TABLE OF CONTENTS

2. SITE AND ENVIRONMENT

~~00100~~

0146

LIST OF TABLES

LIST OF FIGURES

0148 ~~00182~~

2. SITE AND ENVIRONMENT

2.1 SUMMARY

Data are presented in this section as a basis for the selection of design criteria for Rancho Seco Nuclear Generating Station Unit 1. A series of studies (meteorology, population, hydrology, geology and seismology, land use, and earthquake design criteria) have been conducted.

The site is located approximately 26 miles north-northeast of Stockton and 25 miles southeast of the city of Sacramento in Sacramento County, State of California.

The exclusion area will have a radius of approximately 2100 feet within a 2480 acre site. All acreage in this site, except the 320 acres in Sections 33 and 34, are currently owned by the District and negotiations are in progress for the procurement of this acreage. The nearest population of 25,000 or more is Lodi, located about 17 miles southwest of the site. The site area is almost exclusively agricultural and is presently used as grazing land. There are no dairy cattle within a five-mile radius of the site.

The climatology of the Rancho Seco site is typical of the Great Central Valley of California. Cloudless skies prevail during summer and much of the spring and fall seasons due to the Pacific Anticyclone lying off the California coast and preventing Pacific storms from entering the land. The rainy season usually extends from December through March. The atmospheric dispersion factors for the site are considered favorable.

Make-up water for the plant cooling towers and reservoir will be supplied by the Folsom South Canal. An alternate supply from Lake Natoma on the American River is available if the canal construction is delayed.

Ground water in the site area occurs under free or semi-confined conditions. It is stored chiefly in the alluvium, the older alluvial type deposits and the Mehrten formation. Ground water movement in the area is to the southwest with a slope of about ten feet per mile.

There is no indication of faulting beneath the site. The nearest fault system, the Foothill Fault System, is located about ten miles east of the site and has been inactive since the Jurassic Period, some 135 million years ago. Ground accelerations of no greater than 0.1 g are anticipated to occur at the site during the life of the plant.

The soils at the Rancho Seco site are sufficiently strong to safely support the nuclear containment structure and appurtenant facilities. These soils can be categorized as hard to very hard silts and silty clays with dense to very dense sands and gravels.

2.2 SITE AND ADJACENT AREAS

2.2.1 SITE LOCATION

The property -- which will be wholly owned and controlled by the District, herein called the site -- is located in the southeast part of Sacramento County, State of California and lies either wholly or partly in Sections 27, 28, 29, 32, 33 and 34 of Township 6 North, Range 8E. All parts of the site, except the 320 acres in Sections 33 and 34 are currently owned by the District and negotiations are in progress for the procurement of this property.

The site is approximately 26 miles north-northeast of Stockton and 25 miles southeast of Sacramento as shown in Figure 2.2-1. The nuclear reactor unit will lie wholly in Section 29 as shown in Figure 2.2-2.

The site region is located between the Sierra Nevada to the east and the Coast Range along the Pacific Ocean to the west, in an area of flat to lightly rolling terrain at an elevation of approximately 200 feet MSL. To the east of the site the land becomes more rolling, rising to an elevation of 600 feet at a distance of about seven miles and increases in elevation thereafter approaching the Sierra Nevada foothills.

The topographic features of the Sacramento and San Joaquin Valley are shown in Figure 2.2-3. Figure 2.2-4 is an aerial view of the plant site.

2.2.2 SITE OWNERSHIP

The site, totaling 2480 acres, will be wholly owned and controlled by the District. All acreage, except the 320 acres in Sections 33 and 34 are currently owned by the District and negotiations are in progress for the procurement of this property.

Access for transmission lines and water lines will be from the west side of the property. For purposes of this application, an exclusion radius of 2100 feet has been established, the area of which lies completely inside the boundary of the property described above. (See Figure 2.2-2)

2.2.3 SITE ACTIVITIES

At the present time the land is undeveloped. It is used solely for grazing beef cattle.

2.2.4 POPULATION

A population study was conducted for the Rancho Seco site. Its object was to determine the population distribution for the area within a 50-mile radius of the plant site for the years of 1965, 1985 and 2000.

The population projections for 1965 and 1985 were derived from census divisions of the US Census of Population and Housing, 1960, and estimates of future growth supplied to SMUD by the planning commissions of the counties lying within the 50-mile radius. Census divisions (with their further breakdown into census tracts, and then into enumeration districts) were related to 22.5° sector areas by use of a 15-minute geological survey map.

Only two of the fifteen counties involved could provide population projections for the year 2000. However, the Department of Finance, State of California, also has published a population projection for the counties through the year of 1985 and has provided the District with an unofficial population projection for the year 2000. This information, along with the projections received from the counties, has been tabulated on Table 2.2-1. A review of the table shows that the Department of Finance's projections for the year 2000 are, in general, lower than the counties' projections for 1985. When this was discussed with the Department of Finance SMUD was informed that the county figures are normally significantly higher than the State's projections. The county projections have been used to assure the most conservative design and maximum safety.

TABLE 2.2-1
PROJECTED POPULATION WITHIN 50-MILE RADIUS OF RANCHO SECO SITE

County	1965		1985		2000	
	County*	State	County*	State	County***	State**
Alameda	200	200	300	300		400
Amador	12,300	11,600	19,900	18,200		23,600
Calveras	11,800	11,500	43,000	16,100		19,600
Contra Costa	62,000	62,000	192,900	168,900		242,000
El Dorado	26,200	25,900	66,600	47,100		69,800
Nevada	400	300	800	400		500
Placer	61,500	60,700	152,500	113,100		157,600
Sacramento	647,400	611,900	1,501,900	952,500		1,259,500
San Joaquin	272,700	273,300	465,800	355,900		421,500
Solano	58,800	58,800	113,600	104,400		147,600
Stanislaus	95,100	95,000	142,800	128,000		154,700
Sutter	3,400	3,500	4,900	5,000		6,400
Tuolumne	10,400	10,200	26,300	24,100		31,900
Yolo	84,600	75,100	201,800	120,600		161,000
Yuba	2,000	1,900	2,500	2,100		2,800
TOTALS	1,348,800	1,301,900	2,935,600	2,056,700	-	2,698,900

* Plant design calculations based on these population projections.
** Unofficial population projection by Department of Finance, State of California.
*** Not available.

The population distribution estimates for 1965 and 1985 are shown on Figures 2.2-5 and 2.2-6 respectively. The most populated quadrant within five miles of the site in the 1965 distribution is southwest of the site. This distribution is also projected for 1985. The nearest population center of 25,000 or more is Lodi, located 17 miles south-southwest of the site. Other population centers of 25,000 or more within a 50-mile radius include Sacramento at 25 miles, Stockton at 26 miles, and Modesto at 50 miles.

The part-time population within the 0-5 mile radius is not considered to be significant with respect to the overall population. Recreational use or tourist attractions in the specific area are virtually non-existent.

Appendix 2-B includes a copy of a Department of Finance publication defining the projection techniques used in their projections.

2.2.5 LAND USE

2.2.5.1 Current Land Use

The site area is almost exclusively agricultural (See Appendix 2-B). Figure 2.2-7 provides a detailed description of all agriculture and residential activities within a 5-mile radius of the site. It should be noted that there are no dairy cattle within this 5-mile radius.

The agricultural activities in the counties lying within the 50-mile radius are shown on Figures 2.2-8 and 2.2-9 and 2.2-10. The numbers given on the figures represent the total county activity. Table 2.2-2 provides the total area of the counties.

2.2.5.2 Future Land Use

Activities in the area immediately surrounding the site are not expected to change extensively. Proposed land use for the southeast section of Sacramento County as adopted by the Sacramento Planning Department is presented in Appendix 2B.

2.2.6 ACCESS AND EGRESS

Currently, as shown in Figure 2.2-1, State Route 104 runs just north of the site in a general east-west direction and connects with US Route 50 and 99 to the west and State Route 49 to the east. As is shown in Appendix 2B, Southeast Area Plan, the proposed road net will greatly increase the already adequate access and egress to the proposed site.

Rail access to the site will be made available by running a rail spur from the existing Southern Pacific Railroad line that runs roughly parallel to

TABLE 2.2-2
AREA AND POPULATION, CALIFORNIA
COUNTIES, APRIL 1960 AND JULY 1965

County	Land area * in square miles	April 1960 *		July 1965 **	
		Population	Density	Population	Density
Alameda	733	908,209	1239.0	1,033,100	1409.4
Alpine	723	397	0.5	400	0.6
Amador	593	9,990	16.8	10,800	18.2
Butte	1,663	82,030	49.3	98,300	59.1
Calaveras	1,027	10,289	10.0	11,800	11.5
Colusa	1,153	12,075	10.5	12,600	10.9
Contra Costa	734	409,030	557.3	509,900	694.7
Del Norte	1,003	17,771	17.7	18,300	18.2
El Dorado	1,714	29,390	17.1	40,500	23.6
Fresno	5,964	365,945	61.4	408,400	68.5
Glenn	1,317	17,245	13.1	18,900	14.4
Humboldt	3,573	104,892	29.4	106,300	29.8
Imperial	4,284	72,105	16.8	79,500	18.6
Inyo	10,091	11,684	1.2	14,100	1.4
Kern	8,152	291,984	35.8	329,400	40.4
Kings	1,395	49,954	35.8	67,000	48.0
Lake	1,256	13,786	11.0	17,200	13.7
Lassen	4,547	13,597	3.0	15,600	3.4
Los Angeles	4,060	6,038,771	1487.4	6,878,200	1694.1
Madera	2,144	40,468	18.9	44,300	20.7
Marin	520	146,820	282.3	188,700	362.9
Mariposa	1,455	5,064	3.5	6,000	4.1
Mendocino	3,507	51,059	14.6	51,200	14.6
Merced	1,982	90,446	45.6	107,200	54.1
Modoc	4,092	8,308	2.0	8,000	2.0
Mono	3,028	2,213	0.7	2,700	0.9
Monterey	3,324	198,351	59.7	221,300	66.6
Napa	758	65,890	86.9	75,700	99.9
Nevada	978	20,911	21.4	25,100	25.7
Orange	782	703,925	900.2	1,157,900	1480.7
Placer	1,424	56,998	40.0	72,500	50.9
Plumas	2,570	11,620	4.5	12,300	4.8
Riverside	7,177	306,191	42.7	415,400	57.9
Sacramento	983	502,778	511.5	617,200	627.9
San Benito	1,396	15,396	11.0	17,200	12.3
San Bernardino	20,131	503,591	25.0	637,500	31.7
San Diego	4,255	1,033,011	242.8	1,200,800	282.2
San Francisco	45	740,316	16451.5	750,500	16677.8
San Joaquin	1,409	249,989	177.4	273,800	194.3
San Luis Obispo	3,316	81,044	24.4	100,600	30.3
San Mateo	454	444,387	978.8	532,200	1172.2
Santa Barbara	2,738	168,962	61.7	243,100	88.8
Santa Clara	1,302	642,315	493.3	891,200	684.5
Santa Cruz	439	84,219	191.8	103,800	236.4
Shasta	3,798	59,468	15.7	74,700	19.7
Sierra	958	2,247	2.3	2,400	2.5
Siskiyou	6,312	32,885	5.2	34,300	5.4
Solano	827	134,597	162.8	159,900	193.3
Sonoma	1,579	145,375	93.3	178,400	113.0
Stanislaus	1,500	157,294	104.9	176,100	117.4
Sutter	607	33,380	55.0	39,000	64.3
Tehama	2,976	25,305	8.5	28,300	9.5
Trinity	3,191	9,706	3.0	8,800	2.8
Tulare	4,838	168,403	34.8	187,300	38.7
Tuolumne	2,274	14,404	6.3	16,600	7.3
Ventura	1,851	199,138	107.6	302,900	163.6
Yolo	1,034	65,727	63.6	79,000	76.4
Yuba	637	33,859	53.2	41,800	65.6
The State	156,573	15,717,204	100.4	18,756,000	119.8

* U. S. Bureau of the Census, Census of Population: 1960, PC(1)-6A, Table 6.
** Provisional population estimates prepared by State Department of Finance.

0153

~~9017~~

State Route 104 adjacent to the site. Proposed routing of the rail spur is shown in the site plan, Figure 2.2-2.

2.2.7 MAKE-UP WATER SUPPLY

The District will obtain the make-up water for its plant from the Folsom South Canal, which is a feature of the Central Valley Project. The canal is to be constructed by the Bureau of Reclamation. A pipeline and pumping station will be constructed between the plant and the Folsom-South Canal. In the event the Folsom-South Canal is not completed in time to meet the District's requirements, the District will install a pipeline and pumping station between the plant and Lake Natoma on the American River. The District's agreement with the Bureau of Reclamation covers both arrangements. Preliminary design work on both plans is in process.

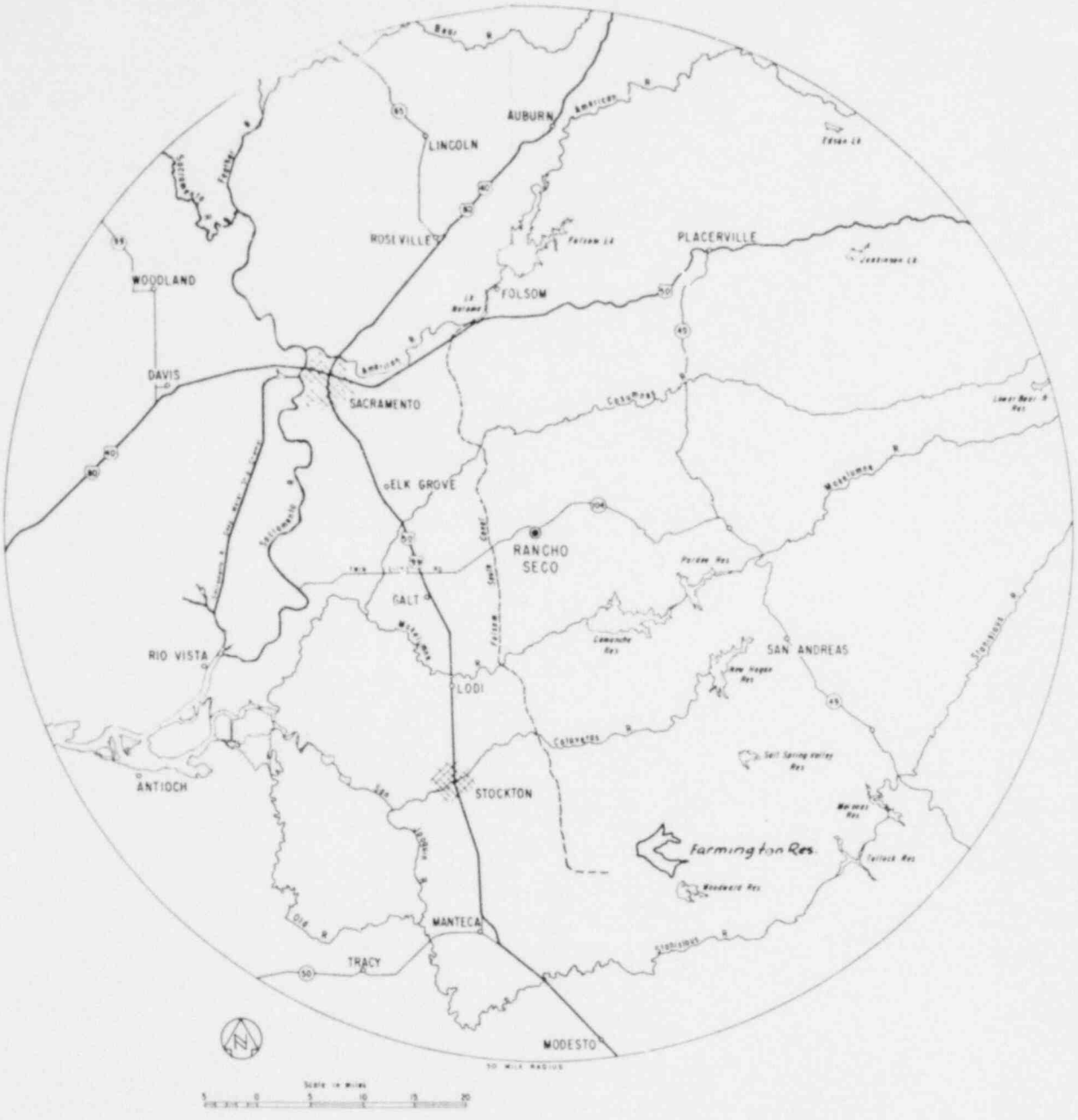


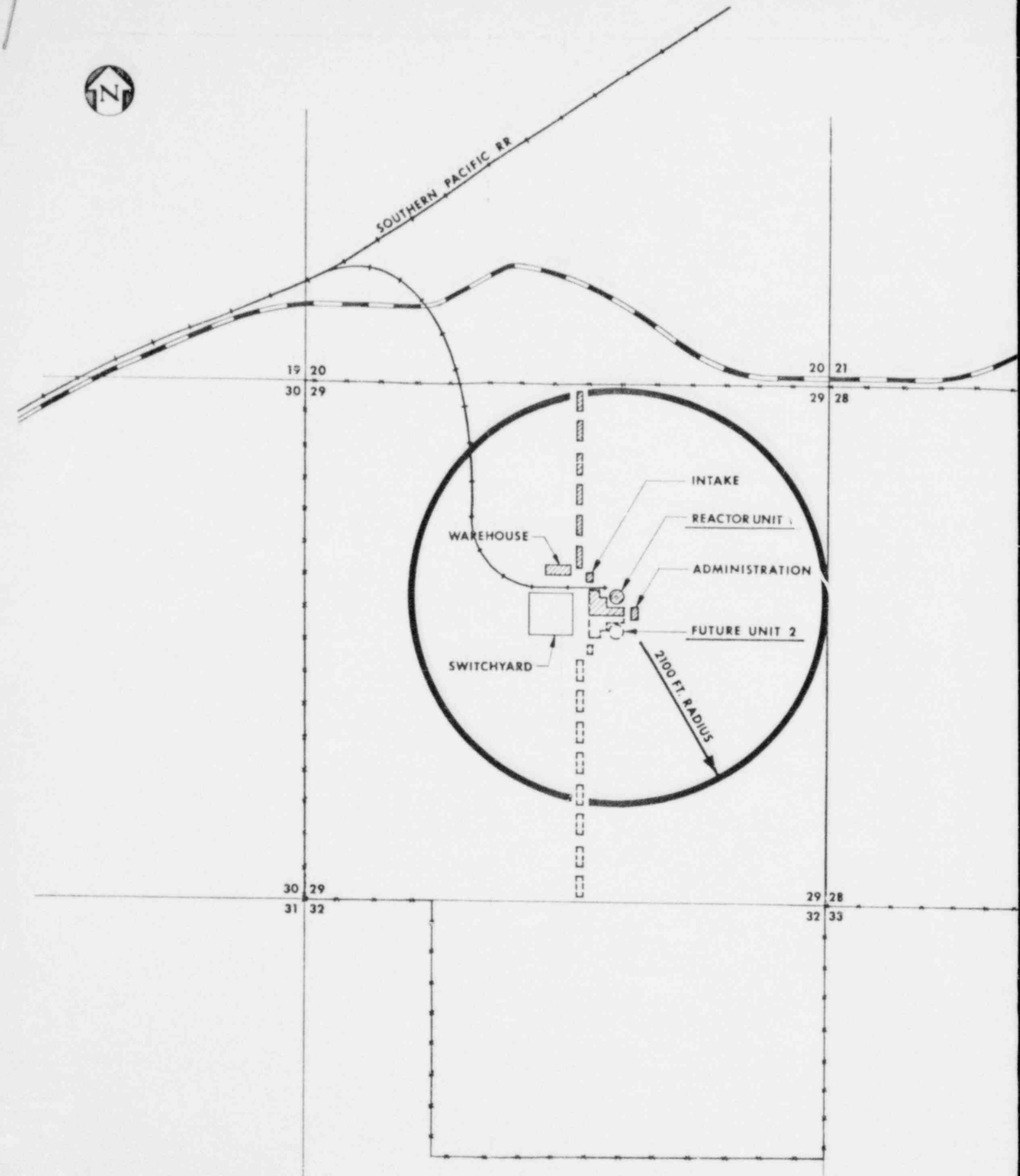
FIGURE 2.2-1
GENERAL AREA MAP

0155

SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT

00169



0156

T. 6N., R. 8E., M.D.M.

~~30170~~

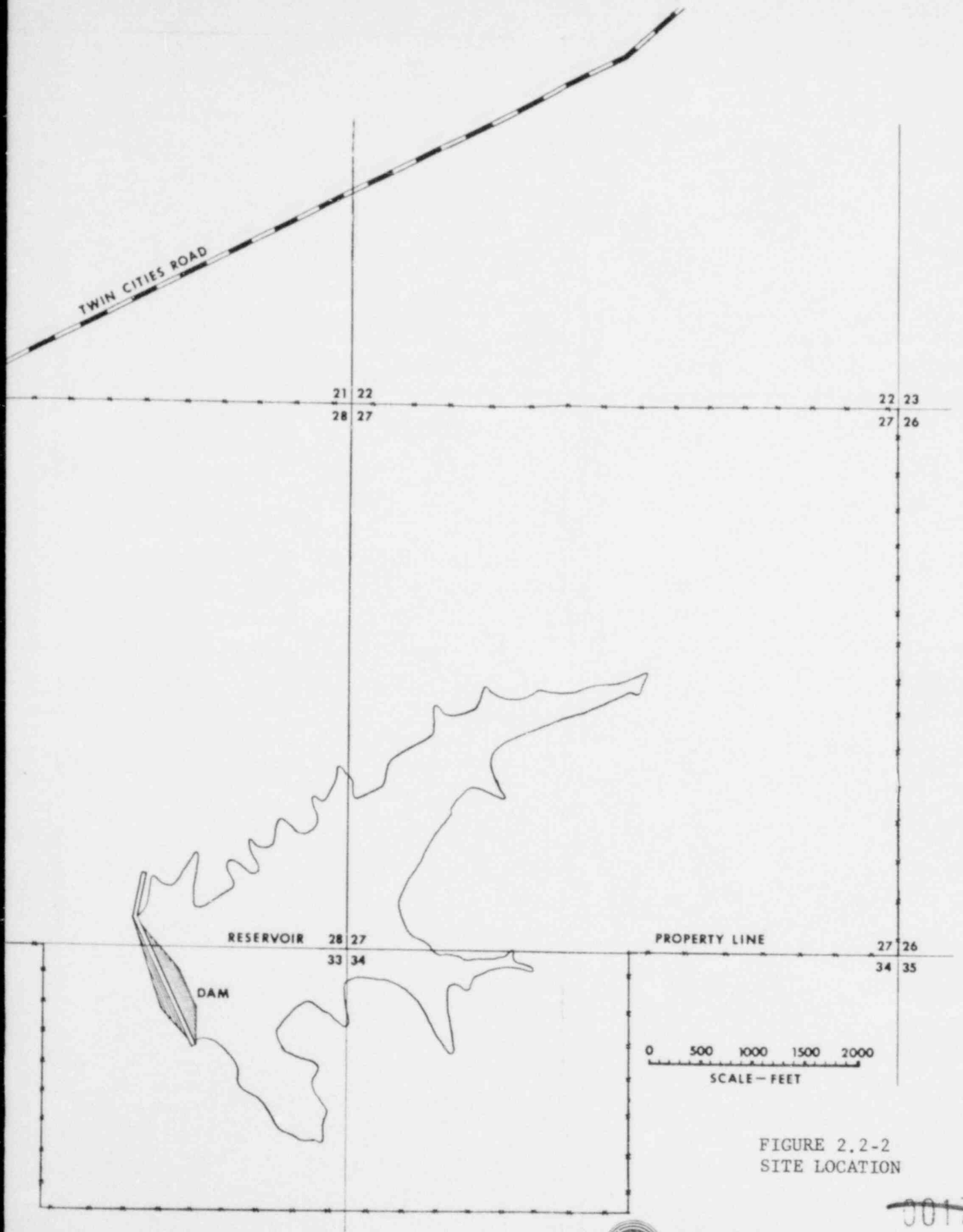


FIGURE 2.2-2
SITE LOCATION

00171

0157

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

DOCUMENT/ PAGE PULLED

ANO. 8004090491

NO. OF PAGES 1

REASON:

☐ PAGE ILLEGIBLE:

☐ HARD COPY FILED AT: PDR CF

OTHER _____

☐ BETTER COPY REQUESTED ON ___/___/___

☒ PAGE TOO LARGE TO FILM:

☒ HARD COPY FILED AT: PDR (CF)

OTHER _____

☒ FILMED ON APERTURE CARD NO 8004090491

0158

~~00172~~

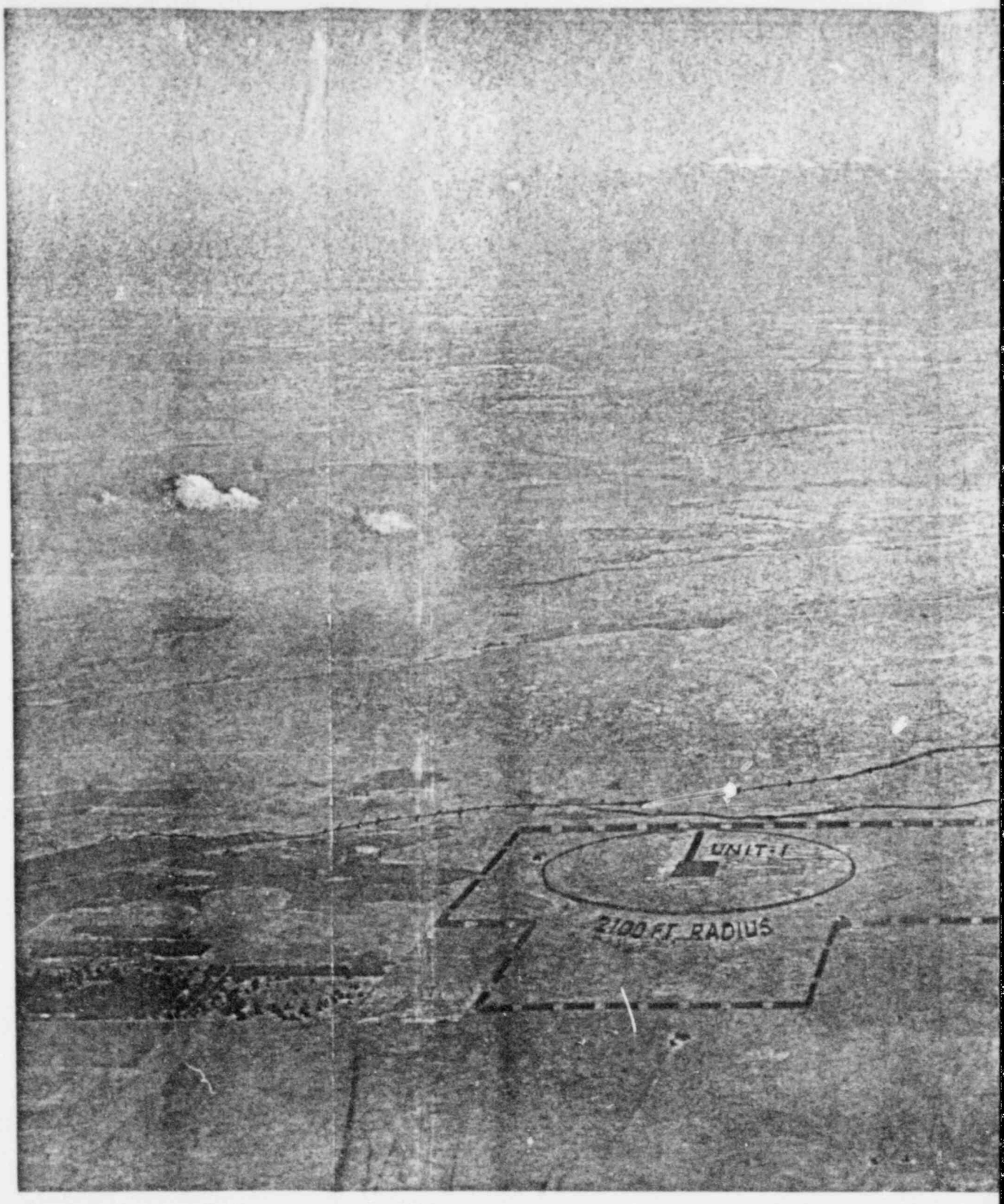

UNIT-1
2100 FT. RADIUS

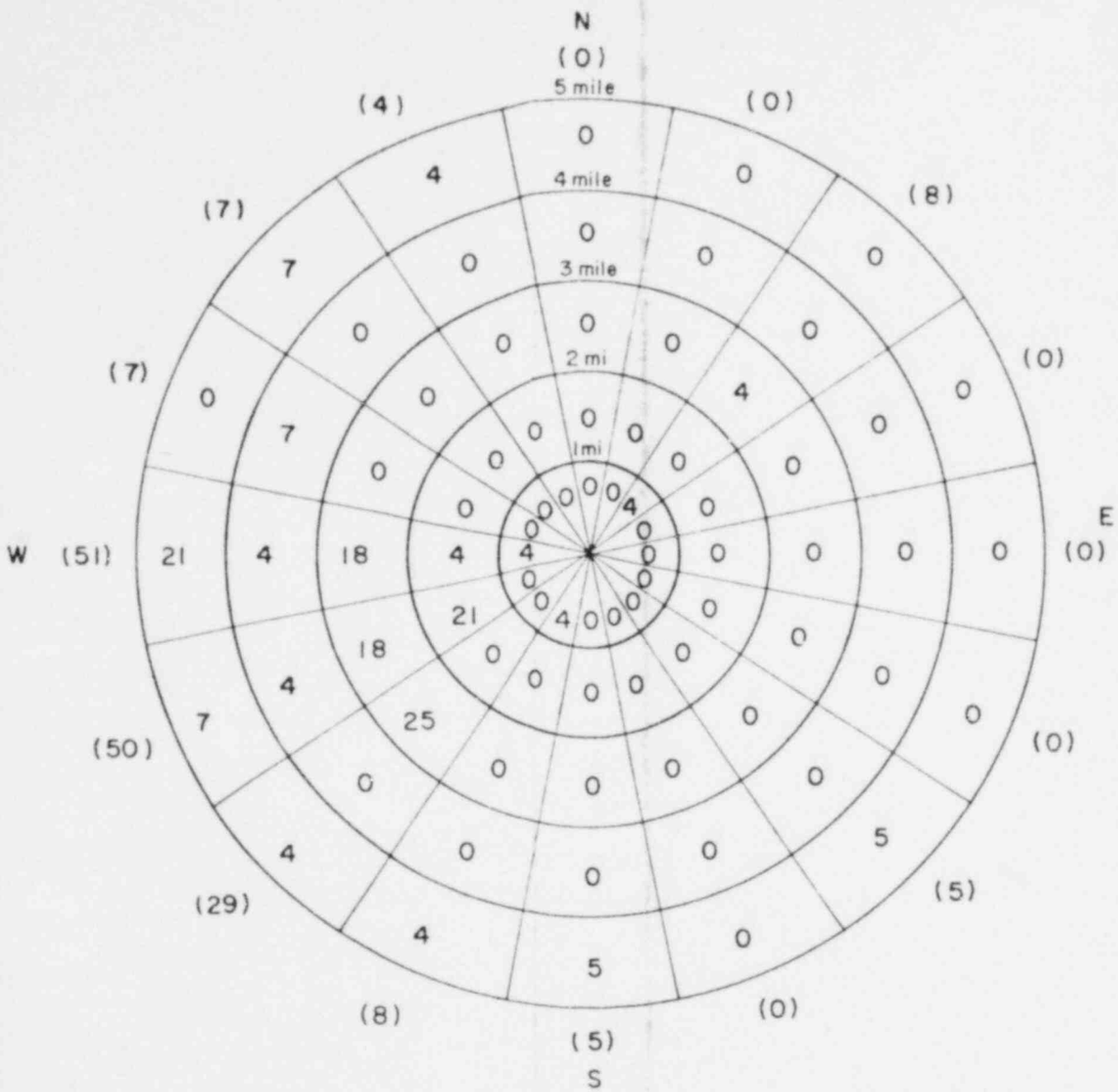
FIGURE 2.2-4
SITE LOCATION
AERIAL VIEW

~~00174~~

0160

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

1965
0-5 Miles ( ) = TOTAL POPULATION FROM 0-5 MILES



RADIUS IN MILES	0-1	0-2	0-3	0-4	0-5	0-10	0-20	0-30	0-40	0-50
ACCUMULATIVE TOTAL	12	37	102	117	174	4,060	103,271	908,115	1,051,877	1,348,58

~~00~~175

SOURCE U.S. Censuses of population 1960, and population projections furnished by County Planning Commissions

0169

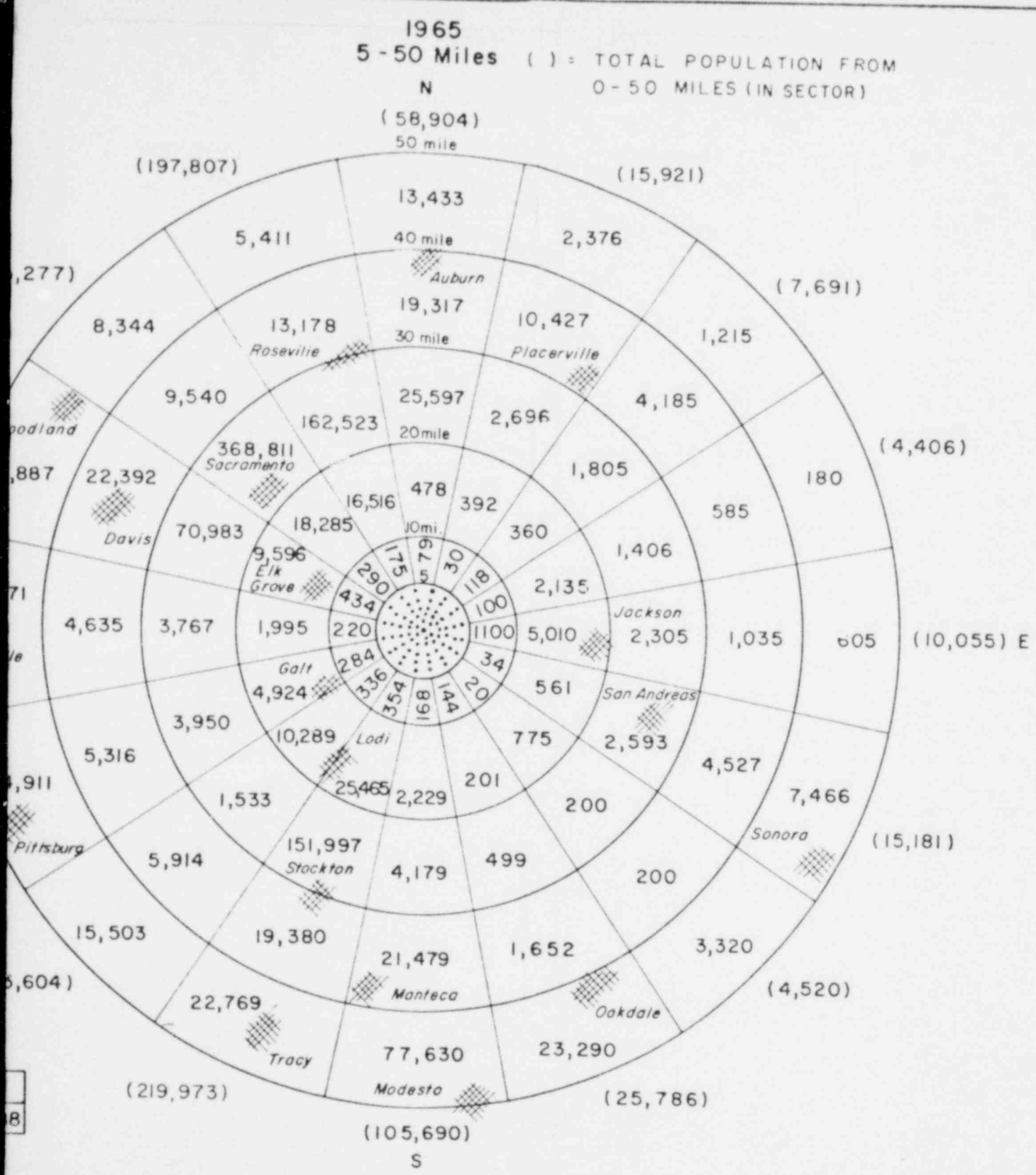


FIGURE 2.2-5
POPULATION DISTRIBUTION
ESTIMATE - 1965

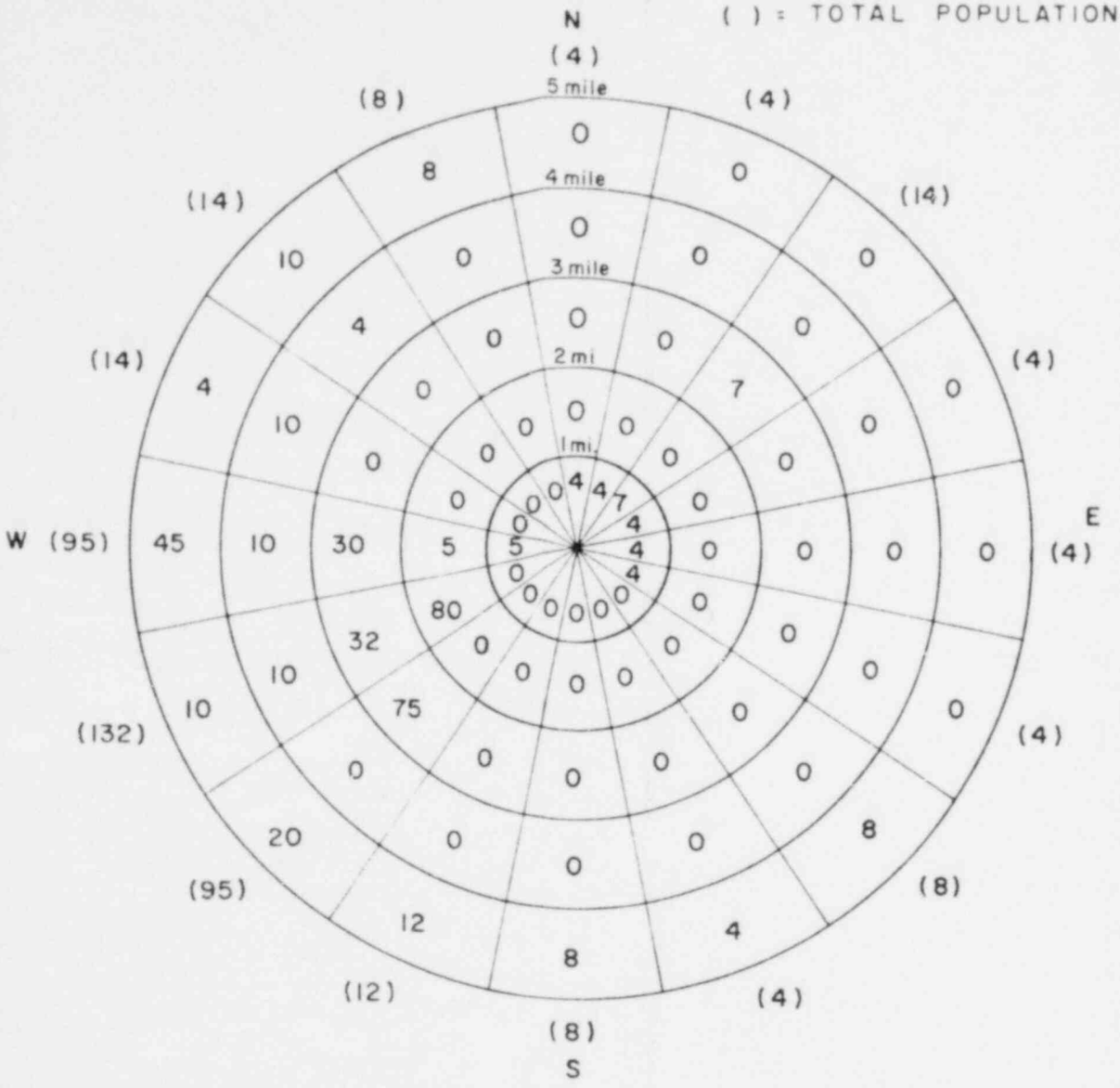
0162

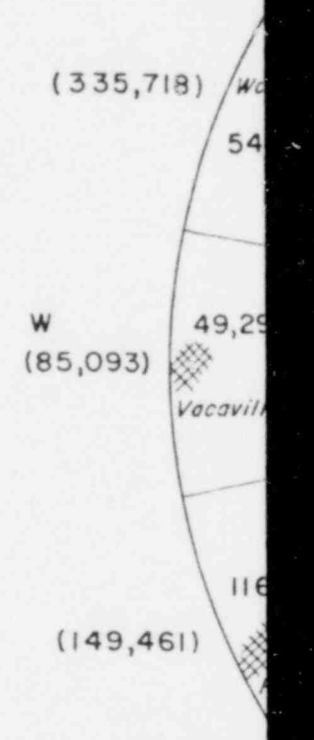
~~00176~~

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

1985
0-5 Miles

( ) = TOTAL POPULATION FROM 0-5 MILE





RADIUS IN MILES	0-1	0-2	0-3	0-4	0-5	0-10	0-20	0-30	0-40	0-50
ACCUMULATIVE TOTAL	32	117	261	295	424	7,111	268,685	1,972,326	2,360,302	2,935,847

SOURCE U.S Censuses of population 1960, and population projections furnished by County Planning Commissions

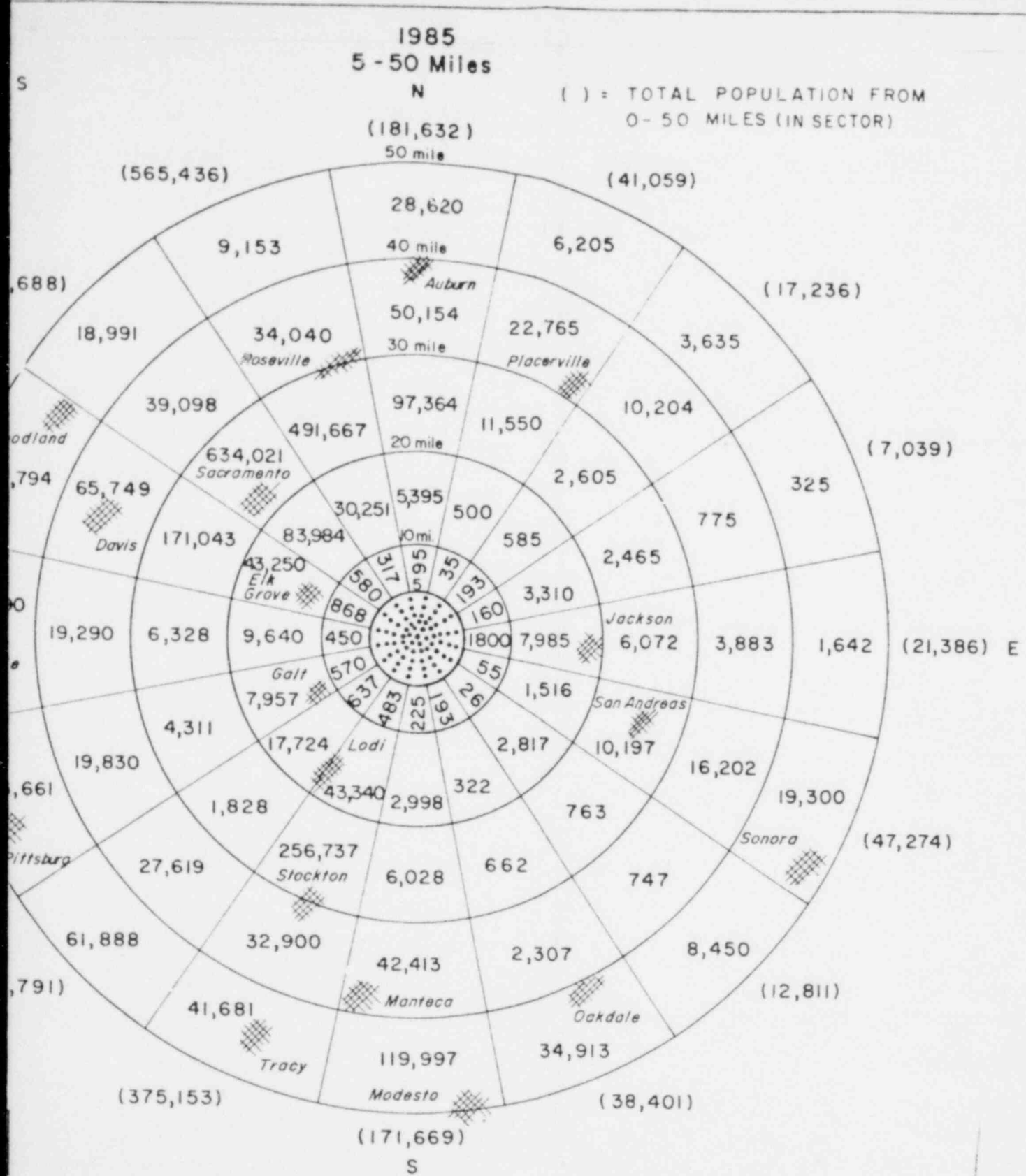
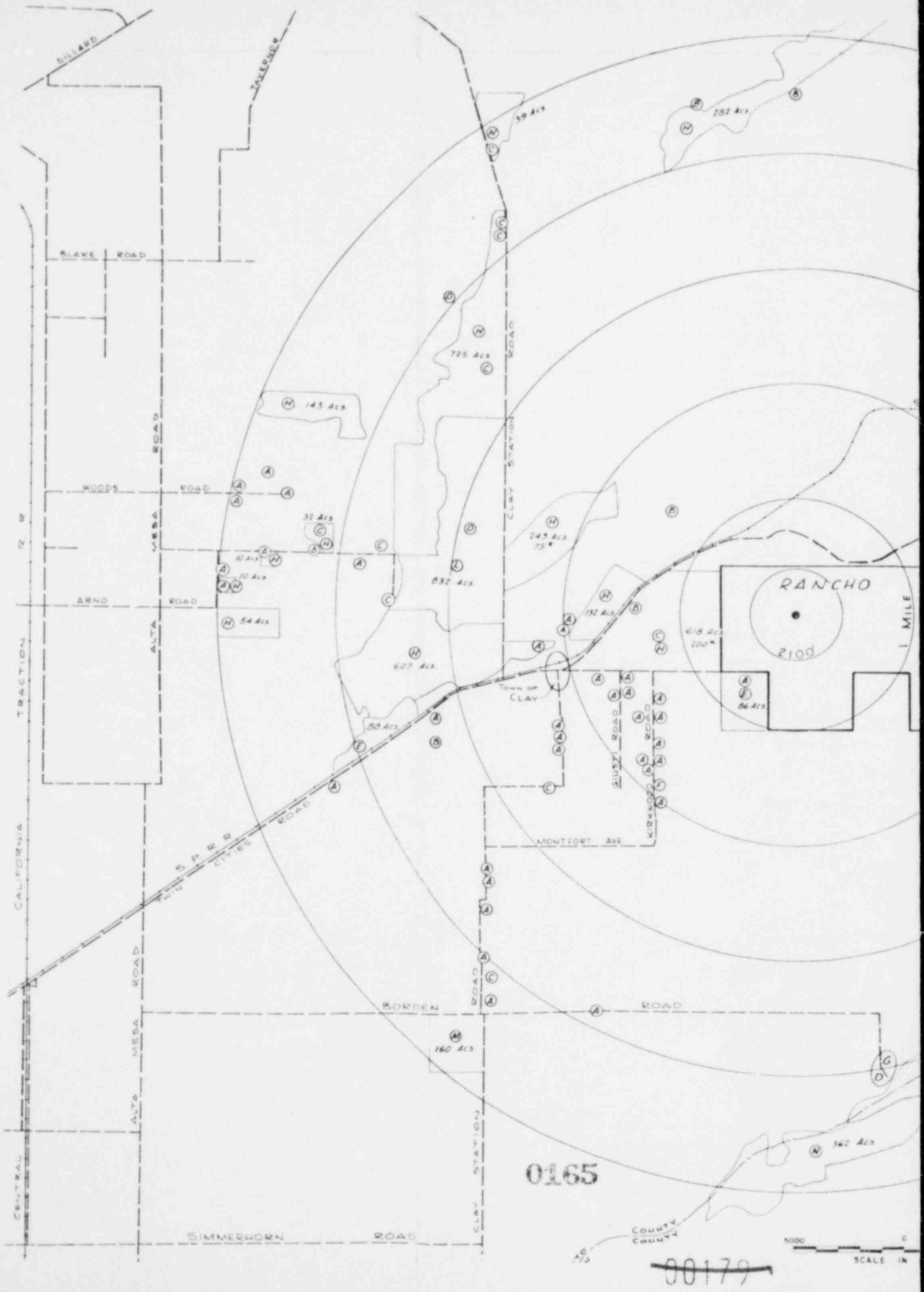
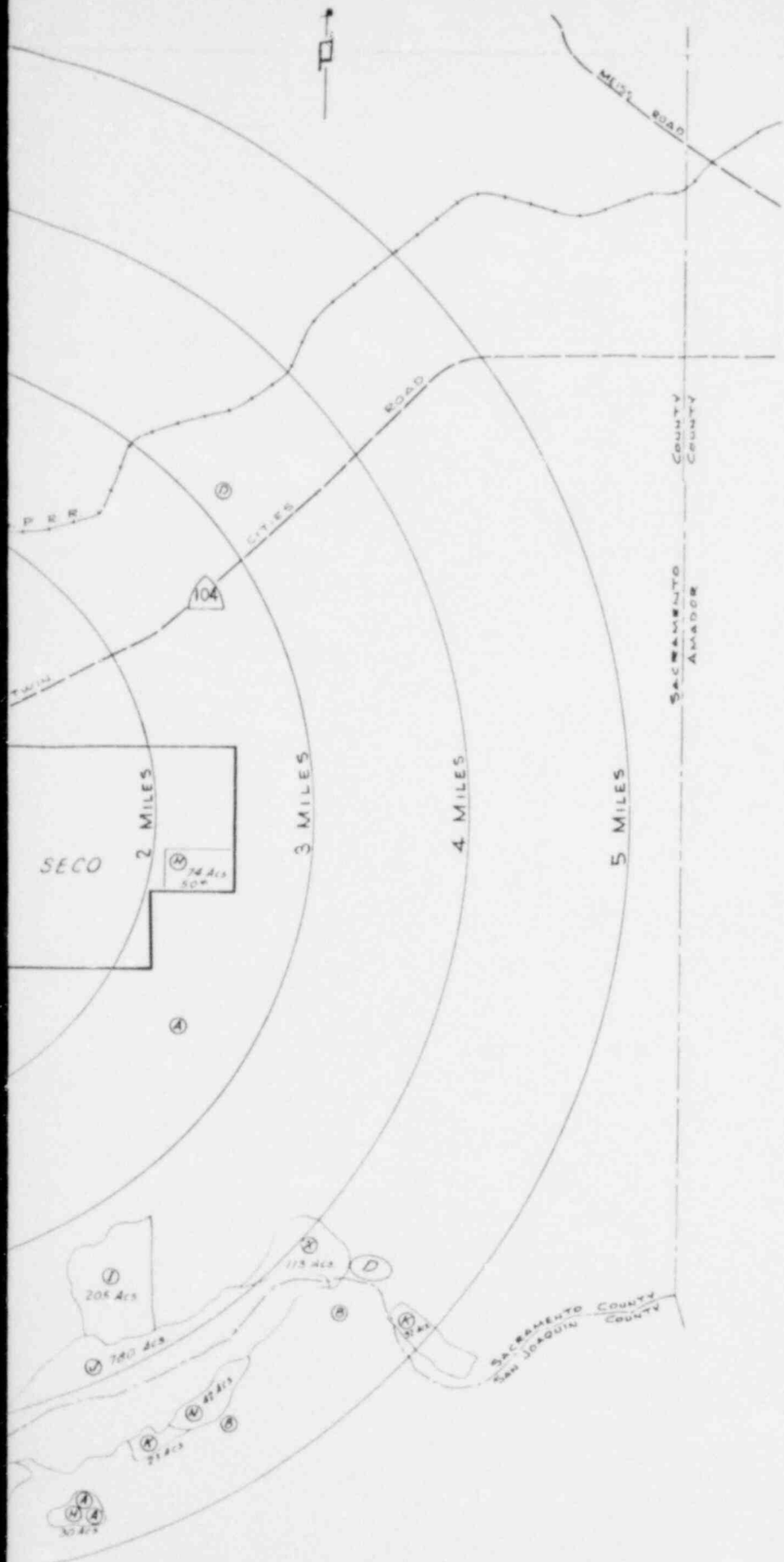


FIGURE 2.2-6
POPULATION DISTRIBUTION
ESTIMATE - 1985

00170

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT


BLAKE ROAD
WOODS ROAD
ARNO ROAD
ALTA MESA ROAD
CALIFORNIA TRACTION
S P R R
TWIN CITIES ROAD
CLAY STATION ROAD
TOWN OF CLAY
RANCHO
2100
1 MILE
MONTFORT AVE
BORDEN ROAD
SIMMERHORN ROAD
CENTRAL
59 Acs
282 Acs
725 Acs
145 Acs
32 Acs
10 Acs
54 Acs
832 Acs
245 Acs
75°
132 Acs
607 Acs
618 Acs
200°
86 Acs
88 Acs
160 Acs
362 Acs
0165
00179
SCALE IN



LEGEND

A	1 HOUSE
B	BARN (S)
C	1 HOUSE & 1 BARN
D	1 HOUSE & BARN (S)
E	FEED LOT
F	HORSE PADDOCK
G	FEED MILL
H	IRRIGATED PASTURE
I	TOMATOES
J	TOMATOES, BEANS, & VARIOUS CROPS
K	ALFALFA
L	CLOVER SEED
M	OATS
N	BEANS
*	HEADS OF BEEF

TOWN OF CLAY (7 HOUSES)
ALL ACREAGE IS WITHIN THE 5-MILE

FIGURE 2.2-7
CURRENT LAND USE WITHIN
A 5-MILE RADIUS

0166

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

~~00180~~

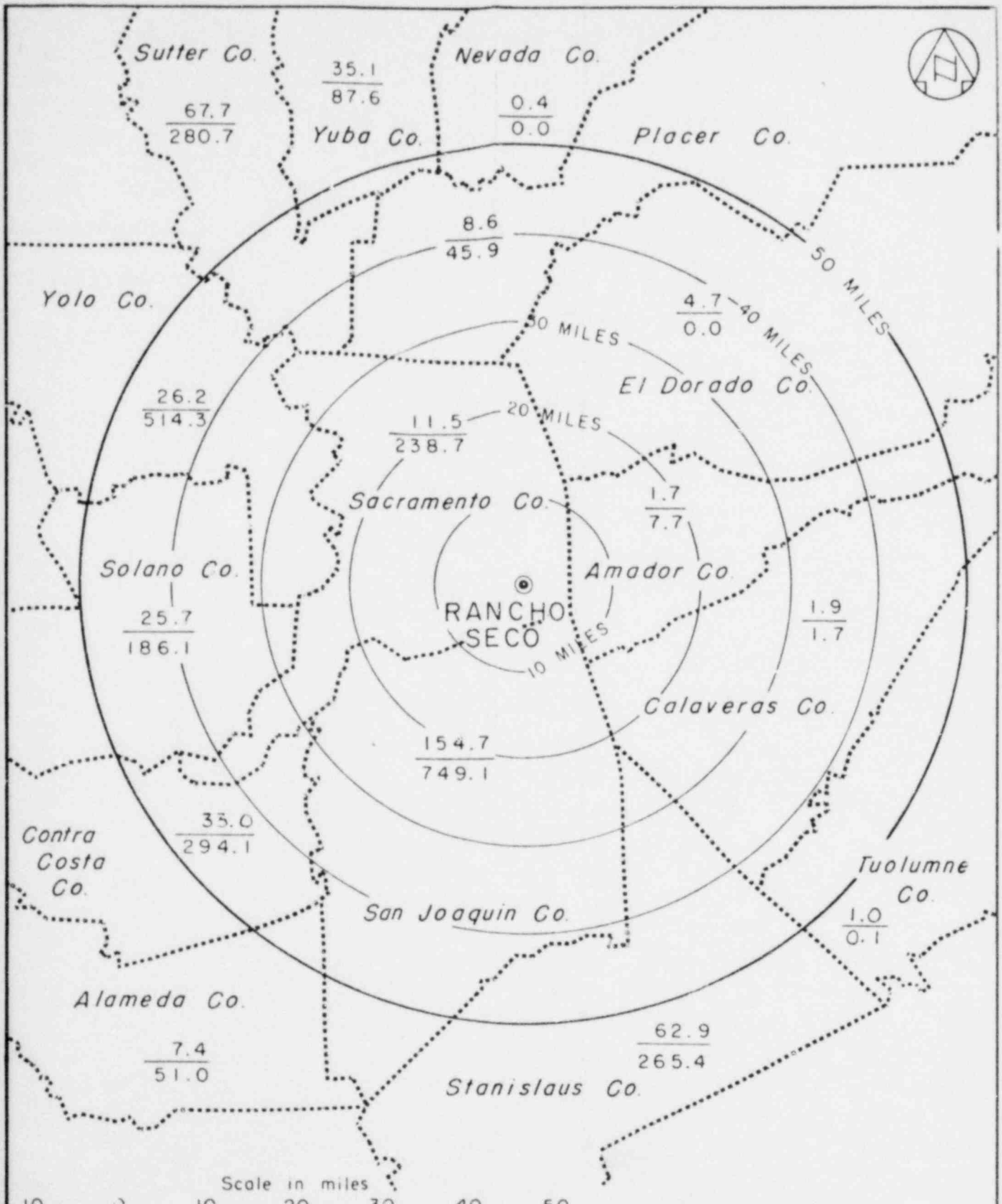


FIGURE 2.2-8
CURRENT LAND USE - FRUITS AND NUTS AND FIELD CROPS

SOURCE: Annual Agricultural Crop Reports
California State Department of Agricultural

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

~~00181~~

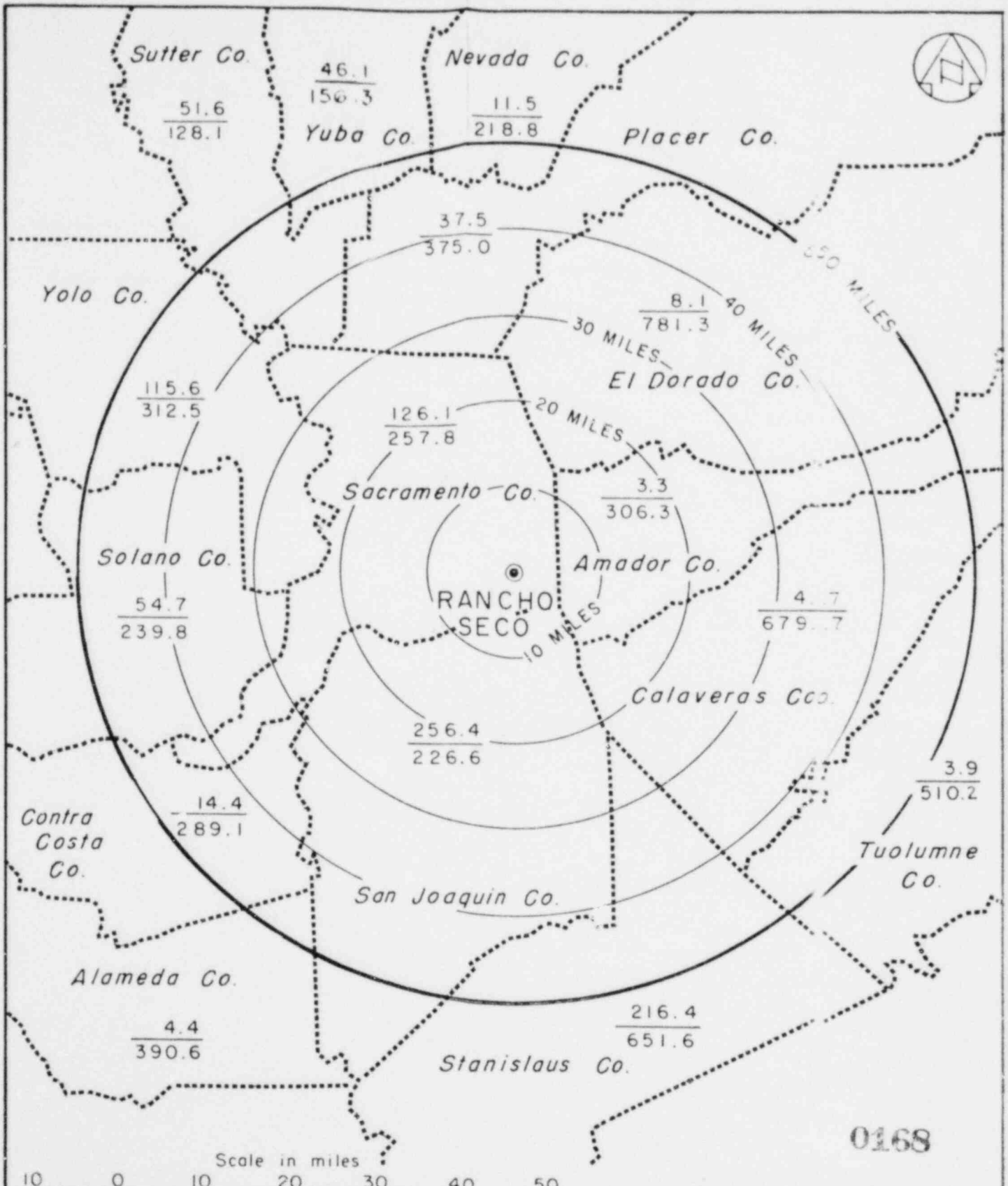


FIGURE 2.2-9
CURRENT LAND USE - PASTURE LAND AND RANGE LAND

SOURCE: Annual Agricultural Crop Reports, California State Department of Agricultural

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

~~00182~~

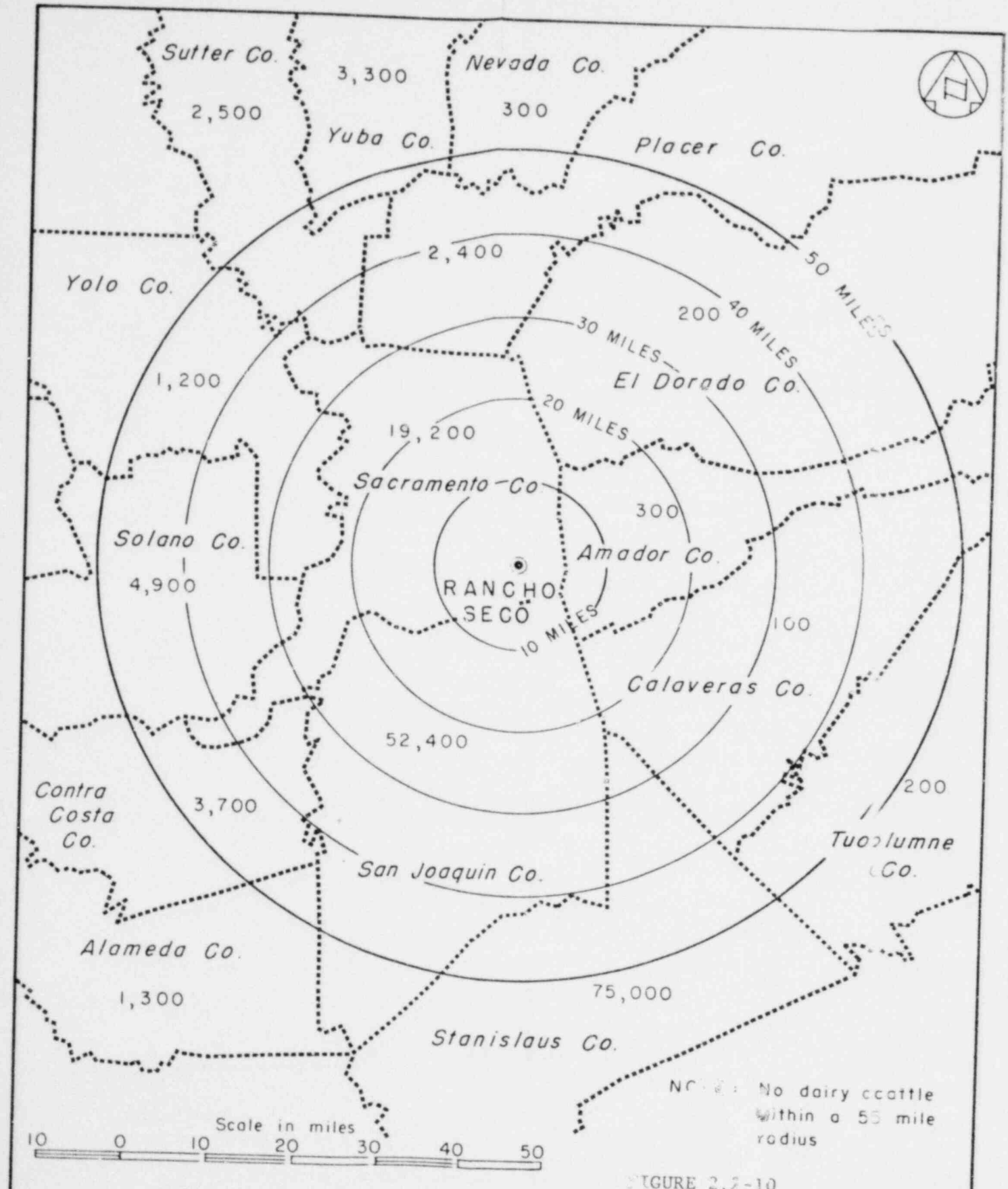


FIGURE 2.2-10
CURRENT LAND USE -
DAIRY CATTLE

0169

SOURCE: California State Department of Agriculture
Division of Crop Reporting

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

~~00187~~

2.3 METEOROLOGY

2.3.1 INTRODUCTION

An evaluation of the meteorology of the site and of the adjacent areas is mandatory in order to determine the atmospheric dispersion characteristics in the general area of the proposed plant. These characteristics are important in the determination of environmental consequences from potential gaseous radioactivity releases.

An extensive on-site meteorological investigation was initiated in the summer of 1967 by District's consultant, Meteorology Research, Inc. This investigation included on-site data collection and compilation of the available meteorological data adjacent to the site. Furthermore, the program of a permanent meteorological data collection station to be installed is described. The report and subsequent supplemental information from Meteorology Research, Inc. is included as Appendix 2A. |2

2.3.2 DESCRIPTIVE METEOROLOGY

The climatology of the Rancho Seco site is typical of the Great Central Valley of California. Cloudless skies prevail during summer and much of the spring and fall seasons due to the Pacific Anticyclone lying off the California coast and preventing Pacific storms from entering the land. The rainy season usually extends from December through March. Approximately two-thirds of the yearly rainfall occurs during this period of the year.

The most important controlling geographical influence on the meteorology of the site as its location in the Valley surrounded by mountains to the west, north, and east. The mountains have a moderating effect on the storms moving from the north and northwest during wintertime, collecting much of the precipitation. The rains in the Valley are usually accompanied by south to southeast winds. During the dry season, marine air enters the Valley along the San Joaquin-Sacramento River flowing at first in the easterly direction and then splitting into a southerly flow into the Sacramento Valley and northerly flow into the San Joaquin Valley. The divergence zone is located between Sacramento and Stockton and has a very marked effect on the site. The divergence zone is usually centered to the north of the site during daytime and to the south during nighttime. When the divergence zone is located north of the Rancho Seco Site, the site and areas to the south of it, including Stockton, have the same meteorological conditions. When the divergence zone moves to the south of the site, the site and areas north of the site assume the same meteorological pattern. Consequently, the site climatology is more nearly related to Stockton during daytime and to Sacramento at night. Hourly recorded meteorological data are available for seven and six year periods for the Sacramento and Stockton areas, respectively.

2.3.3 METEOROLOGICAL DATA

2 The analyzed on-site data for a period of 8 months falls between the hourly-recorded data for Sacramento and Stockton as can be noted in Figures 23 and 24 of Appendix 2A. Therefore, the two sets of existing long-term data are used for the purpose of this report. Continuous data collection on site will be reported to confirm this conclusion. The available data was machine-reduced to obtain yearly averages of Pasquill meteorological stability indices distribution for 16 wind directions, including calms; and to determine average wind speeds for each stability class and compass direction. A summary of the reduced data for the two locations is shown in Table 2.3-1. Figure 2.3-1 through 2.3-6 illustrate wind frequencies and speeds as a function of 16 compass directions and 10 stability classes at these two locations.

TABLE 2.3-1
ANNUAL SUMMARY - METEOROLOGY OF SACRAMENTO AND STOCKTON

	STABILITY CLASSES									
	A	A-B	B	B-C	C	C-D	D	E	F	G
Frequency of Occurrence, %										
Sacramento	< 1	5.3	8.3	4.5	5.3	1.6	33.6	17.3	12.7	10.6
Stockton	< 1	4.7	9.5	7.2	5.9	1.4	21.5	10.8	12.8	25.5
Mean Wind Speed m/sec.										
Sacramento	1.3	1.5	2.1	4.3	3.2	5.6	5.7	4.3	2.5	1.2
Stockton	1.4	1.5	2.2	4.3	2.9	5.3	3.5	4.2	2.4	0.9

2.3.3.1 Meteorological Stability

Computed yearly averages for Sacramento and Stockton indicate that the neutral meteorology conditions (Class D) and stable conditions (Classes E, F and G) exist at Sacramento approximately 34 and 41 percent of the time, respectively. Neutral and stable conditions at Stockton exist approximately 22 and 49 percent of the time, respectively. Unstable conditions (Classes A, B and C) exist at Sacramento and Stockton, approximately 25 and 29 percent of the time, respectively. The extremely unstable condition (Class A) occurs at both locations less than 1 percent of the time.

~~00185~~

0171

With the exception of stability Class D, average wind velocities associated with the various stability conditions are quite similar at both locations (Table 2.3-1). Under neutral conditions the average wind speed is 5.7 meters per second at Sacramento and 3.5 meters per second at Stockton. Under extremely stable meteorological conditions (Class G) the average wind speeds at these two locations are 1.2 and 0.9 meters per second, respectively.

Yearly averages of hourly statistics of meteorological data from Sacramento and Stockton indicate that neutral conditions may exist at the site at any time of the day and night. Stable conditions occur only at night and unstable conditions only during daylight hours, as indicated in Table 2.3-2.

TABLE 2.3-2
ANNUAL SUMMARY - DAY AND NIGHT STABILITY
INDEX DISTRIBUTION

	STABILITY CLASSES									
	A	A-B	B	B-C	C	C-D	D	E	F	G
DAY (09, 12, 15 hrs)										
Sacramento	0.58	5.31	8.49	4.51	5.31	1.42	11.72	0.0	0.0	0.0
Stockton	0.61	4.77	9.45	7.12	5.94	1.58	8.20	0.0	0.0	0.0
NIGHT (18, 21, 00, 03, 06 hrs)										
Sacramento	0.0	0.0	0.0	0.0	0.0	0.0	21.85	17.32	12.73	10.59
Stockton	0.0	0.0	0.0	0.0	0.0	0.0	13.30	10.83	12.81	25.56

2.3.3.2 Day-Night Inversion

Night inversion conditions occur in California at or near ground level and are predominantly associated with stable meteorological conditions. Day inversion may occur at various altitudes but is usually associated with unstable or neutral meteorological conditions existing between the inversion layer and the ground.

0172 ~~00186~~

2.3.3.3 Winds

Wind extremes noted for the Sacramento area reached 70 miles per hour (one minute average) during winter months 1952 and 1953. In 1965 the highest wind speed at Sacramento was 42 miles per hour from the northwest and 44 miles per hour from the south-southeast at Stockton. In 1966 the high for Sacramento was 36 miles per hour from the southwest and 39 miles per hour from the north at Stockton. While these highs occurred at different days and from somewhat different directions, the overall speed is in general agreement. Similar values would be expected at Rancho Seco.

2.3.3.4 Storms and Tornadoes

Severe storms occur in the Valley infrequently. According to the US Weather Bureau, storms in the tornado class occurred in California 22 times between 1953 and 1962. Thunderstorms are more common and in the Rancho Seco area occur three to five times per year.

2.3.3.5 Precipitation

Rainfall in California is brought by storms entering the state from the Pacific Ocean. The maximum 24-hour precipitation recorded in 18 years in the Sacramento area and 25 years in Stockton was 5.59 and 3.01 inches, respectively. The normal yearly precipitation for the Sacramento and Stockton areas is 16.3 and 13.4 inches, respectively. The precipitation intensity recorded in the Sacramento area over a 5-year period was 0.10-0.24 inches per hour less than 15 percent of the time and 0.01-0.09 inches per hour more than 84 percent of the time.

2.3.3.6 Temperatures

Temperature extremes reach 115 F in Sacramento and 113 F in Stockton during June-July. Minimum temperatures fall below the freezing point during winter months. Recorded extremes were 19 F in January 1966 at Stockton and 23 F in Sacramento. Average daily temperature fluctuations in July were 57.4 to 93.4 F in Sacramento and 60.9 to 95.4 F in Stockton. Daily average temperature fluctuations during the coldest month of the year (January) were 37.2 to 53.2 F in Sacramento and 37.0 to 52.4 F in Stockton. Similar temperatures are expected to occur at the Rancho Seco site.

2.3.3.7 Humidity

The average minimum relative humidity recorded at the Rancho Seco Site was 40.6 percent compared to 41.9 percent at Sacramento. Humidity recorded at Stockton varied by approximately 10 percent with the humidity recorded at Sacramento. Consequently, humidity at the site is expected to fall within the same margin.

2.3.4 PROGRAM OF METEOROLOGICAL INVESTIGATION

In order to obtain meteorological data at Rancho Seco for plant design and operating purposes, a data collection network was started at the site in April 1967. The on-site collection system consists of meteorological instruments mounted on a 53-foot pole to be replaced by a permanent tower near the plant location. In addition, it is planned to have the on-site data collection system supplemented by measurements at other locations.

The on-site data collection program included recording of the following parameters:

a. Horizontal fluctuations of the wind

b. Vertical lapse rate

c. Wind speed

d. Wind direction

e. Temperature

f. Humidity

2.3.5 PRELIMINARY ESTIMATES OF DIFFUSION

The meteorological conditions for 2-hour, 24-hour and 30-day releases were determined applying computer reduced data from both Sacramento and Stockton areas. A summary of the yearly averages appears in Appendix 2A. The meteorological parameters considered in this determination were the persistences of the individual Pasquill stability classes and associated wind speeds, directions, and wind persistences in any single direction. 12

2.3.5.1 Short-Term Releases

Atmospheric dispersion for ground-level releases not exceeding a few hours duration were calculated using the standard Pasquill[1] diffusion formula:

$$\chi/Q = \frac{1}{\pi \sigma_y \sigma_z \bar{u}} \qquad (1)$$

The above formula was corrected for the dilution effect in the "wake" of the building by calculating the virtual point source distance from Equation (2) below:

$$\frac{A}{2} = \pi \sigma_y \sigma_z \qquad (2)$$

0174 ~~00180~~

where σ_y, σ_z are the Pasquill dispersion parameters in the Y and Z directions, respectively; A is the minimum cross sectional area of the building; and $\bar{u}$ is the mean wind speed.

The 2-hour release time assumes moderately stable meteorological conditions (Class F) with a unidirectional wind flow of 2.0 m/sec., recommended by Smith and Beesmer. 2

2.3.5.2 24-Hour Release

Atmospheric dispersion for a one-day release takes into consideration that in the Sacramento-Stockton area stable conditions occur only at night (15 hours) and unstable conditions exist only during the daylight hours (9 hours). All unstable conditions were classified as Class C; all stable conditions were classified as Class F, with associated wind velocities for these two classes of 2.9 and 2.0 m/sec., respectively. 2

To increase the conservatism of the one-day dispersion model, the assumption was made that the wind will blow continuously in one direction for 24 hours. The probability that the wind direction will not change from one 20° sector during 24 hours is 1%. The same probability for a 60° sector is 9 percent in summer and 12 percent in winter.

The atmospheric dispersion formula used for longer than a few hours according to Gifford[2] is:

$$\chi/Q = \sqrt{\frac{2}{\pi}} \quad \frac{1}{\beta} \sum_i \quad \frac{F_i \quad f_i}{\sigma_{zi} \quad \bar{u}_i \quad X} \qquad (3)$$

Where F_i is the fraction of time that any single meteorological stability class exists at the site and f_i is the fraction of the time that the wind associated with a single stability class will blow in the sector of interest. For the sector of interest, the width, β, is 2 tan (22.5/2), or 0.397. X is the actual distance between the center of the containment and the downwind position and σ_{zi} is the vertical dispersion parameter associated with distance X and corrected for the effect of dilution in the "wake" of the building at short downwind distances. 1

The following values were used for the 24-hour release model:

Stability Class	Fraction F_i	$\bar{u}$ m/sec	Fraction f_i
C	.375	2.9	1.0
F	.625	2.0	1.0

2

00189

2.3.5.3 Long-Term Releases

Since the Rancho Seco area is more closely related to Stockton during daylight hours, it was assumed that unstable conditions occur there as in Stockton approximately 29 percent of the time and, for the sake of conservatism, correspond to stability Class C. During the nighttime hours the site meteorology resembles more closely that of Sacramento which has the stable conditions distribution of 17, 13, and 11 percent for Classes E, F, and G, respectively. For the balance of the time, or 30 percent, neutral stability (Class D) is assumed.

The basic dispersion model assumed to apply to the 30-day release is the same as for the 24-hour release. The following yearly averaged parameters were used in the 30-day release:

Stability Class	Fraction F_i	$\overline{u}$ m/sec	Fraction* f_i
Pasquill C	0.29	2.9	0.34
D	0.30	4.6	0.18
E	0.17	4.3	0.18
F	0.13	2.0	0.17
G	0.11	1.2	0.10

2

Table 2.3-3 indicates the calculated dispersion factors for the short and long term releases.

TABLE 2.3-3
RANCHO SECO SITE ATMOSPHERIC DISPERSION FACTORS

Distance From Center of Containment	$(X/Q)_{2\ hrs}$	$(X/Q)_{24\ hrs}$	$(X/Q)_{30\ days}$
meters	sec/m^3	sec/m^3	sec/m^3
4×10^2	1.94×10^{-4}	9.3×10^{-5}	1.26×10^{-5}
7×10^2	1.41×10^{-4}	4.8×10^{-5}	6.50×10^{-6}
10^3	1.11×10^{-4}	3.0×10^{-5}	4.10×10^{-6}
2×10^3	5.45×10^{-5}	1.1×10^{-5}	1.51×10^{-6}
4×10^3	2.56×10^{-5}	3.5×10^{-6}	5.72×10^{-7}
7×10^3	1.48×10^{-5}	2.0×10^{-6}	2.59×10^{-7}
10^4	8.85×10^{-6}	1.15×10^{-6}	1.50×10^{-7}
2×10^4	4.32×10^{-6}	4.55×10^{-7}	5.82×10^{-8}

2

* Represents the maximum fraction of the time that the wind associated with a given stability class will blow in any 20° sector.

2.3.5.4 Rainout

The effects of rainout on ground concentration of activity released was evaluated using Gifford's and Culkowski's[3] formula:

1

$$\omega_r = \frac{\Lambda Q_o}{\bar{u} \sigma_y \sqrt{2\pi}} \exp\left[-\frac{\Lambda x}{\bar{u}} - \frac{y^2}{2\sigma_y^2}\right] \quad (4)$$

where ω_r is the rate of deposition per square meter and Q_o is the time averaged activity leaking out of the containment building during a given period of time and Λ is the washout removal coefficient.

Precipitation records at Sacramento indicate that the probability of continuous rainfall for 8 hours is 10 percent and for 24 hours is 0.45 percent when the rain intensity is in the 0.01 to 0.09 inches per hour range. Since more than 80% of all rainfall intensities are less than 0.10 in./hr, an average rain intensity of 0.05 in./hr was assumed for the purpose of rainout evaluation. Heavier rains of 0.1 to 0.25 inches per hour were found not to last for periods longer than approximately 8 hours. Still heavier rains of more than 0.25 inches per hour did not continue for more than 5 hours. Rainfall is associated with winds from the SE-SSE directions approximately 46 percent of the time. For the purpose of this evaluation (see section 14.3), it was conservatively assumed that the rain is associated with neutral meteorological conditions (Class D) and a wind speed of 4.7 m/sec.

2 (Deleted)

~~00194~~

0277

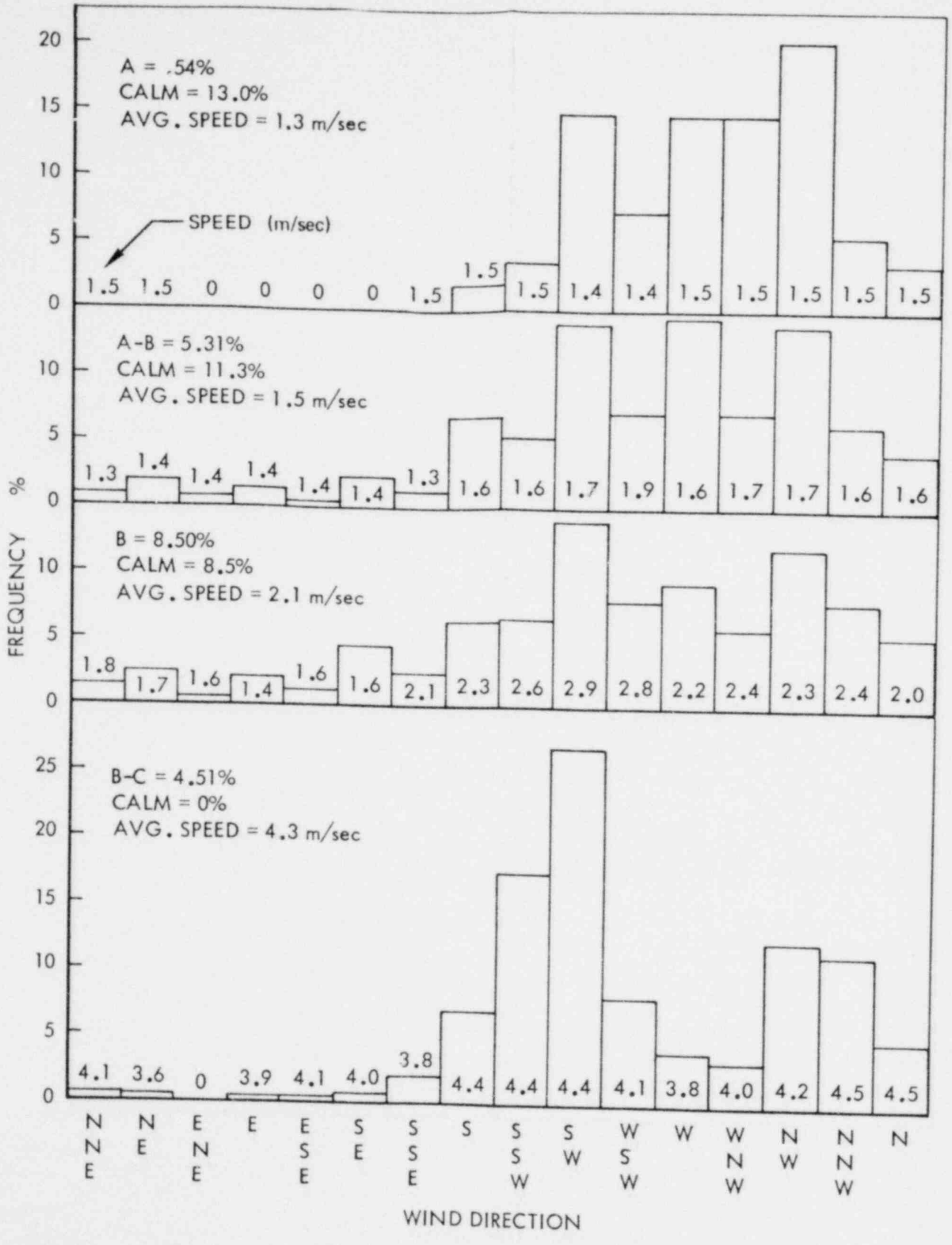


FIGURE 2.3-1
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (SACRAMENTO)

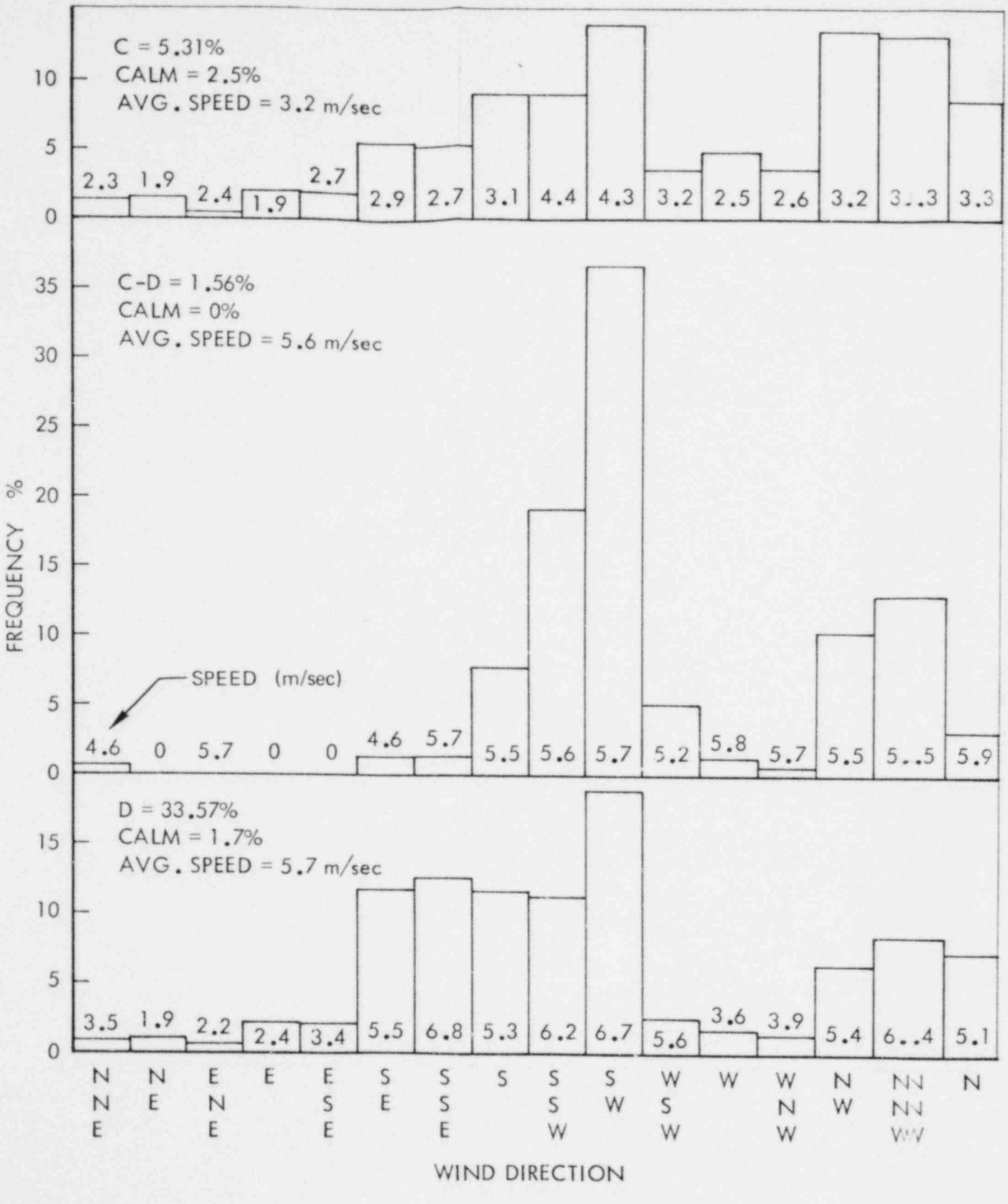


FIGURE 2.3-2
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (SACRAMENTO))

0179

SMUD

~~00193~~

SACRAMENTO MUNICIPAL UTILITY DISTRICT

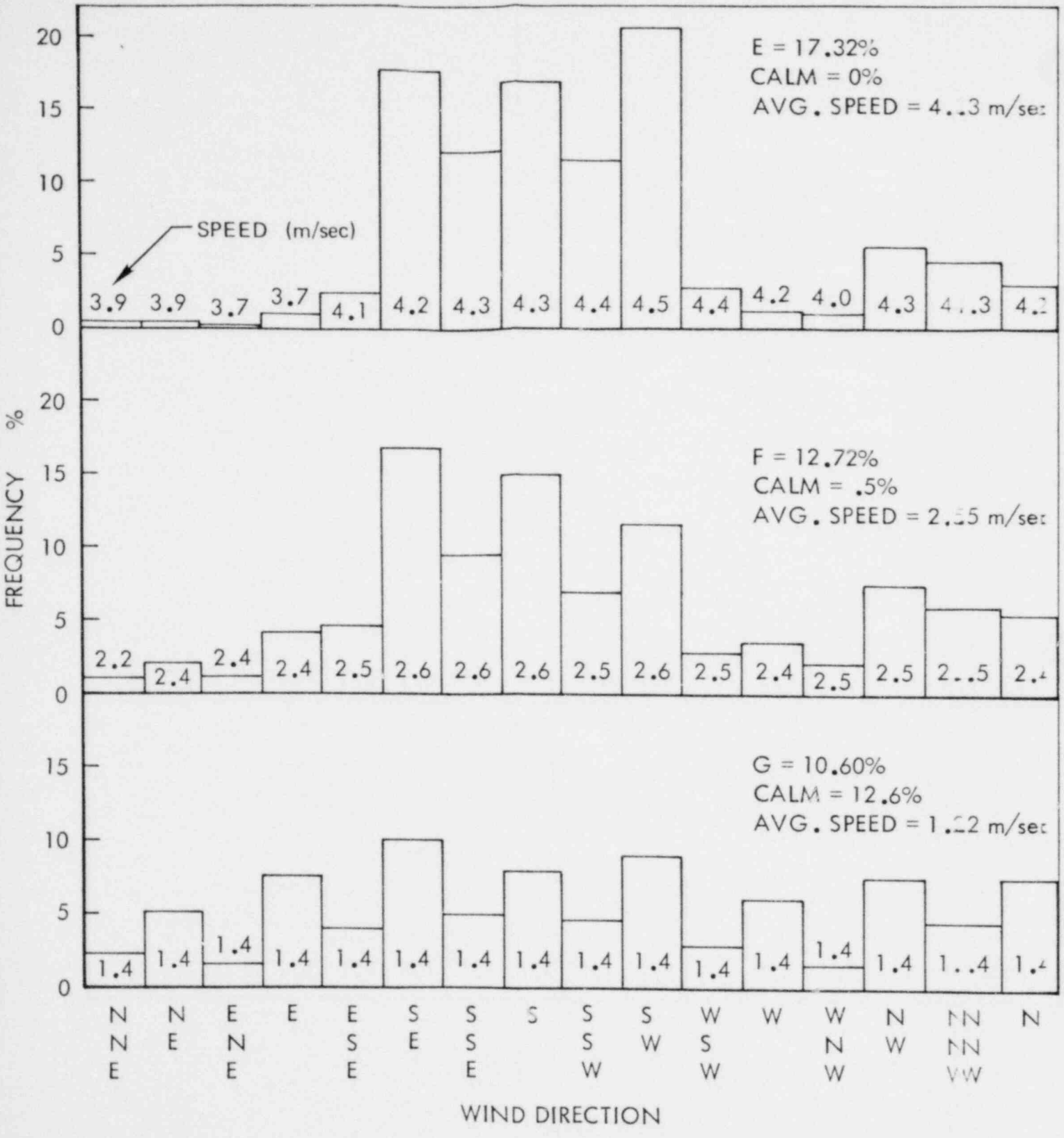


FIGURE 2.3-3
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (SACRAMENTO)

SMUD

~~0019~~

SACRAMENTO MUNICIPAL UTILITY DISTRICT

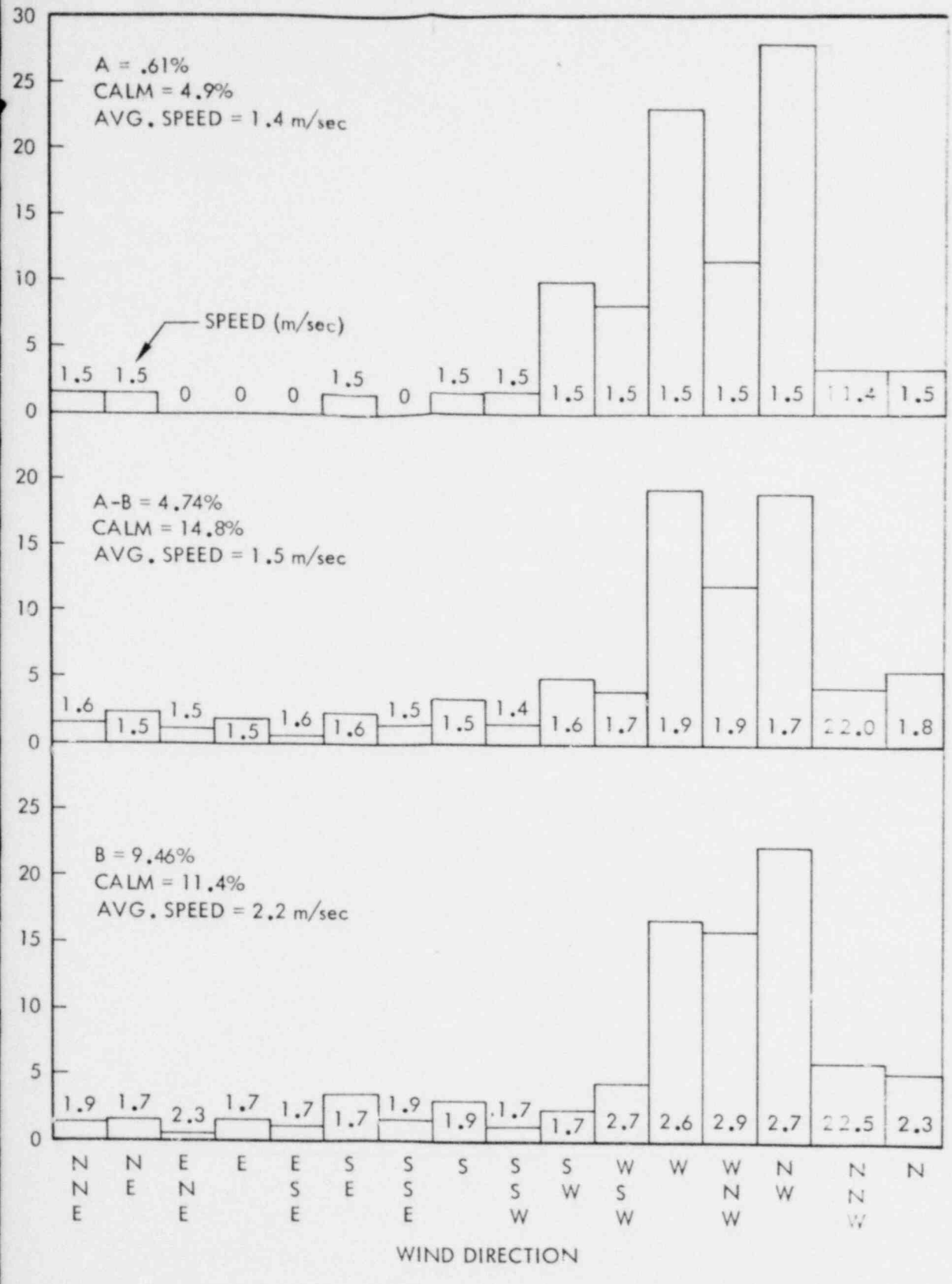


FIGURE 2.3-4
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (STOCKTON)

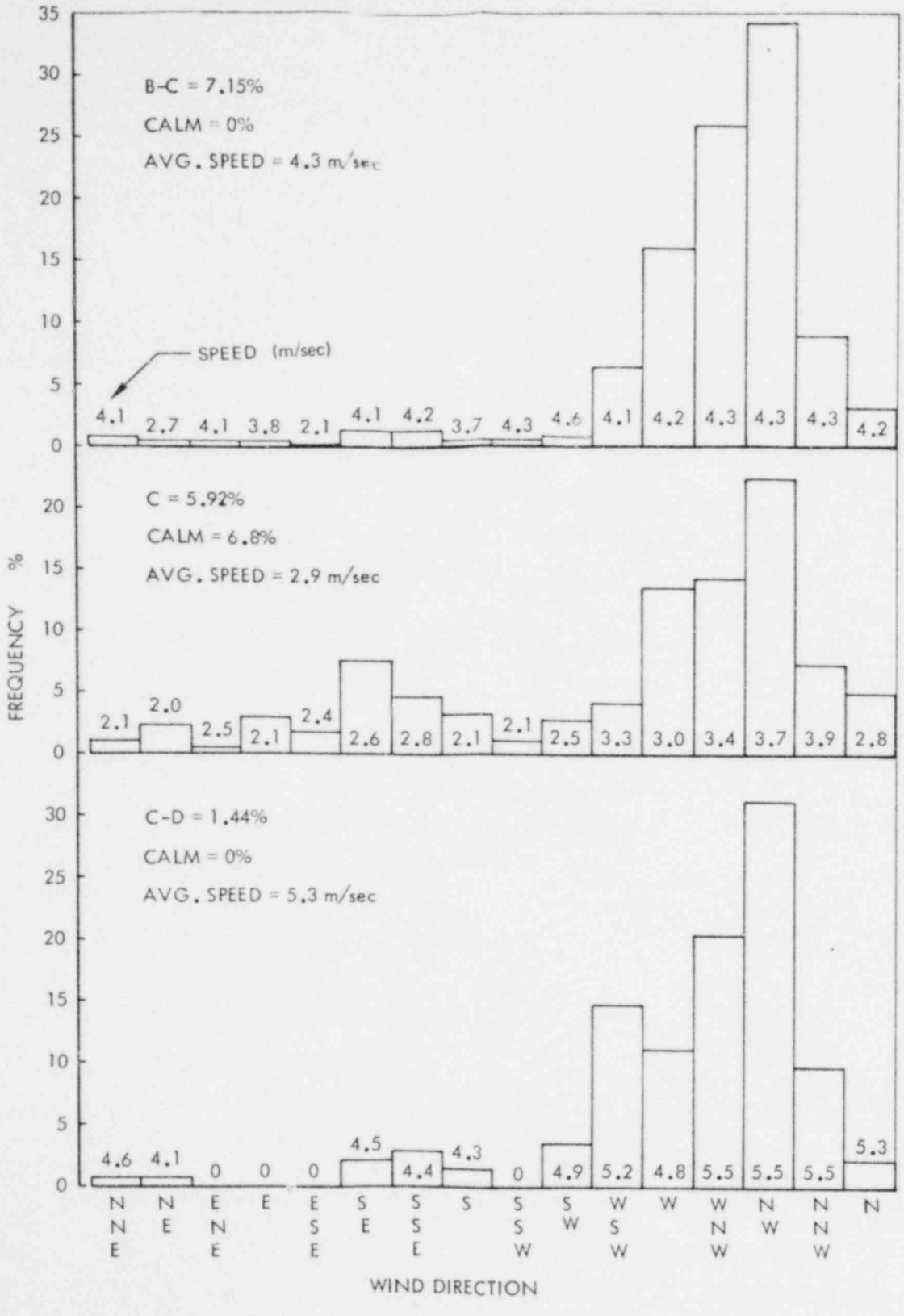


FIGURE 2.3-5
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (STOCKTON)

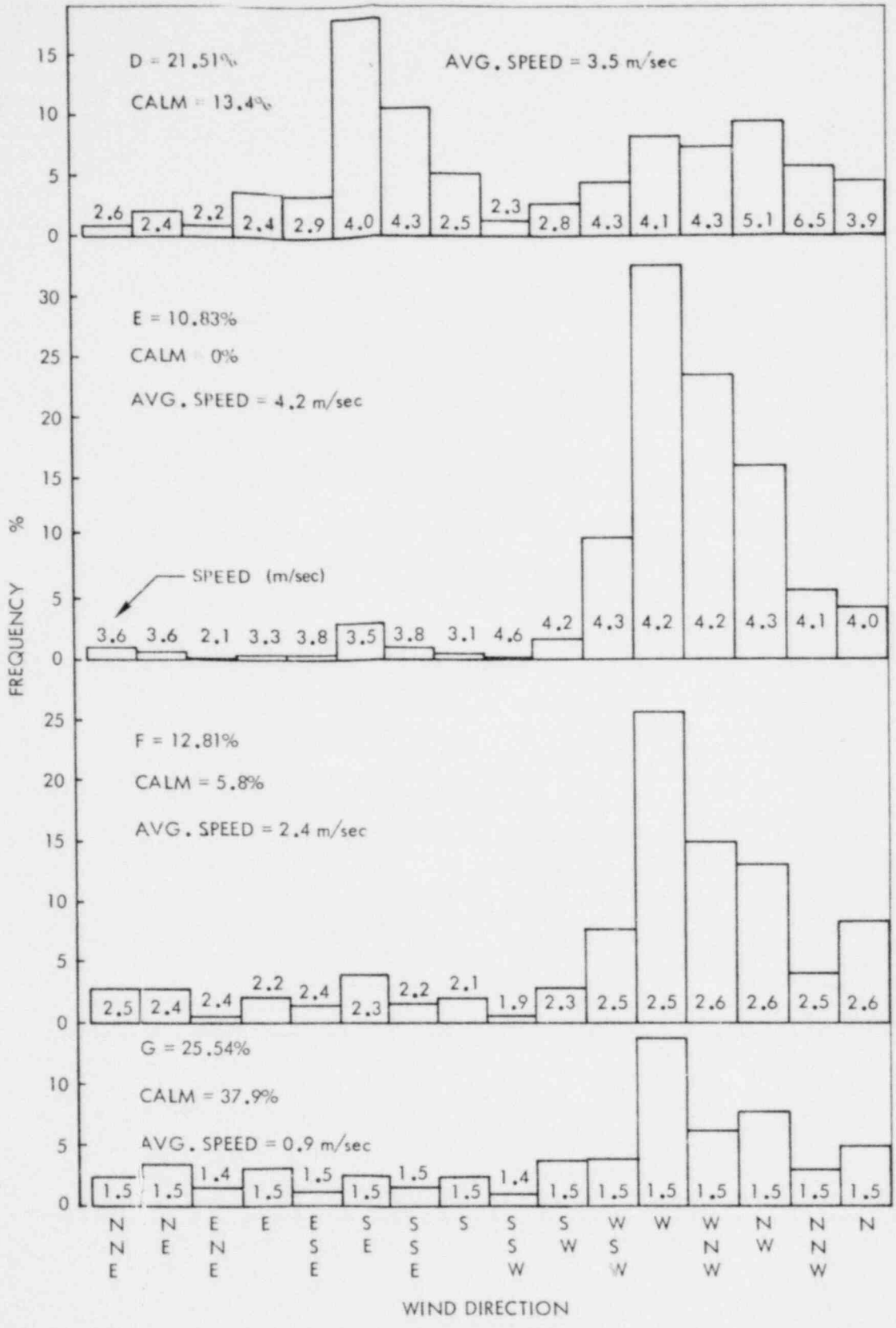


FIGURE 2.3-6
STABILITY INDICES BY WIND DIRECTIONS
AND AVERAGE SPEED (STOCKTON)

2.4 HYDROLOGY

2.4.1 CHARACTERISTICS OF STREAMS AND LAKES IN VICINITY

Table 2.4-1 is a summary of reservoirs and lakes in the vicinity of the Rancho Seco Nuclear Generating Station. Each reservoir and lake is coded by number in Table 2.4-1 for easy location on the location map Figure 2.4-1.

2.4.2 TOPOGRAPHY

The site is gently rolling and is not intersected by any streams, but is bounded by well-defined drainage courses that intercept surface runoff from the higher site topography. Plant grade at approximately 160 feet elevation above sea level will permit excellent drainage at all times without danger of flooding. Plant areas will be graded to provide natural drainage to lower ground. The rolling terrain of the site affords excellent drainage along natural gullies at gradients varying from two to six percent. Elevations vary from 130 feet to 280 feet above sea level.

2.4.3 TERMINAL DISPOSAL OF STORM RUNOFF

The site is bounded on the north by Hadselville Creek, which intercepts all drainage from the site and empties into Laguna Creek to the west. Flow is continued westerly by Laguna Creek South, which is a tributary of the Cosumnes River, and into the Mokelumne River. The Mokelumne is a tributary of the southerly flowing Sacramento River and enters the Sacramento River approximately 20 miles south of the City of Sacramento.

2.4.4 HISTORICAL FLOODING

Within recent historical times no flooding or inundation from storms or runoff has occurred within the site boundaries. It is quite unlikely that the site can inundate or flood, even with abnormal rainfall intensities.

2.4.5 PREDICTION OF LAND URBANIZATION

A survey conducted by the County of Sacramento indicates that the land adjoining the site, within at least a 15-mile radius, will remain primarily for agricultural and grazing use; therefore, the rainfall runoff factors will remain constant and not cause any difference in hydrological properties.

TABLE
RANCHO SECO N
DATA ON RESERVOIRS AND LA

No.	Reservoir	Owner	River
1.	Lake Combie	Nevada Irrigation District	Bear River
2.	Camp Far West	South Sutter Water District	Bear River
3.	Auburn Dam*	US Bureau of Reclamation	Middle Fork/American River
4.	Edson Lake	Georgetown Divide Public Utility District	Pilot Creek
5.	Jenkinson Lake	US Bureau of Reclamation	Sly Park Creek
6.	Slab Creek	Sacramento Municipal Utility District	South Fork/American River
7.	Chili Bar	Pacific Gas & Electric Company	South Fork/American River
8.	Folsom	US Army Corps of Engineers	American River
9.	Lake Natoma	US Bureau of Reclamation	American River
10.	Jackson Creek	Jackson Creek Irrigation District	Jackson Creek
11.	Arroyo Seco	Charles Howard Estates	Tributary/Dry Creek
12.	Lower Bear River	Pacific Gas & Electric Company	Bear River
13.	Camanche	East Bay Municipal Utility District	Mokelumne River
14.	Pardee	East Bay Municipal Utility District	Mokelumne River
15.	Salt Springs	Pacific Gas & Electric Company	North Fork/Mokelumne River
16.	Tiger Creek Afterbay	Pacific Gas & Electric Company	North Fork/Mokelumne River
17.	New Hogan	US Army Corps of Engineers	Calaveras River
18.	Salt Springs Valley	Rock Creek Water District	Rock Creek
19.	Wallace	M. I. Crocker Co.	Tributary/Mokelumne River
20.	Tullock	Oakdale & San Joaquin Irrigation District	Stanislaus River
21.	New Melones	US Army Corps of Engineers	Stanislaus River
22.	Woodward	South San Joaquin Irrigation District	Simmons Creek
23.	Farmington	US Army Corps of Engineers	Littlejohn Creek
24.	Davis No. 2	Fred Podesto	Tributary/Calaveras River
25.	Woodbridge Diversion	Woodbridge Irrigation District	Mokelumne River
26.	Putah Creek Diversion	US Bureau of Reclamation	Putah Creek
27.	Marsh Creek	Contra Costa FCWCD	Marsh Creek

* Completion Scheduled for 1976.
** Information Not Available.

2.4-1
UCLEAR STATION
KES WITHIN A 50-MILE RADIUS

Area of Reservoir (Acres)	Maximum Storage (Acre Feet)	Dead Storage Area (Acres)	Dead Storage Volume (Acre Feet)	Hydrology Average Flow (CFS)	Distance (Miles)	Direction
**	9,000	**	**	**	47	N
2,680	150,000	2,000	100,000	495	50	NNW
10,390	2,500,000	3,250	3,700	2,150	40	N
325	20,000	75	2,000	**	47	NE
648	11,000	**	400	64	40	NE
250	16,600	45	600	870	39	NE
135	3,030	75	1,480	1,070	34	NNE
11,450	1,010,000	2,030	90,000	3,450	26	N
540	8,800	**	1,800	**	21	NNW
385	22,000	75	2,400	46	13	E
104	2,433	0	0	**	6	ENE
720	48,500	**	**	**	49	ENE
**	435,000	**	**	1,080	11	SE
2,134	210,000	**	**	938	15	ESE
925	139,400	120	2,000	252	50	ENE
105	3,960	**	**	154	34	ENE
4,670	325,000	715	15,000	275	21	SE
920	10,000	**	**	27	29	SE
188	3,000	**	**	*	13	SE
1,260	68,400	180	4,000	1,670	42	SE
12,500	2,400,000	**	310,000	1,630	41	SE
2,427	35,000	**	**	**	37	SSE
4,100	52,000	0	0	**	32	SSE
151	1,400	**	**	**	20	SSE
474	2,464	**	**	592	16	SW
125	*	**	**	**	48	WNW
335	4,425	**	**	**	45	SW

0186

~~90200~~

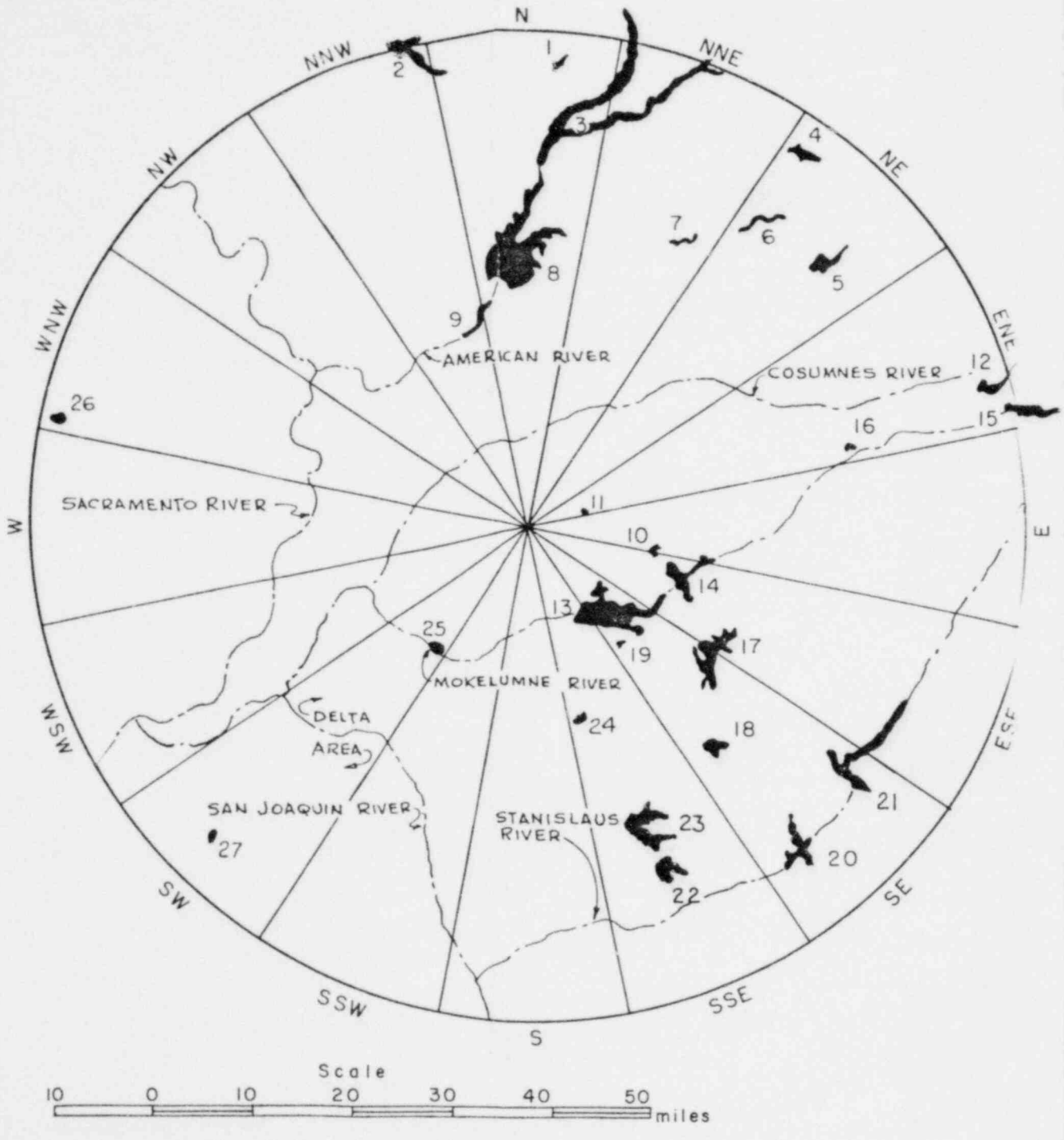


FIGURE 2.4-1
STREAMS AND LAKES

0187

~~00201~~

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

2.5 GEOLOGY

The Rancho Seco project is located about 30 miles southeast of Sacramento in the low hills at the edge of the Sierra Nevada Mountains. The site will be founded on the Pliocene Laguna Formation and is underlain by an estimated 1,500 to 2,000 feet of Tertiary or older sediments deposited on a basement complex of granitic to metamorphic rocks.

Explorations at the site included field mapping, approximately 1,552 feet of bucket auger holes logged in detail, a 602-foot core hole visually and geophysically logged, 874 feet of 4-1/4-inch borings soil-sampled and logged, and approximately 11,500 feet of geophysical refraction profiles. The data obtained indicated the unfaulted nature of the sediments and their suitability as a foundation upon which to build the proposed nuclear generating station.

A detailed account of the conditions at the proposed site will be found in Appendix 2C (Geology and Seismology).

2.6 SEISMOLOGY

There is no indication of faulting beneath the site. The nearest fault system, the Foothill Fault System, is located about 10 miles to the east of the site and has been inactive since the Jurassic Period, some 135 million years ago. The active faulting along which historic large earthquake shocks have originated are the Hayward and San Andreas Faults, some 70 and 89 miles to the west respectively, and the faults 80-plus miles to the east beyond the Sierra Nevada Range.

There is no reason to anticipate fault propagation in the site area. Earthquake shaking will occur as the result of shocks along distant faults, but due to their distant origin and nature of the foundation material beneath the site, ground accelerations of no greater than 0.05 g should occur during the life of the plant. Therefore, a conservative value of 0.1 g will be used for design.

Further discussion of the site seismicity may be found in the Seismic report in the Appendix 2D and supplements and the earthquake design criteria for the site can be found in Appendix 5A. 1

~~00203~~

0189

2.7 SOILS

The soil and foundation investigation program was performed (Appendix 2F) to determine the suitability and the engineering properties of the soil and foundation at the Rancho Seco site. The investigation was carried out concurrently with the geologic and geophysical investigation. Ten soil borings, supplemented by test trenches and bucket auger holes, were drilled into the foundation from which samples were obtained for laboratory testing, and static strength testing were performed on representative soil samples. Standard testing procedures and techniques were utilized throughout the program.

The results of the drilling and sampling and laboratory testing provided the basic technical data from which the foundation and engineering properties of the soils were analyzed. It was concluded that the soils at the Rancho Seco site are sufficiently strong to safely support the nuclear containment structure and appurtenant facilities. These soils can be categorized as hard-to-very-hard silts, and silty clays with dense-to-very-dense sands and gravels.

An allowable bearing value of 9,000 pounds per square foot is recommended for the containment structure and those portions of the nuclear steam supply system critical to nuclear safety, based on maximum tolerable settlement criteria.

2.8 SITE ENVIRONMENTAL RADIOACTIVITY PROGRAM

2.8.1 GENERAL

At least one year prior to the operation of Rancho Seco Nuclear Generating Station Unit 1, an environmental monitoring program will begin, serving two functions. The first function is the determination of the preoperational base or datum level of radioactivity in the environment, above which contributions from plant operations can be measured.

The second function is to determine the effect of plant operations on the environment. The program will also serve as a backup indicator or check of the effectiveness of inplant measurement and control of waste gas discharge. Significant quantities of radioactive material should not be released to the environment, and the operational phase of the program is intended to demonstrate this. To provide a basis of comparison between pre- and post-operational monitoring programs, sample type, location, and frequency will be established in the pre-operational phase with the intent that samples will remain largely unchanged in the post-operational period. However, during the pre-operational phase, a continuing review will be made of the adequacy and suitability of the program for operational monitoring.

2.8.2 LAND ENVIRONMENT

With specific regard to land environment, the only significant route of transfer of material from the plant is via plant vent releases. Under normal conditions, the design of the plant is such that only the noble gases, krypton and xenon, would be released. However, under unusual operating conditions, small quantities of radioactive iodines may be released from the stack. No appreciable amount of strontium-90 would be released in plant gaseous waste under normal operating conditions. 1

2.8.2.1 Noble Gases Effect

The predominant effect of the noble gases, krypton and xenon, derives from the external radiation exposure they may contribute since, as inert gases, they cannot be reconcentrated in environmental media in the human food chain. Since the gases constitute the major contribution of the plant to the environment, the land environment program is primarily intended to detect changes in environmental radiation levels attributed to this source. For the anticipated very low levels of radiation created, the only detector of suitable reliability and sensitivity is one which integrates exposure over a long period. Consequently, film packets will be used at appropriate locations in the vicinity. In order to provide adequate detection sensitivity, these films will be changed on a quarterly basis in the absence of unusual releases.

2.8.2.2 Air Sampling Stations

Radioactive particulates in the air will be detected by high volume air sampling stations. The stations will be equivalent to those which are operated by the California Department of Public Health and the U. S. Public

Health Service. They will provide correlation between activity levels at Rancho Seco and adjacent locations.

2.8.2.3 Iodine Detection

A good sampling medium exists in the vicinity of the plant for the detection of radioactive iodine. This consists of examining the thyroid glands of grazing animals, particularly cottontail and jack rabbits which are abundant in the area. Since the rabbit samples vegetation upon which deposition may have occurred and concentrates any iodine activity in its thyroid, collection and analysis of rabbits at suitable intervals provide an indication of the presence of iodine at levels of sensitivity which far exceed other sampling techniques. The area over which the cottontail and jack rabbit ranges during its lifetime is small enough to ensure that such sampling is representative of the immediate area.

2.8.3 WATER ENVIRONMENT

Spot checks of surface, well, and rain waters will be performed.

2.8.4 SAMPLING

1 The samples collected will include the following:

a. Airborne particulate material

b. Water (rain, surface, and well)

c. Milk

d. Soil and silt

e. Vegetation

f. Fish

g. Animals

The gross alpha and gross beta-gamma activity of the samples will generally be measured and specific radionuclides will be identified when appropriate. Special analyses, such as determination of Sr^{90} in milk, will be performed by an outside laboratory.

Since the program has not been completely developed, the frequency of observations and sampling have not been finally determined. However, a tentative program for environmental radiation monitoring is given in Table 2.8-1. The final program is expected to reasonably conform to this, though changes are expected for such items as sample collection frequency and number of stations.

~~00206~~

TABLE 2.8-1
ENVIRONMENTAL RADIATION MONITORING PROGRAM

Item	Type of Analysis	Type of Sample	Sample Collection Frequency	Number of Stations	Samples per Year
1. Background Gamma Monitoring	Gamma	Continuous recording	Read & record weekly	One	-
2. Airborne Particulate	Gross Beta-Gamma	About 1 cfm continuous	Filter paper collected weekly	One	52
3. Water a. Rain Water	Gross Beta-Gamma	Continuous (Shower cap over funnel during rainless periods)	Monthly	One	12
	Strontium-90	Continuous	Quarterly	One	4
b. Surface Water	Soluble Gross Beta-Gamma	Spot	Weekly	Two	104
	Soluble Gross Alpha	Spot	Weekly	Two	104
	Insoluble Gross Beta-Gamma	Spot	Weekly	Two	104
	Insoluble Gross Alpha	Spot	Weekly	Two	104
	Gamma Spectrum	Spot	Semiannual	Two	4
c. Well Water	Gross Beta-Gamma	Spot	Weekly	Three	156
	Gross Alpha	Spot	Weekly	Three	156
	Uranium	Spot	Quarterly	Three	12
	Strontium-90	Spot	Semi-Annually	Three	6
4. Milk	Gross Beta-Gamma	Spot	Quarterly	Four	16

Amendment 1

2.8-3

0193

00207

TABLE 2.8-1 Continued

Item	Type of Analysis	Type of Sample	Sample Collection Frequency	Number of Stations	Samples per Year
	K-40				4
	Sr-90				4
	I-131	Spot	Semi-Annually	Two	4
	Cs-137				4
5. Soil and Silt					
a. Soil	Gross Alpha Gross Beta-Gamma	Sunshine method	Quarterly	Five	20
	Potassium-40 Strontium-90	Sunshine method	Annually	Two	2
b. Silt	Gross Alpha Gross Beta-Gamma	Spot	Semi-Annually	Two	4
	Strontium-90	Spot	Annually	Two	2
6. Vegetation	Gross Alpha Gross Beta-Gamma Potassium-40	Stems, leaves and fruit	Spring and Fall	Five	10
	Strontium-90	Stems, leaves and fruit	Annually	Five	5
	Gamma Spectrum		Annually	Five	5
7. Fish (Hatchery)	Gross Alpha Gross Beta-Gamma		Quarterly	Two	8
	Potassium-40 Strontium-90				
8. Animal (rabbits)	Gross Beta-Gamma and Potassium-40 of muscle, soft tissue, and bone I-131 of thyroid	Spot	Semi-annually	One	2

2.9 REFERENCES

1. Pasquill, F., "The Estimation of the Dispersion of Windborn Material," Meteorology Magazine 90 (1063) 33-49 (February 1961)

2. Gifford, F. A., Jr., "Atmospheric Dispersion Calculations Using the Generalized Gaussian Plume Model," Nuclear Safety, II, 56-59 (December 1960)

3. Culkowski, W. M., "Deposition and Washout Computations Based on the Generalized Gaussian Plume Model," ORO-599, Weather Bureau Research Station, Oak Ridge Tennessee (September 30, 1963)