17-79	<1
29N/4W-16P2M	10-12-79	<1
29N/5W- 1D1M	10-10-79	<1
29N/6W- 2P1M	10-25-82	<1
	10-26-82	1
		31N/3W-22B1M 10- 1-79 <1
		31N/4W- 1H1M 10- 2-79 <1
		31N/4W- 6M6M 10-10-79 <1
		31N/4W-12L1M 10- 2-79 <1
		31N/4W-22D1M 10- 3-79 <1
30N/3W-12E1M	10-16-79	<1
30N/4W- 1K1M	10-16-79	<1
6D1M	10-10-79	<1
		31N/5W-25M4M 10-10-79 <1
		32N/4W-21C2M 10- 3-79 <1

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EXPLANATION

WELL - Symbol indicates range of selenium concentration, in micrograms per liter

- ○ Not detected
- ◑ 1 to 10
- ● Greater than 10

SCALE 1:1 000 000

25 0 25 50 MILES

25 0 25 50 KILOMETERS

MAP OF CALIFORNIA SHOWING DISTRIBUTION OF SELENIUM CONCENTRATIONS IN WELLS SAMPLED BY THE U.S. GEOLOGICAL SURVEY, 1975-85

By K. D. Evenson and J. M. Neil

1986

Base from U.S. Geological Survey, 1963