DISTRIBUTION OF WELLS IN THE CENTRAL PART OF THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA

By *Jo Ann M. Gronberg, Kenneth Belitz,* and *Steven P. Phillips*

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 89-4158

REGIONAL AQUIFER SYSTEM ANALYSIS

Prepared in cooperation with the

SAN JOAQUIN VALLEY DRAINAGE PROGRAM

Sacramento, California
1990

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This report was prepared by the U.S. Geological Survey in cooperation with the San Joaquin Valley Drainage Program and as part of the Regional Aquifer-System Analysis (RASA) Program of the U.S. Geological Survey.

The San Joaquin Valley Drainage Program was established in mid-1984 and is a cooperative effort of the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, and California Department of Water Resources. The purposes of the program are to investigate the problems associated with the drainage of agricultural lands in the San Joaquin Valley and to develop solutions to those problems. Consistent with these purposes, program objectives address the following key concerns: (1) public health, (2) surface- and ground-water resources, (3) agricultural productivity, and (4) fish and wildlife resources.

Inquiries concerning the San Joaquin Valley Drainage Program may be directed to:

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Sacramento, California 95825-1898

The RASA Program of the U.S. Geological Survey was started in 1978 following a congressional mandate to develop quantitative appraisals of the major ground-water systems of the United States. The RASA Program represents a systematic effort to study a number of the Nation's most important aquifer systems, which in aggregate underlie much of the country and which represent an important component of the Nation's total water supply. In general, the boundaries of these studies are identified by the hydrologic extent of each system, and accordingly transcend the political subdivisions to which investigations were often arbitrarily limited in the past. The broad objectives for each study are to assemble geologic, hydrologic, and geochemical information, to analyze and develop an understanding of the system, and to develop predictive capabilities that will contribute to the effective management of the system. The Central Valley RASA study, which focused on the hydrology and geochemistry of ground water in the Central Valley of California, began in 1979. Phase II of the Central Valley RASA began in 1984 and is in progress. The focus during this second phase is on more detailed study of the hydrology and geochemistry of ground water in the San Joaquin Valley, which is the southern half of the Central Valley.

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CONVERSION FACTORS

For readers who prefer to use International System (SI) units, rather than the inch-pound terms used in this report, the following conversion factors may be used:

Multiply inch-pound units	By	To obtain SI units
acre	4,047	square meter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

Information from 5,860 wells in the central part of the western San Joaquin Valley, California, was collected from several sources and compiled into a common data base. Only 2,547 wells had sufficient information for classification into four categories based on the hydrogeology: wells perforated in the semiconfined zone at depths less than or equal to 50 feet, wells perforated in the semiconfined zone at depths greater than 50 feet, wells perforated in the semiconfined and confined zones, and wells perforated only in the confined zone. Additionally, wells perforated in the semiconfined zone at depths greater than 50 feet were classified by the type of deposits in which they were perforated (Coast Range alluvium or Sierran sand). A computerized data base system was developed to manage well information and to facilitate characterizing the nature and distribution of the wells.

Wells perforated in the semiconfined zone at depths less than or equal to 50 feet are evenly distributed over part of the study area underlain by shallow ground water. These wells generally are used as observation wells.

Most wells perforated in the semiconfined zone at depths greater than 50 feet are perforated in the Sierran sand. This concentration of wells perforated in the Sierran sand indicates a tendency for using the Sierran sand, where it exists, as a source of water.

There are 533 wells perforated in both the semiconfined and confined zones and 410 wells perforated only in the confined zone. Most of these wells are upslope of the valley trough in areas where the Sierran sand is not present. Wells perforated only in the confined zone are concentrated near the creeks.

INTRODUCTION

The San Joaquin Valley, California, is one of the most productive agricultural areas in the United States. However, agriculture in large parts of the valley may be adversely affected by high levels of selenium and other soluble trace elements that occur in soil, ground water, and agricultural drain water. The occurrence and movement of soluble chemical constituents is related to the movement of ground water in which they are dissolved. Thus, the ground-water flow system must be understood in order to manage these constituents.

Many wells have been drilled in the San Joaquin Valley to supply water for agriculture and to monitor water levels. The large data base available for these wells (for example, water levels, depth, construction information, use) is variable in detail and quality. The large quantity of inconsistent data is difficult to use, especially when specific information is needed. A key component in developing an understanding of the ground-water flow system is the compilation of information from these wells and the synthesis of that information to characterize the system.

This report presents an overview of the compilation and synthesis of information from wells in a part of the San Joaquin Valley, California. The study area is between Los Banos and Kettleman City in the central part of the valley (fig. 1). It is bounded on the west by the Coast Ranges and on the east by the San Joaquin River and the Fresno Slough. Some of the wells included in this report are outside the boundaries of the study area.

Well information collected from several agencies was compiled into a common data base. These wells then were classified into categories based on the hydrogeology of the ground-water flow system. Each category is represented by a location map and a well list. The map illustrates the areal distribution of the wells in a category. It is not meant to provide construction information for a particular well. Instead, the well list can be used in conjunction with the computer programs provided in this report to access and retrieve specific information for a particular well without manually searching through the voluminous data base. The actual data are not presented but are available on request for review at the California district office of the U.S. Geological Survey.

The distribution of the wells is used further to compile information about the ground-water flow system and drilling practices in the western San Joaquin Valley. This information can be used as a starting point for further hydrologic investigations in the San Joaquin Valley.

This study is part of a comprehensive investigation by the U.S. Geological Survey of the hydrology and geochemistry of the San Joaquin Valley. The studies are being done as part of the Regional Aquifer System Analysis Program of the U.S. Geological Survey in cooperation with the San Joaquin Valley Drainage Program. The authors would like to thank the following agencies for providing data and assistance: U.S. Bureau of Reclamation, California Department of Water Resources, and Westlands Water District.

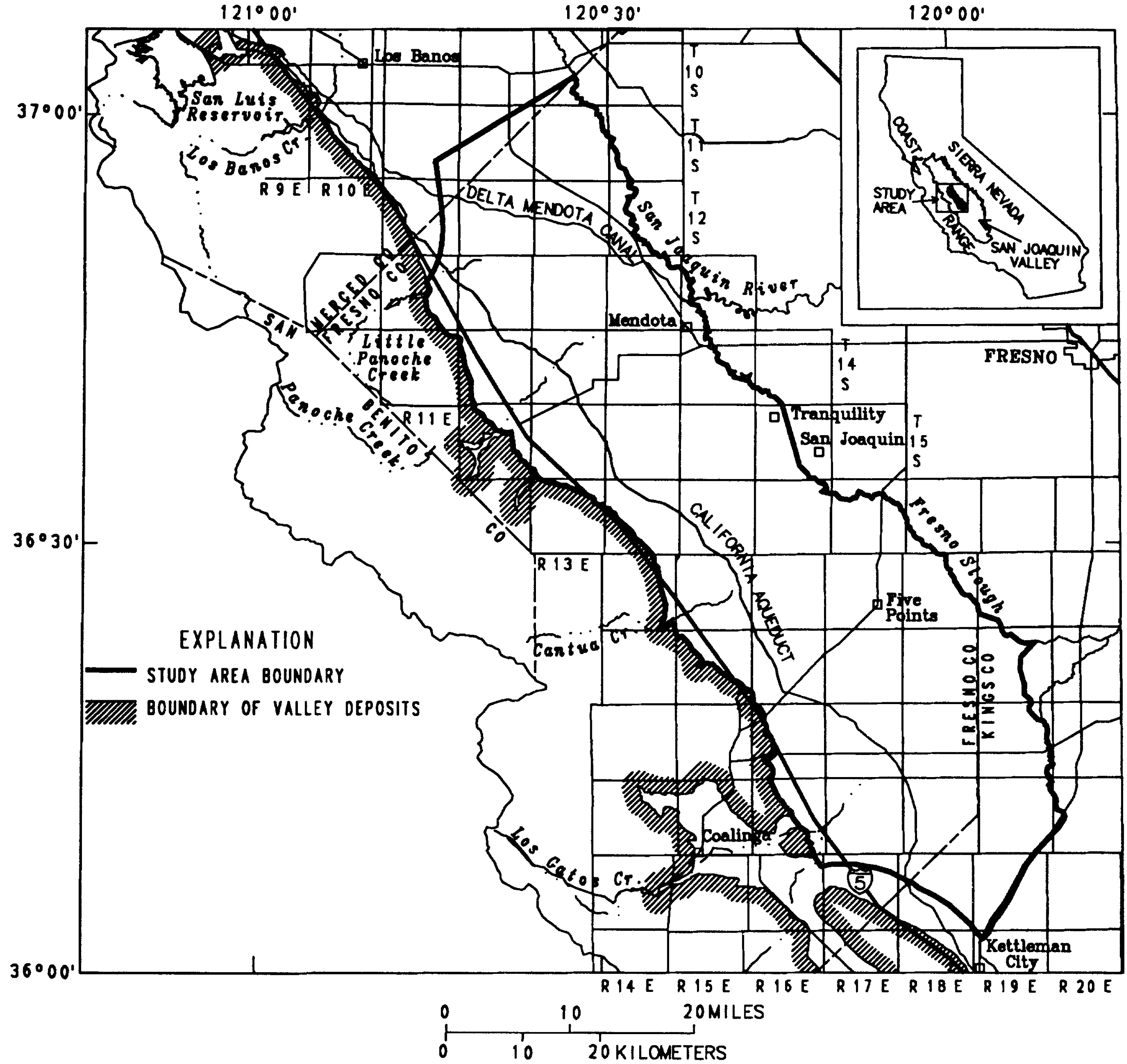

Figure 1. *Location of study area.*

HYDROGEOLOGY

The San Joaquin Valley is underlain by several thousand feet of unconsolidated sediments. The upper several hundred to more than 1,000 feet of these sediments contain primarily fresh ground water (Gilliom and others, 1989, p. 13). The Pleistocene Corcoran Clay Member of the Tulare Formation divides the ground-water flow system into an upper semiconfined zone and a lower confined zone. In the semiconfined zone, three hydrogeologic units can be recognized: Coast Range alluvium, Sierran sand, and flood-basin deposits (fig. 2).

The Coast Range alluvium consists of poorly sorted alluvial-fan deposits derived from the Coast Ranges to the west. The thickness ranges from 850 feet near the Coast Ranges to 0 feet along the valley trough (Page, 1986). Textures range from more than 80 percent sand and gravel in the fanhead regions to more than 80 percent silt and clay in the distal regions (Laudon and Belitz, 1989).

As the Coast Range alluvium thins to the east, it interfingers with sediment derived from the Sierra Nevada. At depth, the Sierran deposits are primarily well-sorted micaceous sand. The Sierran sand is as much as 500 feet thick in the valley trough and thins to the east and west.

Flood-basin deposits form a thin layer (5 to 35 feet thick) over the Sierran sand in the valley trough. They are primarily composed of clays derived from the Coast Ranges and the Sierra Nevada.

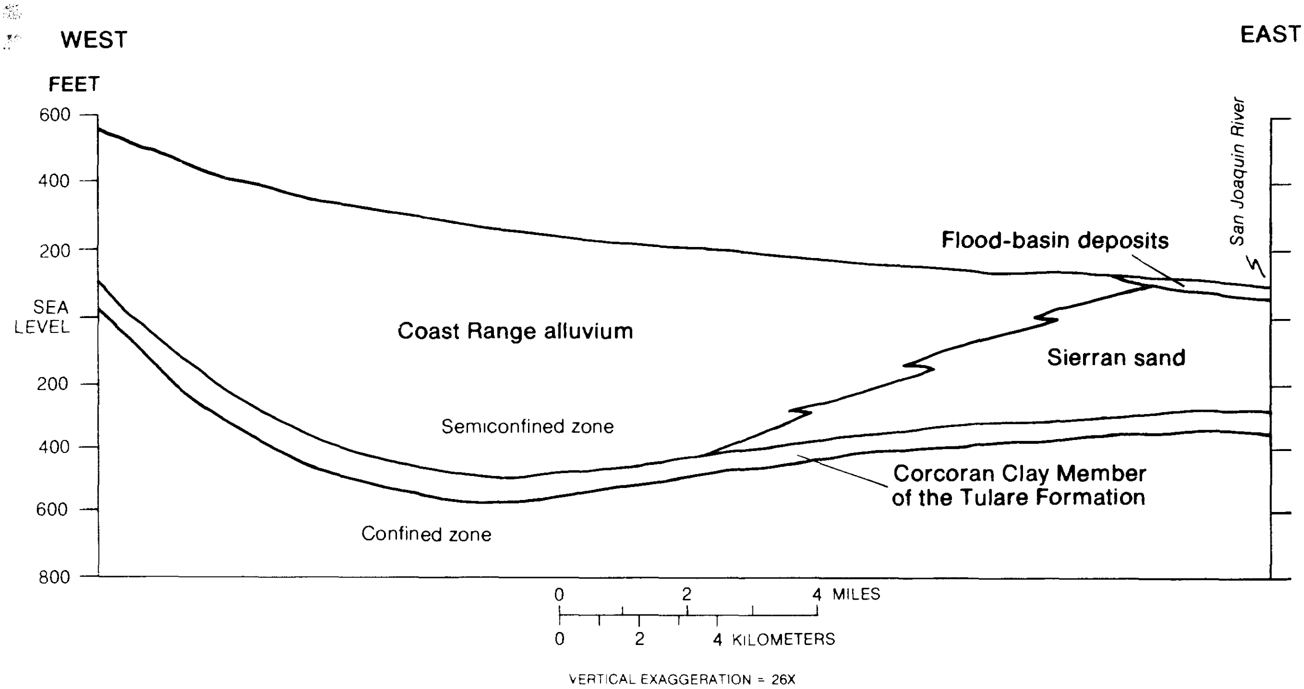

Figure 2. *Generalized hydrogeologic section of the study area perpendicular to the axis of the San Joaquin Valley.*

The Corcoran Clay Member of the Tulare Formation, which separates the semiconfined and confined zones, consists of silty clay to clayey silt in the upper two-thirds of the unit, and sand-silt-clay to clayey silt in the lower one-third (Bull, 1975). The base of the unit ranges from more than 850 feet in depth along the Coast Ranges to 400 feet along the valley trough (Bull and Miller, 1975). The Corcoran ranges in thickness from 20 to 120 feet (Miller and others, 1971).

The lower confined zone below the Corcoran consists of poorly consolidated flood-plain, deltaic, alluvial-fan, and lacustrine deposits of the Tulare Formation. The confined zone extends several hundred feet below the Corcoran before saline water is encountered.

For more information on the hydrogeology of the study area see Belitz (1988) and Gilliom and others (1989).

WELL INFORMATION

Well information was assembled from several sources: the U.S. Bureau of Reclamation, California Department of Water Resources, Westlands Water District, and the U.S. Geological Survey. Additional information on well depths and perforations was obtained from the Survey's Ground Water Site Inventory data base, well logs from the Survey's files, and information found in Ireland (1963) and LeBlanc (1970).

The wells are identified according to their location in the rectangular system for the subdivision of public land, the Public Land Survey System. The identification consists of the township number, north or south; the range number, east or west; and the section number. The section is further subdivided into 16 tracts of 40 acres each consecutively lettered (excepting 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. Wells within the 40-acre tract are numbered sequentially. An example of a well identification is 13S13E13D01. All wells are reinforced to the Mount Diablo base line and meridian. This well-numbering system is shown in figure 3.

For consistency, all data were converted to a format used by the Bureau of Reclamation. The format consists of a well header, followed by water-level measurements. Each well header has a location by township, range, section, and quarter-quarter section, and when available, well depth and period of record for the water-level measurements. Water-level entries include measuring-point altitude, land-surface altitude, depth to water from measuring point, depth to water from land surface, and water-surface altitude. Water levels are recorded on several different schedules: monthly, quarterly, biannually, or miscellaneous measurements. The entire data base can be examined at the California District office of the U.S. Geological Survey.

Because of the large quantity of data, several Fortran programs were written to systematically search the data base for wells by location, depth, and period of record. These programs (Data_Recovery, Strip_Headers, Depth_Sort, Strip_Loc, Date_Select, WL_Diff) are described and presented in the Appendix, Sample Data and Program Documentation, at the back of this report.

A geographic information system data base also was created to store well-construction information and to provide a spatial reference for the data.

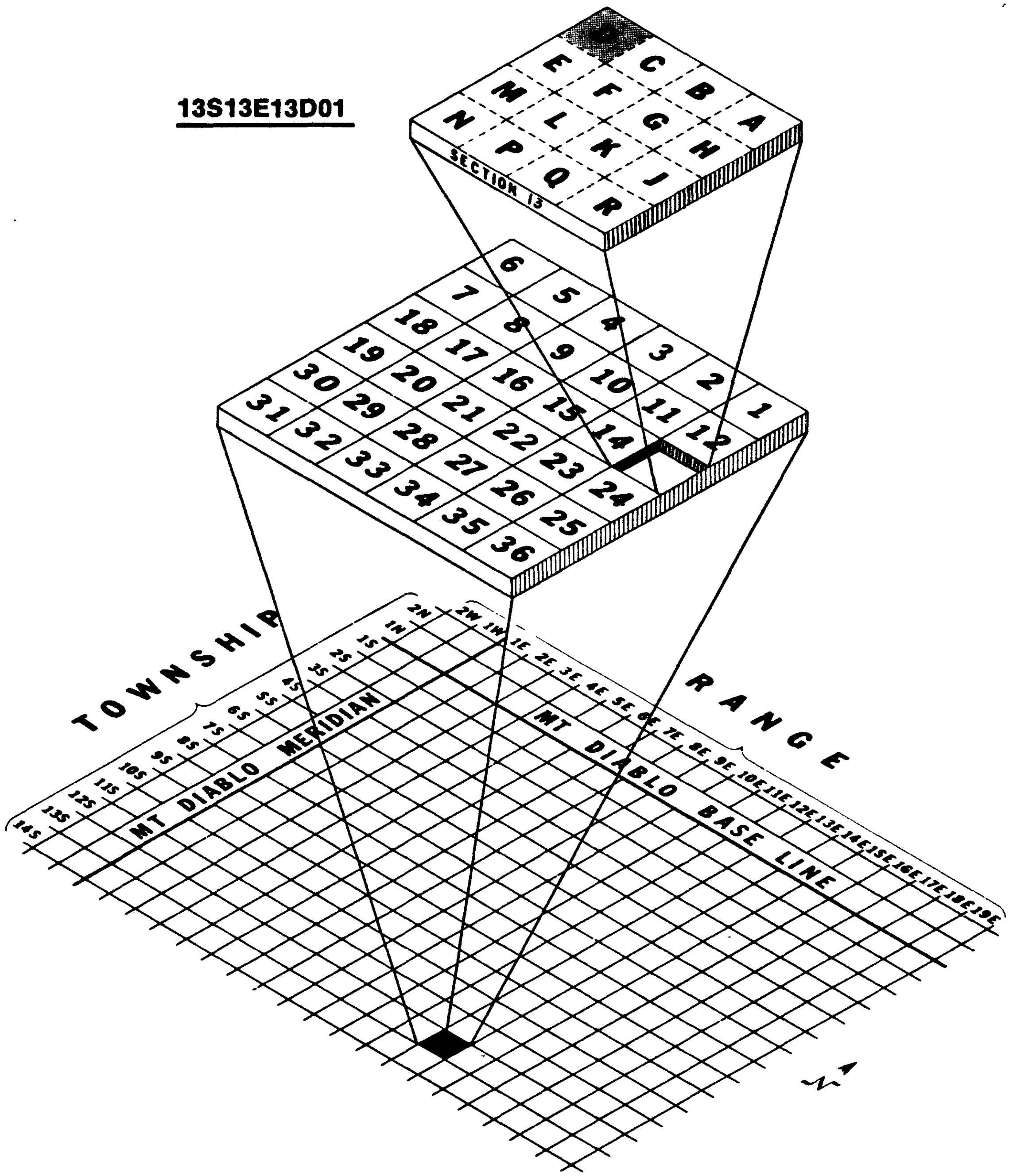

Figure 3. *Well-numbering system.*

DISTRIBUTION OF WELLS

The data base contains information from 5,860 wells. This report focuses on wells within the previously described study area, which limits the data set to 4,715 wells. Of these 4,715 wells, 3,050 wells have depth information and 1,407 have perforated length information. However, only 2,547 wells have sufficient information on depth and perforated length for classification into hydrologically useful categories. Four such categories were identified: (1) wells perforated in the semiconfined zone at depths less than or equal to 50 feet, (2) wells perforated in the semiconfined zone at depths greater than 50 feet, (3) wells perforated in the semiconfined and confined zones, and (4) wells perforated only in the confined zone. (See table 1 for additional detail). An additional 253 wells were drilled below the Corcoran Clay Member of the Tulare Formation, but perforation information was not available to help determine which zones they were perforated in. Also, 267 wells are in areas where the Corcoran is not present.

A discussion of these categories is presented in the following sections. Each section describes the wells and their location in the semiconfined and confined zones. Maps of well locations are included to illustrate the areal distribution of the wells. Complete listings of wells in each category can be used in conjunction with the programs provided in the Appendix to retrieve information on the specific wells.

Wells Perforated in the Semiconfined Zone at Depths Less Than or Equal to 50 Feet

There are 1,114 wells perforated in the semiconfined zone at depths less than or equal to 50 feet. Most of these shallow wells are observation wells. Numerous wells at depths less than or equal to 20 feet were installed by the U.S. Bureau of Reclamation and are maintained by the Westlands Water District to monitor the water table. These wells are perforated over the entire length of the well (Westlands Water District, oral commun., 1987). Many wells at depths of about 50 feet are along the California Aqueduct. The western limit of the 20-foot wells (fig. 4) reflects the upslope limit of the area underlain by a water table within 20 feet of the land surface.

TABLE 1.--*Description of wells*

Description of wells	Number of wells
Wells perforated in the semiconfined zone at depths less than or equal to 50 feet generally used as observation wells.	
1 to 20	637
21 to 50	477
Subtotal	1,114
Wells perforated in the semiconfined zone at depths greater than 50 feet.	
Coast Range alluvium	155
Sierran sand	275
Coast Range alluvium and Sierran sand	21
No perforation information	39
Subtotal	490
Wells perforated in the semiconfined and confined zones	533
Wells perforated only in the confined zone	410
Total	2,547

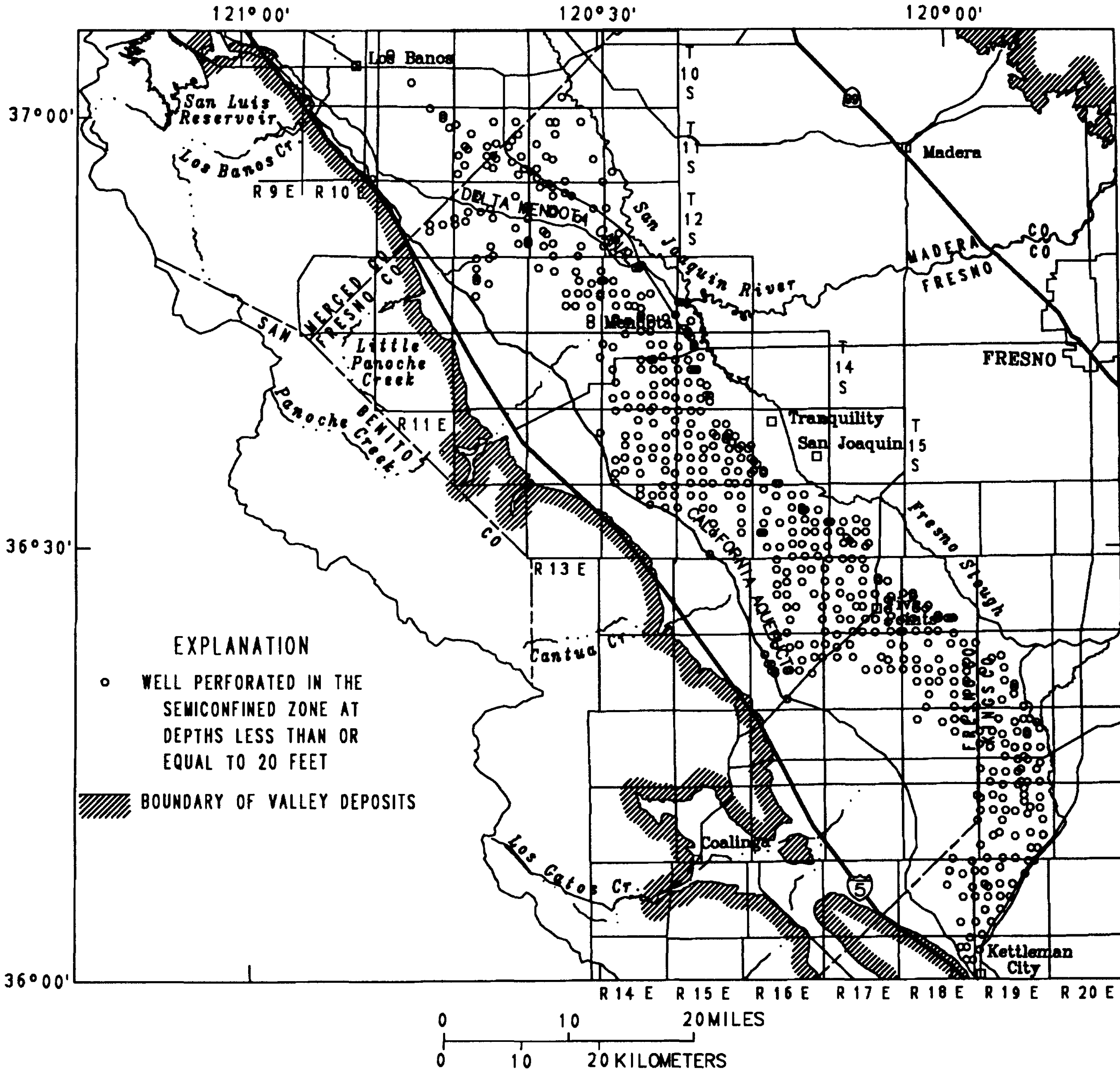

Figure 4. *Areal distribution of wells perforated in the semiconfined zone at depths less than or equal to 20 feet.*

The 637 wells perforated within 20 feet of the land surface are uniformly distributed over the area where the depth to water is less than 20 feet. Figure 5 indicates a sparser coverage of wells at depths of 21 to 50 feet over the study area, with a concentration of wells along the California Aqueduct.

Wells Perforated in the Semiconfined Zone at Depths Greater Than 50 Feet

There are 490 wells perforated in the semiconfined zone at depths greater than 50 feet. These wells are classified by the type of deposits they are perforated in.

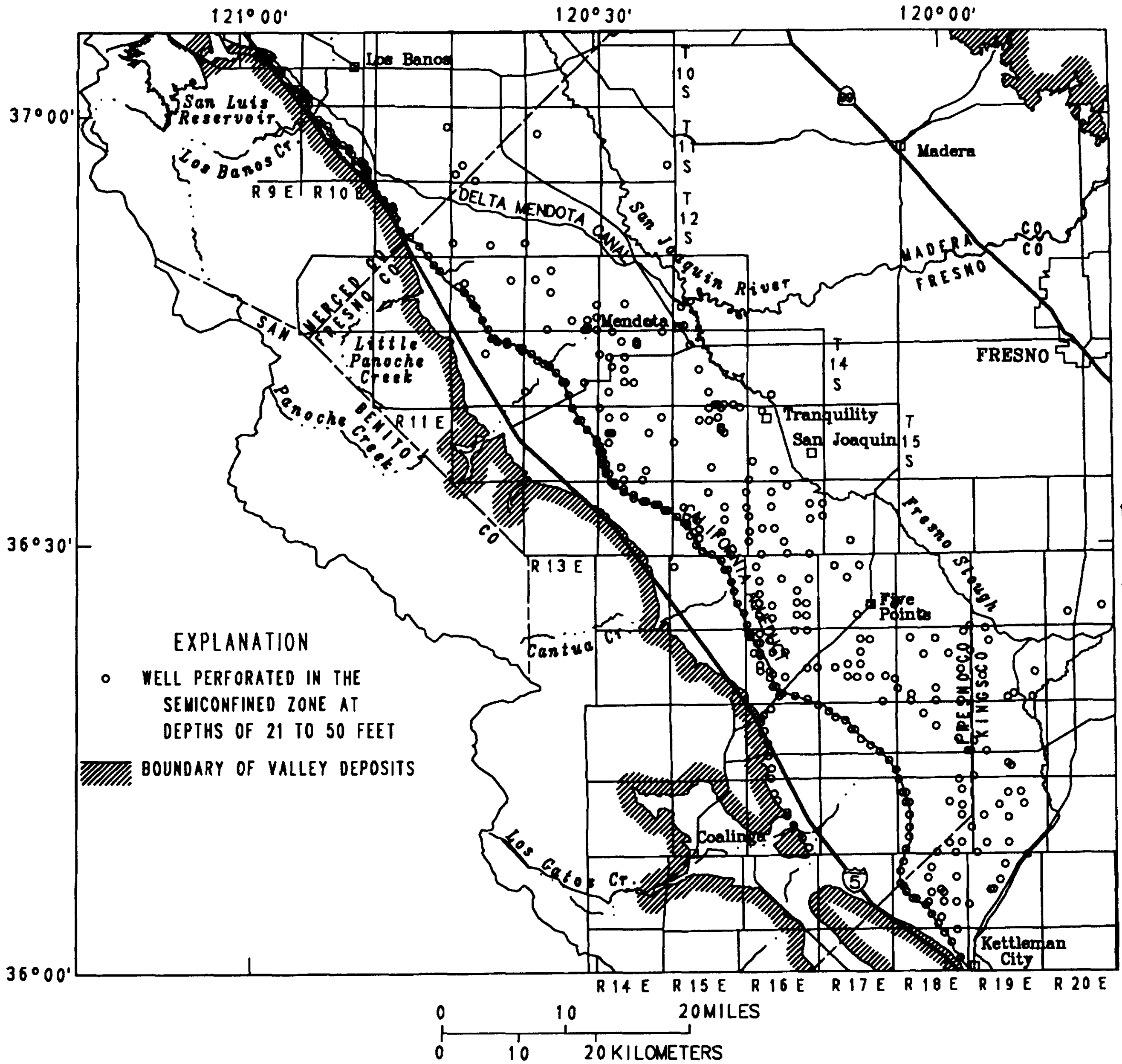

Figure 5. *Areal distribution of wells perforated in the semiconfined zone at depths of 21 to 50 feet.*

Perforated lengths of the wells were compared to thickness maps of the Coast Range alluvium and Sierran sand (Miller and others, 1971). Because the flood-plain deposits generally are less than 50 feet thick, an attempt was not made to separate wells perforated in the flood-plain deposits from those perforated in the Sierran sand. There are 155 wells perforated in Coast Range alluvium (fig. 6; table 2), 275 in Sierran sand (fig. 7; table 3), 21 in both (fig. 8; table 4), and 39 wells without sufficient information to determine which deposits they perforated.

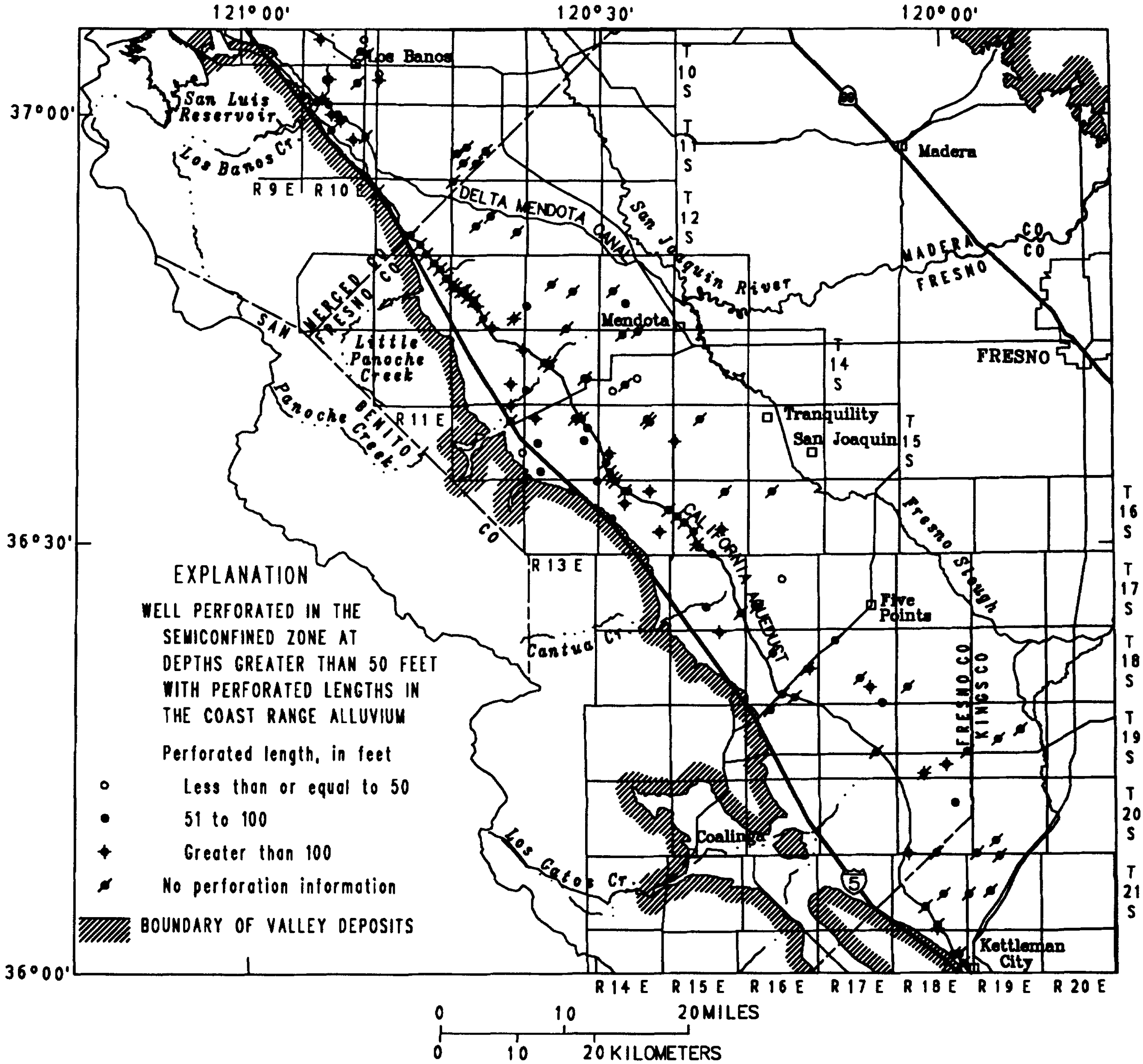

Figure 6. *Areal distribution of wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Coast Range alluvium.*

TABLE 2.--*Wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Coast Range alluvium*

10S10E02R01	12S11E34R02	13S13E34P01	15S13E14R01	16S15E18P02	19S16E05H04
10S10E05P01	12S12E06D01	13S14E17N02	15S13E20D01	16S15E19H01	19S17E23P01
10S10E11Q01	12S12E15N01	13S14E21N04	15S13E32F01	16S15E22R01	19S18E24Q01
10S10E13D01	12S12E20J01	14S12E12J01	15S14E10A01	16S15E29B02	19S18E27R01
10S10E26F01	12S12E25D02	14S12E26H01	15S14E10A02	16S15E32A03	19S18E33M01
10S10E28D01	13S11E02K01	14S13E16N04	15S14E10A03	16S15E32A05	19S18E33M02
10S10E29A01	13S11E12D01	14S13E17K03	15S14E11E01	16S15E33E01	19S19E15A02
10S10E32K02	13S11E12Q01	14S13E23R01	15S14E19R01	16S15E34N05	19S19E16N02
10S10E32N01	13S11E12Q02	14S13E24N02	15S14E30K01	16S16E05R02	20S18E11Q01
10S11E19M01	13S12E17N01	14S13E24N05	15S14E31H02	17S15E25K01	20S18E31R01
10S11E30D01	13S12E18E01	14S13E24N06	15S14E31H03	17S15E28A01	20S18E34N01
11S10E04D01	13S12E18E02	14S13E24N07	15S14E32N03	17S16E09R02	20S18E34N02
11S10E04P01	13S12E18L01	14S13E30N04	15S15E09D05	17S16E30A03	20S19E29R01
11S10E04R01	13S12E18R01	14S14E03D01	15S15E18N01	18S15E03A02	20S19E31P02
11S10E10E01	13S12E20D02	14S14E05H01	16S13E01A01	18S16E09N01	21S18E23D05
11S10E13M01	13S12E20F02	14S14E22N04	16S13E03R01	18S16E23A02	21S18E28B01
11S10E14N01	13S12E20J01	14S14E28E02	16S14E02N01	18S16E24D02	21S18E34K02
11S10E16C01	13S12E20R02	14S14E29N02	16S14E04N04	18S16E33A04	21S18E34Q01
11S12E19P01	13S12E28D03	15S12E02A01	16S14E04P01	18S16E34H02	21S19E04B01
11S12E20E01	13S12E33B04	15S12E11H01	16S14E05C01	18S17E05N04	21S19E17R02
11S12E21K01	13S12E34P02	15S12E11H02	16S14E09N01	18S17E22N01	21S19E19D01
11S12E29J01	13S12E36D03	15S12E24R01	16S14E13G01	18S17E27J01	22S18E11R01
11S12E30J03	13S12E36D04	15S13E07A01	16S14E13G04	18S17E35R02	22S18E12P01
12S11E06N01	13S13E15R01	15S13E11B02	16S14E20D01	18S18E30J02	22S18E12P02
12S11E28G01	13S13E16E01	15S13E11D03	16S14E26A01	19S16E05H02	22S18E13K01
12S11E34C01	13S13E30D01	15S13E12N04	16S15E02N02	19S16E05H03	

Many wells perforated in the Coast Range alluvium are along the California Aqueduct. A large number (41) of these are observation wells monitoring the aqueduct. These wells range in depth from 50 to 60 feet and 190 to 210 feet. The remaining 114 wells tap the Coast Range alluvium as a source of water. The average perforation length for these wells is 114 feet. Most of the wells have perforated lengths less than 100 feet (table 5). The small number and relatively short perforated lengths of these wells reflects the relatively low transmissivity of the Coast Range alluvium.

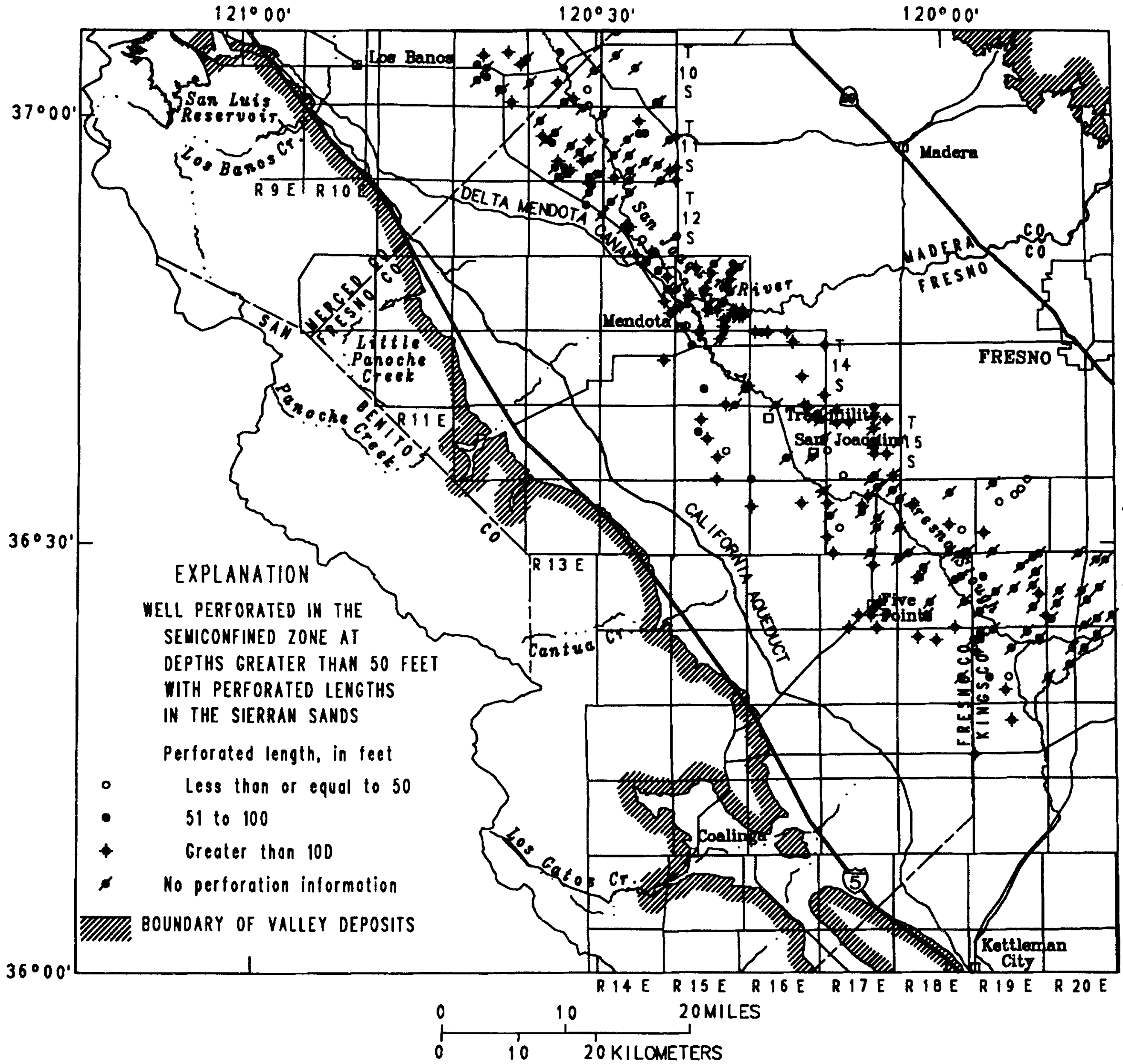

Figure 7. *Areal distribution of wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Sierran sand.*

TABLE 3.--*Wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Sierran sand*

10S12E09P01	11S14E13L01	13S15E14M01	14S16E33N01	16S17E16A01	17S19E07R01
10S12E11L01	11S14E15C01	13S15E14P02	14S16E35P01	16S17E16J01	17S19E10A01
10S12E13A01	11S14E16A01	13S15E16L01	14S16E36A01	16S17E18P01	17S19E12M01
10S12E13L01	11S14E17J01	13S15E18M01	15S15E09D02	16S17E20N02	17S19E14J01
10S12E16Q01	11S14E19R01	13S15E19R01	15S15E09D03	16S17E23D02	17S19E15P01
10S12E17J01	11S14E21N01	13S15E20D01	15S15E16K01	16S17E23N01	17S19E15P02
10S12E20R01	11S14E25R01	13S15E21Q01	15S15E16K02	16S17E24R01	17S19E20A01
10S12E21K01	11S14E26L01	13S15E22J01	15S15E17A01	16S17E30M01	17S19E24F01
10S12E27J01	11S14E27F01	13S15E25F01	15S15E34P01	16S17E31Q01	17S19E26H01
10S12E27K01	11S14E31J01	13S15E25L01	15S15E23M01	16S17E34Q01	17S19E30K01
10S12E35K01	11S14E33D01	13S15E25N01	15S15E27C01	16S18E10A01	17S19E36A01
10S13E09K01	11S14E33N01	13S15E25N02	15S16E01L01	16S18E18A01	17S20E02M01
10S13E16R01	11S14E35Q01	13S15E25P01	15S16E01N01	16S18E22J01	17S20E02J01
10S13E24C01	11S14E36C01	13S15E26G01	15S16E02B01	16S18E26A02	17S20E04B01
10S13E26J01	11S14E36R01	13S15E26H01	15S16E12B01	16S18E31Q01	17S20E14P01
10S13E28C01	12S13E02A01	13S15E26K01	15S16E12C02	16S18E34R01	17S20E20D01
10S13E30D01	12S13E02R01	13S15E27F01	15S16E13J01	16S18E36P01	17S20E22P01
10S13E33J01	12S13E11Q01	13S15E28G01	15S16E26A01	16S19E02D01	17S20E21A01
10S13E34G01	12S13E13J01	13S15E28H01	15S16E28A02	16S19E03Q01	17S20E30A01
10S13E35R01	12S14E04N01	13S15E30C01	15S16E31N03	16S19E05F01	17S20E31F01
10S14E08N01	12S14E07K01	13S15E31J04	15S17E03A01	16S19E08R01	17S20E34N01
10S14E16Q01	12S14E20K01	13S15E34A01	15S17E03R01	16S19E10E01	17S20E36C01
10S14E35K01	12S14E20R01	13S15E34J01	15S17E06H01	16S19E30G01	17S20E[illegible]
10S14E35L01	12S14E21M01	13S15E34J02	15S17E07H01	16S19E32P01	18S18E03N0[illegible]
11S13E02C01	12S14E25H01	13S15E35D05	15S17E08H01	17S17E02N01	18S18E05K01
11S13E07A01	12S14E27M01	14S14E13E03	15S17E10R01	17S17E23Q01	18S18E24N01
11S13E14J01	12S14E33Q01	14S15E03A01	15S17E10R02	17S17E25N01	18S19E02F02
11S13E16D02	12S14E34J03	14S15E03K02	15S17E11A01	17S17E26E04	18S19E01P01
11S13E17E01	12S14E35M01	14S15E03K04	15S17E13R01	17S17E27R02	18S19E05B01
11S13E17L01	13S14E03G01	14S15E05A02	15S17E15R01	17S17E28R04	18S19E06G01
11S13E17R01	13S14E03L01	14S15E05A03	15S17E19M01	17S17E33N01	18S19E06N02
11S13E22C01	13S14E11B01	14S15E05A04	15S17E22H01	17S17E35P01	18S19E07P02
11S13E23M01	13S14E12L01	14S15E05A05	15S17E22R01	17S18E01B01	18S19E06Q02
11S13E26A01	13S14E13L01	14S15E08C04	15S17E23R01	17S18E02A01	18S19E10M01
11S13E26F01	13S14E24M01	14S15E25H02	15S17E32L03	17S18E06E01	18S19E20P02
11S13E28F01	13S14E25H01	14S15E25K01	15S17E34J01	17S18E08Q01	18S19E20P03
11S13E28N01	13S14E25K01	14S15E28L04	15S17E34Q03	17S18E08R01	18S19E21R03
11S13E28R01	13S15E01N01	14S15E35N01	15S17E36L01	17S18E09D01	18S19E28Q01
11S13E33L01	13S15E02K01	14S15E35R01	16S16E01R01	17S18E12N01	18S20E02M01
11S13E34C01	13S15E03M01	14S16E03P01	16S16E11N02	17S18E14B01	18S20E09M01
11S13E34E01	13S15E05Q01	14S16E04A01	16S16E18D01	17S18E21Q02	18S20E10M01
11S13E35J01	13S15E09H01	14S16E05C01	16S17E01P01	17S18E24P01	18S20E17R01
11S13E36G01	13S15E11B01	14S16E06A01	16S17E02M01	17S18E28P01	18S20E19N01
11S14E06M01	13S15E11F01	14S16E06C01	16S17E07N01	17S18E35Q01	19S19E10E02
11S14E09A03	13S15E11P01	14S16E12A01	16S17E10F01	17S19E01C01	19S19E30D01
11S14E13H01	13S15E14E01	14S16E23M01	16S17E12J01	17S19E02H01	

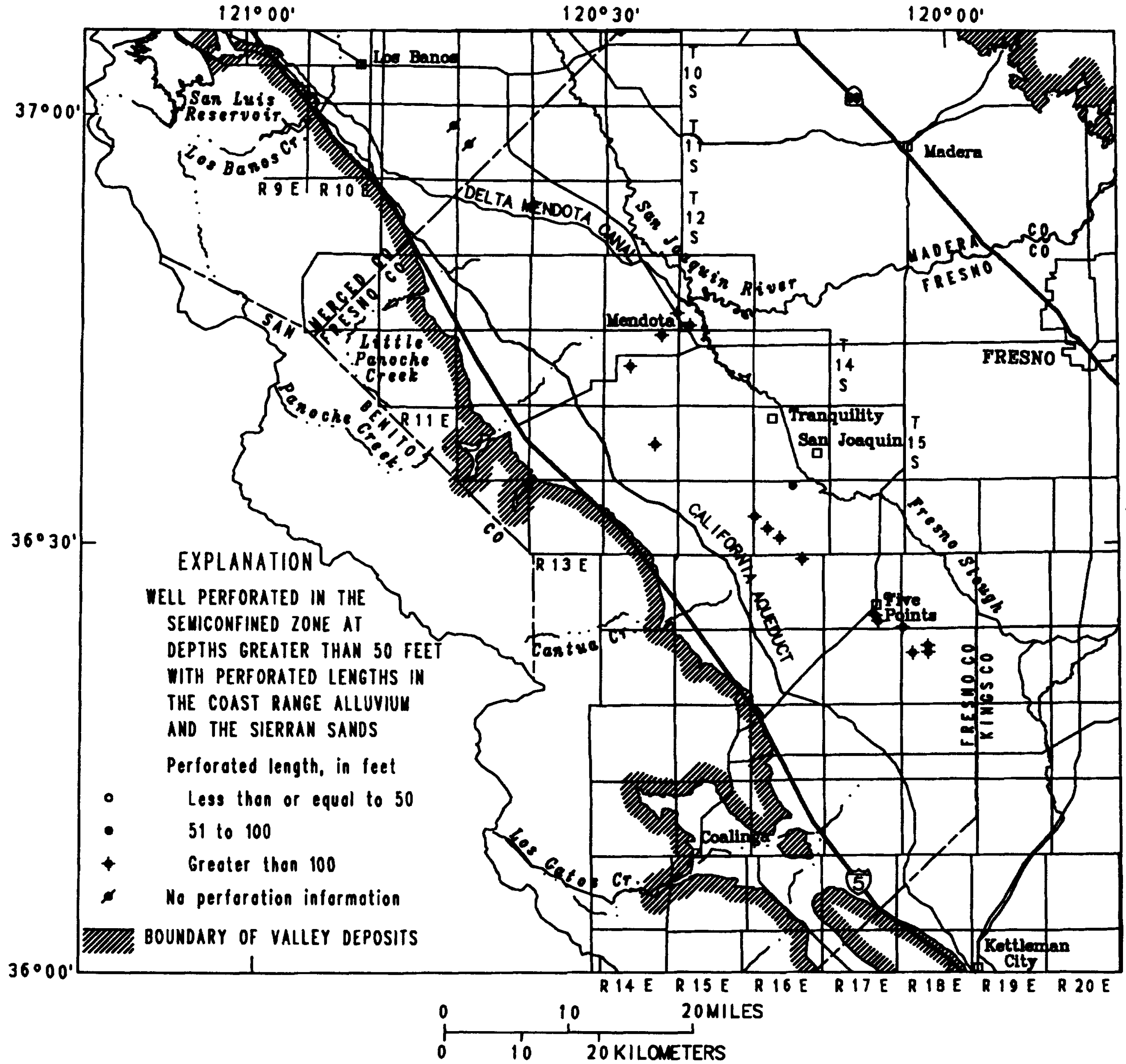

Figure 8. *Areal distribution of wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Coast Range alluvium and Sierran sand.*

TABLE 4.--*Wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Coast Range alluvium and Sierran sand*

11S11E12K03	15S14E23D02	17S17E27R01
11S12E19A01	16S16E03E02	17S17E35E01
12S13E07N01	16S16E18N01	17S18E31N02
13S14E25J01	16S16E20N01	18S18E07R01
13S15E31J05	16S16E28M01	18S18E07R02
14S14E02G02	17S16E02E01	18S18E09E01
14S14E16N01	17S17E23H02	18S18E09N01

TABLE 5.--*Number of wells perforated in the semiconfined zone at depths greater than 50 feet with perforated lengths in the Coast Range alluvium and Sierran sand*

Perforated length (feet)	Number of wells	
	Coast Range alluvium	Sierran sand
Less than 50........	12	19
51 to 100...........	21	27
101 to 250..........	22	81
Greater than 250....	4	22
No perforation information.......	55	126
Total...........	114	275
Average length (feet)............	114	154

Wells perforated in the Sierran sand are primarily in the valley trough, where the Sierran sand is at least 200 feet thick. There are 275 wells perforated in the Sierran sand. The average perforated length of these wells is 154 feet. Most of the wells have perforated lengths more than 100 feet (table 2). The large number and relatively long perforated length of these wells reflects the high transmissivity of the Sierran sand.

The concentration of wells in the semiconfined zone perforated in the Sierran sand and the longer perforated length of wells tapping the Sierran sand compared to wells tapping the Coast Range alluvium indicate a tendency to use the Sierran sand rather than the Coast Range alluvium as a source of water.

Wells Perforated in the Semiconfined and Confined Zones

There are 533 wells perforated in the semiconfined and confined zones. The wells are grouped by the perforated length above and below the Corcoran Clay Member where Sierran sand is present and absent (table 6). The wells are presented by perforated length above the Corcoran in figure 9 and below the Corcoran in figure 10; these wells are listed in table 7.

TABLE 6.--*Number of wells perforated in the semiconfined and confined zones with perforated lengths above and below the Corcoran Clay Member of the Tulare Formation where Sierran sand is present and absent*

Perforated length below the Corcoran where Sierran sand is present (feet)	Perforated length above the Corcoran where Sierran sand is present (feet)			
	Less than or equal to 50	51 to 100	101 to 250	251 to 500
	Number of wells			
Less than or equal to 50....	0	0	4	9
51 to 100........	0	0	2	8
101 to 500.......	8	9	41	22
501 to 1,000.....	17	37	49	10
Greater than 1,000..........	6	7	9	0

Perforated length below the Corcoran where Sierran sand is absent (feet)	Perforated length above the Corcoran where Sierran sand is absent (feet)			
	Less than or equal to 50	51 to 100	101 to 250	251 to 500
	Number of wells			
Less than or equal to 50....	0	0	1	3
51 to 100........	0	0	0	0
101 to 500.......	3	7	9	10
501 to 1,000.....	23	22	40	12
Greater than 1,000..........	42	48	62	13

Most of the wells have perforated lengths less than 250 feet above the Corcoran and all have perforated lengths less than 500 feet above the Corcoran. In contrast, most of the wells (397) have perforated lengths greater than 500 feet below the Corcoran. The distribution of perforated length reflects the tendency to use the confined system as the principal supply of water.

The degree to which the confined aquifer system is tapped as a source of supply depends, in part, on the presence or absence of Sierran sand above the Corcoran. There are 238 wells in or near the valley trough where the Sierran sand is present with a total perforated length of 38,527 feet above the Corcoran and 132,023 feet below the Corcoran. These wells have an average perforated length of 162 feet above the Corcoran and 555 feet below the Corcoran. In contrast, the 295 wells upslope of the valley trough, where the Sierran sand is absent, have a total perforated length of 39,034 feet above the Corcoran and 291,051 feet below the Corcoran. These wells have an average perforated length of 132 feet above the Corcoran and 987 feet below the Corcoran. The distribution of perforated length indicates that water supply wells need to be drilled deeper into the confined zone where the Sierran sand is absent than where it is present (table 6).

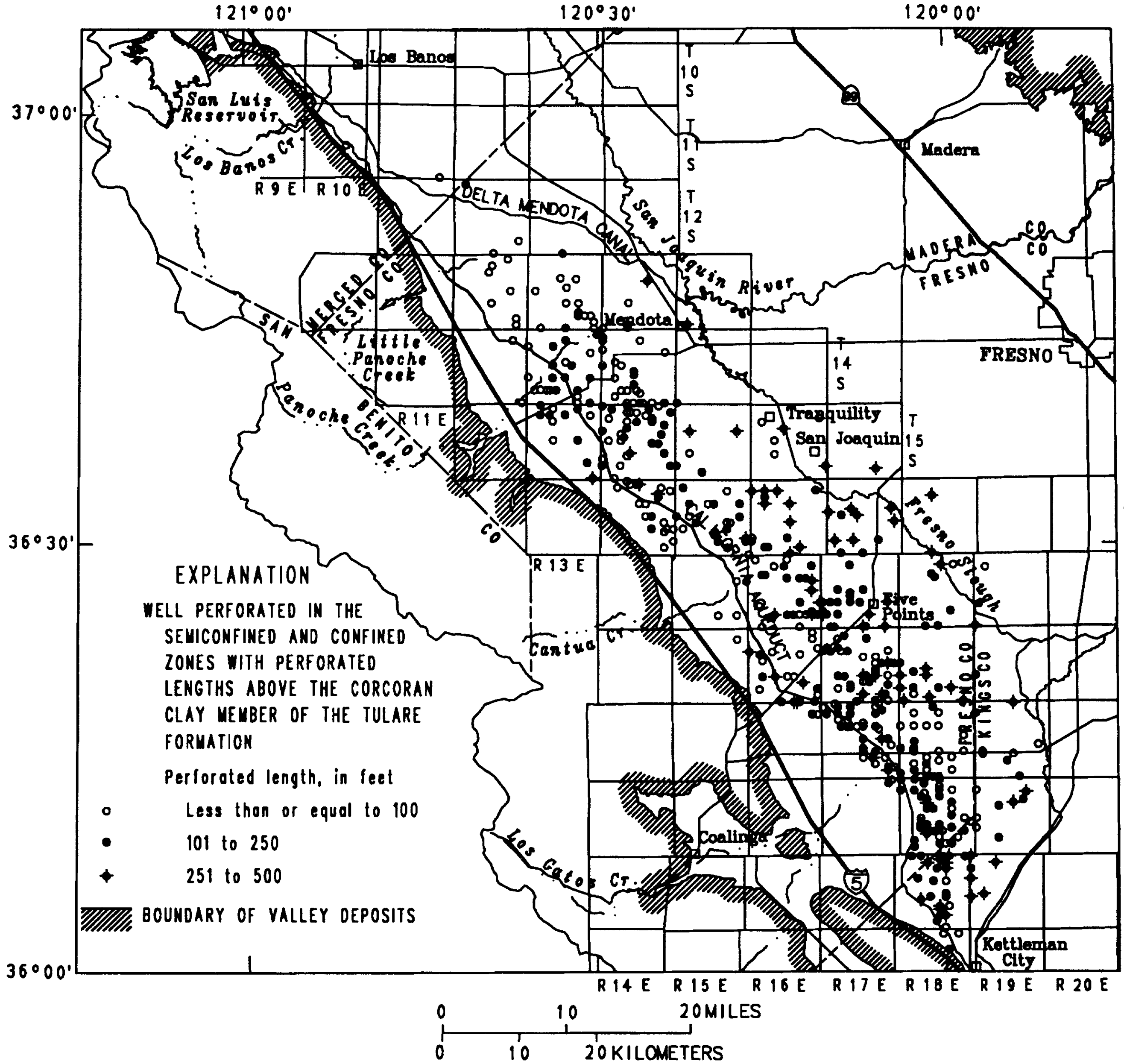

Figure 9. *Areal distribution of wells perforated in the semiconfined and confined zones with perforated lengths above the Corcoran Clay Member of the Tulare Formation.*

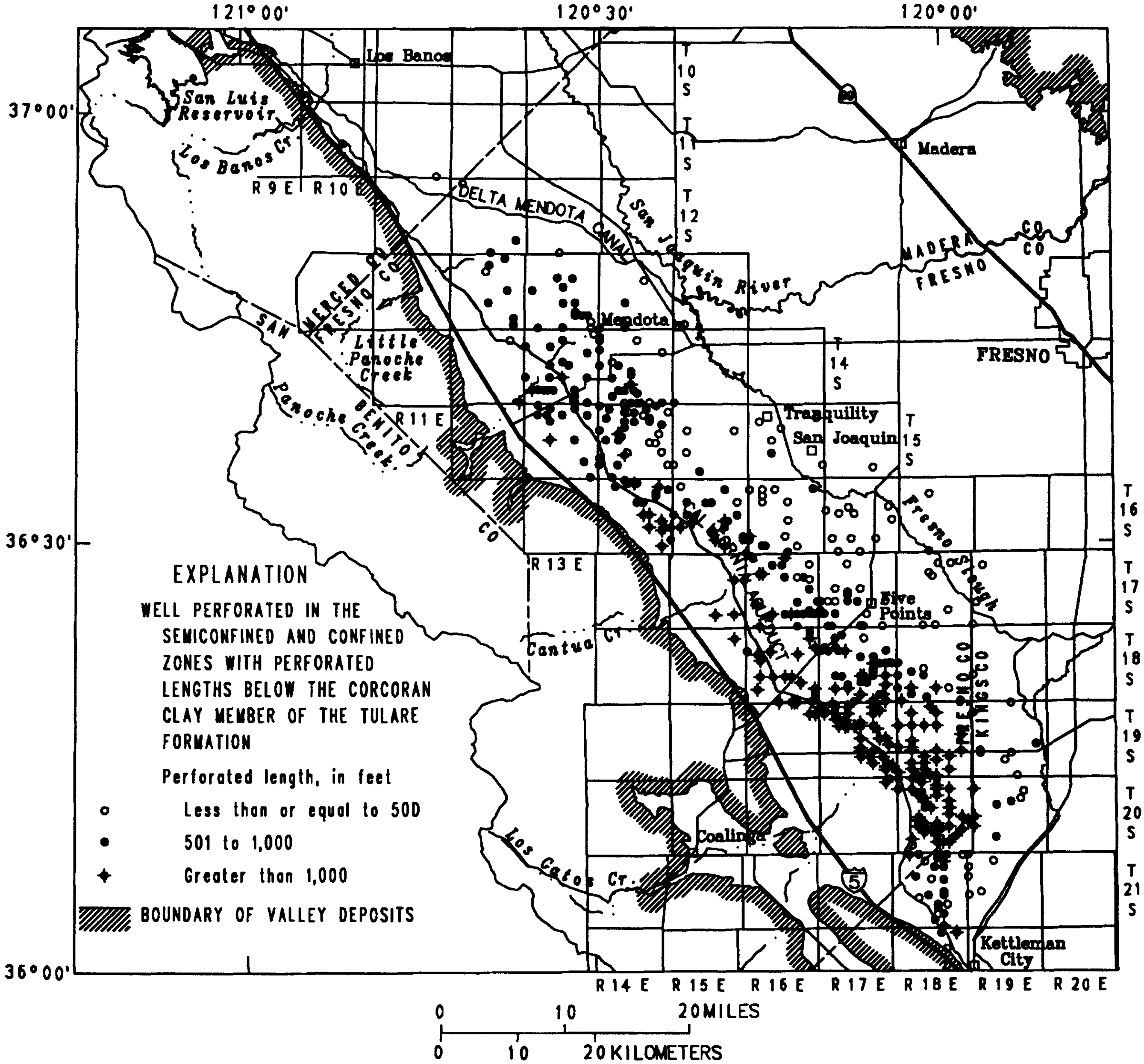

Figure 10. *Areal distribution of wells perforated in the semiconfined and confined zones with perforated lengths below the Corcoran Clay Member of the Tulare Formation.*

TABLE 7.--*Wells perforated in the semiconfined and confined zones with perforated lengths above and below the Corcoran Clay Member of the Tulare Formation*

11S10E22F01	14S13E29Q01	15S14E06D01	16S14E24E01	16S17E32N01	17S17E24N01
11S11E35R01	14S13E29R01	15S14E06H01	16S14E24P01	16S17E33R01	17S17E27Q01
12S12E06H01	14S13E30Q01	15S14E06H02	16S14E24R01	16S18E09F01	17S17E27Q02
12S12E25N01	14S13E35E01	15S14E07B01	16S14E25D01	16S18E33P01	17S17E29N01
12S12E34N01	14S13E35N01	15S14E09E01	16S14E25R01	16S18E33P02	17S17E29N02
12S13E33Q01	14S13E36N01	15S14E09H01	16S14E36E01	17S15E13A01	17S17E30M01
13S12E02F01	14S14E03N02	15S14E09N01	16S15E02N01	17S15E13D01	17S17E30N01
13S12E03N01	14S14E06M01	15S14E11D01	16S15E06K01	17S15E25N01	17S17E30P02
13S12E09H02	14S14E06N02	15S14E11E02	16S15E08N01	17S15E27Q01	17S17E31Q01
13S12E14Q01	14S14E07M01	15S14E12M01	16S15E09Q01	17S16E01N02	17S17E31R01
13S12E22N01	14S14E12N02	15S14E14H01	16S15E10N02	17S16E03E01	17S17E34N01
13S12E36D02	14S14E17M01	15S14E17G01	16S15E10N04	17S16E04N02	17S17E34P01
13S12E36M01	14S14E17Q01	15S14E17J01	16S15E12N01	17S16E04R02	17S17E35R01
13S13E09Q01	14S14E17Q03	15S14E17Q01	16S15E13N01	17S16E06G01	17S18E02P01
13S13E10R01	14S14E18N01	15S14E18D01	16S15E17N01	17S16E08L01	17S18E03P01
13S13E15M01	14S14E20N01	15S14E18Q01	16S15E18N01	17S16E08M02	17S18E09K01
13S13E18Q01	14S14E21G02	15S14E21P01	16S15E19Q01	17S16E10N01	17S18E09R01
13S13E22N01	14S14E21K01	15S14E23B03	16S15E20G01	17S16E11N03	17S18E26M01
13S13E23N01	14S14E28G01	15S14E23D03	16S15E23E03	17S16E11Q01	17S18E33N01
13S13E25N01	14S14E28N01	15S14E24N01	16S15E23F01	17S16E13D01	17S18E34N01
13S13E25N02	14S14E28R01	15S14E25Q01	16S15E23N02	17S16E13N01	17S19E07A01
13S13E26M01	14S14E29Q01	15S14E28D01	16S15E25K01	17S16E13N02	17S19E30C01
13S13E26N02	14S14E32E02	15S14E29Q01	16S15E25Q02	17S16E23N02	17S19E31N01
13S13E26Q01	14S14E33N01	15S14E30E01	16S15E27D01	17S16E24R01	18S15E01N01
13S13E32N02	14S14E33Q01	15S14E30N01	16S15E27E01	17S16E25M01	18S16E01E01
13S13E34N04	14S14E34D01	15S14E32N02	16S15E27P01	17S16E25N01	18S16E01N01
13S13E36F01	14S14E34N01	15S15E14A01	16S15E35E01	17S16E25N02	18S16E07N01
13S13E36P02	14S14E34P01	15S15E17D01	16S15E36R01	17S16E25P01	18S16E08R01
13S14E15B01	14S14E35N01	15S15E20N02	16S16E01N01	17S16E25Q01	18S16E12K01
13S14E21N01	14S14E36N01	15S15E30N02	16S16E04N01	17S16E26N04	18S16E14D01
13S14E31N01	14S15E31N01	15S15E33E01	16S16E05N01	17S16E26Q02	18S16E17M01
13S14E33M01	15S13E01N01	15S16E07H01	16S16E06N01	17S16E27N01	18S16E18A02
13S14E33N01	15S13E02E01	15S16E09Q01	16S16E08E01	17S16E27Q01	18S16E20N02
13S15E31J06	15S13E03N01	15S16E12C03	16S16E08N01	17S16E28N01	18S16E21N01
14S12E02R02	15S13E04E01	15S16E17R01	16S16E10N01	17S16E30A01	18S16E22N01
14S12E36Q01	15S13E05D01	15S16E20R01	16S16E22E01	17S16E32A01	18S16E22Q01
14S13E01G01	15S13E05N01	15S16E25R01	16S16E28J01	17S16E32N01	18S16E25Q01
14S13E01G02	15S13E05R01	15S17E34A01	16S16E30M01	17S16E35N01	18S16E26F01
14S13E03N01	15S13E09E01	16S14E01Q02	16S16E30N01	17S17E04N01	18S16E26F02
14S13E07E02	15S13E14N01	16S14E02J01	16S16E32E02	17S17E15N01	18S16E30R01
14S13E09E01	15S13E16N01	16S14E03E01	16S16E32F01	17S17E15N02	18S16E33Q01
14S13E12N01	15S13E26J01	16S14E04D01	16S16E34H01	17S17E17N01	18S16E34Q01
14S13E15M01	15S13E36P01	16S14E04F01	16S16E34N02	17S17E17N02	18S16E34R01
14S13E15Q01	15S13E36P02	16S14E04H01	16S17E13E01	17S17E19N01	18S16E35N01
14S13E16N01	15S14E01K01	16S14E05L01	16S17E16P01	17S17E19N02	18S16E36G01
14S13E19N01	15S14E02B01	16S14E10N01	16S17E17H01	17S17E19Q01	18S16E36P01
14S13E21N01	15S14E03H01	16S14E10Q01	16S17E17N01	17S17E20N01	18S17E03P01
14S13E22N01	15S14E03Q01	16S14E11B01	16S17E18M01	17S17E21D01	18S17E05K01
14S13E24N01	15S14E04D01	16S14E11G02	16S17E24F01	17S17E21E01	18S17E05K03
14S13E26N01	15S14E04J01	16S14E14N01	16S17E26N01	17S17E21N01	18S17E05N03
14S13E28P01	15S14E04L01	16S14E15Q01	16S17E28N01	17S17E21N02	18S17E07L01
14S13E29N01	15S14E04M01	16S14E23N01	16S17E30Q01	17S17E21R01	18S17E07L02

TABLE 7.--*Wells perforated in the semiconfined and confined zones with perforated lengths above and below the Corcoran Clay Member of the Tulare Formation*--Continued

18S17E07N01	18S17E36N03	19S17E10N01	19S18E29N01	20S18E16E01	21S18E02C01
18S17E07Q01	18S18E18N01	19S17E11N01	19S18E31M01	20S18E16G01	21S18E02M01
18S17E08M01	18S18E19N01	19S17E13N01	19S18E32E01	20S18E16G02	21S18E02M02
18S17E08P01	18S18E19N02	19S17E14C01	19S18E32Q01	20S18E20B01	21S18E03A01
18S17E08P02	18S18E20M01	19S17E14Q01	19S18E33E02	20S18E20G01	21S18E03B01
18S17E08R01	18S18E21E01	19S17E15N01	19S18E33N02	20S18E20K01	21S18E03G01
18S17E12N01	18S18E21N01	19S17E22M01	19S18E33N03	20S18E20Q01	21S18E04D02
18S17E13N01	18S18E26N01	19S17E22N01	19S18E33Q01	20S18E21M01	21S18E04K01
18S17E13N02	18S18E27N01	19S17E23N01	19S18E34N01	20S18E21N01	21S18E05C01
18S17E13P01	18S18E29N01	19S17E24F01	19S18E35E01	20S18E22M01	21S18E08R01
18S17E13Q01	18S18E30N01	19S17E26H01	19S19E03D01	20S18E23N01	21S18E10C01
18S17E14E01	18S18E31P01	19S17E26N01	19S19E06N01	20S18E24D01	21S18E11D01
18S17E14N02	18S18E32E01	19S17E27E01	19S19E19Q01	20S18E24G01	21S18E14D01
18S17E14Q01	18S18E33L01	19S17E27H01	19S19E24E01	20S18E25D01	21S18E15D01
18S17E15E01	18S18E36N02	19S17E36B01	19S19E27D01	20S18E25D02	21S18E21H01
18S17E20N02	18S19E19N01	19S17E36D02	19S19E28K01	20S18E26K01	21S18E21M01
18S17E20Q01	19S16E01N01	19S17E36E01	19S19E30B02	20S18E27C02	21S18E23D06
18S17E22N02	19S16E01Q01	19S18E03N02	19S19E34Q01	20S18E27D01	21S18E23E01
18S17E22P01	19S17E02C01	19S18E04G02	20S17E01C01	20S18E27M01	21S18E26C01
18S17E23E01	19S17E02E01	19S18E05N01	20S17E01E01	20S18E28B01	21S18E26N01
18S17E23M01	19S17E02K01	19S18E07N01	20S18E02N02	20S18E28D01	21S18E27B01
18S17E23N01	19S17E02N01	19S18E08N01	20S18E03D01	20S18E28E01	21S18E27G01
18S17E23N02	19S17E04E01	19S18E09N02	20S18E03M01	20S18E29N01	21S18E27Q02
18S17E24N02	19S17E04N02	19S18E10N01	20S18E03N01	20S18E29N02	21S18E34F01
18S17E25M01	19S17E05E01	19S18E13M01	20S18E05D01	20S18E32E01	21S18E35N01
18S17E27E01	19S17E05N01	19S18E19M01	20S18E05H01	20S18E34B01	21S19E04M01
18S17E27G01	19S17E05N03	19S18E20D01	20S18E05N01	20S18E34D01	21S19E06D01
18S17E28M01	19S17E06A01	19S18E20D02	20S18E06D01	20S18E35D01	21S19E06D02
18S17E28N01	19S17E06E01	19S18E20M01	20S18E06N01	20S19E06N01	21S19E06D03
18S17E28N02	19S17E06P01	19S18E20N01	20S18E08A01	20S19E10J01	21S19E07D01
18S17E29N02	19S17E08E02	19S18E22N01	20S18E08G01	20S19E10N01	21S19E07N01
18S17E33Q01	19S17E08H01	19S18E24N01	20S18E09M01	20S19E11D01	21S19E19E02
18S17E34E01	19S17E08P01	19S18E26E02	20S18E09N01	20S19E17A01	21S19E20D01
18S17E34E02	19S17E08R01	19S18E27M01	20S18E10E01	20S19E19D01	22S18E01E01
18S17E35G01	19S17E09N01	19S18E28E01	20S18E11N01	20S19E19N01	22S18E03H01
18S17E35H01	19S17E09Q01	19S18E28N01	20S18E14E01	20S19E29J01	22S18E11L01
18S17E35N01	19S17E10M01	19S18E28N02	20S18E14N01	21S18E01B01	

Wells Perforated Only in the Confined Zone

There are 410 wells perforated only in the confined zone below the Corcoran Clay Member of the Tulare Formation. Table 8 summarizes these wells by the relative distance between the bottom of the Corcoran and the top of the perforated length where the Sierran sand is present. For most of these wells, the top of the perforated length starts within the first 100 feet below the Corcoran. These wells also have perforated lengths ranging from 100 to more than 1,000 feet. All wells are presented in figure 11 grouped by perforated length. This figure shows that, in general, the perforated length increases in a southwest direction upslope toward the Coast Ranges. Table 9 lists the wells perforated only in the confined zone.

Wells perforated only in the confined zone have a shorter average perforated length in areas where the Sierran sand is present (628 feet) than in areas where the Sierran sand is absent (987 feet). There are 113 wells in the valley trough, where the Sierran sand is present, with a total perforated length of 70,985 feet. There are 297 wells upslope of the valley trough with a total perforated length of 293,038 feet.

Most of the wells are upslope of the valley trough. Wells are highly concentrated near the creeks in the fanhead areas, as compared to the interfan areas. In addition, this indicates a tendency for locating wells in the coarser grained sediments of the upper-fan areas rather than in the finer grained sediments of the interfan areas.

TABLE 8.--*Number of wells perforated only in the confined zone with perforated lengths below the Corcoran Clay Member of the Tulare Formation where the Sierran sand is present and absent*

Perforated length (feet)	Distance between bottom of the Corcoran and top of perforated length where the Sierran sand is present (feet)					
	In Corcoran	Less than 50	51 to 100	101 to 500	501 to 1,000	Greater than 1,000
Less than or equal to 50...	0	1	1	3	0	0
51 to 100.....	1	0	1	1	0	0
101 to 500.....	11	12	5	8	0	0
501 to 1,000...	23	14	4	4	0	0
Greater than 1,000...	10	6	4	4	0	0

Perforated length (feet)	Distance between bottom of the Corcoran and top of perforated length where the Sierran sand is absent (feet)					
	In Corcoran	Less than 50	51 to 100	101 to 500	501 to 1,000	Greater than 1,000
Less than or equal to 50...	0	2	0	0	0	1
51 to 100.....	0	3	0	2	0	0
101 to 500.....	6	14	5	9	1	0
501 to 1,000...	44	38	16	2	0	2
Greater than 1,000...	38	31	33	40	7	3

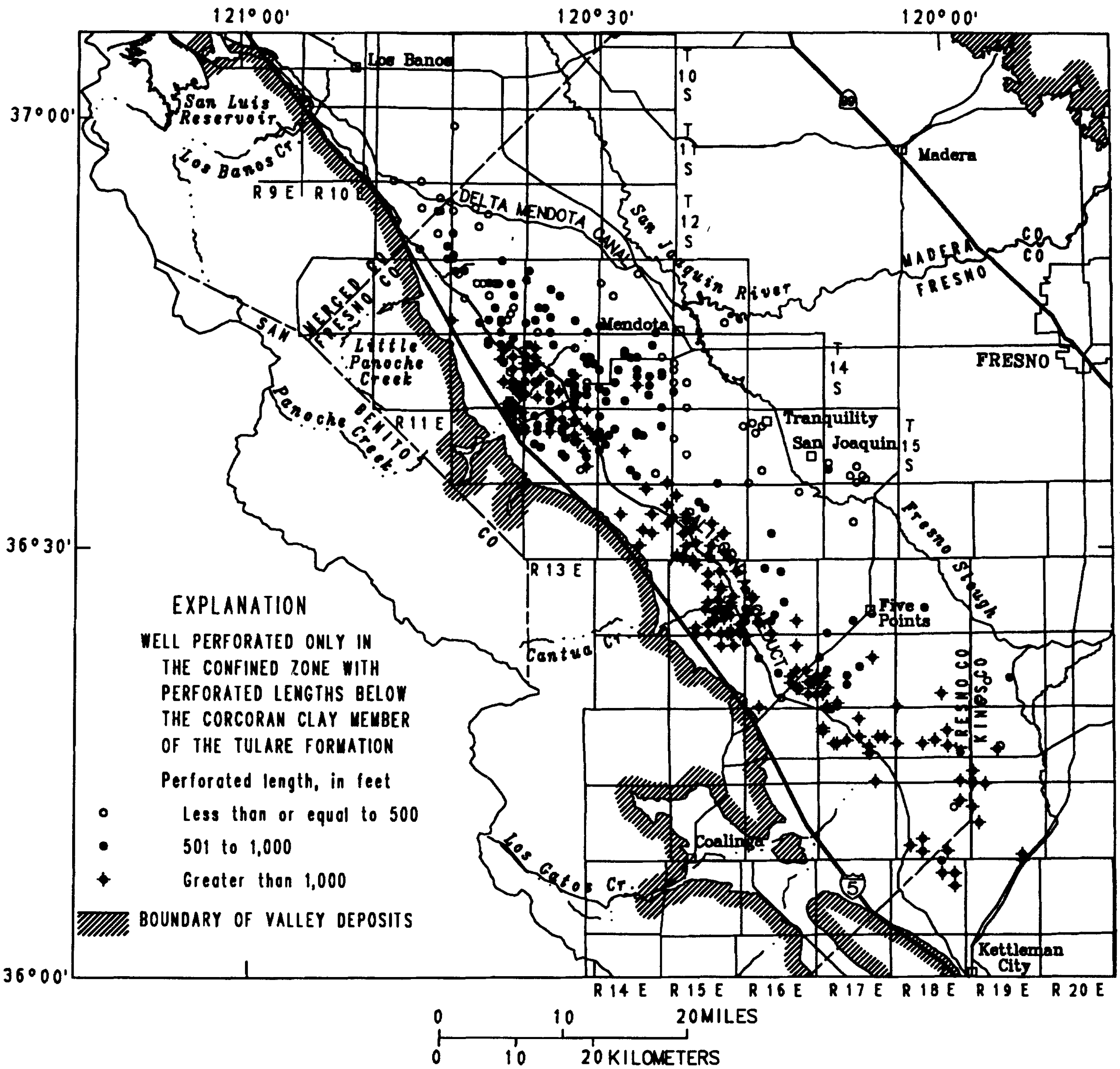

Figure 11. *Areal distribution of wells perforated only in the confined zone with perforated lengths below the Corcoran Clay Member of the Tulare Formation.*

TABLE 9.--*Wells perforated only in the confined zone with perforated lengths below the Corcoran Clay Member of the Tulare Formation*

11S11E32P01	13S13E20N01	14S13E13E02	14S14E30E03	15S14E06M01	16S15E27N02
11S11E34Q01	13S13E20Q01	14S13E13G01	14S14E30K01	15S14E07N01	16S15E29J02
11S12E07E02	13S13E26N03	14S13E17E01	14S14E31G02	15S14E08L01	16S15E29N01
12S11E10Q01	13S13E28M01	14S13E18E01	14S14E33E02	15S14E10N01	16S15E31J01
12S11E12D01	13S13E30R01	14S13E18N01	14S14E36N02	15S14E12E01	16S15E31L01
12S11E12H01	13S13E31D01	14S13E18N02	14S15E18E01	15S14E15B01	16S15E31R01
12S11E13D02	13S13E32N03	14S13E18Q01	14S15E18E02	15S14E15D01	16S15E32Q01
12S11E14A01	13S13E33N02	14S13E19N02	14S15E18N01	15S14E18A01	16S15E33J01
12S11E17Q02	13S13E36N01	14S13E19R01	14S15E19N01	15S14E18F01	16S15E34N04
12S11E23R02	13S14E07N01	14S13E20L01	14S15E20N01	15S14E18Q02	16S15E35E02
12S11E25Q01	13S14E10D01	14S13E21D01	14S15E30M01	15S14E19E01	16S15E35Q02
12S11E34C03	13S14E17N04	14S13E22A01	14S15E32N02	15S14E21E01	16S16E02M01
12S11E36Q01	13S14E31E01	14S13E22Q01	15S12E01B01	15S14E28Q01	16S16E20R01
12S12E08R01	13S14E35Q02	14S13E23E01	15S12E01E01	15S14E34E01	16S17E21C01
12S12E16H05	13S15E35D03	14S13E24N04	15S12E01H01	15S14E35B01	17S15E01P01
12S12E16H06	14S12E01E01	14S13E25E01	15S12E01N02	15S14E36Q02	17S15E02N01
12S12E18D01	14S12E02N01	14S13E25N01	15S12E01R01	15S15E12G01	17S15E04E01
12S12E19N01	14S12E02N02	14S13E26D01	15S12E02G01	15S15E18E02	17S15E05A01
12S12E21E01	14S12E02R01	14S13E26E02	15S12E12E01	15S15E20M01	17S15E10D01
12S12E31M01	14S12E03M01	14S13E26M01	15S12E12Q01	15S15E34Q01	17S15E10N01
12S12E31N01	14S12E03N01	14S13E26M02	15S12E12Q02	15S16E07C01	17S15E13N01
12S12E31N02	14S12E11F01	14S13E26N02	15S13E01D01	15S16E07Q02	17S15E14D01
13S12E02D01	14S12E11F02	14S13E26P01	15S13E02N02	15S16E08E01	17S15E14E01
13S12E05N01	14S12E12H01	14S13E28D01	15S13E03N02	15S16E29N01	17S15E21R01
13S12E06P01	14S12E12N01	14S13E28J01	15S13E04E02	15S16E31N02	17S15E22A01
13S12E07B01	14S12E13N01	14S13E28M01	15S13E04P01	15S17E28K01	17S15E22E01
13S12E09N01	14S12E14D01	14S13E30N01	15S13E06J01	15S17E30F01	17S15E23H01
13S12E09Q01	14S12E14F01	14S13E32D01	15S13E07M01	15S17E30P01	17S15E23J01
13S12E10N01	14S12E23A01	14S13E33E01	15S13E07N01	15S17E33E01	17S15E23N02
13S12E10Q01	14S12E23P01	14S13E34N01	15S13E08E01	15S17E33Q01	17S15E26C01
13S12E10R01	14S12E24N01	14S13E35E02	15S13E08N02	15S17E34E01	17S15E26H01
13S12E11R01	14S12E25A01	14S13E35N02	15S13E09E02	15S17E34L01	17S15E26L01
13S12E13N01	14S12E25D01	14S14E02P01	15S13E09N02	15S17E34L02	17S15E27B01
13S12E15N01	14S12E25E01	14S14E09E02	15S13E10F01	16S14E03H01	17S15E27K01
13S12E20D01	14S12E25Q01	14S14E09E04	15S13E10M01	16S14E12K01	17S15E27Q02
13S12E22Q01	14S12E25Q02	14S14E09M01	15S13E10N01	16S14E14F01	17S15E33E02
13S12E24N01	14S12E35H01	14S14E09Q01	15S13E11D02	16S14E17H01	17S15E33N01
13S12E24N02	14S12E35J01	14S14E10N01	15S13E12M01	16S14E22K01	17S15E34D01
13S12E26H01	14S12E35K01	14S14E10N04	15S13E13B01	16S14E23P01	17S15E34N01
13S12E26N01	14S12E35Q01	14S14E12N01	15S13E13G01	16S14E24B01	17S15E35J01
13S12E26Q01	14S12E36M01	14S14E15N01	15S13E14D01	16S14E27P01	17S15E35N01
13S12E27N01	14S13E04P01	14S14E17Q02	15S13E14L01	16S15E06P01	17S15E35Q01
13S12E30N01	14S13E06P01	14S14E18N02	15S13E14M01	16S15E09E01	17S15E35R01
13S12E33C01	14S13E06P02	14S14E20P01	15S13E15F01	16S15E09Q02	17S15E36B01
13S12E35D01	14S13E07A01	14S14E22E01	15S13E18R01	16S15E17E01	17S15E36K01
13S12E35N01	14S13E07N02	14S14E23E01	15S13E20C01	16S15E17M01	17S15E36Q01
13S12E35N02	14S13E07R01	14S14E24D01	15S13E22M01	16S15E17N02	17S15E36Q02
13S13E06P01	14S13E11D04	14S14E24E01	15S13E22P01	16S15E18M01	17S16E04R01
13S13E06P02	14S13E11D06	14S14E24E02	15S13E23H01	16S15E19R01	17S16E05K01
13S13E07M01	14S13E11R01	14S14E26D01	15S13E24N01	16S15E20G03	17S16E18E01
13S13E16E02	14S13E12N02	14S14E26N01	15S13E25M01	16S15E22D01	17S16E18Q02
13S13E16R01	14S13E12P01	14S14E27D01	15S13E26Q02	16S15E23N01	17S16E19N01

TABLE 9.--*Wells perforated only in the confined zone with perforated lengths below the Corcoran Clay Member of the Tulare Formation*--Continued

17S16E22E01	18S16E02N01	18S16E26F03	18S18E31N02	19S17E35P01	20S18E33E02
17S16E26N01	18S16E06D01	18S16E32N01	18S19E20P01	19S18E11N01	20S18E35E01
17S16E28F01	18S16E06M01	18S16E33A01	18S19E22M02	19S18E15M01	20S19E05D01
17S16E28N02	18S16E08N01	18S17E07N04	18S19E31G01	19S18E16N02	20S19E06D01
17S16E29N01	18S16E14N02	18S17E11N02	18S19E31G02	19S18E18N03	20S19E07N01
17S16E30A05	18S16E14R02	18S17E15M01	19S17E03N02	19S18E23D02	20S19E19B01
17S16E30A06	18S16E21B01	18S17E18Q01	19S17E06A02	19S18E24M01	20S19E35M01
17S16E30E01	18S16E22G01	18S17E19F01	19S17E07L01	19S18E36N01	21S18E02D02
17S16E30N01	18S16E22Q02	18S17E19N01	19S17E07P01	19S19E21C01	21S18E02D03
17S16E32D01	18S16E24H02	18S17E21E01	19S17E13E01	19S19E21E01	21S18E11D02
17S16E33N01	18S16E24N01	18S17E28D01	19S17E14G01	19S19E31D01	21S18E12D01
17S17E26E03	18S16E24P01	18S17E30G01	19S17E15E01	19S19E31N01	21S18E13D01
17S17E28Q01	18S16E24Q01	18S17E30P02	19S17E16M01	20S18E11Q02	21S19E02B01
17S17E31Q02	18S16E24Q02	18S17E31Q01	19S17E17N02	20S18E11Q03	
17S18E21P01	18S16E25N01	18S17E32L01	19S17E17P01	20S18E12E01	
18S15E01N02	18S16E25R01	18S17E32P01	19S17E22A01	20S18E28E02	
18S15E02N02	18S16E26E01	18S18E27Q01	19S17E22J03	20S18E29N03	

WELLS WITH WATER LEVELS REPRESENTATIVE OF THE SEMICONFINED ZONE

A contour map of water-table altitude is helpful for characterizing the flow system of the semiconfined zone. The presence of a downward hydraulic head gradient in the study area necessitates care in selecting wells indicative of the water table. Well depths and 1984 water-level measurements were examined to determine which wells could be used to construct a water-table map. Most of these wells have water-level measurements recorded since 1967. In general, the shallowest wells available were used as indicators of the water table. Where the water table is less than 20 feet deep, 20-foot and shallower wells were used. Further upslope toward the Coast Ranges, where the water table is deeper, wells are more sparsely distributed. In these areas, most of the wells completed in the semiconfined zone were used. Where the Corcoran is not present, wells less than 1,000 feet deep were used to help define the water table. Dry wells also were helpful in determining the upper limit of the water table. Table 10 lists wells with water levels indicative of the water table and dry wells, which help define the water table. Figure 12 shows the areal distribution of these wells. Figure 13 shows the wells perforated below the water table and above the Corcoran Clay Member of the Tulare Formation. These wells are indicative of water levels in the semiconfined zone below the water table and are listed in table 11.

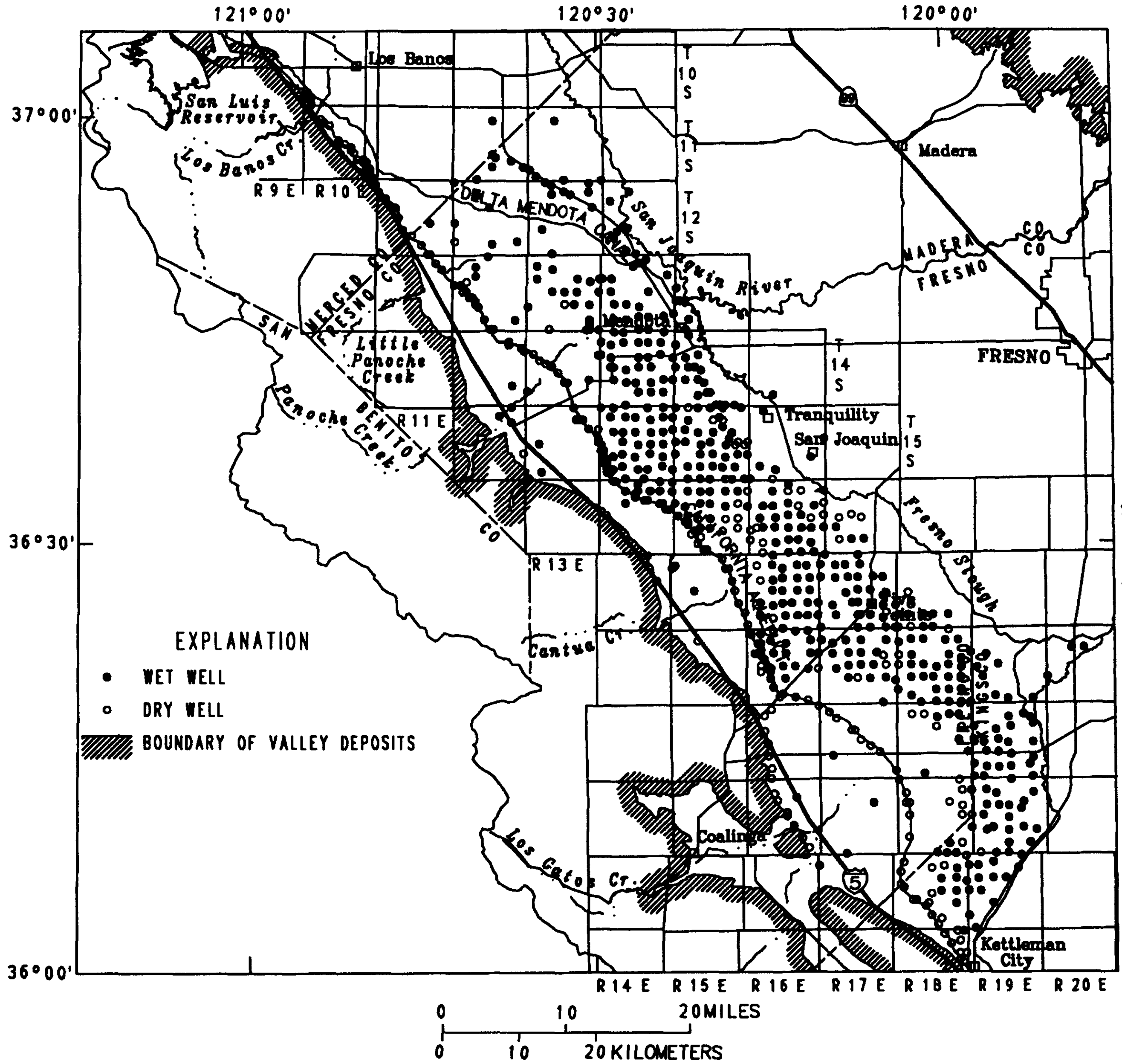

Figure 12. *Areal distribution of wells with water levels indicative of the water table and dry wells which help define the water table.*

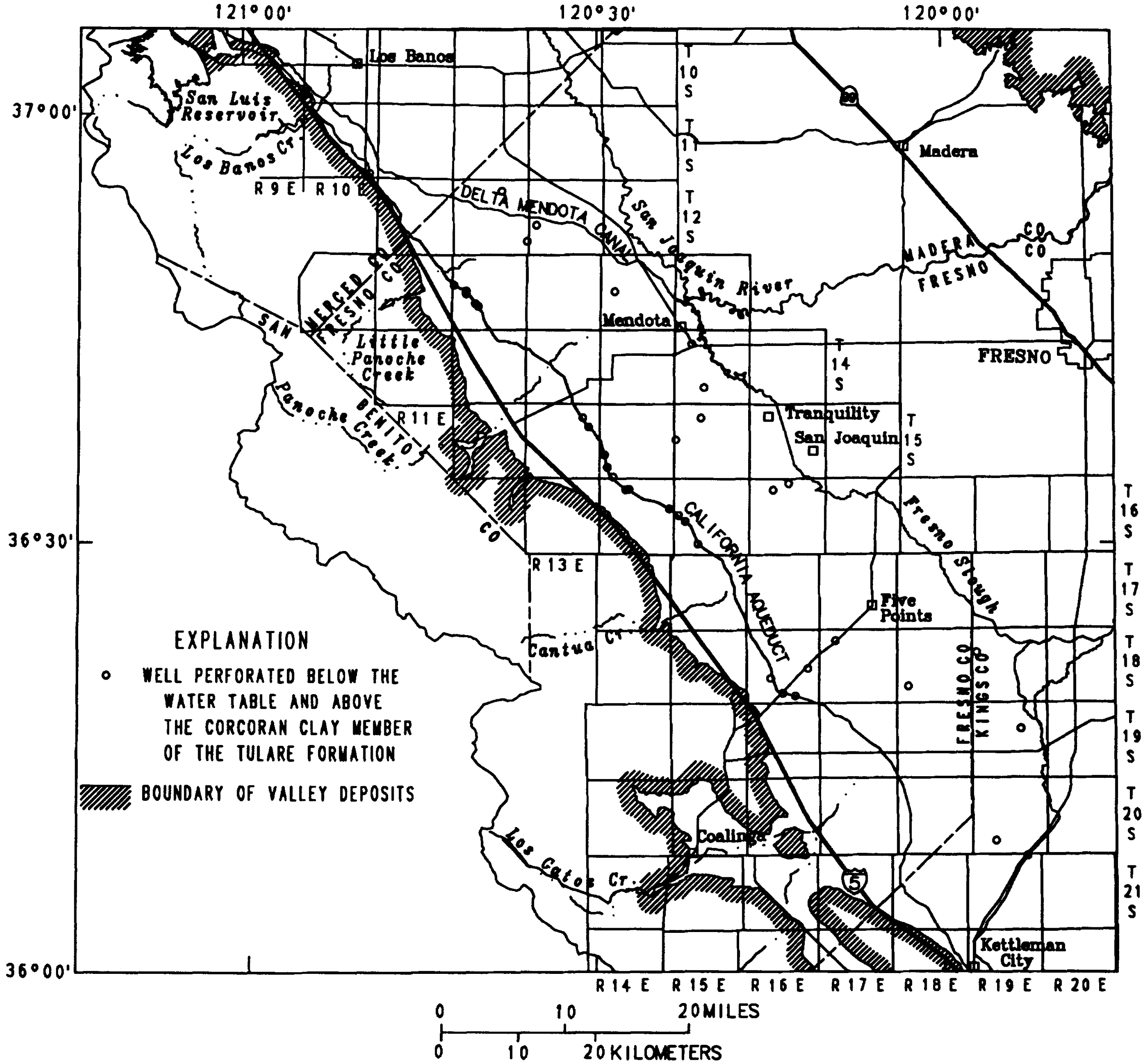

Figure 13. *Areal distribution of wells perforated below the water table and above the Corcoran Clay Member of the Tulare Formation.*

TABLE 10.--*Wells with water levels indicative of the water table and dry wells which help define the water table*

[*, dry wells]

10S10E31D01	*12S11E20R01	13S12E20R01	13S15E19M03	14S14E28A01	15S14E17A01
10S10E31G02	*12S11E20R02	13S12E28D01	13S15E31R02	14S14E28D01	15S14E17D01
*10S10E31Q01	12S11E23E01	*13S12E33B04	13S15E32D01	14S14E33N02	15S14E17R01
10S10E31Q02	*12S11E28G01	*13S12E34N01	*14S12E02Q01	14S15E05E01	15S14E19D01
*11S10E08C02	*12S11E28G02	13S12E34P02	*14S12E11B01	14S15E05E02	15S14E19L01
*11S10E08G01	*12S11E34C01	13S12E36D03	*14S12E12G02	14S15E05E03	15S14E19M01
*11S10E09M01	*12S11E34C02	13S13E06R01	14S12E12J01	14S15E07D01	15S14E20R01
*11S10E09M02	*12S11E34R02	13S13E07R01	14S12E26H01	14S15E08R01	15S14E22D01
*11S10E09M03	*12S11E35N03	13S13E09D02	*14S13E07Q01	14S15E17N01	15S14E23D04
*11S10E16R01	12S12E06D01	13S13E11N03	*14S13E07Q02	14S15E17Q02	15S14E23N01
*11S10E16R02	12S12E08A01	13S13E12R02	*14S13E12R01	14S15E18A01	15S14E24D02
*11S10E21A02	12S12E16A01	13S13E13D01	*14S13E16N02	14S15E18N02	15S14E25D01
*11S10E22C01	12S12E19E01	13S13E13R02	*14S13E16N03	14S15E19R02	15S14E25N01
*11S10E22H02	12S12E25N02	13S13E14N03	*14S13E16N04	14S15E20R01	15S14E28A01
*11S10E22J01	*12S12E30N02	13S13E15N02	*14S13E17E03	14S15E21D01	15S14E29D01
*11S10E23N01	12S12E34D03	13S13E16N02	*14S13E17K01	14S15E28C01	15S14E29R02
11S10E25M01	12S13E02A01	*13S13E22N02	*14S13E17K02	14S15E28Q01	15S14E30C02
11S10E25N01	12S13E02R01	13S13E22R01	*14S13E21G01	14S15E28R01	15S14E30K02
*11S10E26F01	12S13E04R06	13S13E24N01	*14S13E21G02	14S15E32A02	15S14E30L01
11S10E26H01	12S13E05C05	13S13E30D01	14S13E24N02	14S15E34P01	15S14E31B02
11S10E26J01	12S13E05C06	*13S13E32R01	*14S13E27C01	14S15E34Q01	15S14E31G01
11S10E36C02	12S13E05H05	13S13E35R01	*14S13E27D01	14S15E35N02	*15S14E31H04
11S10E36D01	12S13E05H06	13S13E36D01	*14S13E30N02	14S15E35R02	15S14E32D01
11S10E36E01	12S13E08A05	13S13E36E01	14S13E30N04	14S16E32A03	15S14E33N01
11S10E36F01	12S13E10C05	13S13E36M02	14S14E01D04	15S12E02A01	15S14E34A01
11S10E36L02	12S13E13D02	13S13E36N04	14S14E02R01	15S12E03R01	15S14E34D01
11S10E36M01	12S13E20N01	13S13E36R01	14S14E03N04	15S12E11H01	15S14E34Q01
11S10E36Q01	12S13E32R01	13S14E03G01	14S14E03R01	*15S12E24R01	15S14E36A01
11S12E10D01	12S14E04N01	13S14E03L01	14S14E05A01	*15S13E03A01	15S15E01C01
11S12E22N05	12S14E07K01	13S14E03M02	14S14E05A03	15S13E11B01	15S15E03A01
11S12E25Q05	12S14E20K01	13S14E03M04	14S14E05D02	15S13E11C01	15S15E03Q02
11S12E25Q06	12S14E20R01	13S14E04Q01	14S14E05R01	15S13E11D03	15S15E04A01
11S12E26G05	12S14E29D02	13S14E07N05	14S14E06N03	15S13E12N03	15S15E05A01
11S12E26G06	12S14E30J05	13S14E07R01	14S14E07A01	*15S13E12R01	*15S15E05D01
11S12E27C05	12S14E32J01	13S14E12L01	14S14E07N02	15S13E13J01	15S15E06D01
11S12E27N01	12S14E32J03	13S14E15R01	14S14E11R01	15S13E13R01	15S15E07R01
11S12E32R01	12S14E33Q01	13S14E18R01	14S14E13A02	15S13E20D01	15S15E08D01
11S13E09D01	*13S11E02K01	13S14E20N01	14S14E14N01	15S13E32F01	*15S15E10A01
11S13E31D05	*13S11E02K02	13S14E21N06	14S14E15A01	15S14E01D02	*15S15E10D02
11S13E31K05	*13S11E12D01	13S14E25J04	14S14E15D01	15S14E01N03	15S15E10J01
11S13E31K06	*13S11E12D02	13S14E25N03	14S14E15N03	15S14E01R01	*15S15E13N01
11S13E33R02	13S12E04A01	13S14E27D02	14S14E17N01	15S14E03A01	*15S15E13R01
11S13E36R01	13S12E05R02	13S14E27N01	14S14E18A01	15S14E04N01	15S15E14B01
*12S10E01G01	13S12E08J01	13S14E27R01	14S14E18R02	15S14E04R01	15S15E14L01
*12S10E01G02	*13S12E17D01	13S14E32D01	14S14E20N02	15S14E05D01	15S15E15D01
*12S10E01G03	13S12E17N02	13S14E33D01	14S14E21D01	15S14E06D03	15S15E16R01
*12S10E01H01	13S12E18E02	13S14E34N03	14S14E24N06	15S14E06R01	15S15E17A03
12S11E06N02	13S12E18G01	13S14E34R01	14S14E24R01	15S14E11D03	15S15E18N03
*12S11E07G01	*13S12E18R01	13S15E18M01	14S14E25N01	15S14E12R01	15S15E18R01
*12S11E07G02	13S12E20F02	13S15E19L01	14S14E26D02	15S14E13D01	15S15E19N05
12S11E17C01	13S12E20G02	13S15E19M01	14S14E26N02	15S14E14D02	15S15E21D01
12S11E17Q01	13S12E20J01	13S15E19M02	14S14E27N02	15S14E16A01	15S15E21N03

TABLE 10.--*Wells with water levels indicative of the water table and dry wells which help define the water table*--Continued

15S15E22N02	16S15E09R01	*16S16E30N04	17S16E28D01	18S16E03A01	18S17E24N04
*15S15E23A02	*16S15E12N02	*16S16E32D01	17S16E29N02	*18S16E04D01	18S17E25A01
15S15E23D02	16S15E13A02	*16S16E32N02	*17S16E31M01	18S16E05E01	18S17E35R02
*15S15E24B01	16S15E14D01	16S16E33D01	*17S16E33D01	18S16E05R02	*18S18E02D01
15S15E24N02	16S15E17N03	16S16E34N03	17S16E33R03	18S16E06F01	18S18E02R02
15S15E24R02	16S15E18A01	16S16E35A01	17S17E03N01	18S16E07A02	18S18E03R01
15S15E26D02	*16S15E18P01	16S16E35N01	17S17E04A01	18S16E07Q01	18S18E04N01
15S15E26R02	16S15E19H02	16S16E36N01	17S17E05N02	18S16E08D02	18S18E05N04
15S15E27N02	*16S15E20A01	*16S17E16N01	17S17E05R01	18S16E08M01	18S18E07D01
15S15E27R01	16S15E20E01	16S17E19R01	17S17E06C01	18S16E08M02	18S18E12R01
15S15E28N01	16S15E20M01	*16S17E20D01	17S17E06N02	18S16E08N02	18S18E13E01
15S15E29N03	16S15E21A01	*16S17E21A01	17S17E07N01	18S16E09N02	18S18E14D01
15S15E32N01	16S15E21N01	16S17E27N02	17S17E08N01	18S16E10D01	18S18E14N01
15S15E33N01	16S15E21R01	16S17E28N03	17S17E09N01	18S16E10N01	18S18E16N01
15S15E33R01	*16S15E23D01	*16S17E29N01	17S17E09R01	18S16E12N01	18S18E17D01
15S15E35N02	*16S15E24D01	*17S14E02D01	17S17E11N01	18S16E12R01	18S18E17N01
15S15E35Q01	*16S15E24N04	*17S14E14A02	17S17E11R02	18S16E15R02	*18S18E18D01
15S15E36Q01	*16S15E27A01	*17S15E02E01	17S17E15R01	18S16E16R01	*18S18E18N02
15S16E05E02	*16S15E28M02	17S15E06P02	17S17E16R01	18S16E17D01	18S18E20N01
15S16E13J01	16S15E29B01	17S15E07D01	17S17E20A01	18S16E17F01	18S18E21N02
15S16E26A01	*16S15E29F01	*17S15E11B01	17S17E21P01	*18S16E17N03	18S18E21R01
15S16E30R01	*16S15E32A04	*17S15E11C01	17S17E21R02	18S16E17Q01	18S18E22D03
15S16E31N04	16S15E33K01	*17S15E13N04	17S17E23H01	18S16E20A01	18S18E23N02
*15S16E32R02	16S15E33L01	*17S15E13N06	17S17E24D01	*18S16E20E02	18S18E24D02
15S16E33D01	16S16E01R01	*17S15E14A02	17S17E25A01	18S16E20H01	18S18E24N02
16S14E01A01	*16S16E02N01	17S15E17R01	17S17E26A01	18S16E20R02	18S18E25N01
16S14E01R01	16S16E03E01	*17S15E24P02	17S17E27A01	18S16E22N03	18S18E26N03
16S14E02A01	*16S16E03N01	*17S15E25J01	17S17E27N01	18S16E23A03	18S18E27N04
16S14E02N02	*16S16E03N02	17S16E02N02	17S17E27R04	*18S16E24A01	18S18E30N02
16S14E02R01	16S16E05R03	17S16E02R01	17S17E28R03	18S16E28M01	18S18E32E02
16S14E03E02	16S16E10N02	17S16E04D01	17S17E29N03	18S16E33A06	18S18E32R01
16S14E03N01	*16S16E12R01	17S16E04N03	17S17E30A01	*18S16E33G01	18S18E34N01
16S14E04N02	16S16E13D01	*17S16E06R01	17S17E31N02	18S16E34H01	18S18E35N05
*16S14E05C02	*16S16E13R01	17S16E09A01	17S17E33R01	*18S16E35J01	18S18E36N05
*16S14E05D01	16S16E14N02	17S16E09R03	17S17E34R01	18S17E01N01	18S18E36R01
16S14E09A02	*16S16E15A02	17S16E11N04	17S17E35A01	18S17E03N03	18S19E16N02
16S14E09H02	16S16E15N03	17S16E12N02	17S17E36N01	18S17E05R01	18S19E17D01
16S14E09N01	16S16E17A01	17S16E13N03	*17S17E36R01	18S17E06N01	18S19E19C01
16S14E10J01	16S16E17D01	17S16E14N01	*17S18E19A01	18S17E07A01	18S19E19R01
16S14E10K02	16S16E19A01	17S16E16D01	17S18E26N01	18S17E07R01	18S19E32H01
16S14E11R01	*16S16E19Q01	17S16E16N02	17S18E28N02	18S17E09N02	18S19E33J02
*16S14E12N01	16S16E20N02	17S16E16R01	17S18E28R02	18S17E10N01	18S19E35J01
*16S14E13F01	16S16E21D01	*17S16E17D02	*17S18E29D01	18S17E11P01	18S20E09M01
16S14E13G02	16S16E21N01	17S16E20N01	17S18E30N01	*18S17E13N03	18S20E10M01
16S15E01N01	16S16E22N01	17S16E21R01	17S18E30R01	*18S17E14A01	18S20E19N01
*16S15E01R01	*16S16E23A01	17S16E22Q01	*17S18E31N03	18S17E14N03	*19S16E01A02
16S15E02N04	16S16E23N02	17S16E23R01	*17S18E32N01	18S17E15N05	*19S16E05H01
16S15E04N01	16S16E23R01	17S16E24R02	17S18E33N02	18S17E16N01	*19S16E05H02
16S15E04R01	16S16E24R01	17S16E25R01	17S18E33R01	18S17E20D01	*19S16E05H03
16S15E05N01	16S16E27N01	17S16E26N03	*18S15E04N02	18S17E21N01	*19S16E05P01
16S15E07N02	16S16E27R01	17S16E26R01	18S16E01N03	*18S17E21R01	*19S16E17C02
16S15E09N02	*16S16E30D01	17S16E27N02	18S16E02A01	18S17E22R01	*19S16E20B01

TABLE 10.--*Wells with water levels indicative of the water table and dry wells which help define the water table*--Continued

*19S16E29B01	19S19E09A01	*20S16E09L01	20S18E34R01	21S17E06N01	*21S19E04M02
*19S16E32A01	19S19E10N01	20S16E10H03	20S18E35D03	*21S18E01A01	21S19E06N01
*19S16E32R01	19S19E11B01	*20S16E15M01	20S18E35Q01	*21S18E02N01	21S19E06R02
*19S17E06K01	19S19E11J01	*20S16E15N01	*20S18E36D04	*21S18E06J01	21S19E07R01
*19S17E08D02	19S19E16N04	*20S16E22K01	20S19E03D01	*21S18E07G01	21S19E09N01
*19S17E15N02	19S19E17A01	*20S16E22Q01	20S19E05N01	*21S18E10D03	21S19E10N01
*19S17E16B01	*19S19E18N04	*20S16E26L01	20S19E08A01	21S18E10R01	21S19E11D01
*19S17E16C01	19S19E19A01	*20S16E35H01	20S19E11A03	21S18E12D03	21S19E17N01
*19S17E22H01	19S19E19D01	20S17E11N03	20S19E11N02	21S18E12N01	21S19E18N02
*19S17E22H02	19S19E20N01	20S17E32R01	20S19E15H01	21S18E13A01	21S19E21N01
*19S17E23Q01	19S19E21A01	*20S18E01N01	20S19E16A01	21S18E13N01	21S19E30N01
19S17E30A02	19S19E21N02	20S18E01R01	20S19E16D02	21S18E15R01	21S19E31Q01
*19S17E36H02	19S19E23A01	*20S18E02A01	20S19E17D01	*21S18E18G02	22S18E01B01
19S18E02N01	19S19E26H03	*20S18E06D03	20S19E18R01	*21S18E18J02	*22S18E01D02
19S18E02R01	19S19E26Q03	*20S18E07B01	20S19E20Q01	*21S18E20J01	*22S18E01P01
*19S18E04N01	19S19E27D02	*20S18E07Q01	20S19E21A01	*21S18E20K01	*22S18E02E01
*19S18E05N02	19S19E30N01	*20S18E07R01	20S19E23N01	*21S18E21R01	*22S18E11B01
19S18E10D01	19S19E31N02	*20S18E11N02	20S19E25D02	*21S18E22D01	*22S18E11B02
*19S18E10N02	19S19E31R01	*20S18E13D01	20S19E28A01	21S18E24N03	*22S18E12P03
*19S18E12N01	19S19E32D01	*20S18E13N01	20S19E29D01	*21S18E27N03	*22S18E12R02
19S18E14R01	19S19E33D01	*20S18E13R02	*20S19E31Q01	*21S18E28B01	*22S18E13F01
19S18E24Q01	19S19E34D02	*20S18E18R01	20S19E32R01	*21S18E28B02	*22S18E13K01
19S18E33M02	19S19E35R02	20S18E24R01	20S19E33A01	*21S18E34A01	
19S19E02N01	*20S16E09D01	*20S18E30J02	20S19E33R01	*21S18E34K02	
19S19E07N01	*20S16E09D02	20S18E34N01	20S19E35B01	*21S19E02C01	

TABLE 11.--*Wells perforated below the water table and above the Corcoran Clay Member of the Tulare Formation*

10S10E31D02	13S12E20D02	15S14E30C01	16S14E04P01	16S16E05R02	18S16E34H02
11S10E36L01	13S12E20R02	15S14E31B01	16S14E13G01	18S16E20R01	18S17E05N04
12S12E03R02	13S12E28D02	15S14E32N03	16S14E13G04	18S16E23A01	18S18E30J02
12S12E25R02	13S14E17N02	15S15E09D03	16S15E18P02	18S16E23A02	18S19E07P02
12S13E07N01	14S15E08C04	15S15E18N01	16S15E18P03	18S16E33A02	19S19E15A02
12S13E19K01	14S15E28L04	15S15E18N02	16S15E19H01	18S16E33A03	20S19E29R01
13S12E17N01	15S13E11B02	16S14E04N03	16S15E32A03	18S16E33A04	21S19E02A02
13S12E18E01	15S13E12N04	16S14E04N04	16S16E03E02	18S16E33A05	

SUMMARY

A large number of wells have been drilled in the San Joaquin Valley to supply water for agriculture and to monitor water levels. Information from 5,860 of these wells was collected from several sources and compiled into a common data base. These wells were then organized into categories by comparing the location of the perforated lengths with the location of the hydrogeologic units. These categories were used to characterize the nature and distribution of the wells and to compile information on the groundwater flow system. In addition, a computerized system for storing and retrieving well information was developed.

Because of the varying degree of detail and quality of the data, only 2,547 wells had sufficient information for classification into four categories based on the hydrogeology: 1,114 wells are perforated in the semiconfined zone at depths less than or equal to 50 feet, 490 wells are perforated in the semiconfined zone at depths greater than 50 feet, 533 wells are perforated in the semiconfined and confined zones, and 410 wells are perforated only in the confined zone. Additionally, wells perforated in the semiconfined zone at depths greater than 50 feet were classified by the type of deposits they were perforated in (Coast Range alluvium or Sierran sand).

Each hydrogeologically based category is represented by a map showing the location of wells in the category and by a list of those wells. The maps illustrate the areal distribution of the wells in a category. The lists allow the user to obtain more information from the data base with the use of the programs provided. This information can be used as a starting point for further investigations in the San Joaquin Valley.

Wells perforated in the semiconfined zone at depths less than or equal to 20 feet are evenly distributed over the area less than 20 feet from water. They generally are used as observation wells to monitor the shallow water table. The 50-foot wells are used to monitor water levels near the California Aqueduct.

Most wells perforated in the semiconfined zone at depths greater than 50 feet are perforated in the Sierran sand. A few wells are perforated in the Coast Range alluvium, but the coverage is sparse. The concentration of wells perforated in the Sierran sand indicates that there is a greater tendency to use Sierran sand than the Coast Range alluvium as a source of water. Moreover, a large percentage of the wells perforated in the Coast Range alluvium are part of the California Aqueduct monitoring system and are not production wells.

Most of the wells perforated in the semiconfined and confined zones are upslope of the valley trough in areas where the Sierran sand is absent. These wells have an average perforated length of 987 feet below the Corcoran and an average perforated length of 132 feet above the Corcoran. Wells in or near the valley trough where the Sierran sand is present have a shorter average perforated length below the Corcoran (555 feet) and a slightly longer average perforated length above the Corcoran (162 feet). This indicates that wells which are able to access the Sierran sand do not need to be drilled deep into the confined zone to obtain an adequate yield of water.

Similarly, wells perforated only in the confined zone are predominantly upslope of the valley trough. These wells also reflect the influence of the presence or absence of Sierran sand

above the Corcoran. Wells in the valley trough have an average perforated length of 628 feet, and wells upslope of the valley trough have a longer average perforated length of 987 feet.

Wells perforated only in the confined zone also are concentrated near the creeks. This indicates a tendency for locating wells in the coarser grained sediments of the upper-fan areas, rather than in the finer grained sediments of the interfan areas.

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APPENDIX--SAMPLE DATA AND PROGRAM DOCUMENTATION

The following Fortran programs were designed to retrieve well records from the water-level data base. Data_Recovery, which is a compilation of many of the smaller programs described later, is an interactive program which allows the user to query the data base for specific information. Data_Recovery accepts as input any file that is in a "standard format." Methods of recovering data from the input file include: (1) interactive entry of specific well locations; (2) a list-driven search using an external file containing well locations; (3) recovering wells in a specified township/range; and (4) a search of the entire input file. Searches can be further restricted by imposing ranges or limits on the dates of record and/or the depth of the wells.

Strip_Headers accepts any subset of the water-level data base as input, and creates a listing of only the headers without the water-level entries. The list of headers has many uses, including its role as input to Depth_Sort, which searches through the list of headers and produces well records for the subset of wells having depths within a specified range. Strip_Loc also uses the output from Strip_Headers, and converts it to a list of well locations (township, range, section, quarter-quarter section, and well number) which can be used as input for the list-driven search in Data_Recovery.

Date_Select accepts any subset of the water-level data base as input, and retrieves header and water-level information for these wells that have a measurement on a user-specified date. The output consists of one line per successful search, containing the location, water level (on the specified date), and depth of the well. WL_Diff compares two files created by Date_Select, and calculates the differences between the water levels.

Sample Data (in "standard" USBR format):

```
               1         2         3         4
1234567890123456789012345678901234567890123456
----------------------------------------------
Q005M13S13E13D0110                 6 N0016 83  0
830110    02040020300088000780195 2    0
830405    02040020300078000680196 2    0
830706    02040020300070000600197 0    0
831004    02040020300081000710195 9    0
840117    02040020300086000760195 4    0
840402    02040020300082000720195 8    0
840702    02040020300062000520197 8    0
841003    02040020300086000760195 4    0
850102    02040020300087000770195 3    0
850403    02040020300073000630196 7    0
850708    02040020300065000550197 5    1
```

The first line, called a "header", is organized as follows:

COLUMNS	DESCRIPTION
1-5	Code for origin of data
6-16	State Well Number
37-40	Well depth
42-43	First year of measurement
44-45	Last year of measurement (if discontinued)

The remaining lines are organized as follows:

COLUMNS	DESCRIPTION
1-6	Date of measurement (Year,Month,Day)
11-14	Measuring point elevation
16-19	Land surface elevation
21-24	Depth-to-water from measuring point
26-29	Depth-to-water from land surface
30-33	Water surface elevation
38	Flag - 1=last record

Note: There are implied decimals between the 13th and 14th, 18th and 19th, 23rd and 24th, 28th and 29th, and 32nd and 33rd columns.

If the digit after the implied decimal is not a number, then the value is negative.

```
      PROGRAM DATA_RECOVERY
C     S.P.PHILLIPS 05/87 This program is an interactive data retrieval system
C     designed to accept data in "standard" USBR format, and output that
C     data which meets the user-specified requirements for LOCATION, DEPTH,
C     and DATE.
C
C     INPUT:
C     Example Input (in "standard" USBR format):
C                  1         2         3         4
C         1234567890123456789012345678901234567890123456
C         Q005M13S13E13D0110             6 N0016 83  0
C         830110    020400203000880007801952    0
C         830405    020400203000780006801962    0
C         830706    020400203000700006001970    0
C         831004    020400203000810007101959    0
C         840117    020400203000860007601954    0
C         840402    020400203000820007201958    0
C         840702    020400203000620005201978    0
C         841003    020400203000860007601954    0
C         850102    020400203000870007701953    0
C         850403    020400203000730006301967    0
C         850708    020400203000650005501975    1
C
C     The first line, called a "header", is organized as follows:
C
C         COLUMNS  DESCRIPTION
C           1-5    Code for origin of data
C           6-16   State Well Number
C          37-40   Well depth
C          42-43   First year of measurement
C          44-45   Last year of measurement (if discontinued)
C
C     The remaining lines are organized as follows:
C
C         COLUMNS  DESCRIPTION
C           1-6    Date of measurement (Year,Month,Day)
C          11-14   Measuring point elevation
C          16-19   Land surface elevation
C          21-24   Depth-to-water from measuring point
C          26-29   Depth-to-water from land surface
C          30-33   Water surface elevation
C            38    Flag - 1=last record
C
C     OUTPUT:
C
C         The output consists of well records that satisfy the user-specified
C     requirements, which are defined in two phases. The first phase involves
C     the geographic bounds of the search, and offers the following options:
C
C         1) Interactively enter specific well locations.
C         2) Use list of well locations contained in an external file.
C         3) Search a specified township/range.
C         4) Let the data in the input file determine the geographic bounds.
```

```
C     The second phase allows the user to select additional criteria for a
C     successful search. One or more of the following options may be applied
C     to any of the geographic searches chosen in the first phase:
C
C         1) Search for well within a specified depth range.
C         2) Search for well records within a specified date range.
C         3) Search for well records with a particular date.
C
C         The default output is a file containing sequential well records for
C     those wells satisfying the search criteria. The user has the option of
C     creating a separate file for each well.
C
C**** Begin MAIN program ***************************************************
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /INFILS/ INFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /HDRS/ HEADER
      COMMON /CHRS/ HLDATE,MONTHS,YEAR,YEARMO
      COMMON /INTG/ DEEP,NUMMON(15),NUMYR,SHALL
C     Global variables
      CHARACTER HEADER*80,HLDATE*4,MONTHS*120,SEPFLG*1,YEAR*30,
     +                                        YEARMO*30
      CHARACTER PASSFL*1,SAVEFL*1,SORTFL*1
      INTEGER BDFILE,DEEP,SHALL,INFILE,NUMMON,NUMYR,OFILE
C     Local variables
      CHARACTER*1 OPTION(5)
      CHARACTER ANSWER*1,BDFLNM*32,BLANK*1,INNAME*32,OUTNAM*32,TYPE*1
      INTEGER MINDEX,MON,OPTNUM,TMON,YINDEX
C
C     Initialize variables
      INFILE=30
      OFILE=31
      BDFILE=5
      BLANK=' '
C     Initialize/reset variables
   10 CONTINUE
      DEEP=0
      SHALL=0
      HLDATE='    '
      YEAR(1:2)='  '
      YEARMO(1:2)='  '
      OPTNUM=0
      NUMYR=0
      TMON=0
      SEPFLG='N'
```

```
C     Ask series of questions to define user needs, and open appropriate files
      WRITE(1,300) BLANK
      WRITE(1,300) 'How do you wish to recover well data?'
      WRITE(1,300) BLANK
      WRITE(1,300) '     1) Enter well location(s) from the terminal'
      WRITE(1,300) '     2) Read well locations from a file'
      WRITE(1,300) '     3) Gather data from specified Township/Range'
      WRITE(1,300) '     4) Gather data from entire input file'
      WRITE(1,300) BLANK
      WRITE(1,300) 'ENTER 1, 2, 3, or 4:'
      READ(1,300) TYPE
      WRITE(1,300) BLANK
      WRITE(1,300) 'Additional options:'
   20 CONTINUE
      OPTNUM=OPTNUM+1
      WRITE(1,300) BLANK
      WRITE(1,300) '     1) Specify depth range'
      WRITE(1,300) '     2) Specify date range'
      WRITE(1,300) '     3) Specify particular date - Year(s) only'
      WRITE(1,300) '     4) Specify particular date-Year(s) + Month(s)'
      WRITE(1,300) '     5) None'
      WRITE(1,300) BLANK
      WRITE(1,300) 'ENTER 1, 2, 3, 4, or 5:'
      READ(1,300) OPTION(OPTNUM)
      IF(OPTION(OPTNUM).NE.'5') THEN
        WRITE(1,300)'Would you like to use another option (Y/N)?'
        READ(1,300) ANSWER
        IF(ANSWER.EQ.'Y') GOTO 20
      ENDIF

      WRITE(1,300) 'Enter the name of the INPUT file containing'
      WRITE(1,300) '"standard" raw data'
      READ(1,300) INNAME
      OPEN(INFILE,FILE=INNAME)
      WRITE(1,300)'Is the above input file sorted by location (Y/N)?'
      READ(1,300) SORTFL
      IF(SORTFL.EQ.'Y') THEN
        IF(TYPE.EQ.'1') THEN
          WRITE(1,300)'Is your list of well locations sorted (Y/N)?'
          READ(1,300) SORTFL
        ELSE IF(TYPE.EQ.'2') THEN
          WRITE(1,300)'Is the file containing locations sorted (Y/N)?'
          READ(1,300) SORTFL
        ELSE IF(TYPE.EQ.'3') THEN
          WRITE(1,300)'Is your list of Township/Ranges sorted by'
          WRITE(1,300)'Township and Range, respectively (Y/N)?'
          READ(1,300) SORTFL
        ENDIF
```

```
      ENDIF
      WRITE(1,300) 'Enter the name of the OUTPUT file:'
      READ(1,300) OUTNAM
      OPEN(OFILE,FILE=OUTNAM)
      WRITE(1,300)'You have the option to create a separate file for'
      WRITE(1,300)'each set of well data that passes the search'
      WRITE(1,300)'criteria - would you like this option (Y/N)?'
      READ(1,300) ANSWER
      IF(ANSWER.EQ.'Y') SEPFLG='Y'
      WRITE(1,300)'Would you like to save a file of headers/locations'
      WRITE(1,300)'that do not pass the search criteria (Y/N)?'
      READ(1,300) ANSWER
      IF(ANSWER.EQ.'Y') THEN
        SAVEFL='Y'
        WRITE(1,300)'Enter file name:'
        READ(1,300) BDFLNM
        OPEN(BDFILE,FILE=BDFLNM)
      ENDIF
C
C     If options are chosen, ask user for additional information

      DO 30 I=1,OPTNUM
        WRITE(1,300) BLANK
        IF(OPTION(I).EQ.'1') THEN
          WRITE(1,300) 'Specify a depth range -'
          WRITE(1,300) '  Enter the largest well depth desired:'
          READ(1,200) DEEP
          WRITE(1,300) '  Enter the smallest well depth desired:'
          READ(1,200) SHALL
        ELSE IF(OPTION(I).EQ.'2') THEN
          WRITE(1,300) 'Specify a date range -'
          WRITE(1,300) '  Enter largest year (last 2 digits only):'
          READ(1,300) HLDATE(3:4)
          WRITE(1,300) '  Enter smallest year (last 2 digits only):'
          READ(1,300) HLDATE(1:2)
        ELSE IF(OPTION(I).EQ.'3') THEN
          WRITE(1,300) 'Specify particular Year(s) -'
   40     CONTINUE
          NUMYR=NUMYR+1
          YINDEX=(NUMYR*2)-1
          WRITE(1,300) '  Enter a desired year (last 2 digits only):'
          READ(1,300) YEAR(YINDEX:(YINDEX+1))
          WRITE(1,300) 'Are more years desired (Y/N)?'
          READ(1,300) ANSWER
          IF(ANSWER.EQ.'Y') GOTO 40
        ELSE IF(OPTION(I).EQ.'4') THEN
          WRITE(1,300) 'Specify particular Year(s) and Month(s) -'
   50     CONTINUE
          NUMYR=NUMYR+1
          YINDEX=(NUMYR*2)-1
          WRITE(1,300) '  Enter a desired year (last 2 digits only):'
          READ(1,300) YEARMO(YINDEX:(YINDEX+1))
          MON=0
```

```
   60     CONTINUE
          MON=MON+1
          TMON=TMON+1
          MINDEX=(TMON*2)-1
          WRITE(1,301) '  Enter one desired month for the year 19',
     +                                YEARMO(YINDEX:(YINDEX+1))
          WRITE(1,300) '  (2 DIGITS - leading 0 is often required):'
          READ(1,300) MONTHS(MINDEX:(MINDEX+1))
          WRITE(1,300) 'Are there more months for this year (Y/N)?'
          READ(1,300) ANSWER
          IF(ANSWER.EQ.'Y') GOTO 60
          NUMMON(NUMYR)=MON
          WRITE(1,300) 'Do you wish to enter another year (Y/N)?'
          READ(1,300) ANSWER
          IF(ANSWER.EQ.'Y') GOTO 50
        ENDIF
   30 CONTINUE
C
C     Go to appropriate subroutine where header/well locations will be
C     selected/entered, and sent to SEARCH.
      IF(TYPE.EQ.'1') CALL INTERACT
      IF(TYPE.EQ.'2') CALL LOCFILE
      IF(TYPE.EQ.'3') CALL TRSEARCH
      IF(TYPE.EQ.'4') CALL ALLSEARCH
C
      ENDFILE (OFILE)
      CLOSE (INFILE)
      CLOSE (OFILE)
C
      WRITE(1,300)'Would you like to continue recovering data (Y/N)?'
      READ(1,300) ANSWER
      IF(ANSWER.EQ.'Y') GOTO 10
  200 FORMAT(I4)
  300 FORMAT(A)
  301 FORMAT(2A)
      STOP
      END
C**** End MAIN program ***********************************************
C
C
C
C*********************************************************************
      SUBROUTINE SEARCH
C*********************************************************************
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /INFILS/ INFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /INTG/ DEEP,NUMMON(15),NUMYR,SHALL
      COMMON /HDRS/ HEADER
      COMMON /CHRS/ HLDATE,MONTHS,YEAR,YEARMO
```

```
C     Global variables
      CHARACTER HEADER*80,HLDATE*4,MONTHS*120,SEPFLG*1,YEAR*30,
     +                                           YEARMO*30
      CHARACTER PASSFL*1,SAVEFL*1,SORTFL*1
      INTEGER BDFILE,DEEP,SHALL,INFILE,NUMMON,NUMYR,OFILE
C     Local variables
      CHARACTER FILNAM*12,LINE*80,DATRNG*1,DEPRNG*1,PASS*1,SPYEAR*1,
     +                                        SPYMON*1,FLAG*1
      INTEGER DEPTH,FILNUM,MINDEX,WRITES,YINDEX
C
C     Initialize variables
      DATRNG='Y'
      DEPRNG='Y'
      SPYEAR='Y'
      SPYMON='Y'
      PASSFL='P'
      FILNAM(1:1)='L'
      FILNUM=33
C
C     Determine needs
      IF(DEEP.EQ.0) DEPRNG='N'
      IF(HLDATE.EQ.'    ') DATRNG='N'
      IF(YEAR(1:2).EQ.'  ') SPYEAR='N'
      IF(YEARMO(1:2).EQ.'  ') SPYMON='N'
C
C     First check to see if header meets specs - if yes, write it out - if no,
C     advance to the last line of record and RETURN
      IF(DEPRNG.EQ.'Y') THEN
        READ(HEADER,200) DEPTH
        IF((DEPTH.LT.SHALL).OR.(DEPTH.GT.DEEP)) GOTO 90
      ENDIF
      IF(DATRNG.EQ.'Y') THEN
        IF(HEADER(44:45).EQ.'  ') THEN
          IF(HEADER(42:43).GT.HLDATE(1:2)) GOTO 90
        ELSE IF((HEADER(42:43).GT.HLDATE(1:2)).OR.
     +           (HEADER(44:45).LT.HLDATE(3:4))) THEN
          GOTO 90
        ENDIF
      ENDIF
C
C     If this point is reached, the header meets specs, so write out to file
      WRITE(OFILE,300) HEADER
C
C     Search for and write out data that meets specs
      WRITES=0
   10 READ(INFILE,300) LINE
      PASS='N'
      TMON=0
      IF(SPYEAR.EQ.'Y') THEN
        DO 20 I=1,NUMYR
          YINDEX=(I*2)-1
          IF(LINE(1:2).EQ.YEAR(YINDEX:(YINDEX+1))) GOTO 50
```

```
   20   CONTINUE
      ELSE IF(SPYMON.EQ.'Y') THEN
        DO 30 I=1,NUMYR
          YINDEX=(I*2)-1
          IF(LINE(1:2).EQ.YEARMO(YINDEX:(YINDEX+1))) THEN
            DO 40 L=1,NUMMON(I)
              TMON=TMON+1
              MINDEX=(TMON*2)-1
              IF(LINE(3:4).EQ.MONTHS(MINDEX:(MINDEX+1))) GOTO 50
   40       CONTINUE
          ELSE
            TMON=TMON+NUMMON(I)
          ENDIF
   30   CONTINUE
      ELSE
        PASS='Y'
      ENDIF
C
      GOTO 60
   50 PASS='Y'
C     If the line of data passed inspection, write it out, and note that data
C     was written to the output file. If no data was written for a given
C     header (WRITES=0), the header, which was already written to the output
C     file, must be erased (or written-over).
   60 IF(PASS.EQ.'Y') THEN
        WRITES=WRITES+1
        IF((WRITES.EQ.1).AND.(SEPFLG.EQ.'Y')) THEN
          FILNAM(2:12)=HEADER(6:16)
          OPEN(FILNUM,FILE=FILNAM)
          WRITE(FILNUM,300) HEADER
        ENDIF
        IF(SEPFLG.EQ.'Y') WRITE(FILNUM,300) LINE
        WRITE(OFILE,300) LINE
      ENDIF
C
C     Check for end of record
      IF(LINE(38:38).EQ.'1') GOTO 80
      GOTO 10
C
C     Check to see if any data was written out - if not, set it up so that the
C     header will be overwritten. If data was written out, set the flag on the
C     last entry to "1", indicating the final line of data for the preceeding
C     header.
```

```
   80 IF(WRITES.EQ.0) THEN
        BACKSPACE OFILE
        PASSFL='F'
      ELSE
        BACKSPACE OFILE
        READ(OFILE,300) LINE
        LINE(38:38)='1'
        BACKSPACE OFILE
        WRITE(OFILE,300) LINE
        IF(SEPFLG.EQ.'Y') CLOSE (FILNUM)
      ENDIF
      GOTO 99
C
C     If header failed, read up to next header, and RETURN
   90 READ(INFILE,250) FLAG
      IF(FLAG.NE.'1') GOTO 90
      PASSFL='F'
C
  200 FORMAT(36X,I4)
  250 FORMAT(37X,A1)
  300 FORMAT(A)
   99 RETURN
      END
C
C
C*******************************************************************************
      SUBROUTINE HDRSEARCH (LOCATN)
C*******************************************************************************
      COMMON /HDRS/ HEADER
      COMMON /INFILS/ INFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
C     Global variables
      CHARACTER HEADER*80,PASSFL*1,SAVEFL*1,SEPFLG*1,SORTFL*1
      INTEGER INFILE
C     Local variables
      CHARACTER LOCATN*11,LINE*80,FLAG*1
C
      IF(SORTFL.EQ.'N') REWIND INFILE
      PASSFL='P'
C
   10 READ(INFILE,300,END=80) LINE
      IF(LINE(6:16).EQ.LOCATN) THEN
        HEADER=LINE
        GOTO 99
      ELSE
   20   READ(INFILE,200) FLAG
        IF(FLAG.NE.'1') GOTO 20
```

```
      ENDIF
      GOTO 10
C
   80 PASSFL='F'
      REWIND INFILE
C
  200 FORMAT(37X,A1)
  300 FORMAT(A)
   99 RETURN
      END
C
C
C*****************************************************************************
      SUBROUTINE INTERACT
C*****************************************************************************
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /HDRS/ HEADER
C     Global variables
      CHARACTER HEADER*80,PASSFL*1,SAVEFL*1,SEPFLG*1,SORTFL*1
      INTEGER BDFILE,OFILE
C     Local variables
      CHARACTER*11 LOCATN(100)
      CHARACTER BLANK*1
      INTEGER NUMBER
C
      BLANK=' '
      WRITE(1,300) BLANK
      WRITE(1,300)'WELL LOCATION entry section:'
      WRITE(1,300) BLANK
      WRITE(1,300)'  How many well locations would you like'
      WRITE(1,300)'  to enter (max 100)?'
      READ(1,200) NUMBER
      WRITE(1,300) BLANK
      DO 10 I=1,NUMBER
        WRITE(1,250)'  Enter the 11 digit location for well number',I
        READ(1,300) LOCATN(I)
   10 CONTINUE
C     Send each location to SEARCH, one at a time
      DO 20 I=1,NUMBER
        CALL HDRSEARCH (LOCATN(I))
        IF(PASSFL.EQ.'F') THEN
          IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) LOCATN(I)
        ELSE
          CALL SEARCH
          IF(PASSFL.EQ.'F') THEN
            IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) LOCATN(I)
          ENDIF
        ENDIF
   20 CONTINUE
C
```

```
  200 FORMAT(I3)
  250 FORMAT(A,I4)
  300 FORMAT(A)
      RETURN
      END
C
C
C*******************************************************************************
      SUBROUTINE LOCFILE
C*******************************************************************************
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /HDRS/ HEADER
C     Global variables
      CHARACTER HEADER*80,PASSFL*1,SAVEFL*1,SEPFLG*1,SORTFL*1
      INTEGER BDFILE,OFILE
C     Local variables
      CHARACTER BLANK*1,FILNAM*32,LOCATN*11
      INTEGER FILNUM
C
C     Initialize variables
      FILNUM=6
      BLANK=' '
C
      WRITE(1,300) BLANK
      WRITE(1,300)'Locations will be read from an external file -'
      WRITE(1,300)'  Enter the file name:'
      READ(1,300) FILNAM
      OPEN(FILNUM,FILE=FILNAM)
C
   10 READ(FILNUM,300,END=99) LOCATN
      CALL HDRSEARCH (LOCATN)
      IF(PASSFL.EQ.'F') THEN
        IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) LOCATN
      ELSE
        CALL SEARCH
        IF(PASSFL.EQ.'F') THEN
          IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) LOCATN
        ENDIF
      ENDIF
      GOTO 10
C
   99 CLOSE (FILNUM)
  300 FORMAT(A)
      RETURN
      END
C
C
```

```
C*****************************************************************************
      SUBROUTINE TRSEARCH
C*****************************************************************************
      COMMON /INFILS/ INFILE
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /HDRS/ HEADER
C     Global variables
      CHARACTER HEADER*80,PASSFL*1,SAVEFL*1,SEPFLG*1,SORTFL*1
      INTEGER BDFILE,OFILE
C     Local variables
      CHARACTER BLANK*1,FLAG*1
      CHARACTER*3 RNG(50),TWN(50)
      INTEGER NUMTR
C
      BLANK=' '
C
      WRITE(1,300) BLANK
      WRITE(1,300) 'Township/Range search -'
      WRITE(1,300)'  Enter the number of Township/Range pairs:'
      READ(1,200) NUMTR
      WRITE(1,300) BLANK
C
      DO 10 I=1,NUMTR
        WRITE(1,250)'Enter the Township for pair number',I
        WRITE(1,300)'(2 digits, 1 letter -ex: 16S)'
        READ(1,300) TWN(I)
        WRITE(1,250)'Enter the Range for pair number',I
        WRITE(1,300)'(2 digits, 1 letter -ex: 14E)'
        READ(1,300) RNG(I)
        WRITE(1,300) BLANK
   10 CONTINUE
C
   20 READ(INFILE,300,END=150) HEADER
      DO 30 I=1,NUMTR
        IF(HEADER(6:8).EQ.TWN(I)) THEN
          IF(HEADER(9:11).EQ.RNG(I)) GOTO 100
        ENDIF
   30 CONTINUE
      GOTO 80
C
   80 READ(INFILE,210) FLAG
      IF(FLAG.NE.'1') GOTO 80
      GOTO 20
C
  100 CALL SEARCH
      IF(PASSFL.EQ.'F') THEN
        IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) HEADER
      ENDIF
      GOTO 20
```

```
C
  200 FORMAT(I2)
  210 FORMAT(37X,A1)
  250 FORMAT(A,I4)
  300 FORMAT(A)
  150 RETURN
      END
C
C
C*************************************************************************
      SUBROUTINE ALLSEARCH
C*************************************************************************
      COMMON /INFILS/ INFILE
      COMMON /OFILES/ OFILE,BDFILE
      COMMON /FLAGS/ PASSFL,SAVEFL,SEPFLG,SORTFL
      COMMON /HDRS/ HEADER
C     Global variables
      CHARACTER HEADER*80,PASSFL*1,SAVEFL*1,SEPFLG*1,SORTFL*1
      INTEGER BDFILE,OFILE
C
   10 READ(INFILE,300,END=99) HEADER
      CALL SEARCH
      IF(PASSFL.EQ.'F') THEN
        IF(SAVEFL.EQ.'Y') WRITE(BDFILE,300) HEADER
      ENDIF
      GOTO 10
C
  300 FORMAT(A)
   99 RETURN
      END
```

```
      PROGRAM STRIP_HEADERS
C     S.P.PHILLIPS 2/85 This program creates a file of headers given well
C     data in "standard" USBR format.
C
C     INPUT:
C     Example Input (in "standard" USBR format):
C
C         Q005M13S13E13D0110               6 N0016 83  0
C         830706   020400203000700006001970    0
C         840702   020400203000620005201978    0
C         850708   020400203000650005501975    1
C
C     OUTPUT:
C     Example Output (given example input):
C
C         Q005M13S13E13D0110               6 N0016 83  0
C
C**** Begin program ****
      CHARACTER HEADER*48,IC*1,INFILE*32,OFILE*32
C
      WRITE(1,300)'Enter INPUT file name (max 32 char):'
      READ(1,300) INFILE
      WRITE(1,300)'Enter OUTPUT file name (max 32 char):'
      READ(1,300) OFILE
      OPEN(30,FILE=INFILE)
      OPEN(40,FILE=OFILE)
C
   10 READ(30,300,END=99) HEADER
      WRITE(40,300) HEADER
   20 READ(30,'(37X,A1)') IC
      IF(IC.EQ.'0') GOTO 20
      GOTO 10
C
  300 FORMAT(A)
   99 STOP
      END
```

```
      PROGRAM DEPTH_SORT
C     S.P.PHILLIPS 7/86 This program collects well data within a
C     specified depth range given "standard" USBR format.
C
C     INPUT:
C
C     Example Input (in "standard" USBR format):
C
C         Q005M13S13E13D0110              6 N0016 83  0
C         830706   02040020300070000600 1970    0
C         840702   02040020300062000520 1978    0
C         850708   02040020300065000550 1975    1
C
C     OUTPUT:
C         - Format is identical to input
C
C**** Begin program ****
      CHARACTER HEADER*46,DATA*38,INFILE*32,OFILE*32
      INTEGER DEPTH,MINDEP,MAXDEP
C
C     Interactively determine user needs
      WRITE(1,310)
      WRITE(1,300)'Enter name of INPUT file:'
      READ(1,300) INFILE
      OPEN(30,FILE=INFILE)
      WRITE(1,300)'Enter name of OUTPUT file:'
      READ(1,300) OFILE
      OPEN(40,FILE=OFILE)
      WRITE(1,300)'Enter minimum depth (integer):'
      READ(1,200) MINDEP
      WRITE(1,300)'Enter maximum depth (integer):'
      READ(1,200) MAXDEP
C
   10 CONTINUE
      READ(30,300,END=99) HEADER
      READ(HEADER,210) DEPTH
      IF ((DEPTH.GE.MINDEP).AND.(DEPTH.LE.MAXDEP)) THEN
        WRITE(40,300) HEADER
   20   CONTINUE
        READ(30,300) DATA
        WRITE(40,300) DATA
        IF (DATA(38:).NE.'1') GOTO 20
      ELSE
   30   CONTINUE
        READ(30,300) DATA
        IF (DATA(38:).NE.'1') GOTO 30
      ENDIF
      GOTO 10
  200 FORMAT(I3)
  210 FORMAT(37X,I3)
  300 FORMAT(A)
  310 FORMAT( )
   99 STOP
      END
```

```
      PROGRAM STRIP_LOC
C     S.P.PHILLIPS 05/87 This program reads in a list of "standard" USBR
C     headers, and returns only the location in the proper format for the file
C     to be read by DATA_RECOVERY (for list-driven search).
C
C     INPUT:
C     Example of header in "standard" USBR format:
C
C         Q005M13S13E13D0110              6 N0016 83  0
C
C     OUTPUT:
C     Example output (given example input):
C
C         13S13E13D01
C
C**** Begin program ****
      CHARACTER INFILE*32,LOC*11,OFILE*32
C
      WRITE(1,300)'Enter INPUT file name (max 32 char):'
      READ(1,300) INFILE
      WRITE(1,300)'Enter OUTPUT file name (max 32 char):'
      READ(1,300) OFILE
      OPEN(30,FILE=INFILE)
      OPEN(40,FILE=OFILE)
C
      I=0
   10 CONTINUE
      READ(30,'(5X,A11)',END=99) LOC
      I=I+1
      WRITE(40,300) LOC
      GOTO 10
C
   99 WRITE(1,200) I
  200 FORMAT(//,'Total number of wells is:',I5)
  300 FORMAT(A)
      STOP
      END
```

```
      PROGRAM DATE_SELECT
C     S.P.PHILLIPS 12/85 This program accepts well data in 'standard' USBR
C     format, and outputs the location, water level, and depth for those wells
C     with a water level measurement on the user-specified date.
C
C     INPUT:
C     Example Input (in "standard" USBR format):
C
C         Q005M13S13E13D0110               6 N0016 83  0
C         830706   02040020300070000600 1970   0
C         840702   0204002030006200052 01978   0
C         850708   0204002030006500055 01975   1
C
C     OUTPUT:
C     Example Output given the example input, and specifying the date 7/84:
C
C         Q005M13S13E13D01     197.8      0016
C
C**** Begin MAIN program ****
      CHARACTER ANSWER*1,DECIMAL*1,HEADER*80,INFILE*32,LINE*38,
     +          MONTH*2,OFILE*32,YEAR*2
C
      DECIMAL='.'
C
C     User entry section (interactive)
      WRITE(1,300)'Enter INPUT file name (max 32 chars):'
      READ(1,300) INFILE
      WRITE(1,300)'Enter OUTPUT file name (max 32 chrs):'
      READ(1,300) OFILE
      OPEN(30,FILE=INFILE)
      OPEN(40,FILE=OFILE)
      WRITE(1,300)'This program selects data given a specific date:'
      WRITE(1,300)'Would you like to include the MONTH (Y/N)?'
      READ(1,300) ANSWER
      IF(ANSWER.EQ.'N') GOTO 5
      WRITE(1,300)'    Enter the MONTH (2 digits):'
      READ(1,300) MONTH
      WRITE(1,300)'    Enter the YEAR (2 digits):'
      READ(1,300) YEAR
      GOTO 10
    5 WRITE(1,300)'    Enter the YEAR (2 digits):'
      READ(1,300) YEAR
      GOTO 30
C
```

```
C     This procedure is used if a particular month is specified
   10 READ(30,300,END=99) HEADER
      IOUT=1
   20 READ(30,300) LINE
      IF((LINE(1:2).EQ.YEAR).AND.(LINE(3:4).EQ.MONTH)) THEN
        IF(IOUT.EQ.1) WRITE(40,250)
     +  HEADER(1:16),LINE(30:32),DECIMAL,LINE(33:34), HEADER(37:40)
        IOUT=2
      ENDIF
      IF(LINE(38:).NE.'1') GOTO 20
      GOTO 10
C
C     This procedure is used when only the year is specified
   30 READ(30,300,END=99) HEADER
   40 READ(30,300) LINE
      IF(LINE(1:2).EQ.YEAR) WRITE(40,250)
     +  HEADER(1:16),LINE(30:32),DECIMAL,LINE(33:34)
      IF(LINE(38:).NE.'1') GOTO 40
      GOTO 30
C
  250 FORMAT(A16,5X,A3,A1,A2,5X,A4)
  300 FORMAT(A)
   99 STOP
      END
```

```
      PROGRAM WL_DIFF
C     S.P.PHILLIPS 02/87 This program reads two files in the format
C     of the output from DATE_SELECT, and produces a file containing
C     the locations common to both, and the difference between the
C     water levels.
C
C     INPUT:
C     Example of input file 1:
C
C     Q005M13S13E13D01     197.0      0016
C
C     Example of input file 2:
C
C     Q005M13S13E13D01     197.5      0016
C
C     OUTPUT:
C
C     Q005M13S13E13D01      -0.5        16
C
C**** Begin program ****
      CHARACTER LOC_1*16,LOC_2*16,INFIL1*32,INFIL2*32,OFILE*32
      INTEGER DEPTH1,DEPTH2
C
      WRITE(1,310)
      WRITE(1,300)'Enter name of Input file 1:'
      READ(1,300) INFIL1
      OPEN(30,FILE=INFIL1)
      WRITE(1,300)'Enter name of Input file 2:'
      READ(1,300) INFIL2
      OPEN(31,FILE=INFIL2)
      WRITE(1,300)'Enter name of Output file:'
      READ(1,300) OFILE
      OPEN(40,FILE=OFILE)
C
      READ(30,200) LOC_1,WSELEV1,DEPTH1
      READ(31,200) LOC_2,WSELEV2,DEPTH2
   10 CONTINUE
C     Check to see if locations are  , , or = to each other, and
C     deal with each case separately.
      IF(LOC_1(6:16).GT.LOC_2(6:16)) THEN
        READ(31,200,END=99) LOC_2,WSELEV2,DEPTH2
      ELSE IF(LOC_1(6:16).LT.LOC_2(6:16)) THEN
        READ(30,200,END=99) LOC_1,WSELEV1,DEPTH1
      ELSE
        DIFF=WSELEV1-WSELEV2
        WRITE(40,200) LOC_1,DIFF,DEPTH1
        READ(30,200,END=99) LOC_1,WSELEV1,DEPTH1
        READ(31,200,END=99) LOC_2,WSELEV2,DEPTH2
      ENDIF
      GOTO 10
  200 FORMAT(A16,5X,F5.1,5X,I5)
  300 FORMAT(A)
  310 FORMAT( )
   99 STOP
      END
```