STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

FINAL PROJECT REPORT

UPDATE OF BASIN PLAN FOR PIRU, SESPE, AND SANTA PAULA HYDROLOGIC AREAS

JUNE 1989

Gordon K. Van Vleck
Secretary for Resources
The Resources Agency

George Deukmejian
Governor
State of California

David N. Kennedy
Director
Department of Water Resources

Exhibit 8

Exhibit U33

State of California | The Resources Agency

Memorandum

Date : June 20, 1989

To : California Regional Water Quality
Control Board, Los Angeles Region
107 South Broadway, Room 4027
Los Angeles, CA 90012
Attention: Mr. Robert P. Ghirelli
Executive Officer

From : **Department of Water Resources**
Los Angeles, CA 90055

Subject : Update of Basin Plan for Piru, Sespe, and Santa Paula Hydrologic Areas

This memorandum report documents all work and results of a project by the Department under an interagency agreement with your Board. The goal of the project was to review, update, revise, and add to, as appropriate, beneficial use designations and mineral quality objectives of the Water Quality Control Plan for surface and ground waters of the Piru, Sespe, and Santa Paula Hydrologic Areas. Also, correlation of mineral quality objectives was to be evaluated for areas where surface and ground waters are hydraulically interconnected. The project was funded by the State Water Resources Control Board, using Section 205(j) grant funds.

Results of the project indicate some mineral quality objectives need to be changed to be more representative of current quality, trends in quality, current and future beneficial uses, and quality criteria and policies. Additional beneficial uses for surface waters were identified and these are recommended to be added to those in the Water Quality Control Plan.

We thank you for the opportunity to work with your agency. Also, we wish to thank those agencies that supplied data for this project, in particular, Ventura County Flood Control District and United Water Conservation District.

Carlos Madrid, Chief
Southern District

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GEORGE DEUKMEJIAN, Governor

The Resources Agency
GORDON K. VAN VLECK, Secretary for Resources

Department of Water Resources
DAVID N. KENNEDY, Director

ROBERT G. POTTER Deputy Director	JOHN P. CAFFREY Chief Deputy Director	LAWRENCE A. MULLNIX Deputy Director

SALLE S. JANTZ Assistant Director	SUSAN N. WEBER Chief Counsel

SOUTHERN DISTRICT

Carlos Madrid . . . . Chief, Southern District

This report was prepared under
the direction of

Ahmad A. Hassan, Ph.D. . . . . Chief, Resources Inventory Branch
Harry Iwanaga . . . . Senior Engineering Geologist

by

Evelyn Tompkins . . . . Associate Engineering Geologist

Assisted by

Phyllis J. Yates . . . . Research Writer
Yvette Lopez . . . . Senior Graphic Artist
Tahnda Adams Bailey . . . . Word Processing Technician
Linda Holguin . . . . Office Technician
Susan Woolam . . . . Editorial Aid

I. INTRODUCTION

Both State (Porter-Cologne Act) and Federal (Clean Water Act of 1977) water quality planning requirements mandate periodic review and update of Water Quality Control Plans (Basin Plans). The Basin Plan for the Santa Clara River Basin was last updated by the Regional Water Quality Control Board, Los Angeles Region, in 1978; therefore, review, update, and, as appropriate, revision are warranted. To update the Basin Plan, the Regional Board contracted with the Department of Water Resources under an interagency agreement with the State Water Resources Control Board*.

TABLE 1
HYDROLOGIC AREAS AND SUBAREAS OF THE SANTA CLARA RIVER BASIN IN STUDY

In acres

Areas and Subareas	Gross area	
Piru Area	318,880	
Santa Felicia Subarea		70,690
Upper Piru Subarea		169,760
Hungry Valley Subarea		40,730
Stauffer Subarea		37,700
Sespe Area	207,700	
Fillmore Subarea		47,180
Topatopa Subarea		160,520
Santa Paula Area	75,050	
Sulphur Springs Subarea		68,050
Sisar Subarea		7,000

A Basin Plan for waters of an area consists of three components: (1) beneficial uses that are to be protected, (2) water quality objectives that protect those uses, and (3) implementation plan that achieves those objectives (Section 13050 of California Water Code). Carrying out the implementation plan is the responsibility of the Regional Board and is achieved by issuing and enforcing waste discharge regulations for those discharges that can affect water quality.

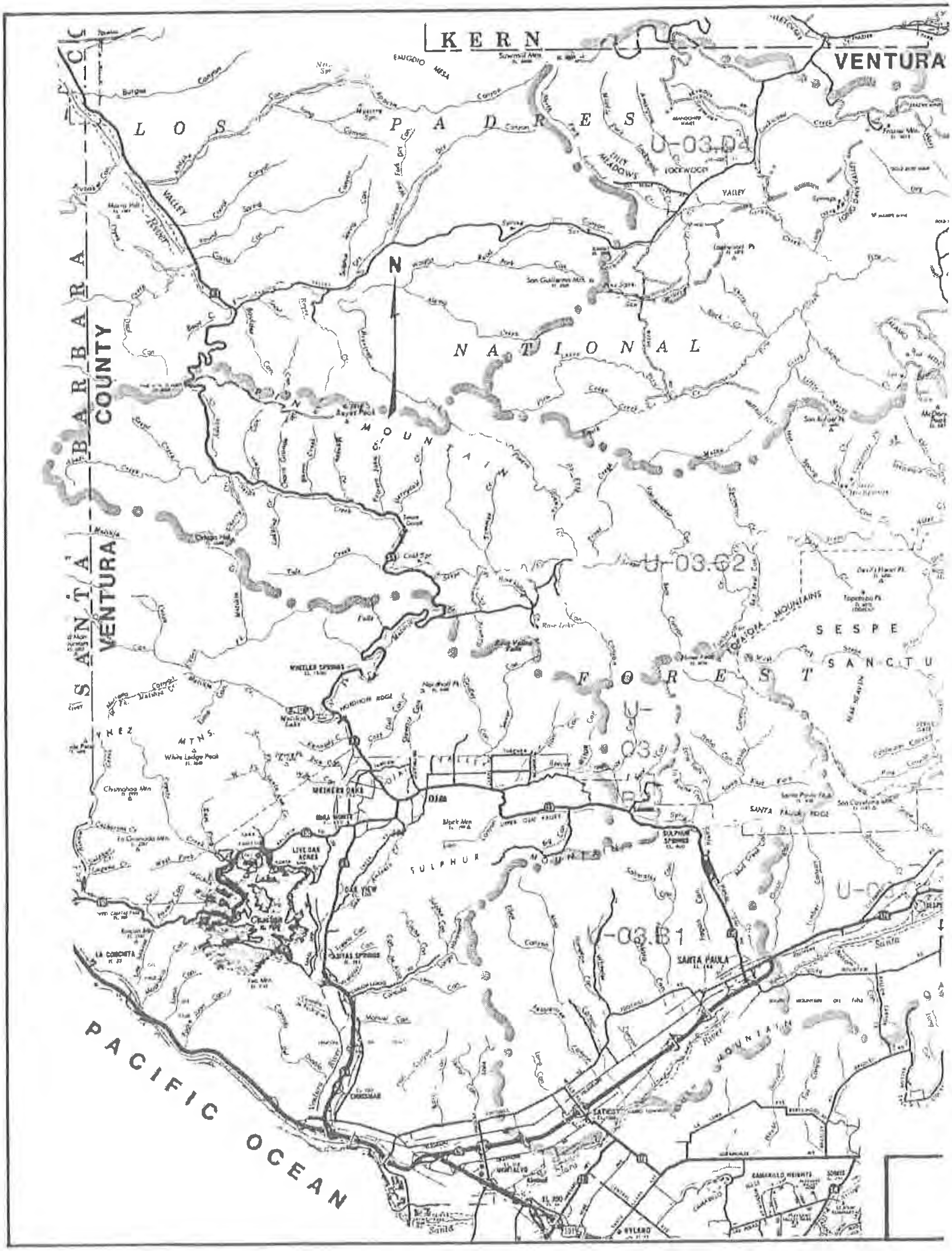
Those regulations can be more effective if they reflect current water quality conditions and trends. Therefore, as part of its workplan, the Board sought to determine the current quality and beneficial uses of the surface and ground waters and quality trends.

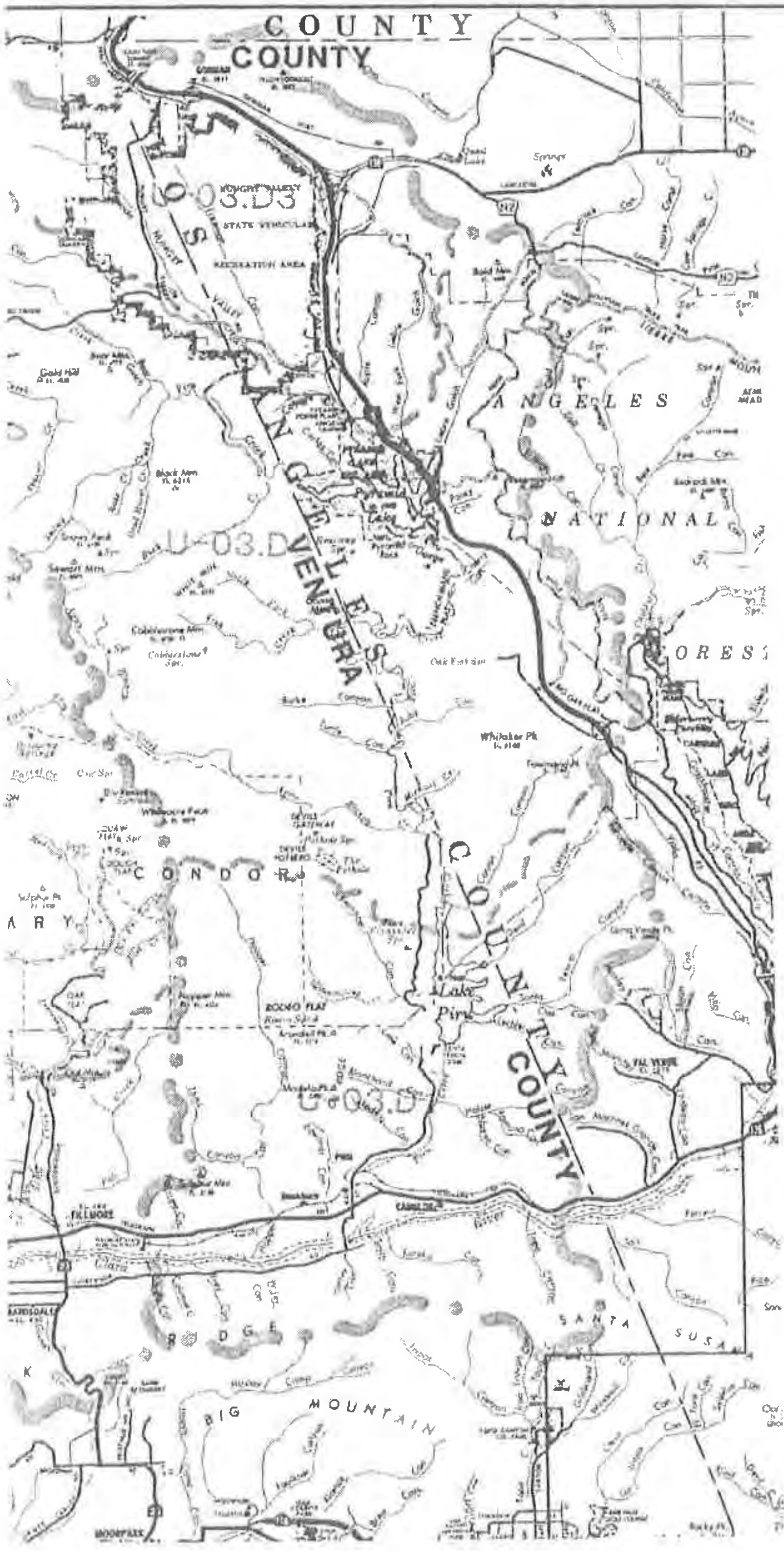
With the limited funding that was available, it decided to focus on updating three hydrologic areas of the Santa Clara River Basin Plan--Piru, Sespe, and Santa Paula.** Table 1 lists the areas and subareas of this study and their respective acreages, and Figure 1 shows their locations.

The work to be performed for this study was specifically detailed in the

* "Primary funding for this study has been provided by the California State Water Resources Control Board using Section 205(j) [sic] grant funds made available by the U.S. Environmental Protection Agency. This does not signify that the contents necessarily reflect the views and policies of the U. S. Environmental Protection Agency or the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement of recommendations for use." (Revised 205(J) Project Workplan, Update of Basin Plans, April 27, 1987)

** In September 1987, the State Water Resources Control Board issued a revised "Index to Watersheds in California". The new index adopts the term "area" for "subunit" and changes the names of some watersheds. The name changes that affected this study are: Piru Hydrologic Subarea (HSA) changed to Santa Felicia HSA, Sespe HSA to Topatopa HSA, and Santa Paula HSA to Sulphur Springs HSA. This report uses the new names, as well as the term "area".


KERN
VENTURA
LOS PADRES
NATIONAL
FOREST
SANTA BARBARA
VENTURA
COUNTY
N
U-03.D
U-03.C2
U-03.B1
SESPE
TOPATOPA MOUNTAINS
SULPHUR
PACIFIC OCEAN
SANTA PAULA
WHEELER SPRINGS
LIVE OAK ACRES
SULPHUR SPRINGS
CAMARILLO HEIGHTS



L E G E N D

U-03.B0 Santa Paula Hydrologic Area
- U-03.B1 Sulphur Springs Hydrologic Subarea
- U-03.B2 Sisar Hydrologic Subarea

U-03.C0 Sespe Hydrologic Area
- U-03.C1 Fillmore Hydrologic Subarea
- U-03.C2 Topatopa Hydrologic Subarea

U-03.D0 Piru Hydrologic Area
- U-03.D1 Santa Felicia Hydrologic Subarea
- U-03.D2 Upper Piru Hydrologic Subarea
- U-03.D3 Hungry Valley Hydrologic Subarea
- U-03.D4 Stauffer Hydrologic Subarea

Study Area Boundary

Hydrologic Area

Hydrologic Subarea

FIGURE 1 - STUDY AREA

Revised 205(J) Project Workplan (April 27, 1987) developed by the Regional Board. The elements of that workplan are as follows:

"1. The Department of Water Resources, Southern District, (DWR) will search through available literature to gather historical and updated mineral data on surface and ground water.

"2. DWR will meet with appropriate federal, state and local agencies to gather additional data that may have been obtained by individual agencies.

"3. DWR will compile and list those waters with little or incomplete mineral quality data.

"4. For these waters, Board staff will take samples which will be analyzed at the State Department of Health Services (DOHS) Laboratory.

"5. Board staff will make the test results available to DWR.

"6. DWR will review all the results and data collected to make comparisons with the current Basin Plans.

"7. DWR will make recommendations for revisions and additions to the beneficial uses and mineral quality objectives. These recommendations will include correlations of surface and ground water objectives where appropriate.

"8. Board staff will review all data and recommendations and implement the program by incorporating these results into the Basin Plans." (Revised 205(J) Project Workplan, Update of Basin Plans, April 27, 1987)

This report summarizes and incorporates all the results of the project workplan and completes documentation of element 7.

Appendix A contains a list of references consulted in fulfillment of element 1, and Appendix B contains the documents pertaining to elements 3, 4, and 5.

Objective and Scope

As specified in the workplan (Task 5), the objective of this report is as follows:

> "Objective: DWR will summarize and incorporate the results of the project; subsequently, DWR will make recommendations for new beneficial uses and mineral objectives and point out any problem areas.
>
> "Methodology: DWR will prepare a draft project report incorporating all results and reports developed by the project. From these results, DWR will draw conclusions, make recommendations for additions or revisions of beneficial uses and mineral objectives, and discuss the rationale for the recommendations, especially for problem areas. The rationale should include an evaluation of current water quality, trends in water quality, compatibility of recommendations with nondegradation policy and other policies which protect beneficial uses, and water quality criteria for beneficial uses..."

Description of Study Area

The Santa Clara River Basin is in the western part of the Transverse Ranges Geomorphic Province, a province characterized by geologic structures trending mostly east, in contrast to the northwest trend exhibited elsewhere

III. SESPE HYDROLOGIC AREA

The Sespe Hydrologic Area encompasses 207,700 acres and two subareas --Fillmore and Topatopa (Figure 1). The hydrologic area contains the mainstream of the Santa Clara River and its largest tributary, Sespe Creek. Sespe Creek has its headwaters on the south flank of Pine Mountain and, like Piru Creek, drains an extensive mountain area.

The distinctive geologic feature of the hydrologic area is the enigmatic Sespe Formation. The type locality is found about 6 miles north of the City of Fillmore. A distinguishing characteristic of the Sespe Formation is its red color, although the sandstones and conglomerates of the formation are also green, gray, and white. The strata are economically important as reservoir rocks for petroleum resources.

Fillmore Hydrologic Subarea

The Fillmore Subarea contains the more significant quantity of ground water resources in the Sespe Hydrologic Area. The subarea encompasses the mainstream of the Santa Clara River and the lower part of Sespe Creek below the gaging station. Several smaller tributaries in the subarea are Pole, Timber, and Boulder Creeks.

The subarea covers about 47,180 acres. The highest elevation is at Santa Paula Peak (4,957 feet) and the elevation of the valley floor ranges from 280 to 470 feet.

Surface Water

Current quality data collected for this study are in Table 11. Historical data were reviewed in the Department's files and in the literature.

During flood flows, water in the Santa Clara River entering the subarea has been of relatively good quality (TDS content of about 500 to 600 mg/L) and predominantly calcium sulfate in character. Low flows entering the subarea are essentially rising ground waters from the Santa Felicia Subarea and typically show a poorer quality (TDS content more than 1,000 mg/L). The sparse data suggest the flows are substantially irrigation return waters being discharged from Santa Felicia Basin. The chemical character of the low flows is similar to that of extracted ground waters. It is more complex than that of flood flows, being calcium-magnesium sulfate to calcium-sodium-magnesium sulfate.

Sespe Creek is usually a significant source of good quality waters for mixing with Santa Clara River flows and for recharging the basin's ground water. High flows have had TDS concentrations below 200 mg/L and low flows below 1,000 mg/L. Generally, the TDS content of Sespe Creek shows less variation with discharge than does that of other tributaries of the Santa Clara River. Low-flow Sespe Creek waters, usually less than 30 cubic feet per second, show high boron concentrations, exceeding the irrigation criteria. However, soils of the basin are very permeable and there is excellent subdrainage, thus allowing continued use of the high boron waters without significant damage to boron-sensitive crops.

The source of boron in Sespe Creek appears to be, in part, inflows from Hot Springs Creek in the Topatopa Subarea. Also, Hot Springs Creek appears to increase the chloride content of Sespe Creek. The increased chloride content does not affect beneficial uses of Sespe Creek. The past practice of direct discharge of oilfield brines to Sespe and Tar Creeks may also be a continuing source of boron and chloride.

Recent analyses indicate the chemical character of Sespe Creek's waters is calcium-magnesium-sodium sulfate to calcium-sodium-magnesium sulfate. Historical data indicate that, during flood flows, bicarbonate was sometimes dominant over sulfate and magnesium was lower than sodium.

Generally, for any rate of discharge, the chemical character of the waters of the Santa Clara River leaving the subarea reflects the contributions of Sespe Creek waters and is calcium-magnesium-sodium sulfate or calcium-sodium-magnesium sulfate. The quality of the flows has ranged from poor to good, with the poorer quality flows usually those of rising waters. Sulfate and boron concentrations may exceed criteria for crop irrigation.

Pole Creek contributes mineralized waters to the subarea. The sulfate content is substantial, with concentrations between 650 and 800 mg/L and historically as high as 950 mg/L. The TDS concentrations range from about 700 to 1,400 mg/L. The boron, chloride, and nitrate concentrations are low. The character is usually calcium sulfate at high flows and calcium-magnesium-sodium sulfate at low flows.

The sparse historical data for other smaller tributaries indicate flows can be poor, with TDS concentrations of

TABLE 11
SURFACE WATER QUALITY, FILLMORE SUBAREA

In mg/L, unless otherwise noted

Parameter	Pole Creek*	Sespe Creek**	Santa Clara River: Near Santa Paula*** (3N/21W-12P)	Santa Clara River: At Atmore Rd+ (3N/20W-3A)	Santa Clara River: At Chambersburg Rd++ (4N/19W-31E)	Santa Clara River: Near fish hatchery+++ (4N/19W-34F)
Calcium	152-186	82-139	92-207	106	134	157
Magnesium	83-98	22-53	33-81	32	53	58
Sodium	78-138	50-97	52-150	56	85	94
Potassium	3.4-7.0	2.0-5.0	1.9-6.8	2.3	4.5	4.8
Bicarbonate	216-384	143-249	227-325	215	245	296
Sulfate	648-780	190-449	276-759	280	431	481
Chloride	15-18	11-123	25-67	26	40	48
Nitrate	0-1.4	0-8.6	1.7-24.0	2.0	6.0	9.6
Fluoride	0.7-1.9	0.8-1.3	0.6-1.5	0.9	0.9	1.0
Boron	0.5-1.0	0.5-2.6	0.4-2.3	--	--	0.9
Total dissolved solids	719-1,430	260-968	598-1,549	649	938	1,075
Electrical conductivity (umhos/cm)	1,080-1,700	370-1,260	867-2,059	900	1,200	1,175
Hydrogen ion concentration (pH)	8.0-8.3	7.5-8.2	7.4-8.5	8.2	8.0	7.6
Iron	0-1.0	0-0.1	--	ND	ND	ND
Manganese	0	0	--	ND	ND	ND
Nitrite	ND	ND	--	--	--	0.1
Total phosphate (as P)	0.4	--	--	0.03	0.07	0.07
Discharge (cubic feet per second)	0.4-30.0	0.3-1,480	6.5-750	20	1	--

ND = not detected
*Data represent 1 partial and 3 complete analyses from 4N/19W-30J and -19R for 1977-87.
**Data represent 59 partial analyses and 6 complete analyses from three sites for 1975-88.
***Data represent 22 complete analyses and 7 analyses complete except for bicarbonate for 1976-87.
+Board sampled May 1988.
++Board sampled March 1988.
+++Board sampled November 1987.

1,400 to 1,600 mg/L. The chemical character is different in the various creeks, ranging from sodium bicarbonate to calcium sulfate or sulfate-bicarbonate.

There did not appear to be any trend of a quality change. The seasonal changes in quality are to be expected. Threats to surface water quality include urban and agricultural runoff, agricultural erosion on hillsides, natural erosion in the watershed, and various point sources.

A point source within the subarea is the Fillmore Sewage Treatment Plant, which discharges 1.33 million gallons per day of treated domestic and industrial waste waters to the Santa Clara River. The Regional Board has designated this discharge as being a major threat to water quality.

Ground Water

Holocene alluvium, late Pleistocene alluvium and terrace deposits, and the Pleistocene San Pedro Formation form the ground water basin of the Fillmore Subarea. The surface area of the blanket of alluvial and terrace deposits is about 18,580 acres, or about 40 percent of the total subarea acreage. The thickness of the alluvial and terrace deposits ranges from 60 to 170 feet; that of the San Pedro Formation is as much as 4,000 feet (Mann, 1959, and Thomas, et al., 1954).

The boundaries of these deposits, which delineate the basin, are defined by structural and hydrologic features. The boundaries are shown on Figure 18.

The eastern boundary is the arbitrary division with the Santa Felicia Basin drawn at the fish hatchery. The western boundary is also an arbitrary line, about 1 mile east of the City of Santa Paula, in an area of a geologic and hydrologic constriction. The cross-sectional area of subsurface flow in the San Pedro Formation has been reduced by warping of the Santa Clara River syncline, thus producing a zone of perennial rising water.

The San Pedro Formation underlies practically all Fillmore Basin. Structurally, the formation is bounded on the south by the Oak Ridge fault, the trace of which is covered by alluvium, and on the north, east of Sespe Creek, by the San Cayetano fault. On the south side of the basin, the alluvium overlies an erosional bench cut into older rocks, which were thrust upward by the Oak Ridge fault.

In an area referred to as the Sespe Upland (Mann, 1959) in the northern part of the basin west of Sespe Creek, the basin boundary is the contact of the exposed, upturned basal beds of the San Pedro Formation with younger surficial materials. In the upland, the surficial materials are a complex of Pleistocene terrace and alluvial fan deposits and Holocene alluvial fan deposits. These deposits rest on an erosional surface cut on the San Pedro Formation, with a steep southerly slope. Because of the steep slope, runoff from the north percolates downward to the base of the surficial deposits and freely drains southward.

Ground water is unconfined, with some areas of partial confinement.

The direction of ground water flow depends upon where the water is. In the alluvium of the Santa Clara River and the underlying San Pedro Formation, ground water movement is westward. In the alluvium of Sespe Creek, movement is southwesterly. Ground water movement is largely southerly and downslope within the alluvial fan deposits of Sespe Upland, and within the underlying San Pedro Formation, movement is also southerly, but some is westerly (Mann, 1959). In the terrace deposits flanking South Mountain, ground water flow is northerly.

Water wells generally range from 150 to

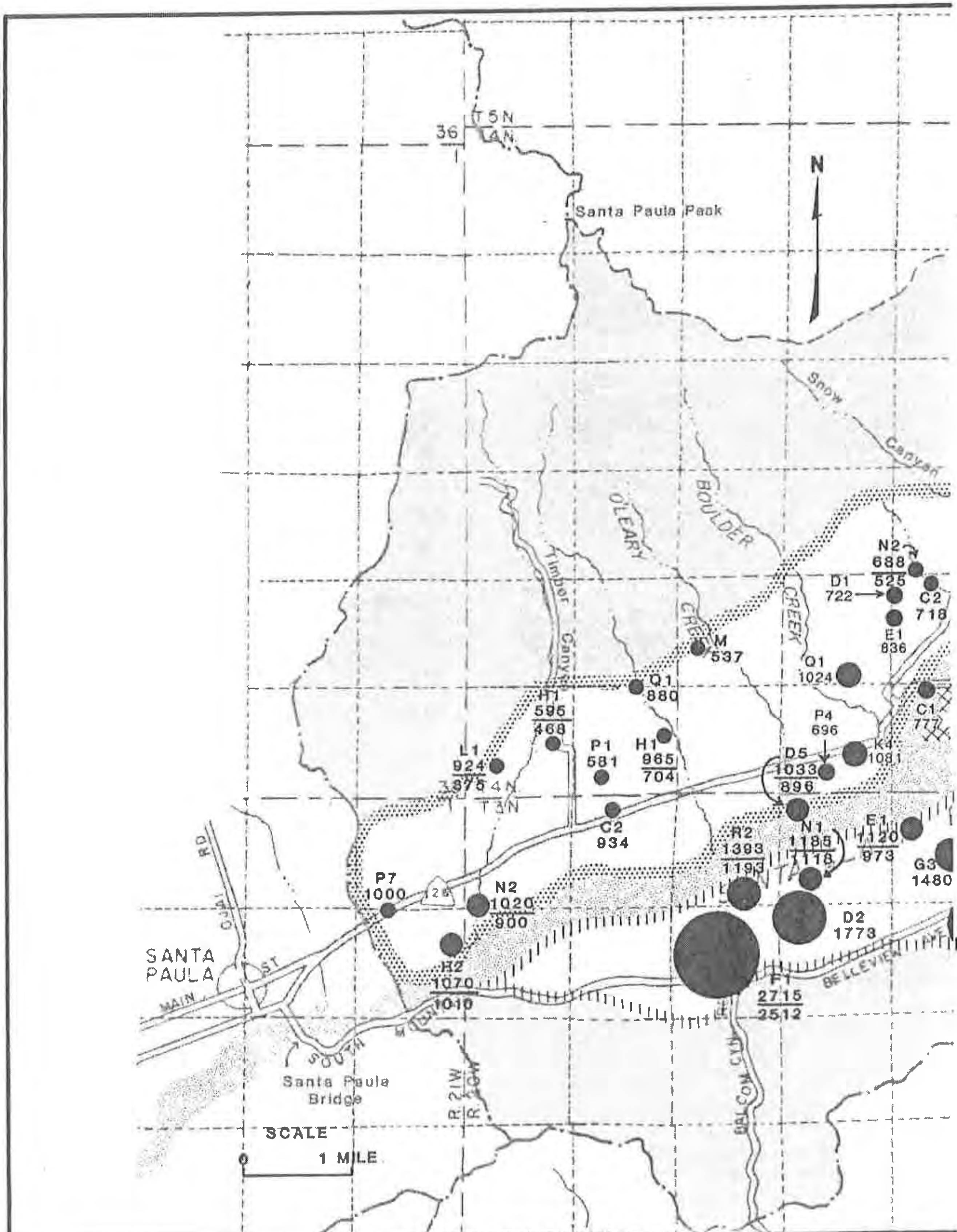
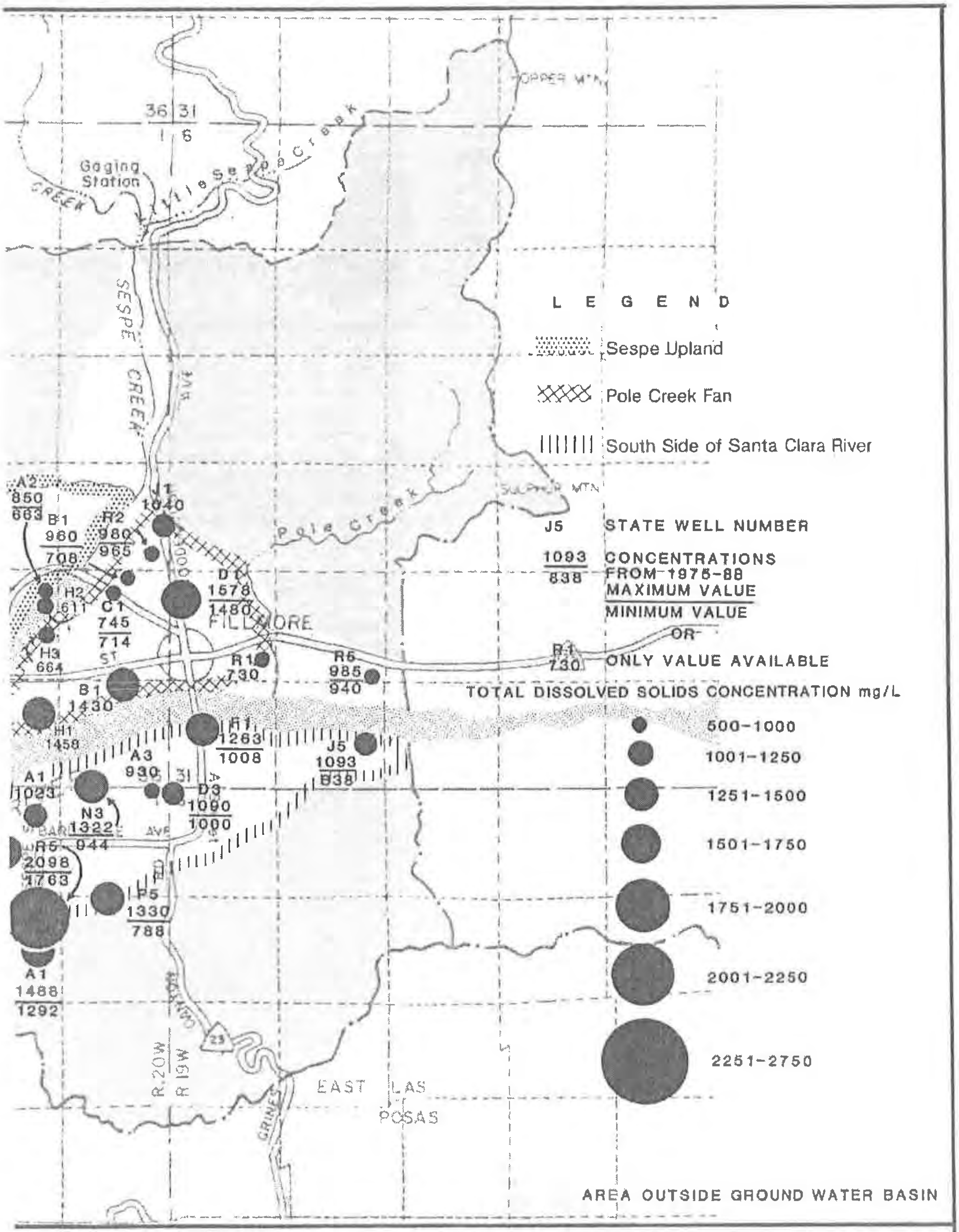


FIGURE 18 – CONCENTRATIONS OF TOTAL
FILLMORE



DISSOLVED SOLIDS IN WELL WATERS, 1975-88
SUBAREA

670 feet in depth, with only a few wells 1,000 feet deep. Yields are usually about 700 gallons per minute, but can be as high as 3,000 gallons per minute. The specific capacity of wells generally averages 50 gallons per minute per foot of drawdown.

The storage capacity of Fillmore Basin is about 7.3 million acre-feet, or about 1 million acre-feet in the top 1,000 feet of the basin. Specific yield is about 12 percent.

Recharge and Discharge. The primary natural recharge of Fillmore Basin is from percolation of the surface flows of the Santa Clara River and Sespe Creek (estimated yearly average of about 25,000 acre-feet, about 50 percent of total natural recharge). A smaller, but persistent source of recharge is subsurface inflow from Santa Felicia Basin (estimated average of 16,870 acre-feet per year). Recharge of the Sespe Upland is by percolation of surface flows from northern tributaries, such as Timber, Boulder, and O'Leary Creeks. A small amount of recharge for the basin comes from surface runoff from South Mountain. About 20 percent of the recharge comes from percolation of precipitation. The relatively impervious Tertiary rocks flanking the basin on the south may contribute some subsurface flows (of poor quality) to the alluvium.

Incidental recharge is from irrigation return water and treated waste water effluent.

Ground water is discharged from Fillmore Basin by both rising water and subsurface flows at the western boundary and by evapotranspiration losses to phreatophytes. Historically, outflow of rising water has averaged 27,500 acre-feet per year and subsurface outflow has averaged 5,400 acre-feet per year.

A significant amount of ground water is extracted to meet consumptive demands.

Quality. Ground waters of the Fillmore Subarea vary spatially in quality and chemical character; therefore, the basin can be divided into three subdivisions--Pole Creek Fan, South Side of Santa Clara River, and Remainder of Basin. In the Basin Plan, objectives were established for these subdivisions.

Figures 18-22 represent the concentrations of TDS, chloride, sulfate, boron, and nitrate from the ground water quality data collected for this study. In addition, the median and range of the maximum concentrations for all the constituents evaluated in the study are presented in Table 12 and graphed, along with data for the Santa Felicia and Sulphur Springs Subareas, in Figure 10.

The quality will be discussed for each subdivision. Figure 23 presents frequency distributions for current concentrations of selected constituents in each subdivision.

- The Pole Creek Fan has poor quality waters. The fan is a triangular area east of Sespe Creek and north of the Santa Clara River, composed of alluvial fan deposits unconformably overlying the San Pedro Formation. The City of Fillmore is located on the fan. Historical data indicate TDS concentrations were typically greater than 1,000 mg/L and ranged up to 1,600 mg/L in waters of the San Pedro Formation. Shallow alluvial waters were of poorer quality, with TDS concentrations of 1,900 mg/L. Sulfate concentrations ranged from 600 to more than 800 mg/L. Some wells had high nitrate and fluoride concentrations, possibly coming from native waters in the San Pedro Formation.

  Current data are limited, but indicate some ground waters still have TDS concentrations of up to about 1,600 mg/L. However, along the northwestern edge of the fan, ground waters have TDS concentrations of less than 1,000 mg/L. Sulfate continues to be the problem constituent, with concentrations exceeding 600 mg/L. The higher sulfate concentrations are found in the southern portion of the fan. Chloride and nitrate concentrations are within the criteria for beneficial uses. One well has boron concentrations greater than 1.0 mg/L. The chemical character of the waters is typically calcium sulfate.

Good quality flood flows of the Santa Clara River and Sespe Creek largely bypass this area, providing little recharge to ameliorate deterioration of ground waters, particularly shallow waters. Pole Creek, with its poor quality waters, recharges the ground waters of the fan. Other recharge sources causing degradation may be applied water returns and septic systems still in use. Also, the San Cayetano fault may act as a conduit for migration of poor quality deep waters toward the surface.

- The poorest quality waters in the Fillmore Subarea are found south of the Santa Clara River. These waters show a progressive deterioration in quality from east to west, but not uniformly so. The degradation can be attributed to irrigation return, oilfield brines, treated waste water effluent, and leakage from older rocks of South Mountain. Also the Oak Ridge fault may act as a conduit for migration of poor quality deep waters toward the surface. The poor quality waters appear to be largely found in the alluvial and terrace deposits. Most wells are shallow, perforating only these deposits and not the underlying San Pedro Formation. Historically, TDS concentrations have exceeded 3,200 mg/L (well 3N/20W-9F1). This same well currently has TDS concentrations that range from about 2,500 to 2,700 mg/L. A few wells extract waters with TDS concentrations of less than 1,000 mg/L.

  Sulfate, nitrate, and boron concentrations in many of the extracted waters continue to be problem constituents, exceeding the criteria for beneficial uses. Sulfate concentrations, in more than half the wells, measure greater than 600 mg/L and have measured over 1,400 mg/L historically; almost half the wells have boron concentrations of more than 1.0 mg/L; and about one-third of the wells have nitrate concentrations over 45 mg/L and up to 117 mg/L. Although not exceeding criteria for beneficial uses, chloride concentrations are higher in some wells in Sections 2 and 11, Township 3 North, Range 20 West. The chemical character of the waters is mostly calcium-magnesium-sodium sulfate.

- The best quality ground waters in the subarea are found in the Remainder of the Basin, where wells pump primarily from the San Pedro Formation. This subdivision receives significant recharge from surface flows of the Santa Clara River and Sespe Creek and, in Sespe Upland, from the northern tributaries.

  Because of the recharge from the northern tributaries, most of the ground waters of the Sespe Upland have a chemical character of calcium bicarbonate-sulfate or calcium sulfate-bicarbonate. The chemical character of the waters in the mainstream alluvium is largely calcium-magnesium-sodium sulfate.

  Historical evaluations of quality data for this subdivision recognized two areas--the mainstream alluvium

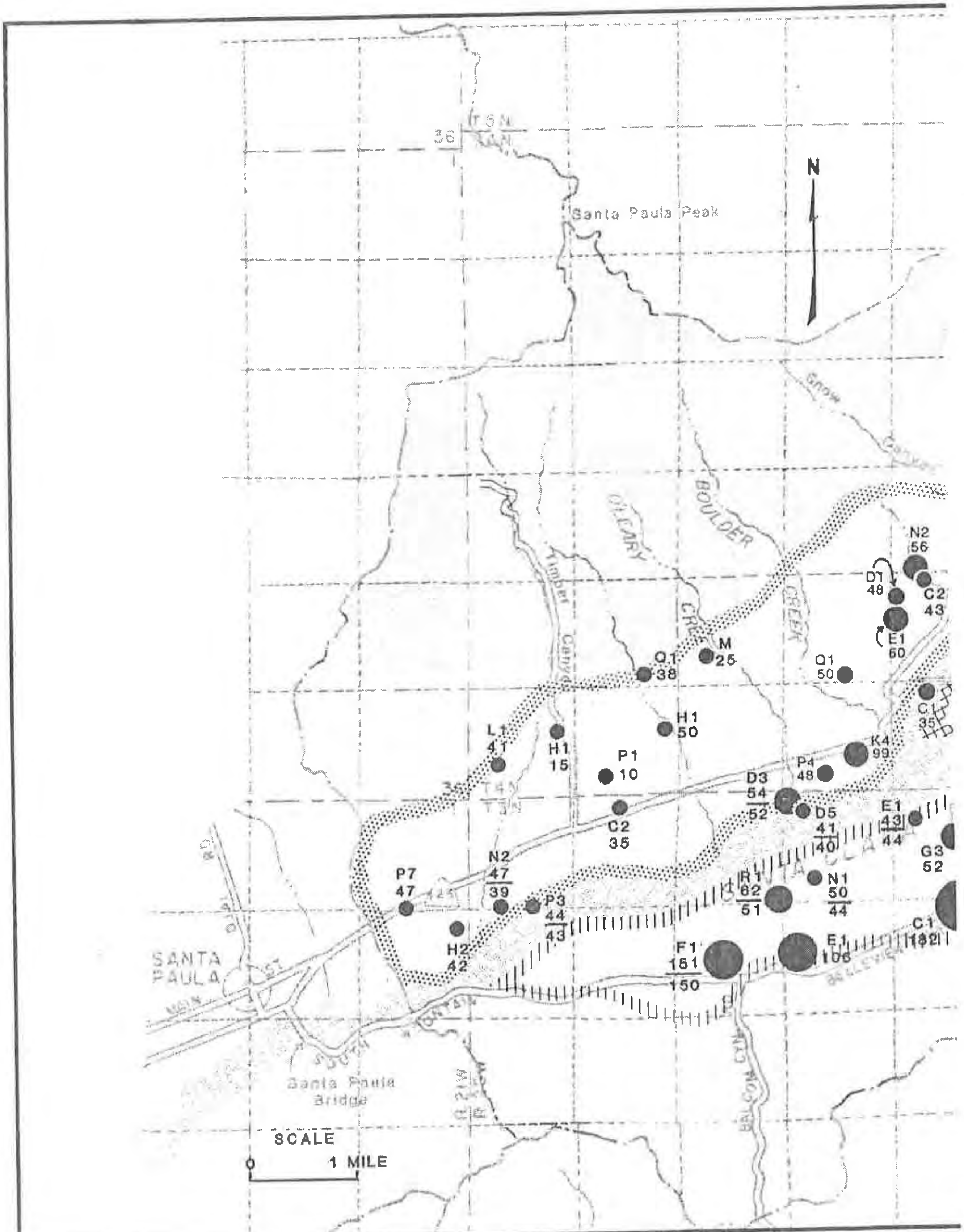
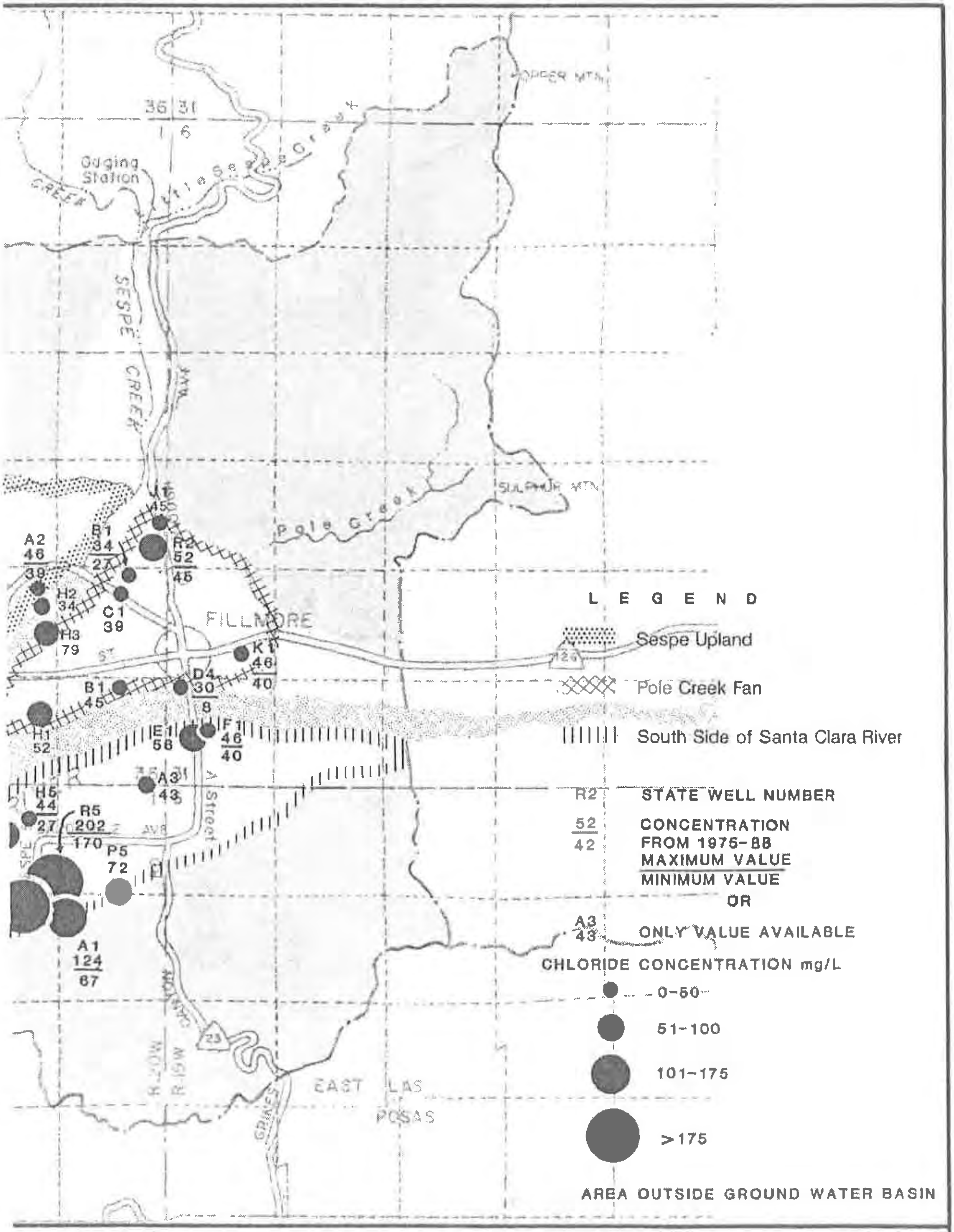


FIGURE 19 - CONCENTRATIONS OF
FILLMORE



CHLORIDE IN WELL WATERS, 1975-88
SUBAREA

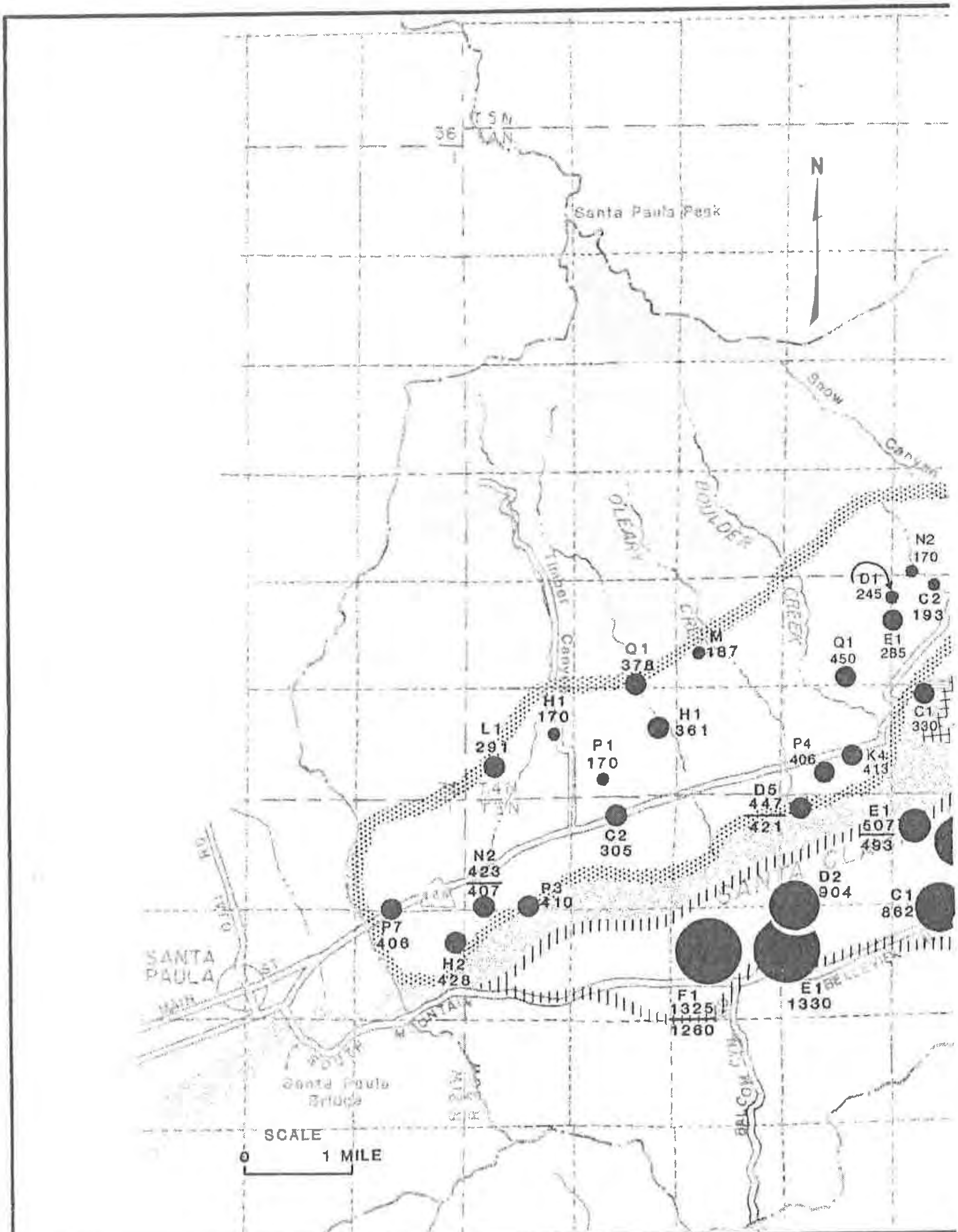
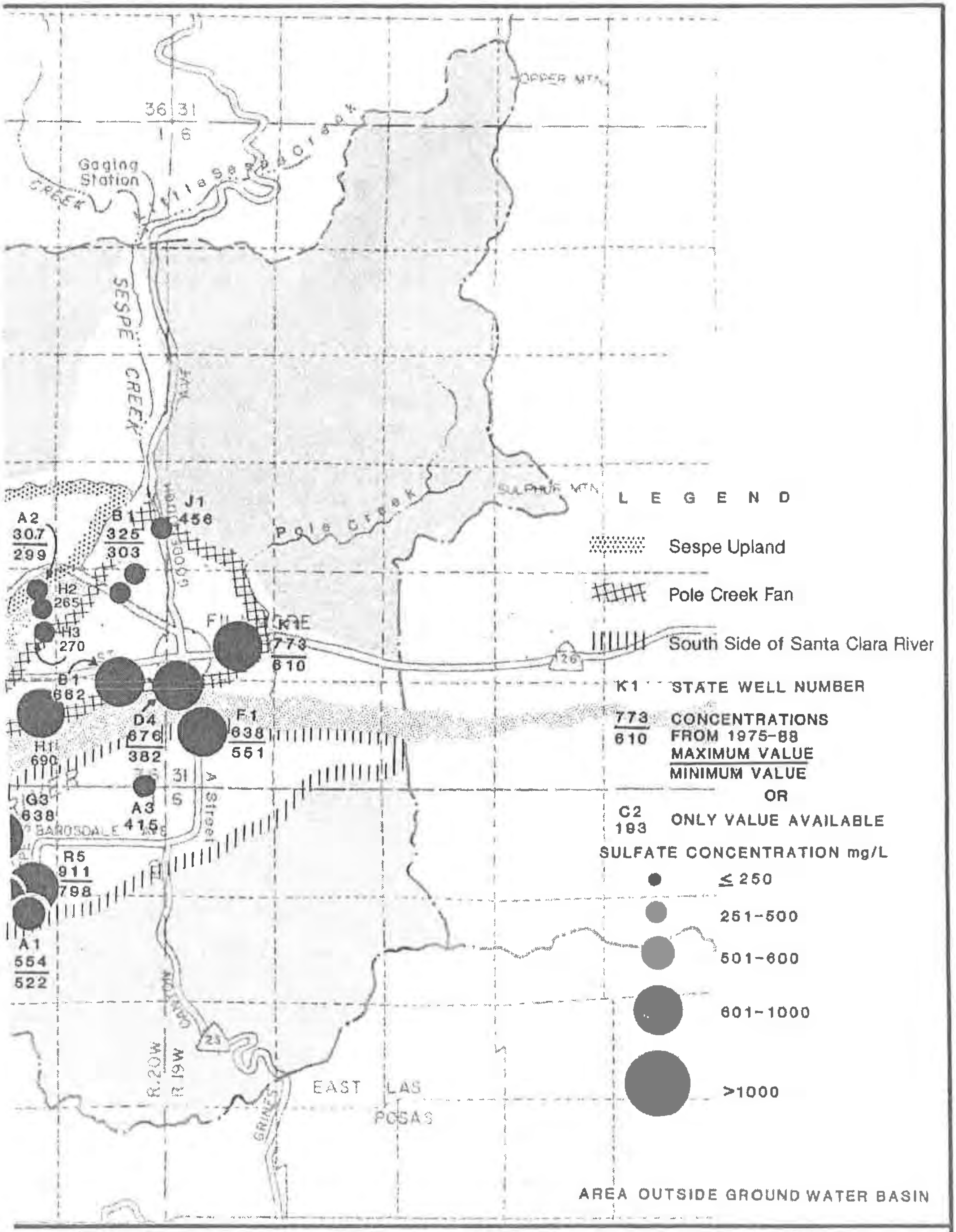


FIGURE 20- CONCENTRATIONS OF
FILLMORE



SULFATE IN WELL WATERS, 1975-88
SUBAREA

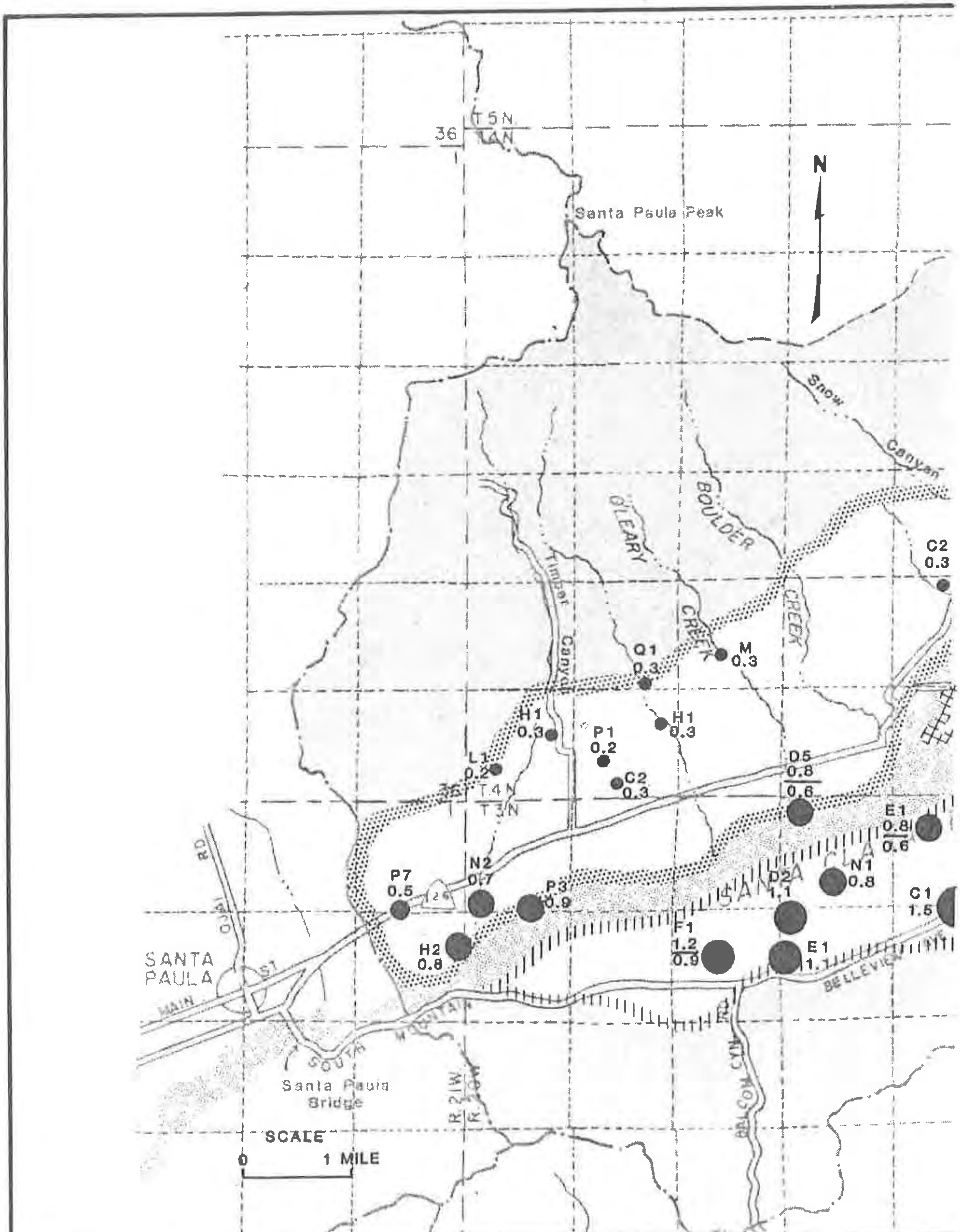
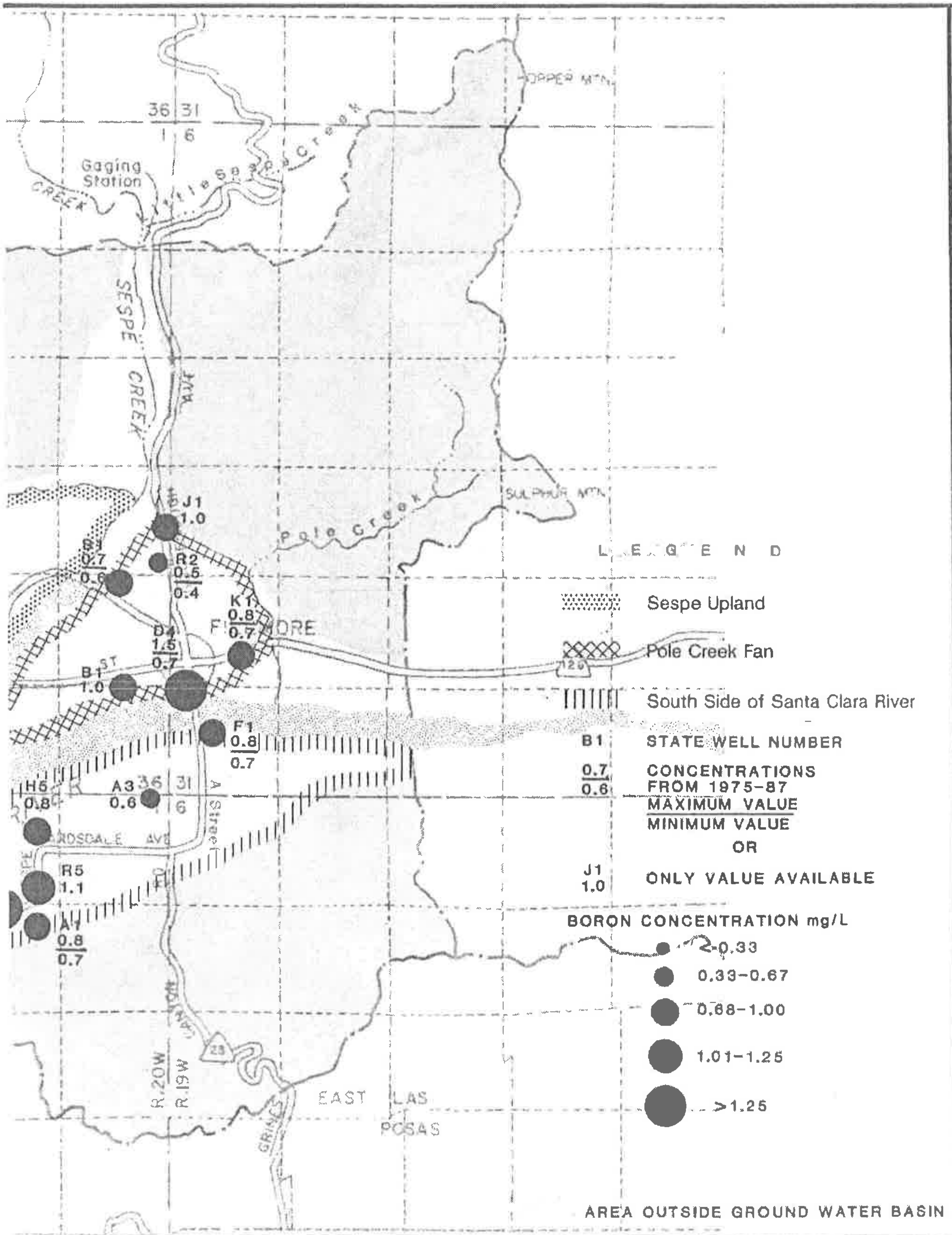


FIGURE 2.12 - CONCENTRATIONS OF
FILLMORE



BORON IN WELL WATERS, 1975-87
SUBAREA

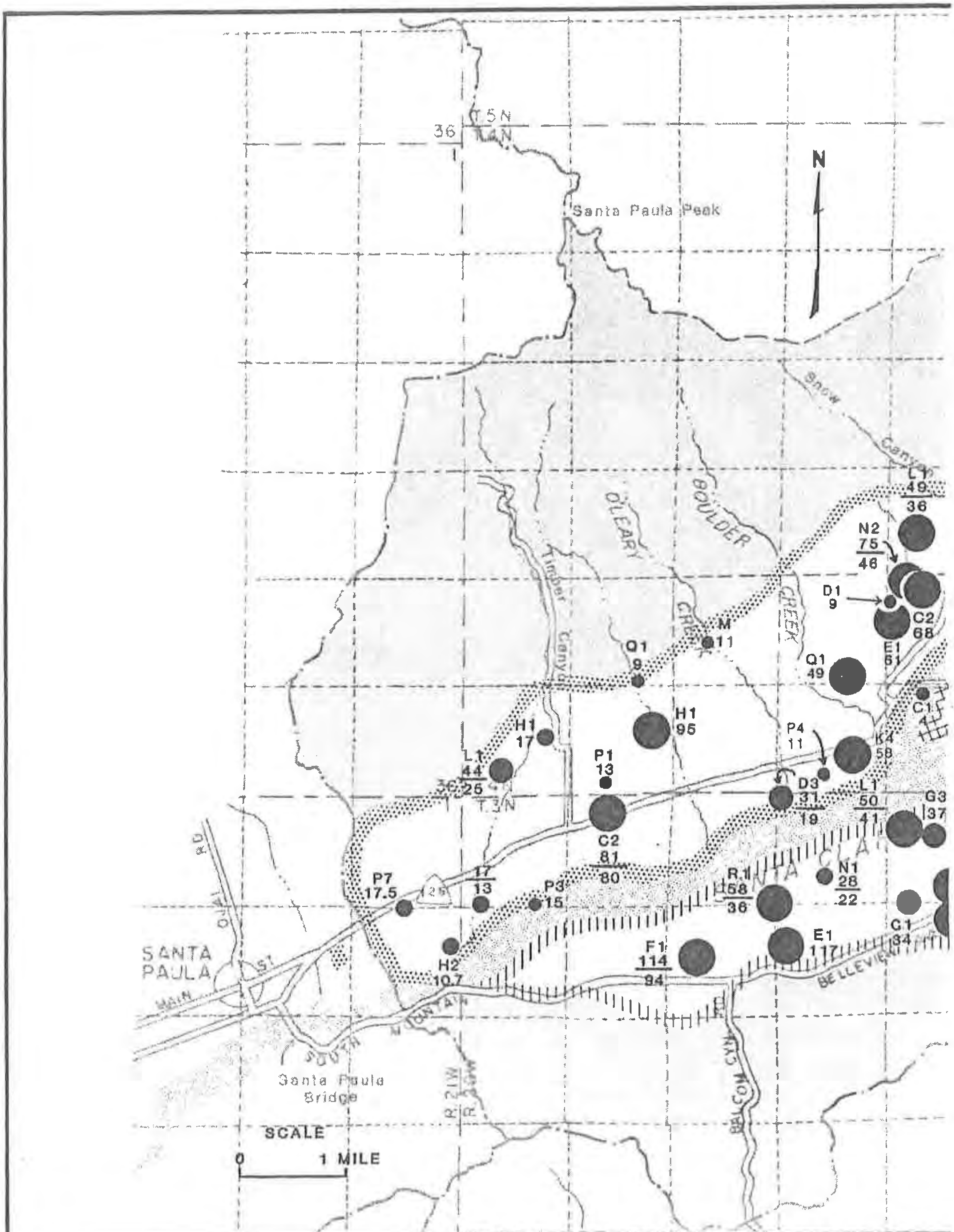
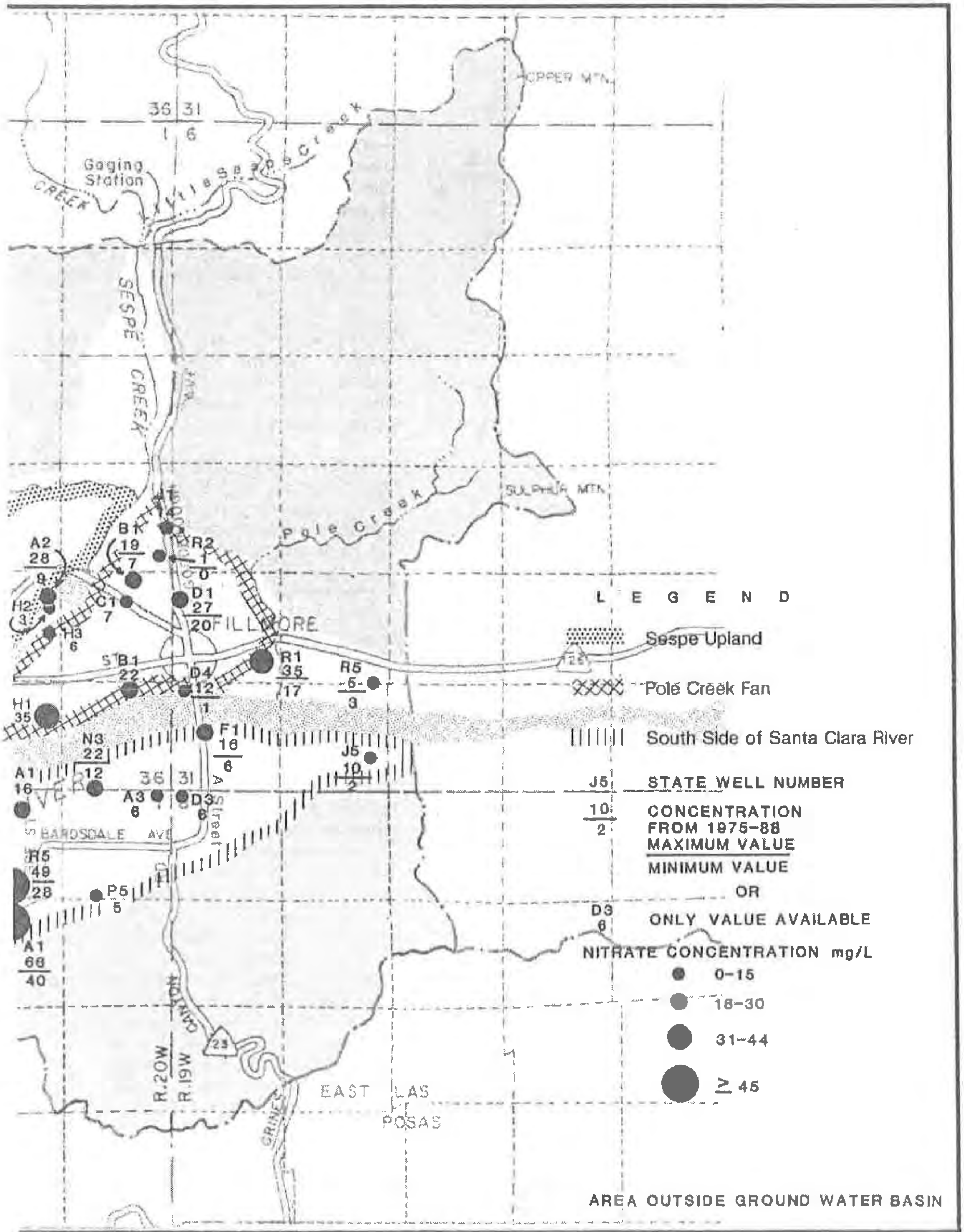


FIGURE 22 - CONCENTRATIONS OF FILLMORE



NITRATE IN WELL WATERS, 1975-88
SUBAREA

TABLE 12
MEDIAN AND RANGE OF CONCENTRATIONS OF SELECTED PARAMETERS IN WELL WATERS, 1975-88: FILLMORE SUBAREA

In mg/L, unless otherwise noted

Parameter	Median concentration	Range of concentrations
Calcium	150	80-360
Magnesium	46	7-144
Sodium	86	30-252
Potassium	4.0	0.2-15.0
Sulfate	412	170-1,330
Chloride	46	8-202
Nitrate	22	0-117
Fluoride	0.8	0.3-1.2
Boron	0.8	0.2-1.5
Total dissolved solids	1,023	468-2,715
Electrical conductivity (umhos/cm)	1,363	737-3,190
Hydrogen ion concentration (pH)	--	7.2-8.2
Iron	--	0-0.7
Manganese	--	0-0.22

and Sespe Upland. The mainstream alluvium is affected by inflows, both surface and ground waters, from Santa Felicia Subarea and Sespe Creek. Little ground water from the mainstream alluvium moves into the alluvial deposits of Sespe Upland.

Historical data for the mainstream alluvium show the quality of the ground water varying widely in response to fluctuations in recharge. TDS concentrations in wells varied over 600 mg/L. Wells in the alluvium at the eastern boundary of the basin had TDS concentrations ranging from 800 to 1,200 mg/L. TDS concentrations of alluvial outflow from the basin measured from about 700 mg/L to greater than 1,350 mg/L and sulfate concentrations from about 250 to 500 mg/L. During dry years, highly mineralized irrigation return waters may move slowly from the flanking alluvium into the mainstream alluvium, causing a deterioration in quality of those waters, which is reversed during wet years.

Historical quality data for the Sespe Upland indicate that mineralization of ground waters progressively increased westerly across the upland from Section 23 (T4N/R20W) near Sespe Creek, where TDS concentrations were about 500 mg/L, to near the western boundary of the basin, where TDS concentrations in wells degraded by irrigation return waters measured about 1,250 mg/L. At the western boundary in section 12 (T3N/R21W), ground waters seriously degraded by irrigation return waters had TDS concentrations almost as high as 3,500 mg/L. Sulfate concentrations were less than 500 mg/L. Nitrate concentrations were high, approaching 100 mg/L in some well waters. Either these waters were native San Pedro Formation waters or they had been degraded by irrigation return waters.

For this study, the current quality data for the subdivision "Remainder of the Basin" are from the Sespe Upland. Wells near the mainstream alluvium pump from the underlying San Pedro Formation. Well 4N/19W-33M2, considered by Mann (1968) as representative of alluvial underflow from Santa Felicia Basin, has one current sulfate measurement of 411 mg/L. No other current data for the mainstream alluvium were available.

Currently, the quality shows the same increasing mineralization of ground waters westerly across the upland from section 23, where TDS concentrations are about 600 to 800 mg/L, to the western boundary of the basin, where TDS concentrations exceed 1,000 mg/L. Sulfate concentrations measure less than 500 mg/L. Sulfate concentrations measure 0.3 mg/L or less near the mountain front, increasing to less than 1.0 mg/L near the western boundary. The main problem constituent continues to be nitrate. About 30 percent of the wells have nitrate concentrations over the 45 mg/L primary drinking water standard.

To evaluate any trend of quality deterioration in the basin, chloride hydrographs were plotted for three wells with long-term data records (Figure 24). The hydrographs show both increasing and decreasing trends of chloride concentrations. It appears that any quality trends are well specific and not basinwide.

The ground waters have always been substantially mineralized. Several factors have affected and continue to affect the quality. The largest quantity of salts is from natural conditions. These include: percolation of surface flows and precipitation, which leach minerals from the sedimentary formations in the watershed; subsurface inflows from Santa Felicia Basin; inflows of high sulfate waters from Wheeler and Aliso Canyons; evapotranspiration where rising water occurs; and a lack of diluting floodflows during dry seasons.

Development of the basin has further deteriorated the ground water quality. Of the human activities, the largest contributor to water quality problems is agriculture. The use of fertilizers, soil conditioners, and pesticides adds leachable salts to the lands. Evapotranspiration concentrates salts so that the salinity of irrigation return waters is typically more than twice that of the applied waters. Agriculture deteriorates the quality of the water not only by using it, but also by reusing it.

Other factors that deteriorate ground

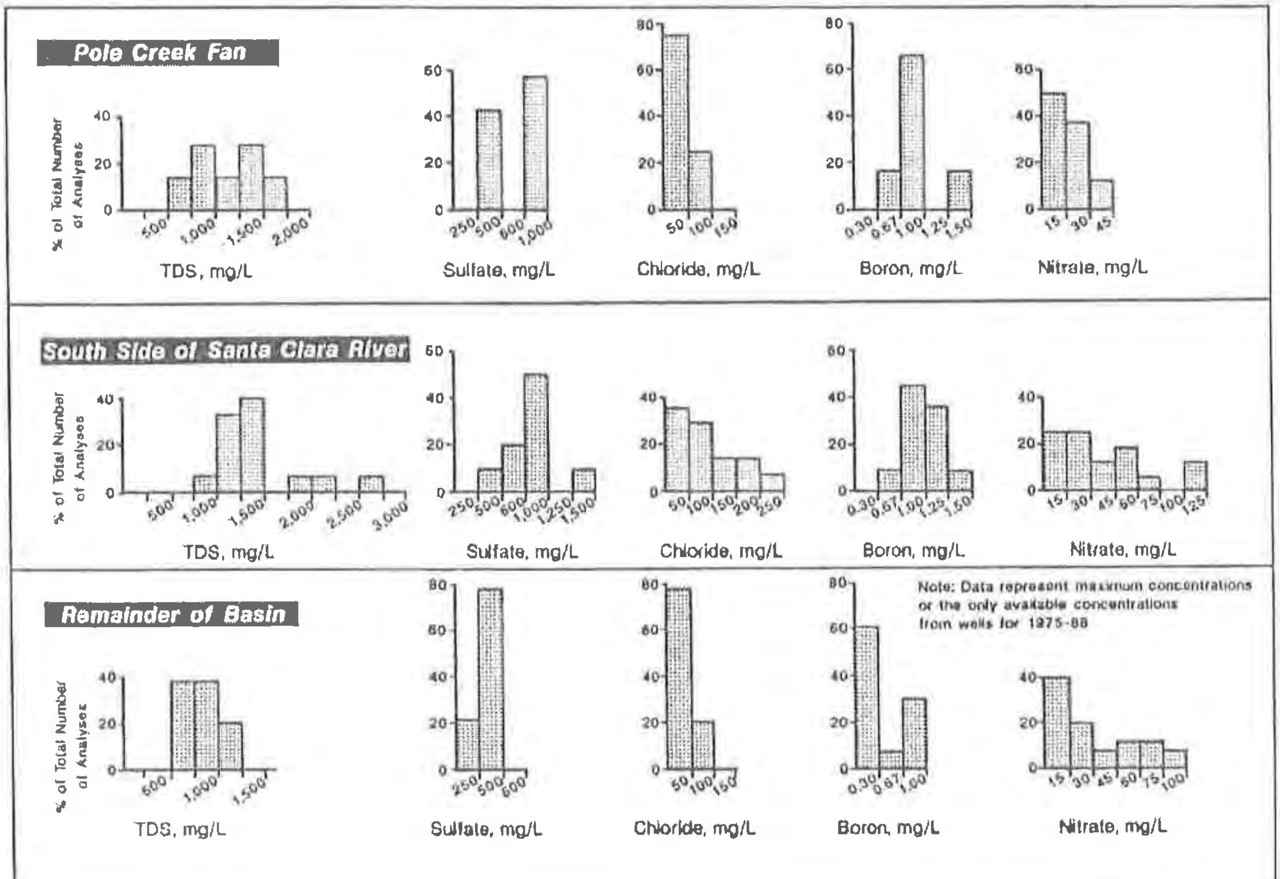


FIGURE 23 - FREQUENCY DISTRIBUTION FOR CONCENTRATIONS OF SELECTED CONSTITUENTS IN WELL WATERS, FILLMORE SUBAREA

water quality include municipal and industrial use and reuse, discharge of municipal and industrial waste water effluent, discharge of brine from oilfields, percolation of urban and agricultural runoff, and leaking of underground storage tanks.

Of the current waste dischargers in the subarea, the Fillmore Sewage Treatment Plant, 1.33 million gallons per day of domestic and industrial sewage (secondary treatment), was classified by the Regional Board as posing a major threat to water quality. The Toland Road Disposal Site, a nonhazardous solid waste disposal site, is also classified as posing a major threat.

Topatopa Hydrologic Subarea

The Topatopa Subarea encompasses 160,520 mountainous acres, or about 75 percent of the Sespe Hydrologic Area's total acreage, with numerous rugged slopes and canyon walls (Figure 1). Elevations range from about 2,500 feet to 7,510 feet at Reyes Peak. The subarea is undeveloped national forest land.

Sespe Creek flows in a narrow synclinal east-west trending graben between the Pine Mountain fault and the Santa Ynez fault, before turning southward at the juncture of those faults. In the upper reaches, Sespe Creek is joined by several small tributary creeks, which are bordered by moderately dense riparian vegetation. Mid-reach flows are through steep, narrow, boulder-lined canyons, with little or no riparian vegetation, but with many deep pools.

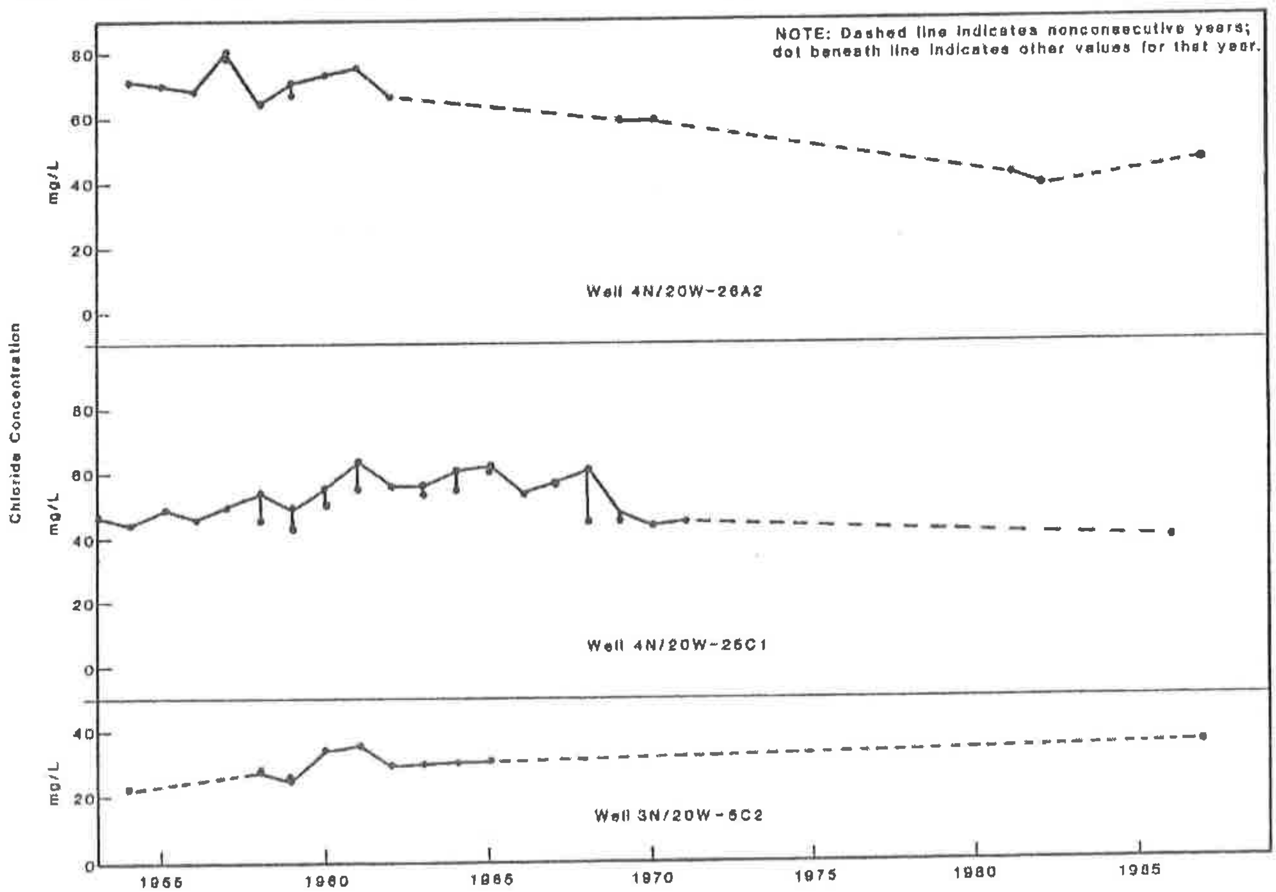


FIGURE 24 - CHLORIDE HYDROGRAPHS FOR SELECTED WELLS, FILLMORE SUBAREA

TABLE 13
SURFACE AND GROUND WATER QUALITY, TOPATOPA SUBAREA

In mg/L, unless otherwise noted

Parameter	Surface water		Ground water	
	1945-58*	1987-88**	1954-72***	1987-88+
Calcium	25-337	83-380	17-273	3-136
Magnesium	8-75	5-92	7-60	2-43
Sodium	6-310	38-252	30-324	15-171
Potassium	1.0-6.0	2.0-10.3	1-4	0.2-3.0
Bicarbonate	87-325	154-299	51-432	267-370
Sulfate	40-1,110	210-1,283	0-824	21-355
Chloride	5-272	13-214	5-291	7-29
Nitrate	0-4	ND-1.5	0-3	ND-1.4
Fluoride	0.2-2.2	0.4-10.3	0.2-10.0	0.1-1.1
Boron	0-11.6	0.3-10.3	0.1-14.0	ND-0.6
Total dissolved solids	361-1,976	513-2,252	368-1,850	305-787
Electrical conductivity (umho/cm)	398-2,170	755-2,980	658-2,296	500-1,100
Hydrogen ion concentration (pH)	7.2-8.5	7.5-8.1	7.4-8.2	6.8-8.7
Nitrite	--	ND-0.53	--	--
Total iron	--	ND	--	--
Manganese	--	ND	--	--
Total phosphate (as P)	--	ND-0.06	--	--

ND=not detected.
*Data represent 46 analyses from 12 sample locations; discharge ranged from 0.28 to 8,000 cubic feet per second.
**Board sampled at 5 sites in Fall 1987 and 1 site in May 1988 (estimated discharge in May was 25 cubic feet per second).
***Data represent 16 analyses from 10 wells and one spring.
+Data represent 1 analysis in May 1987 of well 5N/22W-5A1 and 8 analyses from Board's sampling in July and September 1988.

In this regional anticline are more than 22,000 feet of predominantly marine, stratified sedimentary rocks, ranging in age from mid-Miocene to Upper Cretaceous (Merrill, 1952). Thin alluvium can be found in a few short sections of the Sespe Creek channel.

Surface Water

The Regional Board sampled surface waters in the fall of 1987 at three locations along Sespe Creek and two tributaries of the creek--Hot Springs and Little Sespe Creeks--and in May 1988 at one location on Sespe Creek. These six analyses are the only current data for this study. Table 13 shows the range in concentrations for the various constituents both for the current samples and for historical data. Higher flows typically had the lower concentrations for the constituents. Appendix B lists the analyses of the Regional Board's samples.

The chemical character of the waters reflects the older marine sedimentary rocks of the subarea. The predominant cation is calcium and the predominant anion is sulfate; chloride is a secondary anion in two samples (Hot Springs Creek and Sespe Creek above its confluence with Little Sespe Creek). Historical data show that, at times during high flows, bicarbonate became the predominant anion.

The poorest quality surface waters measured, both past and present, are from Little Sespe Creek, which flows in an area of oilfields. Sulfate content was measured as high as 1,283 mg/L, and

TDS content as more than 2,200 mg/L.

Hot Springs Creek is a major source of increased fluoride and boron concentrations found in Sespe Creek waters downstream of the confluence of the two creeks. In 1987, the concentrations of fluoride and boron both measured 10.3 mg/L in Hot Springs Creek, and they measured 1.2 and 2.6 mg/L, respectively, in Sespe Creek below Hot Springs Creek. This represents a significant increase from the upper reaches of Sespe Creek, where fluoride and boron concentrations were 0.6 to 0.7 mg/L and 0.3 to 0.5 mg/L, respectively.

Historical and current surface water quality are essentially the same. The quality appears to have had no variations beyond the spatial and temporal that operate in the drainage system. The quality would vary chiefly as a function of geologic and hydrologic characteristics of the watershed, waste discharges, and natural degradation and pollution.

In the subarea, waters with higher flows generally meet quality requirements for existing and potential beneficial uses. For low flows and waters of Hot Springs and Little Sespe Creeks, the concentrations of sulfate, fluoride, boron, and TDS may exceed recommended limits for drinking water and irrigation. At times, the high fluoride concentrations (greater than 1.5 mg/L) may impair migration, spawning, warm, cold, and wildlife freshwater habitat beneficial uses (Appendix D).

Ground Water

The few wells in the Topatopa Subarea are found near Sespe Creek. Except for one well sampled in 1987, ground waters were last sampled in 1972. Therefore, the Department noted this subarea as in need of sampling in its memorandum of August 14, 1987, to the Regional Board (Appendix B). The Board sampled eight wells in 1988. The current data, plus historical data, are in Table 13.

The analyses of the ground water indicate that generally in the upper reaches of the watershed, the predominant cation is sodium and the predominant anion is either bicarbonate or sulfate. In the middle reaches of the watershed, the predominant cation is calcium and the predominant anion is bicarbonate. The chemical character of Sespe Hot Springs is sodium chloride.

The water quality data show the spatial variability of ground waters in the subarea. Ground waters in Section 18, Township 6 North, Range 23 West were the poorest, with TDS content ranging from 1,280 to 1,850 mg/L and sulfate content from 528 to 824 mg/L. The Hot Springs water (Section 22, Township 6 North, Range 20 West) had fluoride and boron contents of 10.0 and 14.0 mg/L, respectively; TDS content of more than 1,100 mg/L; and sodium content of more than 300 mg/L. The quality data from the remaining wells sampled in the subarea showed no significantly high concentrations of constituents, except possibly sulfate, which was measured up to 394 mg/L (TDS content ranged from 368 to 806 mg/L).

The quality of ground waters throughout the subarea has not significantly changed over time. The quality fluctuates in response to hydrogeologic and hydrologic phenomena. Land use and waste discharges have probably not had any significant impact.

Generally, ground waters of Topatopa Subarea meet the requirements for their existing and potential beneficial uses. The concentrations of sulfate, chloride, fluoride, boron, and TDS in waters from Sespe Hot Springs exceed recommended limits for drinking water and irrigation. Also, ground waters found in Section 18, Township 6 North, Range 23 West have concentrations of sulfate and TDS that exceed the recommended limits for beneficial uses.