QUESTION 2H.1 (DRL 2.7) Discuss the water flow patterns in the vicinity of the plant and their associated consequences on plant operations following a failure of the on-site water storage facilities.

ANSWER Section 2.4 of the PSAR describes the topography and drainage patterns of the site. As stated, the site is located very favorably for natural drainage.

Open ditches and culverts will be provided around the plant area to intercept any overland flow. The paved area within the plant slopes away from the buildings and toward the perimeter drainage system. Storage tanks are located between the buildings and perimeter drainage system. Any discharge from these tanks will flow away from the buildings. The circulating water system canal and intake have a water surface below nominal plant grade.

The result of a postulated failure of the on-site reservoir has been investigated. The flow from a reservoir failure would pass to the south of the plant. The invert of the natural drainage channel is approximately 20 feet below the plant grade with a top width of over 1500 feet and could safely pass a flow in excess of 175,000 cfs.

Due to the elevation of the plant above the adjacent Sacramento River Delta (see Fig. 2.2-3), there is no downstream control which would affect the stage-discharge relationship of water flowing past the plant. The water flowing past the plant is free to flow at normal depth. The reservoir is far enough upstream from the plant for the bore wave to collapse prior to passing the plant. It is difficult to postulate a sudden failure of an earth structure and due to the relative small quantity of water stored in the reservoir any time lag to reach the maximum break will have a substantial influence on the peak flow. 4

An instantaneous break 50' wide and the full height of the dam, occurring simultaneously with the peak discharge of the maximum probable flood, resulting from storm runoff at the plant and adjacent catchment area, will produce a flow of less than 50,000 cfs past the plant. Peak discharge of the maximum probable flood, computed by methods developed by the Soil Conservation Service, is less than 2,000 cfs. 4

Peak runoff from the maximum probable storm was based on the probable maximum 6-hour point storm value of 6 inches from storm analyses data prepared by the Bureau of Reclamation.

It is concluded that a failure of a dam occurring simultaneously with the peak discharge of the maximum probable storm will not flood the site. The resulting 50,000 cfs flow will have its water surface more than 10 feet below any of the safeguards equipment located in the plant yard. This would be the controlling elevation in the event of flooding.

068

QUESTION 2H.2 (DRL 2.8)

Provide a map of earthquake epicenters within a radius of 200 miles showing all earthquakes of intensity V or greater at the epicenter.

ANSWER

The instrumented epicenters and non-instrumented seismic events within a 50 mile radius of the Rancho Seco site are shown on Figures 2H.2-1 and 2 respectively.

The epicenter map shows the magnitude of earthquakes actually recorded, while the non-instrumented seismic event map shows the highest intensity reported for any earthquake. It is considered that the 50 mile radius map presents a meaningful description of the site and adjacent area since varying geological conditions need not be evaluated. Similar maps for a 200 mile radius are shown in Figures 2H.2-3 and 4. 3

Appendix A to this answer is Professor Byerly's explanation of epicenter maps (Figures 2H.2-1 and 2).

069

QUESTION 2H.3 (DRL 5.8)

Our current review indicates that the design basis earthquake (the maximum earthquake) for the Rancho Seco site should correspond to a maximum horizontal ground acceleration of at least 0.25g. The basis for this conclusion stems from the possibility that historical evidence may underestimate the maximum earthquake likely to occur in this province and from a need to provide both for the possible occurrence of local faults that may be unknown in this region because of the great depth of overburden and for the possible amplification in the alluvium in this geological region. You are asked to consider this basis for the design basis earthquake for the Rancho Seco site.

ANSWER

A value of horizontal ground acceleration of 0.25g will be used for the maximum hypothetical earthquake and 0.13 g will be used for the design earthquake.

QUESTION 2H.4 (DRL 5.9)

Provide the elevations of the proposed foundations for the containment structure, turbine buildings, and auxiliary buildings, in order that they can be compared with the boring data provided in the PSAR.

ANSWER

The following structure foundation elevations can be used for correlation with the boring logs:

| Structure | | Elevation |
|---|---|---|
| Containment Structure | - | 130'-0 |
| Spent Fuel Storage Pool | - | 158'-6 |
| Auxiliary Building | - | 145'-0 |
| Radwaste Building | - | 140'-0 |
| Turbine Building - Mat | - | 155'-6 |
| Turbine Building - Condenser Area | - | 150'-0 |

Elevation 0'-0" on general arrangement drawings equals elevation 165 MSL.

070

Docket 50-312
Amendment No. 2
April 15, 1968
Appendix A to Question 2H.2

Perry Byerly
6037 Contra Costa Road
Oakland, California 94618
Phone 654-6893

March 25, 1968

Mr. John Mattimoe
Sacramento Municipal Utility District
Box 2391
Sacramento, California 95811

Re: Epicenter Maps

Dear Mr. Mattimoe:

You have asked for epicenter maps and Bechtel has constructed them according to my specifications.

There must be two of them because two different kinds of epicenters are involved in the historical record.

1) Since and where there have been established seismographic stations, instrumental epicenters may be located. Insofar as we know the earth's structure and the velocities of seismic waves we may from seismograms locate the place where the waves start, i.e. the first source of the earthquake or its focus. The point on the earth's surface above the focus is the epicenter.

If we hold to the theory that all earthquakes originate by fault breaks the instrumental focus should lie on a fault surface and the epicenter near the fault trace on the earth's surface. In practice we find in California that the instrumental epicenters of the larger shocks do lie near the traces of recognized faults although very many of the smaller shocks are not so located.

2) In the early days, say over 35 years ago in California, and in some parts of the United States even today, there are not enough seismographic stations to locate the centers of smaller shocks. In no part of the world were seismographs used to locate epicenters before about 1885, and the instrumental location of the epicenters of large distant earthquakes awaited the turn of the century.

Lacking seismographs, the term epicenter, now called field epicenter, was taken as the center of greatest damage. This location depends on the presence of structures that can be damaged, both natural (steep slopes for landslides, loose natural filled land and swamps to be cracked) and built by man. It depends on the geologic foundations as well as the distance to the source of

the waves. A source in the mountains usually produces the greatest damage in adjacent alluvial valleys so the field epicenter does not lie on a fault even if that is the source of the waves.

Since there is a tendency now for non-geologists to draw supposed faults on maps through epicenters, we must supply one map showing the instrumental epicenters, on which these men may work, and another for the "center of greatest damage epicenters" which are not supposed to lie on faults by any theory.

On the first map we plot circles for instrumental epicenters, and by each the year of the shock and its magnitude in Arabic numerals.

On the second map we designate the center of greatest shaking by a Roman numeral, indicating the Modified Mercalli Intensity there and also the year of the shock.

The construction of the second map requires somewhat more than consulting the Earthquake History of the United States (U.S.C.& G.S.) because in the early days Captain Heck and others having only intensity data were inclined to "round out" the latitudes and longitudes of their field epicenters. Thus too many lay at intersections of the even degree parallels and meridians--an example from our map is the earthquake of April 10, 1881, in which the catalog gives Modesto as having the greatest intensity although the History puts it half a degree north. (The reports suggest strongly that this shock centered in the Coast Ranges.)

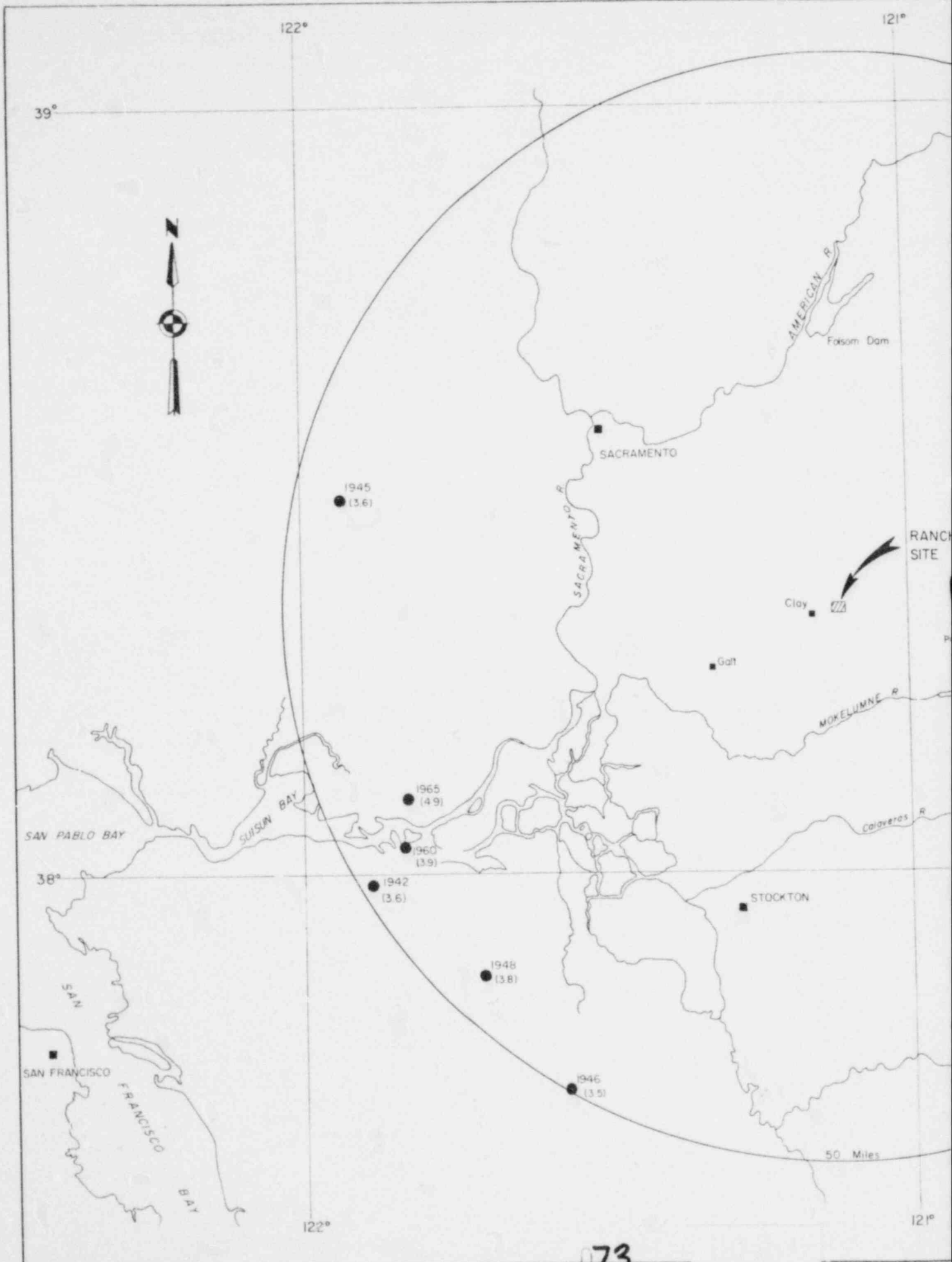
Yours sincerely,

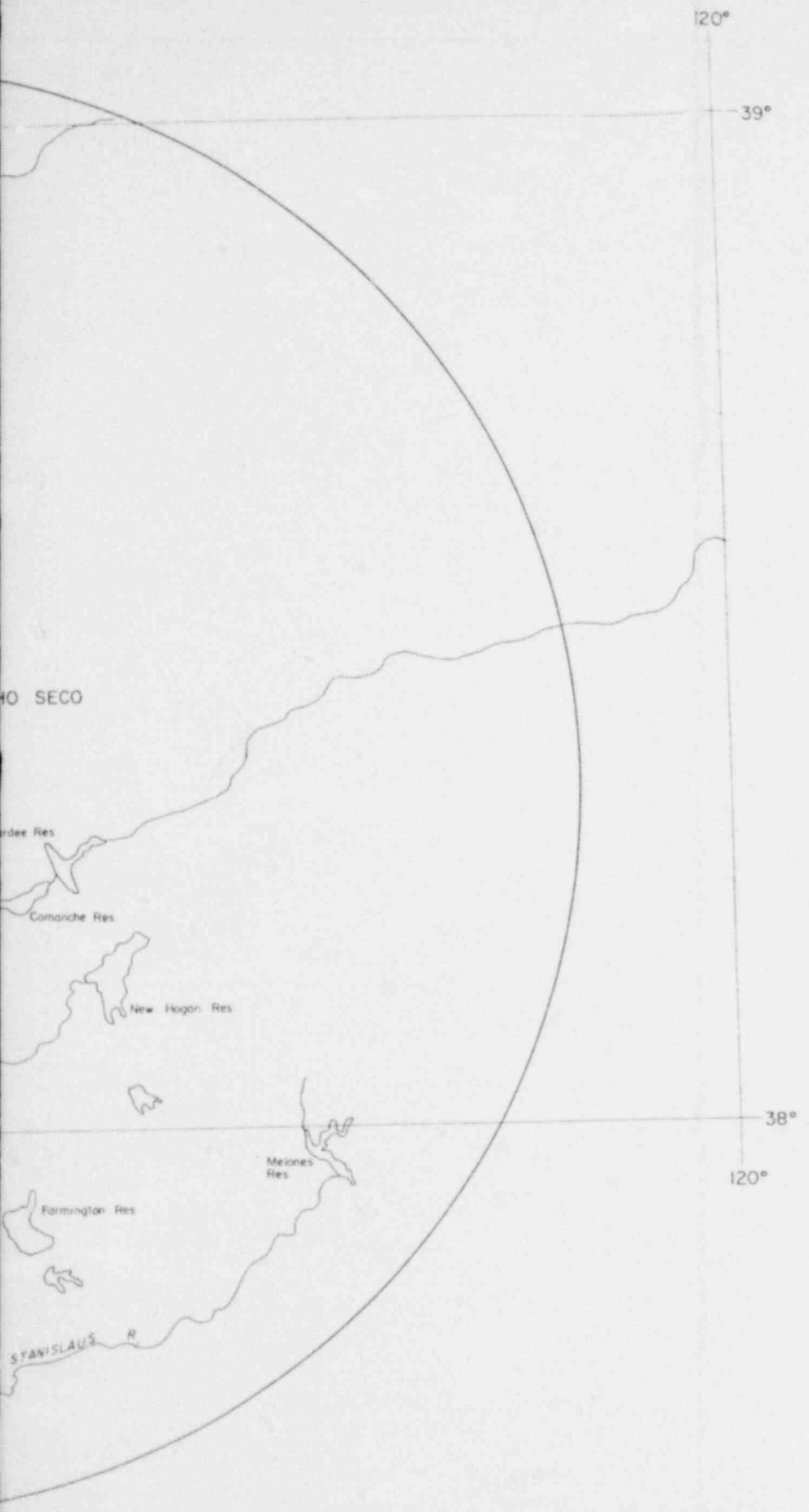
Perry Byerly

Perry Byerly

cc Mr. Cole R. McClure, Jr.

072


122°
121°
39°
38°
N
AMERICAN R.
Folsom Dam
SACRAMENTO
SACRAMENTO R.
1945
(3.6)
RANCH
SITE
Clay
Galt
MOKELUMNE R.
1965
(4.9)
SUISUN BAY
SAN PABLO BAY
Calaveras R.
1960
(3.9)
1942
(3.6)
STOCKTON
1948
(3.8)
SAN
SAN FRANCISCO
FRANCISCO
BAY
1946
(3.5)
50 Miles
122°
121°




EXPLANATION

EPICENTER

● 1945 Year of earthquake
(3.6) (Magnitude on Richter Scale)

REFERENCES

1. Base map, U.S.G.S. California — North Half.
2. Bulletin of the Seismograph Stations, University of California, Berkeley.

10 0 10 20

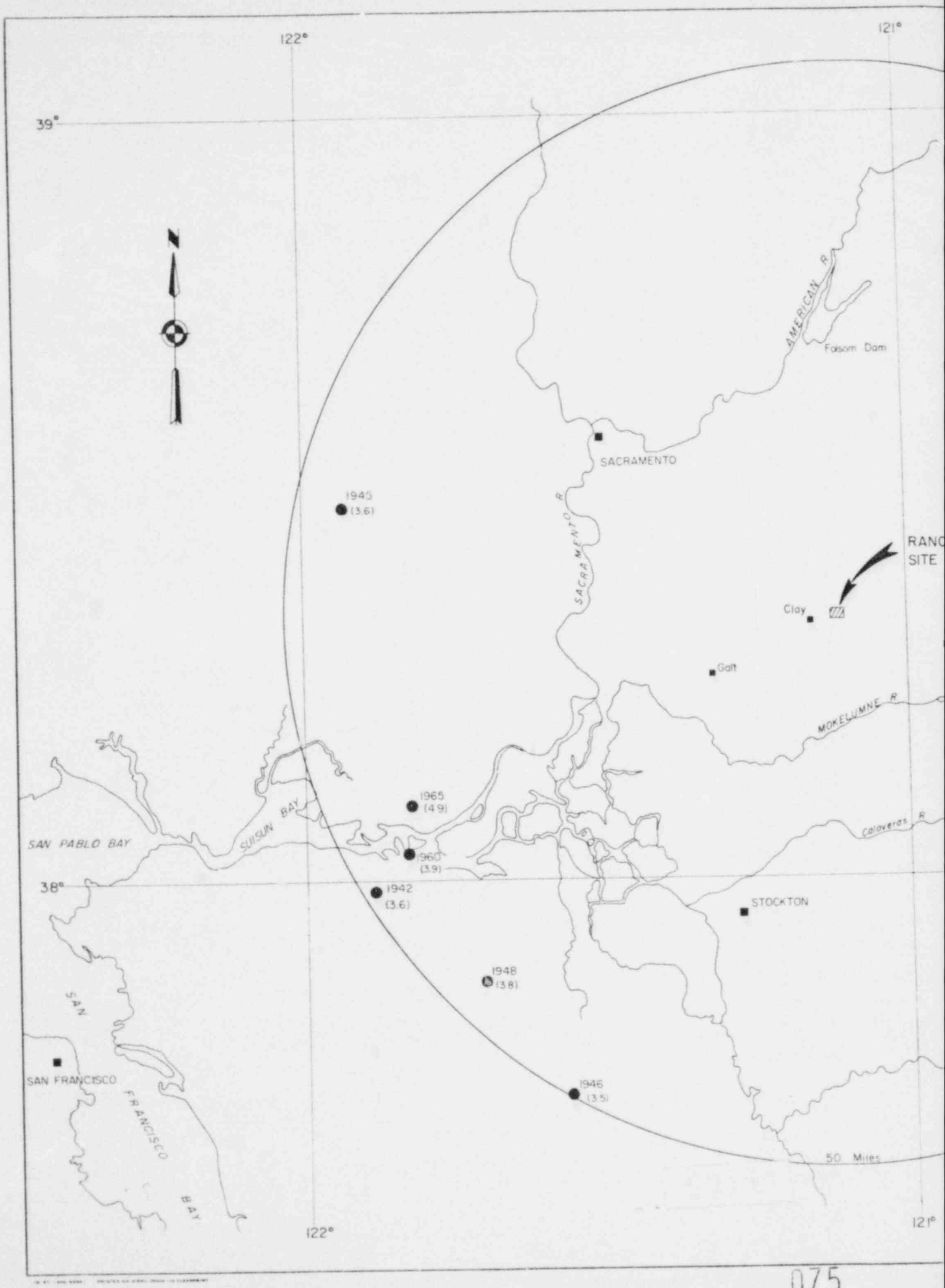
SCALE – MILES

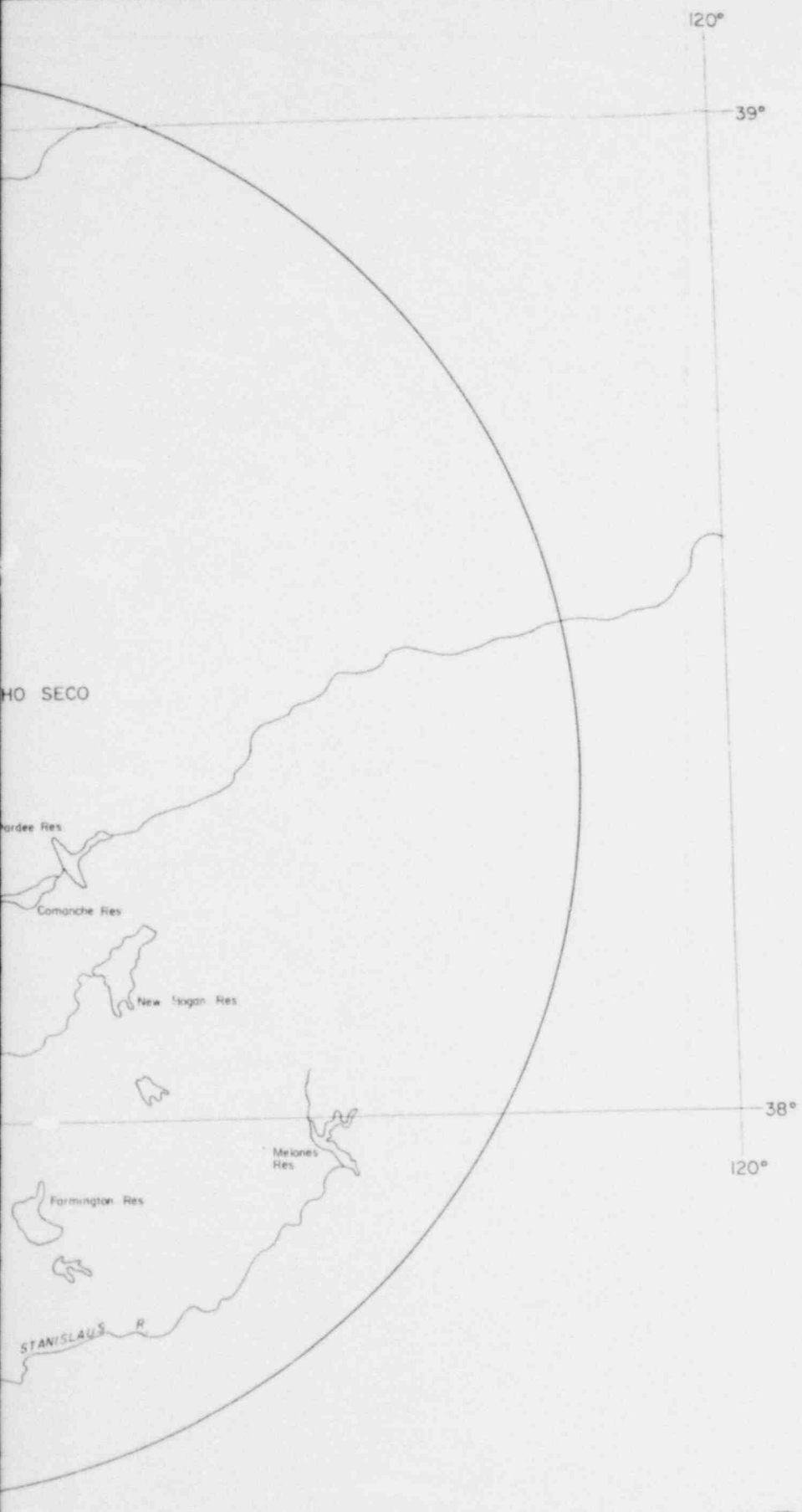
074

FIGURE 2H.2-1
EARTHQUAKE EPICENTERS
1941-1966

SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT


122°
121°
39°
38°
AMERICAN R.
Folsom Dam
SACRAMENTO
SACRAMENTO R.
1945
(3.6)
RANC
SITE
Clay
Galt
MOKELUMNE R.
1965
(4.9)
SUISUN BAY
SAN PABLO BAY
1960
(3.9)
Calaveras R.
1942
(3.6)
STOCKTON
1948
(3.8)
SAN
SAN FRANCISCO
FRANCISCO
BAY
1946
(3.5)
50 Miles
122°
121°




EXPLANATION

EPICENTER

● 1945 Year of earthquake.
(3.6) (Magnitude on Richter Scale)

REFERENCES:

1. Base map, U.S.G.S. California — North Half.
2. Bulletin of the Seismograph Stations, University of California, Berkeley.

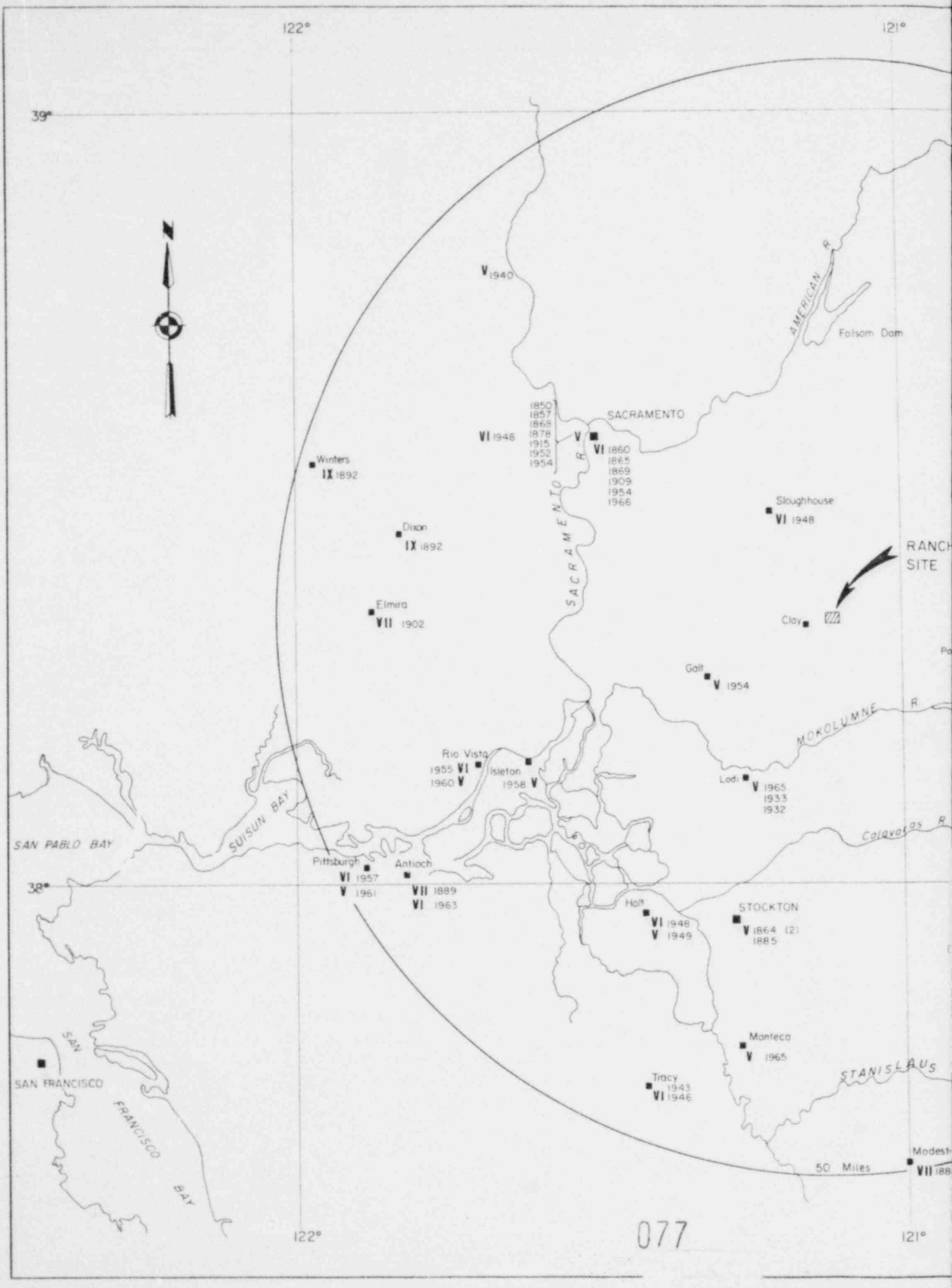
10 0 10 20

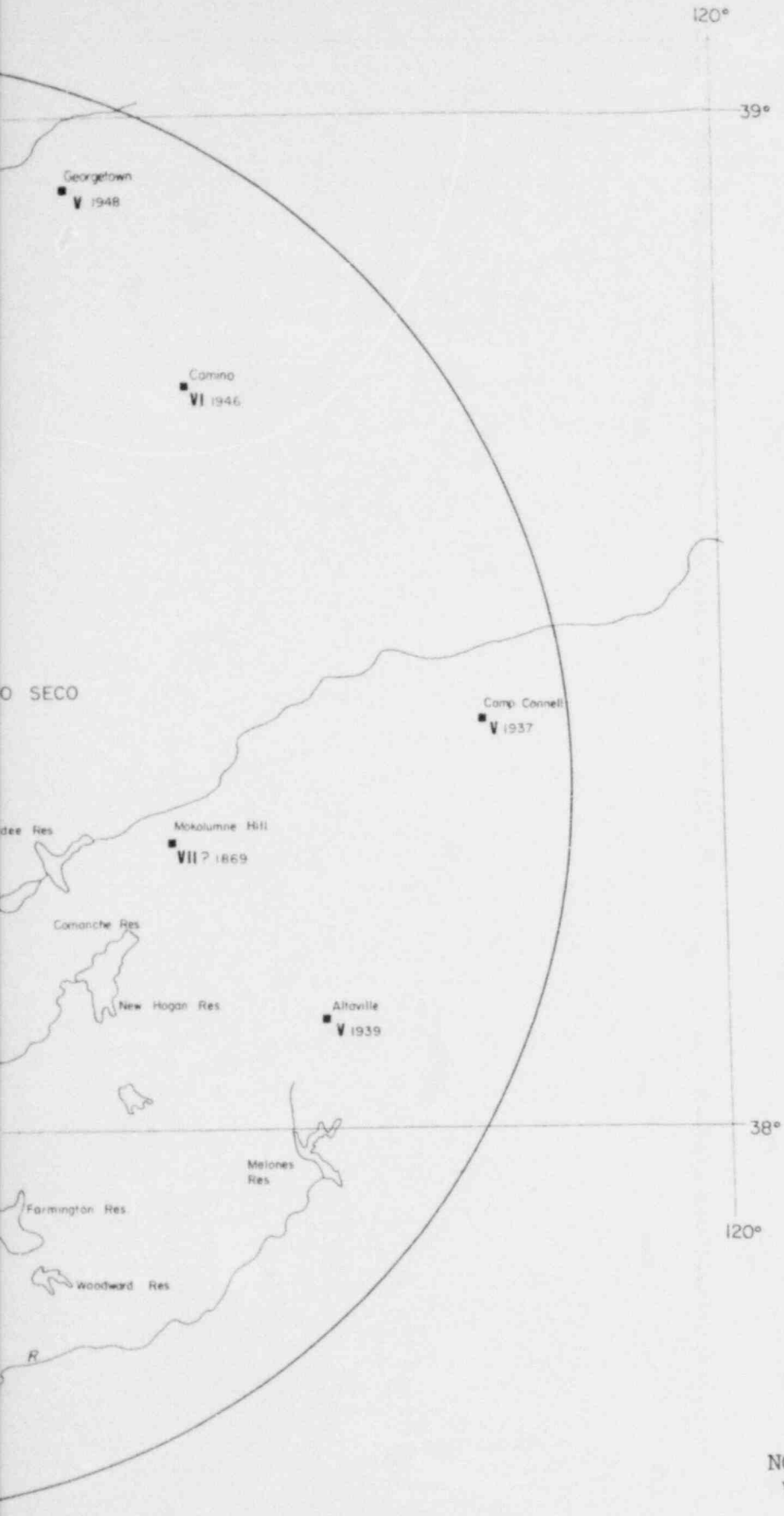
SCALE – MILES

076

FIGURE 2H.2-1
EARTHQUAKE EPICENTERS
1941-1966

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT


122°
121°
39°
38°
V 1940
AMERICAN R.
Folsom Dam
1850
1857
1868
1878
1915
1952
1954
SACRAMENTO
VI 1948
V
VI 1860
1865
1869
1909
1954
1966
SACRAMENTO R.
Winters
IX 1892
Sloughhouse
VI 1948
Dixon
IX 1892
RANCH
SITE
Elmira
VII 1902
Clay
Galt
V 1954
MOKOLUMNE R.
Rio Vista
1955 VI
1960 V
Isleton
1958 V
Lodi
V 1965
1933
1932
SUISUN BAY
SAN PABLO BAY
Pittsburgh
VI 1957
V 1961
Antioch
VII 1889
VI 1963
Holt
VI 1948
V 1949
STOCKTON
V 1864 (2)
1885
Manteca
V 1965
SAN
SAN FRANCISCO
FRANCISCO
BAY
Tracy
1943
VI 1946
STANISLAUS
50 Miles
077




REFERENCES:

1769-1928

Descriptive Catalogue of Earthquakes of the Pacific Coast of the United States, 1769 - 1928 Townley and Allen, SSA Bulletin Vol. 29, No. 1.

1928-1966

United States Earthquakes, U.S.C. & G.S. Publication

Base map, U.S.G.S. California - North Half

NOTE

Place of highest intensity plotted, i.e., "field epicenter."

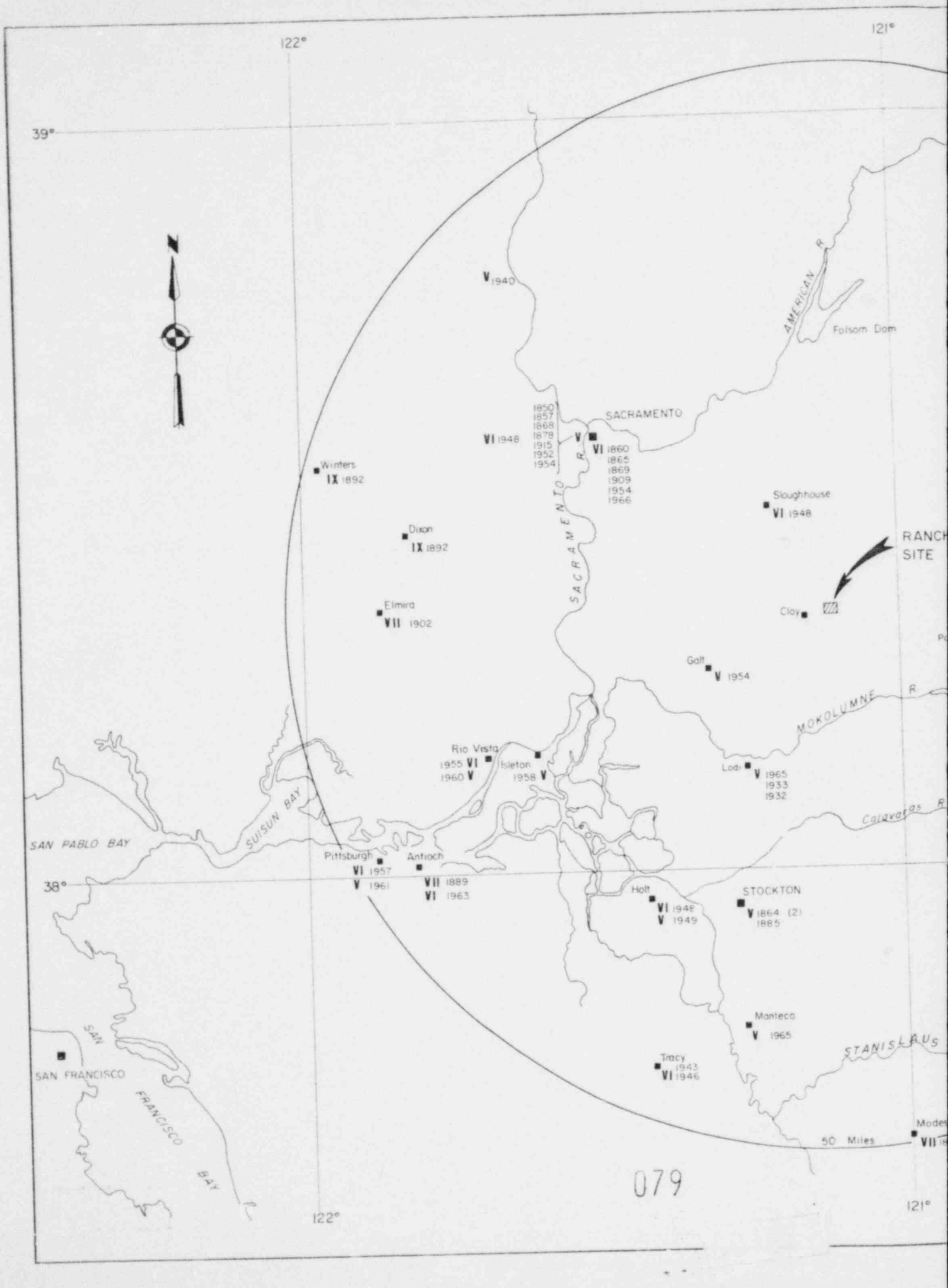
10 0 10 20

SCALE — MILES

078

FIGURE 2H.2-2
NON-INSTRUMENTED SEISMIC EVENTS
V INTENSIVE (M.M.) AND ABOVE

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT


122°
121°
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N
V 1940
AMERICAN R.
Folsom Dam
1850
1857
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1915
1952
1954
SACRAMENTO
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VI 1948
VI 1860
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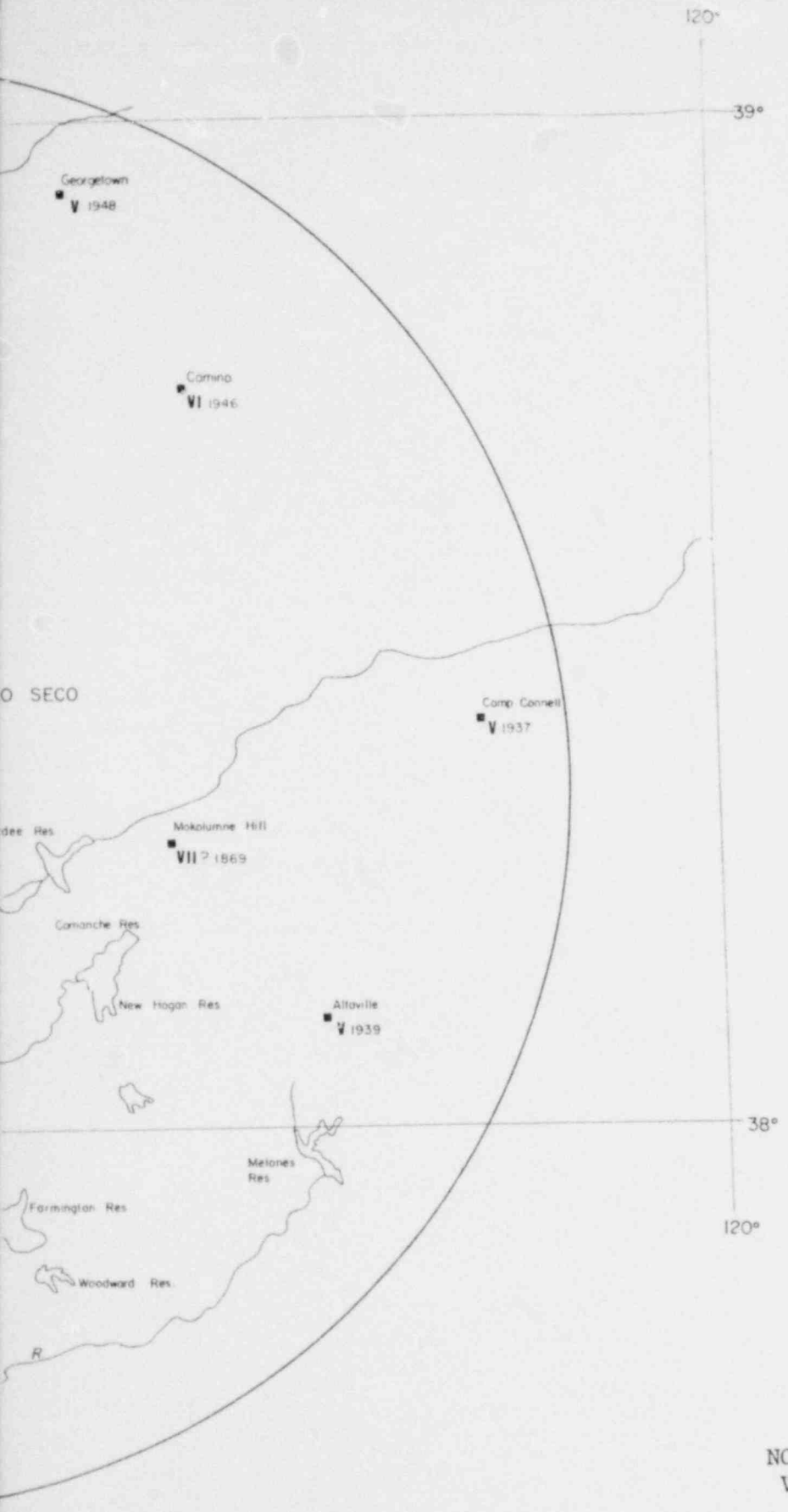
1909
1954
1966
SACRAMENTO R.
Winters
IX 1892
Dixon
IX 1892
Elmira
VII 1902
Sloughhouse
VI 1948
RANCH
SITE
Clay
Galt
V 1954
MOKOLUMNE R.
Rio Vista
1955 VI
1960 V
Isleton
1958 V
Lodi
V 1965
1933
1932
Calaveras R.
SUISUN BAY
SAN PABLO BAY
Pittsburgh
VI 1957
V 1961
Antioch
VII 1889
VI 1963
Holt
VI 1948
V 1949
STOCKTON
V 1864 (2)
1885
Manteca
V 1965
Tracy
1943
VI 1946
STANISLAUS
SAN FRANCISCO
SAN FRANCISCO BAY
50 Miles
Modes
VII
079




REFERENCES

1769-1928

Descriptive Catalogue of Earthquakes of the Pacific Coast of the United States, 1769 - 1928. Townley and Allen, SSA Bulletin Vol. 29, No. 1.

1928-1966

United States Earthquakes, U.S.C. & G.S. Publication.

Base map, U.S.G.S. California - North Half

NOTE

Place of highest intensity plotted, i.e., "field epicenter"

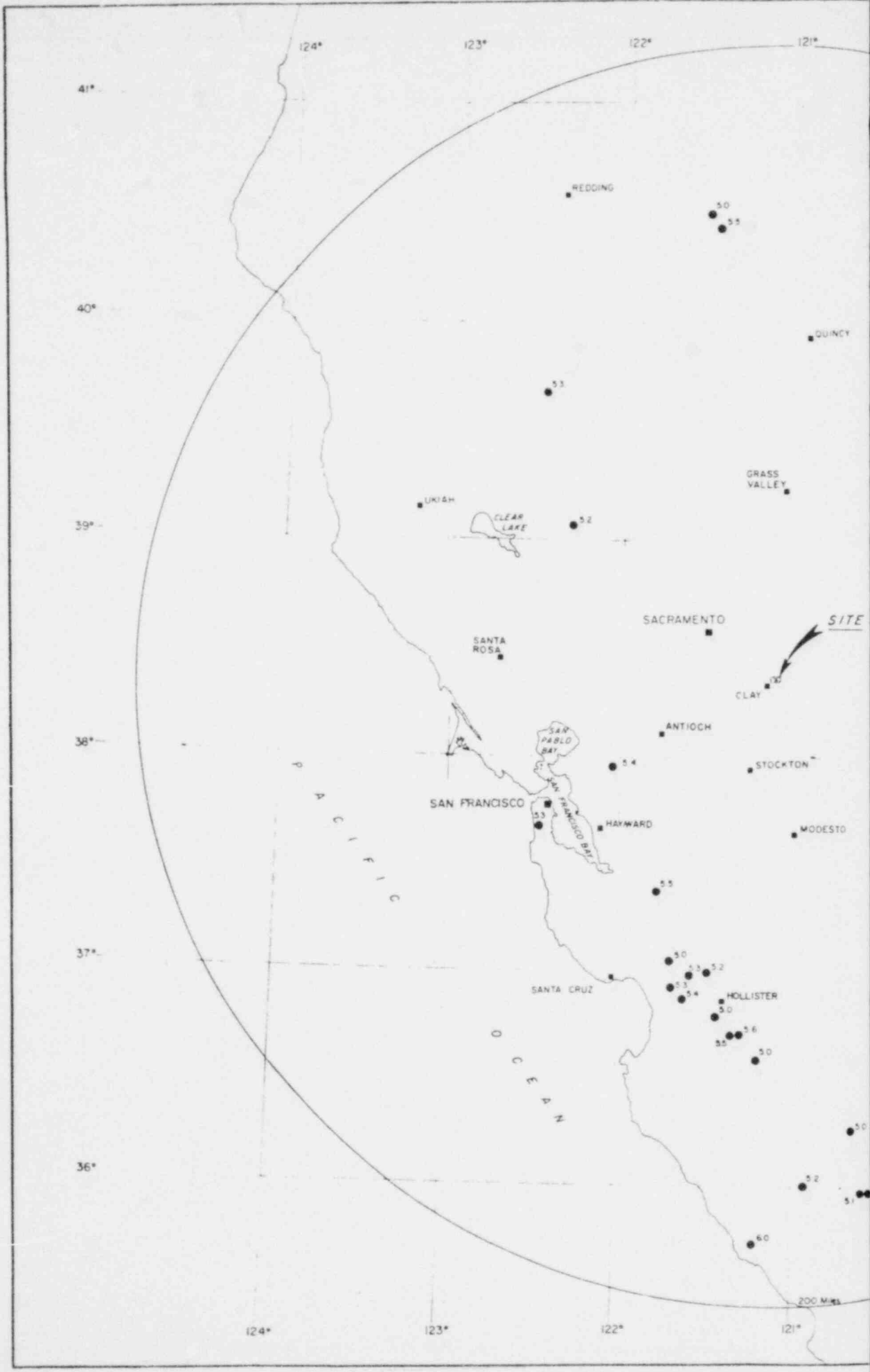
10 0 10 20

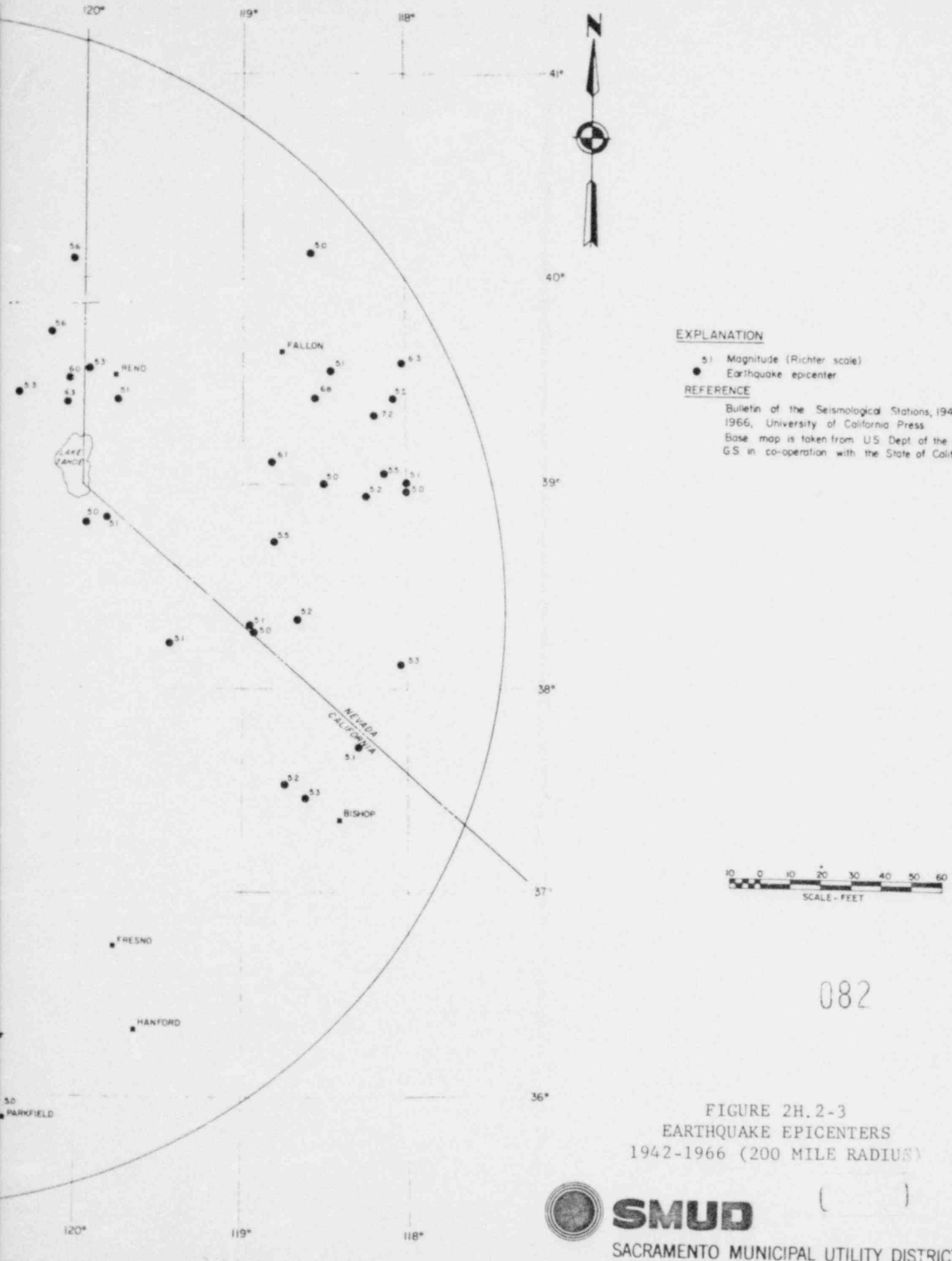
SCALE — MILES

080

FIGURE 2H.2-2
NON-INSTRUMENTED SEISMIC EVENTS
V INTENSIVE (M.M.) AND ABOVE

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

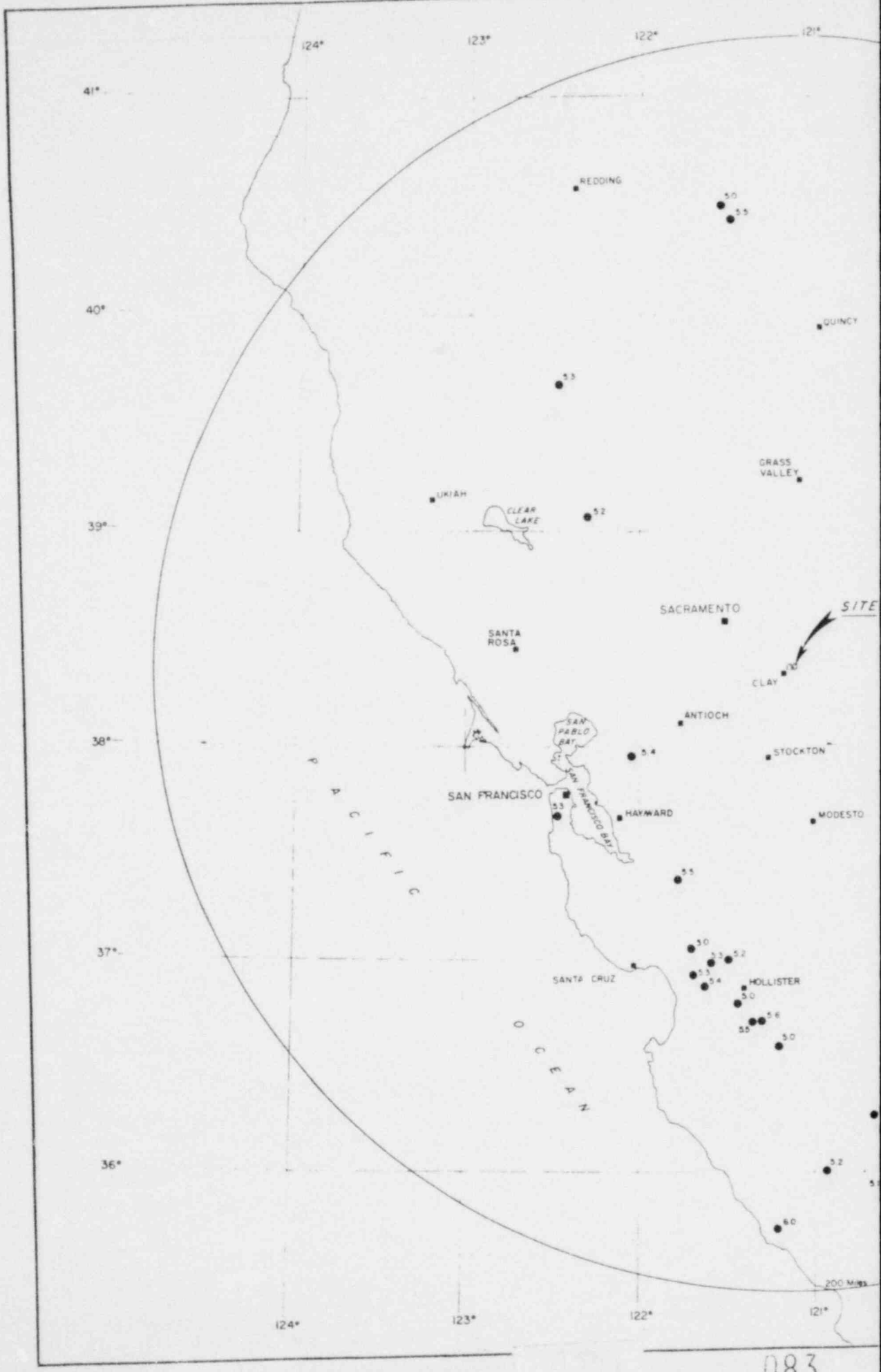

124°
123°
122°
121°
41°
40°
39°
38°
37°
36°
REDDING
5.0
5.5
QUINCY
5.3
GRASS VALLEY
UKIAH
CLEAR LAKE
5.2
SACRAMENTO
SITE
SANTA ROSA
CLAY
5.0
ANTIOCH
SAN PABLO BAY
5.4
STOCKTON
SAN FRANCISCO
5.3
HAYWARD
SAN FRANCISCO BAY
MODESTO
5.5
5.0
5.3
5.2
5.3
5.4
SANTA CRUZ
HOLLISTER
5.0
5.5
5.6
5.0
5.0
5.2
5.1
6.0
200 MILES
PACIFIC
OCEAN




082

FIGURE 2H.2-3
EARTHQUAKE EPICENTERS
1942-1966 (200 MILE RADIUS)

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT


124°
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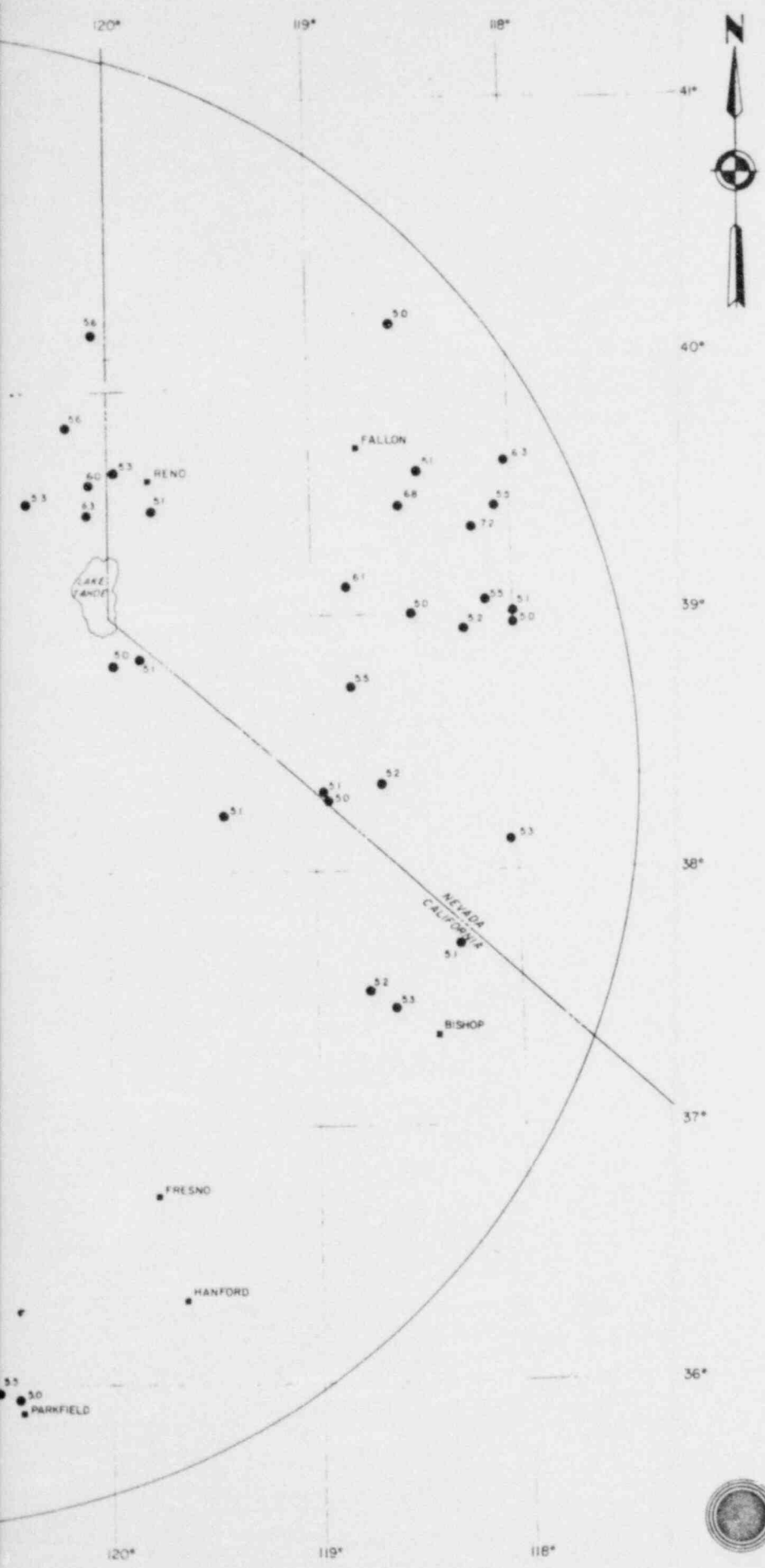
REDDING
5.0
5.5
QUINCY
5.3
GRASS VALLEY
UKIAH
CLEAR LAKE
5.2
SACRAMENTO
SITE
SANTA ROSA
CLAY
ANTIOCH
SAN PABLO BAY
5.4
STOCKTON
SAN FRANCISCO
5.3
HAYWARD
SAN FRANCISCO BAY
MODESTO
5.5
3.0
3.3
5.2
5.3
5.4
SANTA CRUZ
HOLLISTER
3.0
5.6
5.5
5.0
PACIFIC OCEAN
5.2
6.0
200 MILES
124°
123°
122°
121°




EXPLANATION

5.1 Magnitude (Richter scale)
● Earthquake epicenter

REFERENCE

Bulletin of the Seismological Stations, 1942 - 1966, University of California Press.

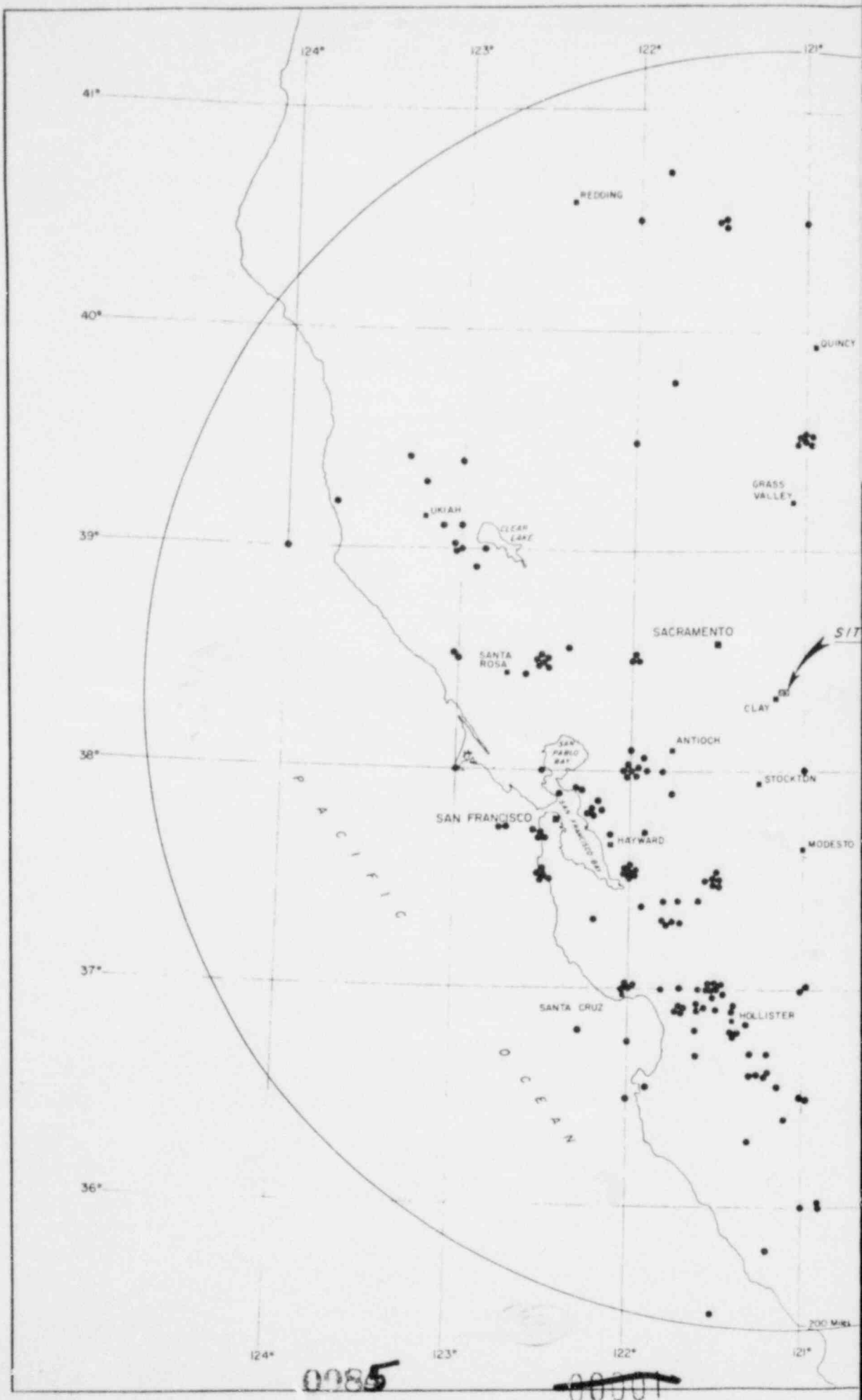
Base map is taken from U.S. Dept. of the Interior G.S. in co-operation with the State of California.

10 0 10 20 30 40 50 60
SCALE - FEET

084

FIGURE 2H.2-3
EARTHQUAKE EPICENTERS
1942-1966 (200 MILE RADIUS)

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT


124°
123°
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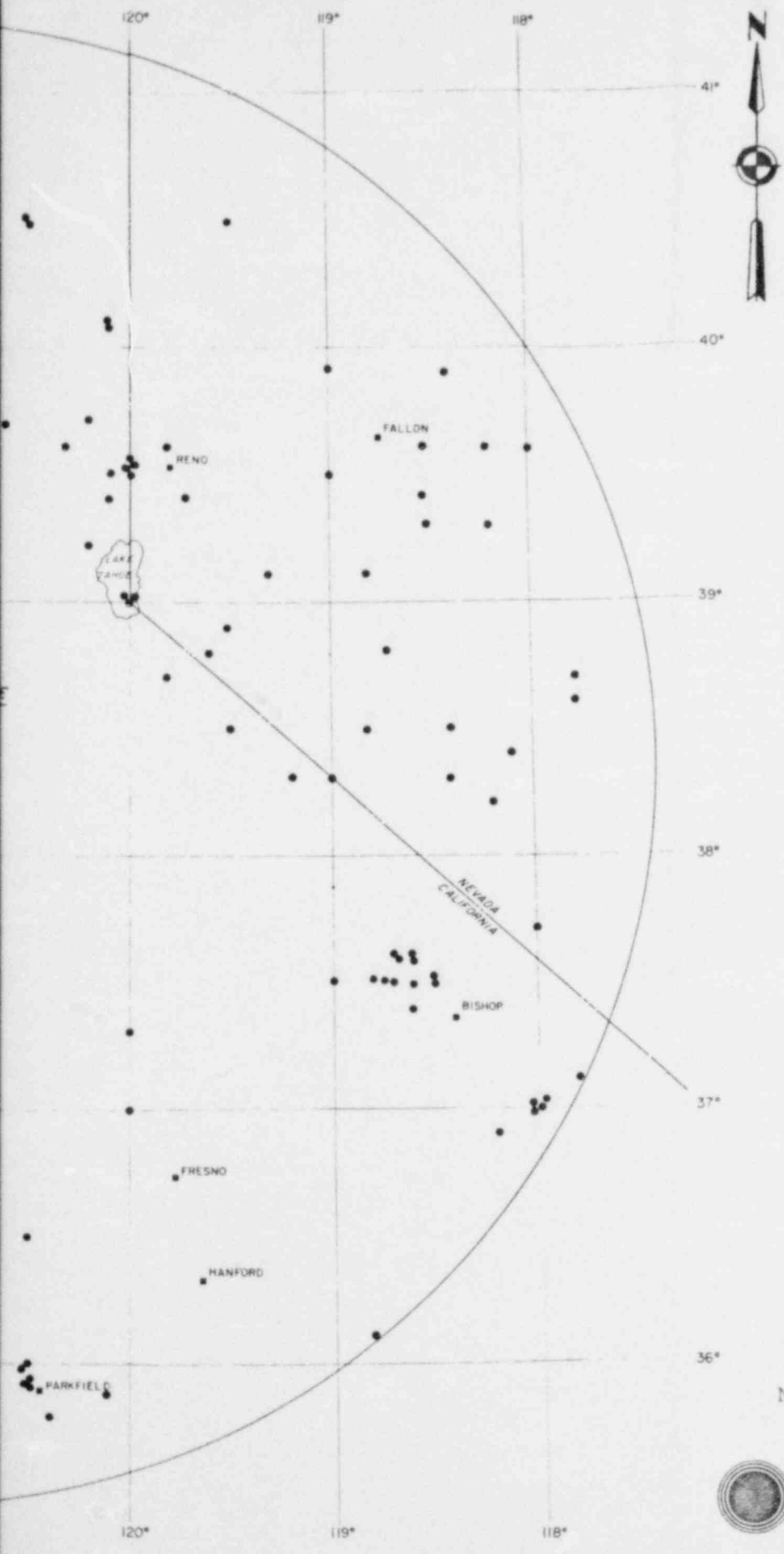
39°
38°
37°
36°
REDDING
QUINCY
GRASS VALLEY
UKIAH
CLEAR LAKE
SACRAMENTO
SITE
SANTA ROSA
CLAY
ANTIOCH
SAN PABLO BAY
STOCKTON
SAN FRANCISCO
HAYWARD
MODESTO
SAN FRANCISCO BAY
SANTA CRUZ
HOLLISTER
Pacific Ocean
200 Miles




EXPLANATION

Circles show earthquake intensities (V or greater on the Modified Mercali Scale) plotted at locality reporting maximum damage

REFERENCES

1. Earthquake History of the United States, U.S. & G.S.
2. Descriptive Catalogue of Earthquakes of the Pacific Coast of the United States, 1769 to 1928 Bull. S.S.A. Vol. 29 No. 1
3. Base map is taken from U.S. Dept of the Interior G.S. in co-operation with the State of California

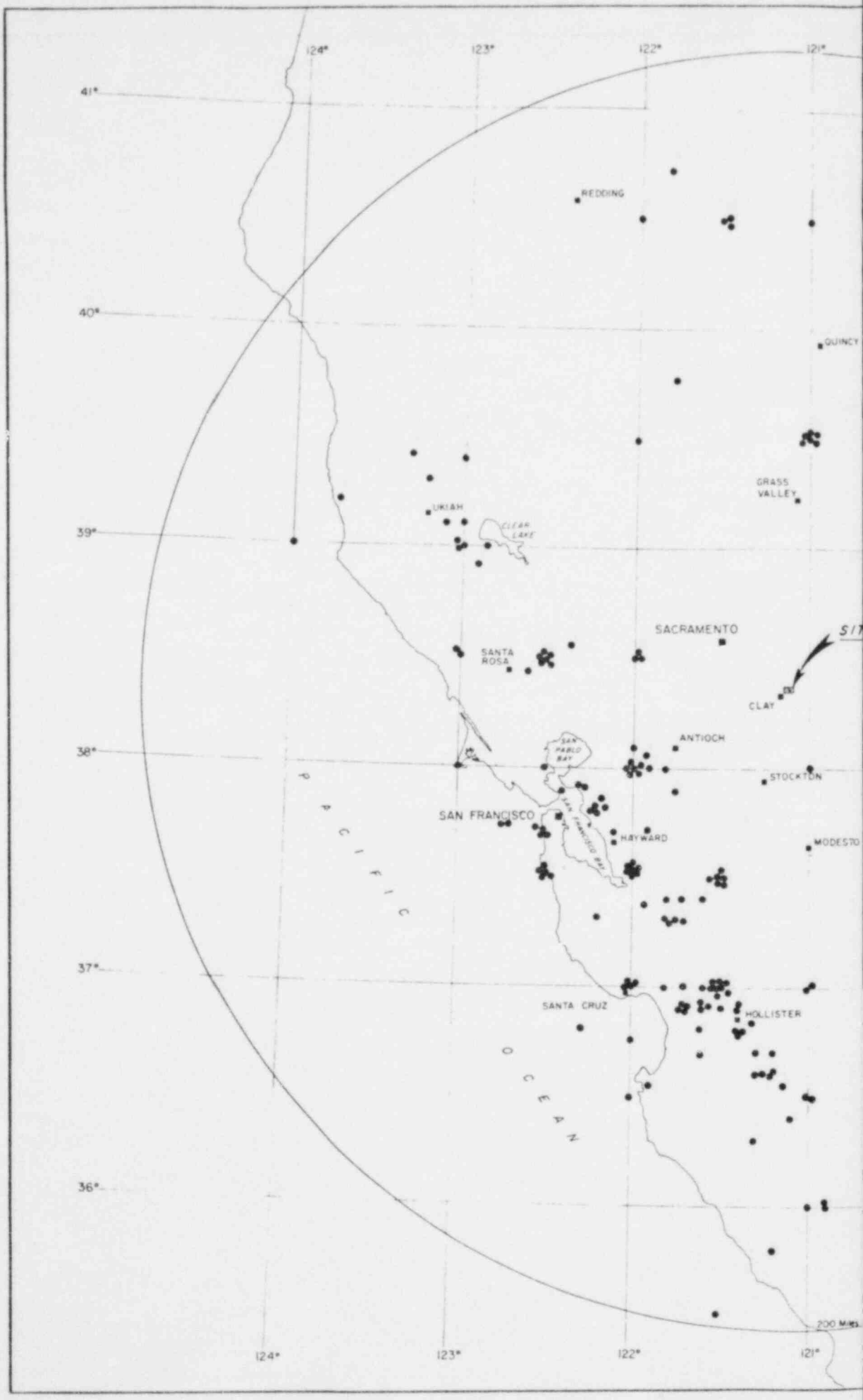
10 0 10 20 30 40 50 60
SCALE - MILES

FIGURE 2H.2-4
NON-INSTRUMENTAL SEISMIC EVENTS
1769-1966

SMUD

~~00002~~

SACRAMENTO MUNICIPAL UTILITY DISTRICT


124°
123°
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121°
41°
40°
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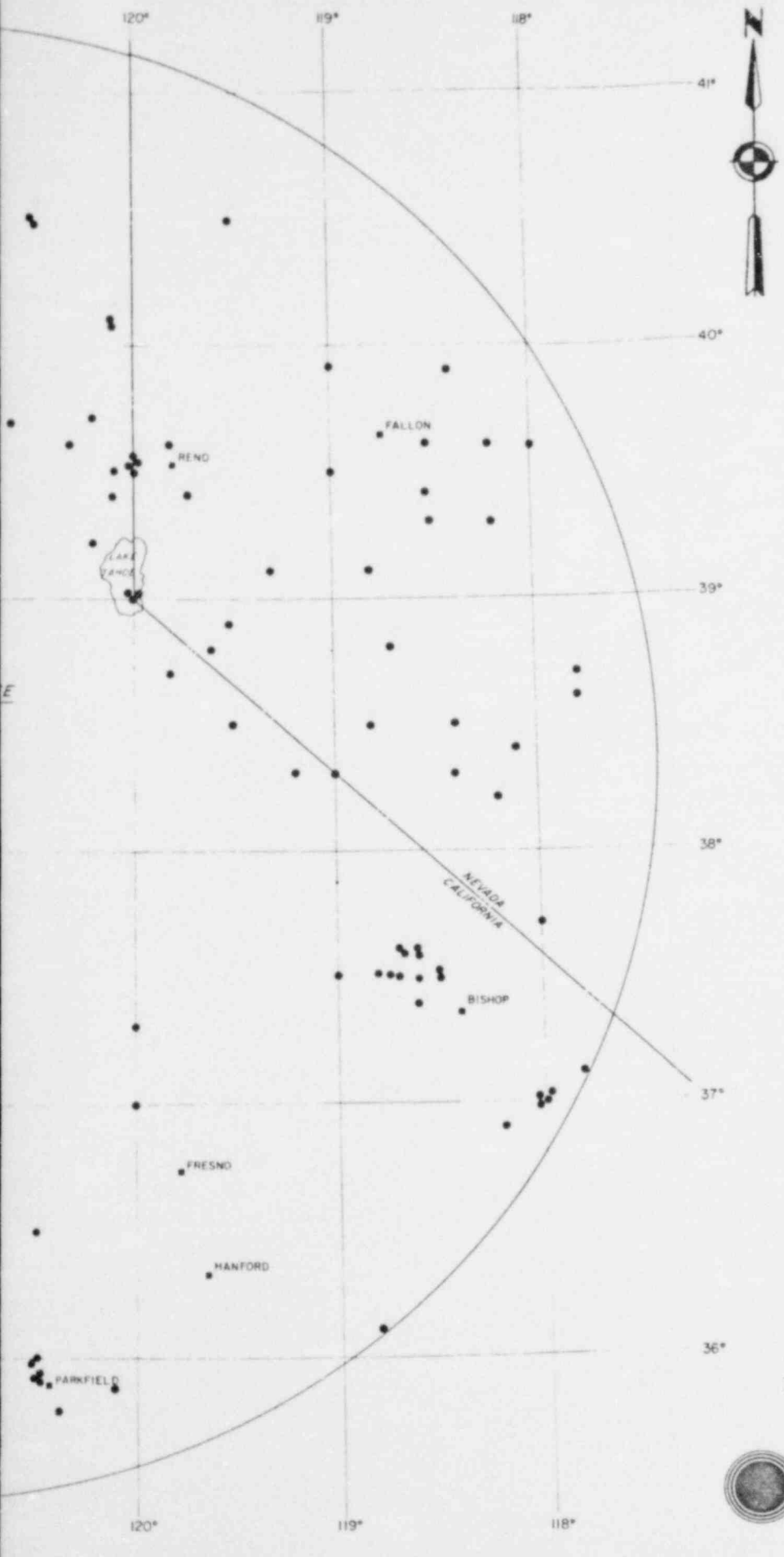
38°
37°
36°
REDDING
QUINCY
GRASS VALLEY
UKIAH
CLEAR LAKE
SACRAMENTO
SITE
SANTA ROSA
CLAY
ANTIOCH
SAN PABLO BAY
STOCKTON
SAN FRANCISCO
HAYWARD
MODESTO
SAN FRANCISCO BAY
PACIFIC OCEAN
SANTA CRUZ
HOLLISTER
200 Miles

0087

00303




EXPLANATION

Circles show earthquake intensities (V or greater on the Modified Mercalli Scale) plotted at locality reporting maximum damage

REFERENCES

1. Earthquake History of the United States, U.S. & G.S.
2. Descriptive Catalogue of Earthquakes of the Pacific Coast of the United States, 1769 to 1928 Bull. S.S.A. Vol 29 No. 1
3. Base map is taken from U.S. Dept of the Interior G.S. in co-operation with the State of California.

10 0 10 20 30 40 50 60
SCALE - MILES

FIGURE 2H.2-4
NON-INSTRUMENTAL SEISMIC EVENTS
1769-1966

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

~~00004~~