#350

GEOLOGIC INVESTIGATION REPORT
SONOMA TANK SITE #2

prepared for the

SONOMA COUNTY WATER AGENCY
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by

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INTRODUCTION

This report presents the results of my geologic investigation for the proposed Sonoma Tank Site #2. The site is located on a hill to the north of the Vallejo Home State Historical Monument in Sonoma just behind the two existing water storage tanks. Proposed site development will include construction of a level pad used to support a single multi-million gallon water storage tank, between two and eight million gallons capacity. The tank will be approximately 48 feet in height, 168 feet (maximum) in diameter, surrounded by a fifteen foot wide access road, and exert 3000 PSF. The base elevation will be 212.5 feet above sea level. Most of the tank pad will be situated in cut slope. Geologically, the tank would be underlain by welded tuffs, tuffacious agglomerates and fractured andesitic to basaltic flow rock of the Sonoma Volcanics Group.

PURPOSE

The purpose of my site study was to identify any potentially hazardous geologic conditions at or near the project site and evaluate how they may affect the proposed construction.

SCOPE

The scope of work for this project, in addition to preparing this report, included the following items:

1. review of published literature containing data pertinent to this project
2. several geologic field investigations of the site and vicinity
3. review of stereo pair aerial black and white photographs and false color infrared images of site and vicinity
4. soil and rock testing and classification
5. recommendations based on my conclusions

SITE CONDITIONS

GENERAL

The proposed tank pad site lies on the top of a small hill between two existing tanks just behind the Vallejo Home State Historical Monument in Sonoma. The site is accessible from an access road off of First St. West (see Plate 1). The site is covered with low annual grasses and dotted by several Blue Oaks and Live Oaks. The area is presently used for cattle and goat grazing. There are random exposures of hard volcanic rocks of various sizes at the site.

Average slope inclinations on the proposed tank pad site are about 45:1 (extrapolated from topographic map). Maximum difference in elevation across the tank pad is approximately twelve feet. The tank will largely be constructed in cut slope requiring a maximum excavation depth of twelve feet on the uphill sides. A specific spoil area has not been determined as of yet. Previous grading between the two existing tanks will serve only as a small portion of the proposed tank pad.

SOILS AND GEOLOGY

Geologically, the site is underlain by various rock types of the Sonoma Volcanics Groups (see Plate 1 and 2). A ten-foot high cut slope (base at 212.5), which trends through a portion of the proposed construction site, exposes three dominant rock types: fractured, hard basaltic to andesitic flow rock in the eastern section; fractured, welded tuffacious agglomerate in the central section; and weathering welded tuff flow rock in the western portion. The proposed tank pad will be predominantly underlain by the fractured basaltic flow rock (see Plate 1). The soil and rock thicknesses measured from the ten-foot cut are as follows: the soils overlying the basaltic flow rock are brown silty clays six to twelve inches thick; the basaltic rocks extending to the base of the cut (elevation at 212.5) are assumed to continue at depth and may contain lenses of tuffacious rock; the soils overlying the tuffacious rocks are grey silty clays one to two feet thick; the welded tuffacious rocks and agglomerates are assumed to continue at depth and may contain beds of basaltic flow rock. The existing graded area consists of sandy clays with abundant rock fragments. The western end of the existing graded pad is locally excavated fill material of a maximum depth of five feet. Soil test data are summarized in Table 1.

LANDSLIDES

The potential for landsliding is determined by the stability of the slope. Stability is determined by the shear strength of the soil and rock; the steepness of the slope; and, the moisture

content. The entire County of Sonoma has been mapped on a slope stability scale by the California Division of Mines and Geology in the Special Report #120, Geology for Planning in Sonoma County (see Plate 3). The proposed tank site lies in an area marked as "C". The areas designated "C" are defined as "areas of relatively unstable rock and soil on slopes greater than 15% containing abundant landslides," (Geology for Planning in Sonoma County, Special Report #120) thus having a high landslide potential. The Sonoma Mountains and foothills have been extensively mapped as a "C" area. A few patches within the hilly terrain that have slopes less than 15% and no landslides are mapped as "Bf" areas, therefore having a lower landslide potential. The tank site lies in an area that warrants a "Bf" rating but is too small to be mapped as such.

On-site investigations and stereo-pair aerial-photograph analysis found no evidence of landslides or the potential for landslide activity. Field penetration tests, which estimates the shear strength of soils, resulted in very high values: greater than 9000 PSF at the proposed tank site.

EARTHQUAKE FAULTS

Historical occurence of ground rupture has generally closely followed the trace of the more recently active faults. In relation to the site, the closest fault generally considered active is the Rogers Creek Fault Zone. This fault and the Healdsburg Fault have been designated as a special zone and mapped on the County's 1984 Special Study Zone Map (see Plate 4). The proposed tank site area lies 4.5 miles east of this zone. Review of aerial-photographs and on-site investigations suggest no evidence of earthquake faults. However, in a seismicly active region such as Northern California, there is always some possibility for future faulting at any site and definite possibility of ground shaking.

GROUNDWATER

Seepage was not encountered in the ten-foot cut slope, which trends through the proposed site, or in a two foot test hole. At the proposed site, groundwater is not likely to be encountered at a depth influenced by construction. The Sonoma Volcanics Group is generally considered non-water bearing; however, these rocks have a highly variable specific water yield of 0-15%.

CONCLUSION

Based on the results of my investigation, I conclude that the proposed tank site is an excellent location both geologically and

topographically for the construction of the proposed water storage tank.

Those features which may constitute a geologic hazard at the site consist of seismic shaking and a slight potential for landslumping and/or soil creep on the hills around the site area. Geologic features investigated and their possible affects on the project are summarized below.

1. Fault Hazard -- The potential for fault offset at the site is considered unlikely since evidence of active faults were not found at the site area (see Plate 5).

2. Seismic Hazards -- Ground shaking generated during periods of tectonic activity in Northern California will be felt at the site. This hazard can be mitigated by building structures on the property using current building code criteria for earthquake design (see Plate 5).

3. Landslides -- No evidence of landslides within the proposed construction area was found. The potential for deep or shallow seated landsliding affecting the proposed project is minimal (see Plate 3).

4. Liquifaction -- This phenomenon is not a site hazard since the occurance of high water table conditions and fine-grained, uniform sand were not found and are highly unlikely (see Plate 6).

5. Groundwater -- Except for slight moisture in some soils, seepage, springs and/or water table conditions are not expected to be encountered.

6. Erosion -- It is anticipated that cutslopes constructed during site grading will have a low erosion potential.

7. Expansive Soils -- Expansive soils contain swelling clays which undergo strength and volume changes with seasonal changes in moisture content. Soils at the site have no swelling clays therefore, have low shrink-swell potential.

RECOMMENDATIONS

I recommend that the 2 to 8 million gallon water storage tank be constructed only partially on the existing graded pad. Centering the tank in cut on the flat-topped hill just north of the existing tank will allow (1) a 25 foot minimum margin between the tank and slopes steeper than 2.5:1; (2) the tank to be situated on the hard basaltic/andesitic bedrock rather than the more readily erodible tuffacious rocks, and (3) will avoid the five foot deep fill area (see Plate 1).

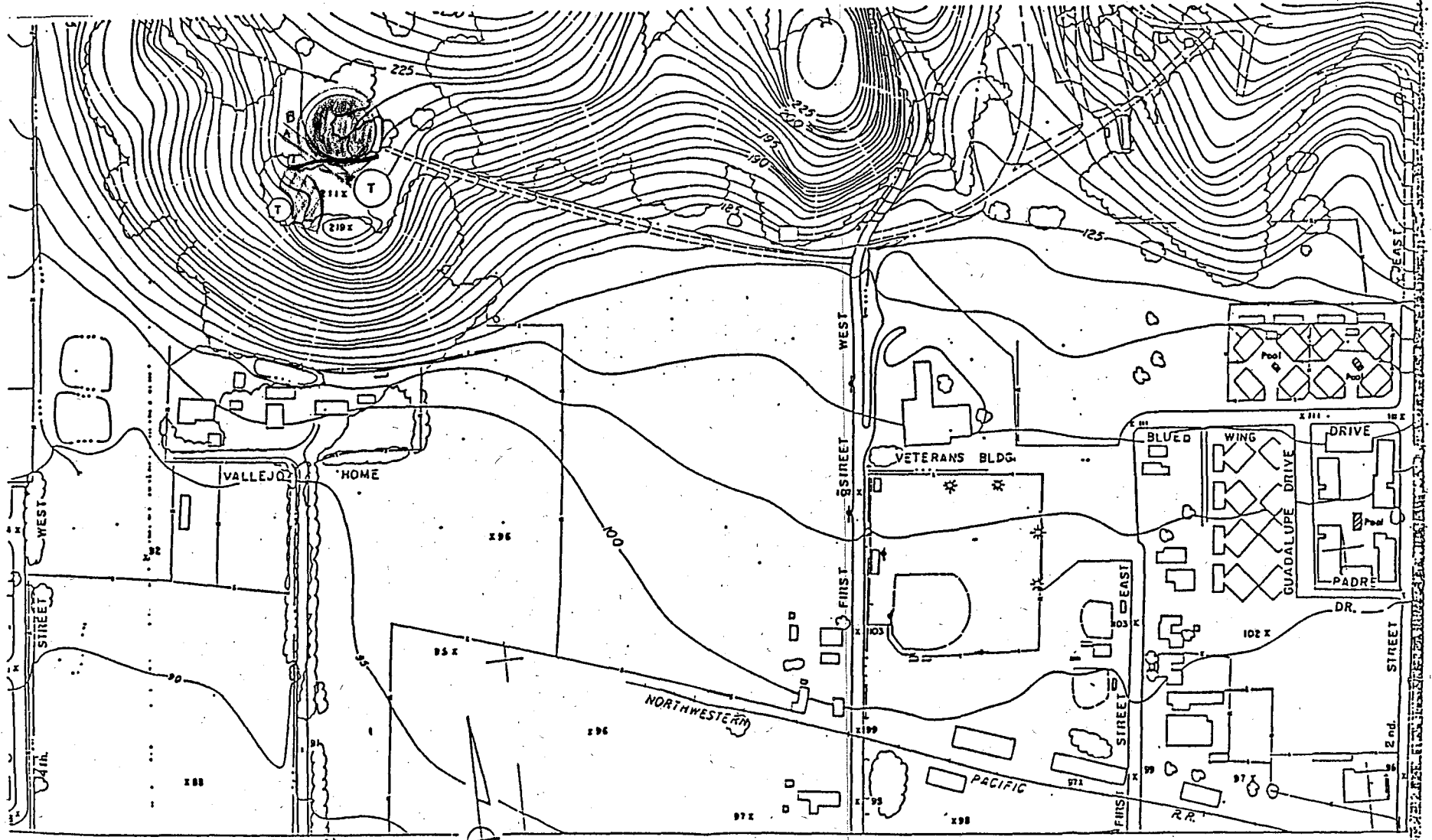
After grading, the materials exposed on the tank pad will consist of weathered bedrocks of the Sonoma Volcanic Group. However, excavation could expose areas of highly weathered rock or soil. Where encountered, the materials should be removed (overexcavated) for their full depth and replaced with properly compacted rock like materials that simulate the firm bedrock condition of the balance of the tank pad. If needed, on-site excavated materials, minus the organic matter and large rock fragments (greater than about six inches), will be suitable as compacted refill. Rocks should not be allowed to nest or create voids. The soil engineer should observe the actual conditions exposed and determine the need for and location of such overexcavation. Satisfactory foundation support for the planned tank can then be obtained from the compacted pad. A conventional ringwall type foundation can be used.
Cutslopes should be no steeper than an overall inclination of 2.5:1. The potential for severe erosion is low; however, proper drainage control measures may prove beneficial.

Subsurface conditions are complex and may differ from those indicated by surface features. Geologic drilling or geophysical surveys can determine depths and thicknesses of subsurface conditions.

TABLE 1

SOILS TEST DATA

TEST	TEST RESULTS	TEST INTERPRETATION
SIEVE ANALYSIS	total sample SC fines (24.6%) CL-ML	75.4% sandy clays 24.6% silty clays
SAND EQUIVALENCE	15	clay to sand ratio 2:13
DIFFRACTION CLAY	no expansive montmorillonite	no expansive clays
FIELD PENETROMETER	>4.5 tons/sq.ft.	dense, hard, high soil strength
LIQUID LIMIT	below 30	low compressibility
FIELD PLASTICITY	3-15%	low shrink-swell potential
FIELD PERMEABILIY	poor to impervious	poor drainage
DEPTH TO BEDROCK	2 - 6 inches	thin topsoil layer
FOUNDATION SUITABILTY	excellent to good	suitable



Tank (8 MG, d=168.4)
with 15' wide perimeter road
smaller tanks decrease in radius
maintaining center point

existing fill area (5' max. depth)

contact between rock units

cutslope trace (10' high)

soil sample location

B - basaltic/andesitic hard flow rock

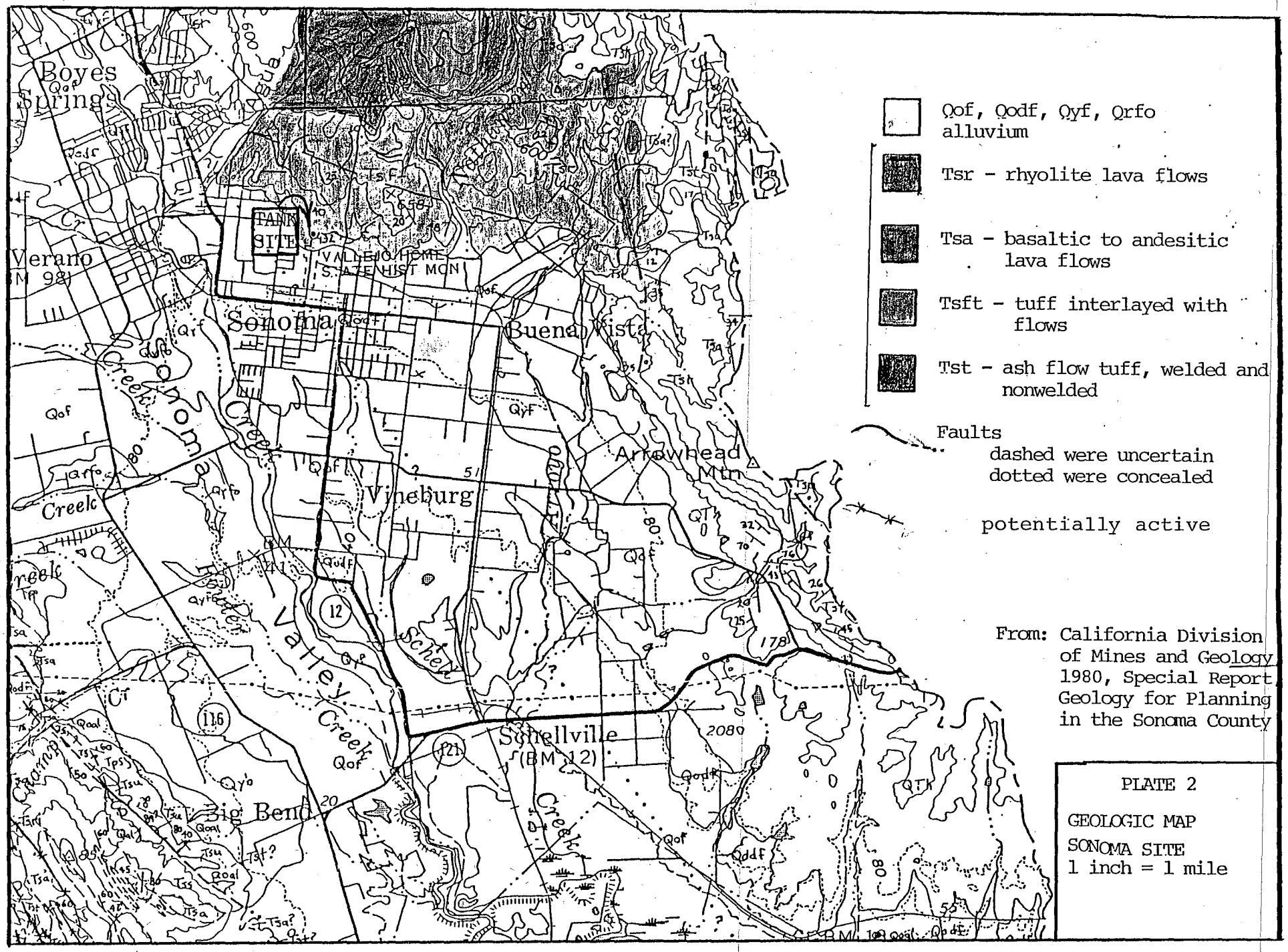
A - tuffacious agglomerate

T - welded tuffacious flow rock

0 200 400 600

PLATE 1

SITE GEOLOGY and LOCATION MAP



From: California Division of Mines and Geology 1980, Special Report 15' Geology for Planning in the Sonoma County

PLATE 2

GEOLOGIC MAP
SONOMA SITE
1 inch = 1 mile

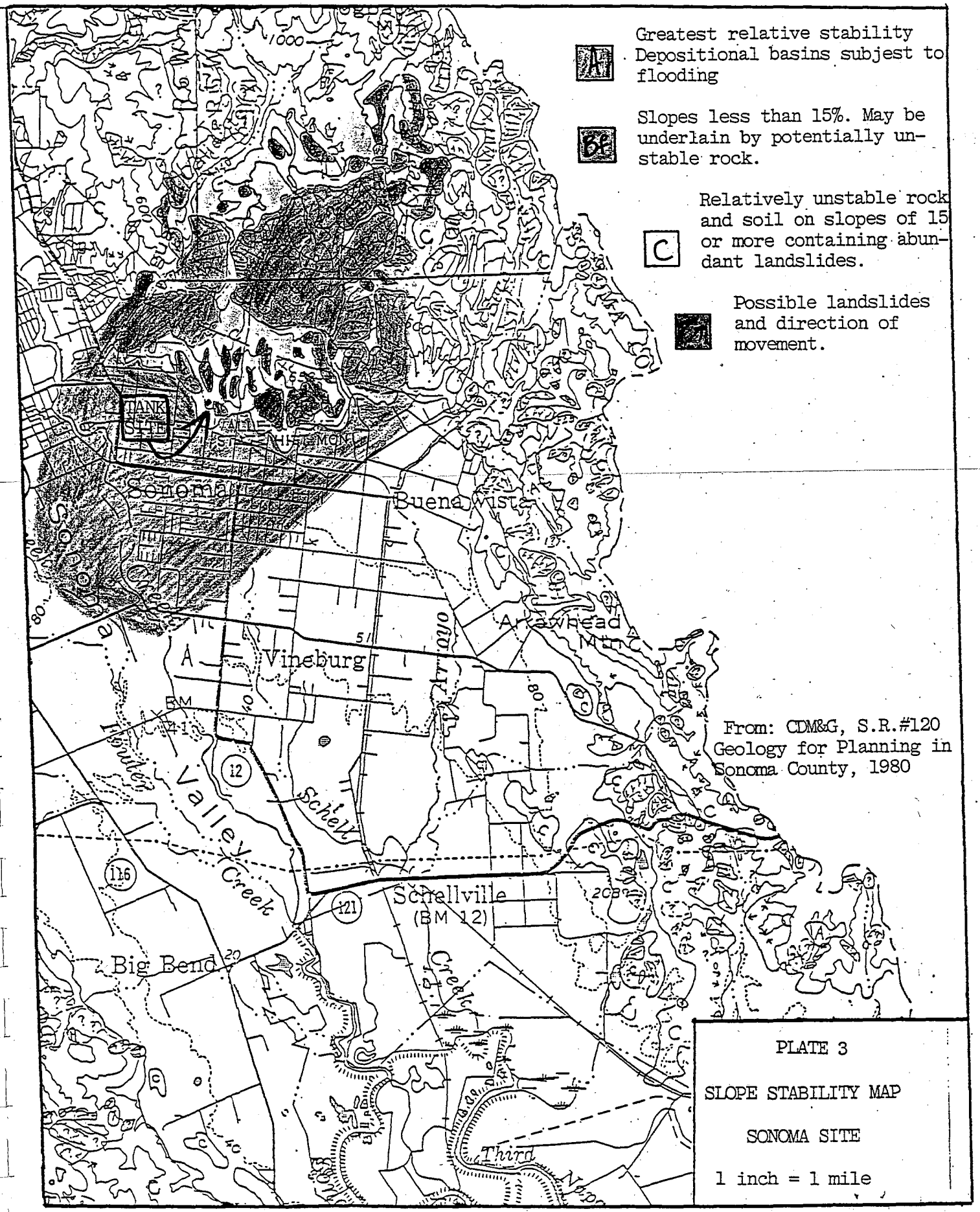


PLATE 3

SLOPE STABILITY MAP

SONOMA SITE

1 inch = 1 mile

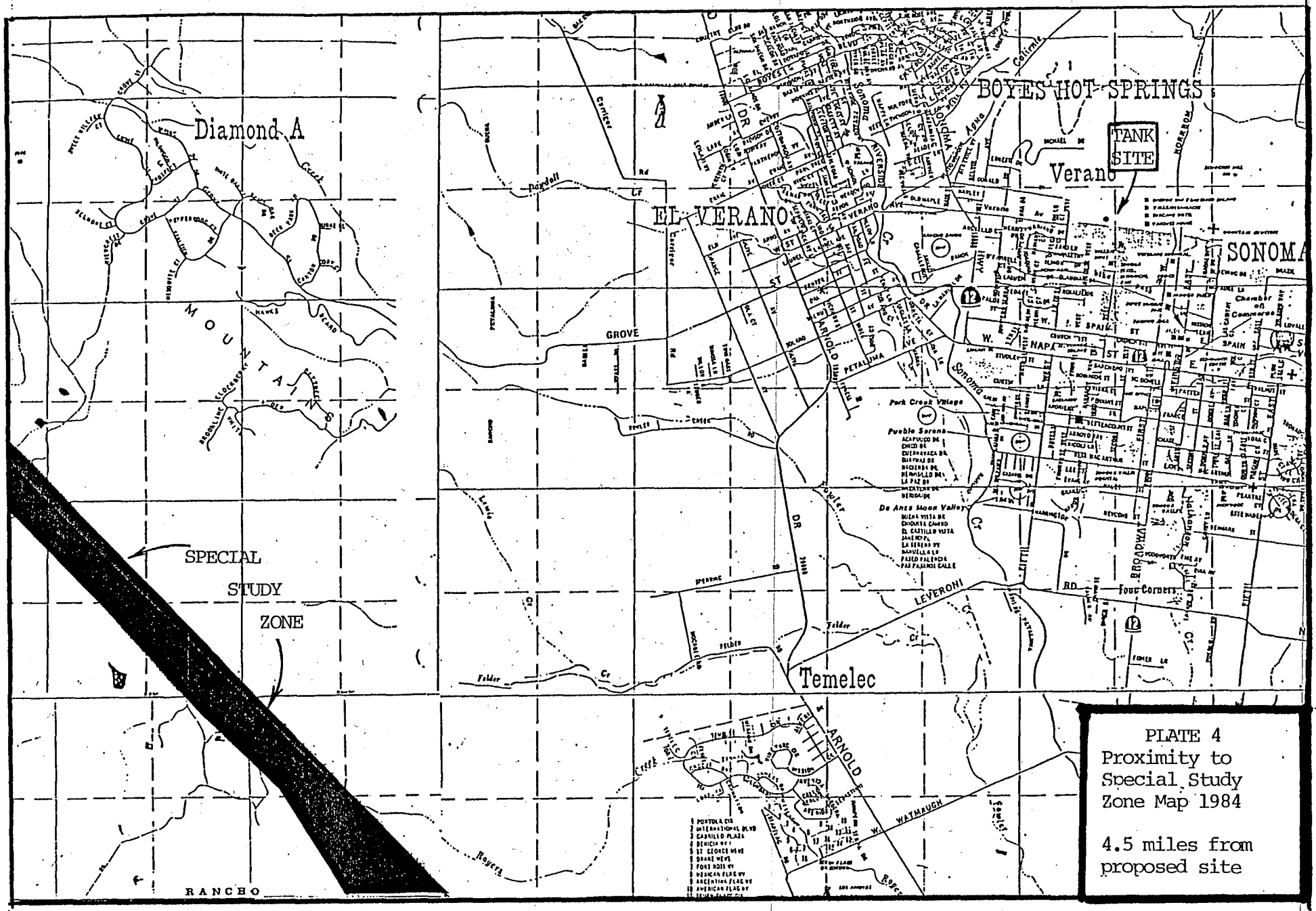
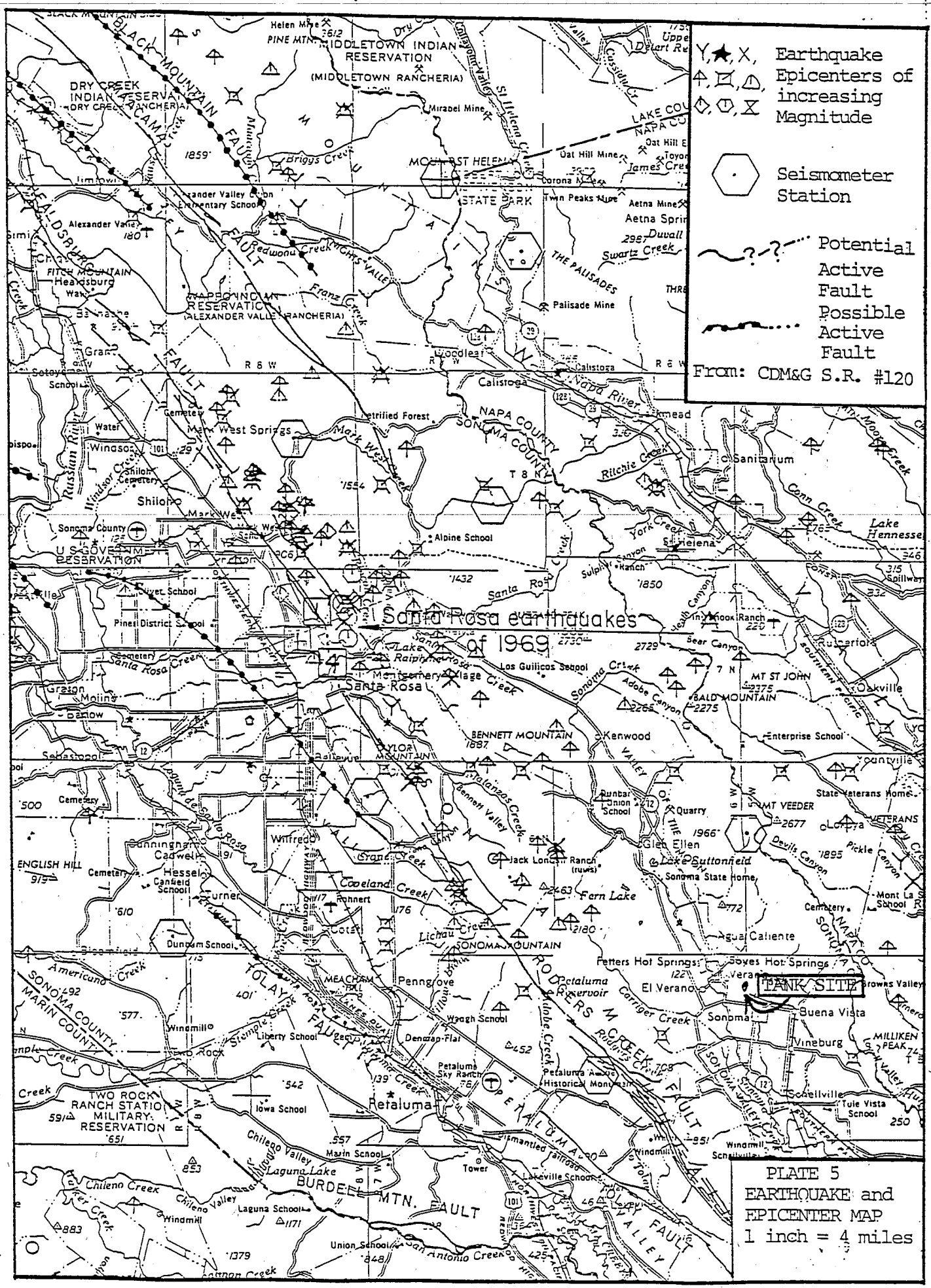
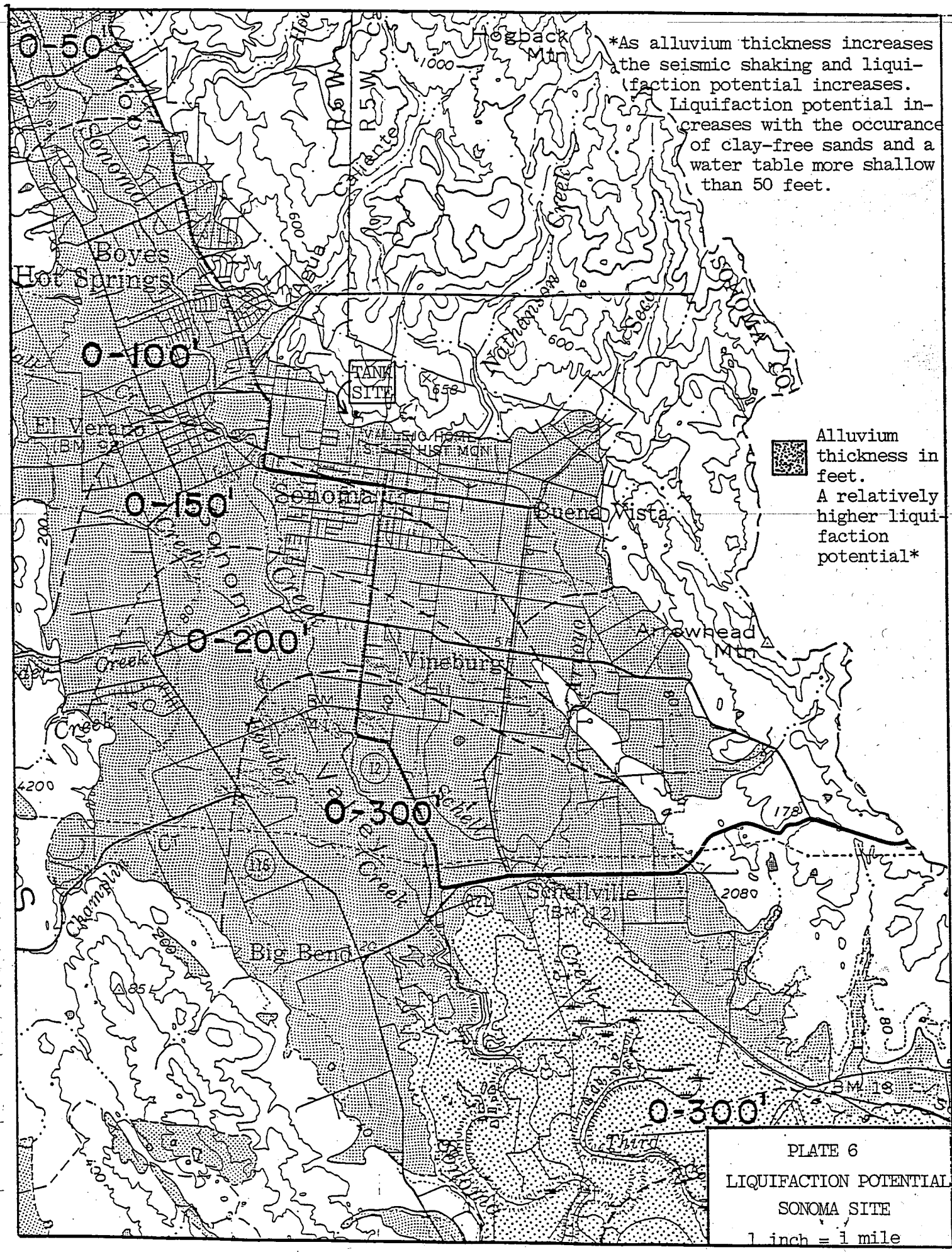


PLATE 4
Proximity to
Special Study
Zone Map 1984

4.5 miles from
proposed site

1 inch = 3322 feet


Earthquake Epicenters of increasing Magnitude
Seismometer Station
Potential Active Fault
Possible Active Fault
From: CDM&G S.R. #120
Santa Rosa earthquakes of 1969
TANK SITE
BLACK MOUNTAIN FAULT
MAYACAMAS FAULT
FALLSBURG FAULT
MIDDLETOWN INDIAN RESERVATION
(MIDDLETOWN RANCHERIA)
DRY CREEK INDIAN RESERVATION
MOUNT HELENA
STATE PARK
THE PALISADES
WAPPO INDIAN RESERVATION
(ALEXANDER VALLEY RANCHERIA)
NAPA COUNTY
SONOMA COUNTY
Calistoga
Santa Rosa
Petrified Forest
Mark West Springs
Windsor
Shiloh
Sonoma County
U.S. GOVERNMENT RESERVATION
Alpine School
Santa Rosa Creek
Los Guilicos School
Montgomery Village
Kenwood
BENNETT MOUNTAIN
TAYLOR MOUNTAIN
Sonoma Creek
Glen Ellen
Jack London Ranch (ruins)
Sonoma State Home
Fern Lake
Cooleland Creek
Lichau Creek
SONOMA MOUNTAIN
Petaluma Reservoir
Penngrove
Petaluma
Petaluma Adobe Historical Monument
Sonoma
Buena Vista
Vineburg
Schellville
Tule Vista School
Fetters Hot Springs
Boyes Hot Springs
El Verano
Agua Caliente
Cotati
Rohnert
Cloverdale
Liberty School
Denman Flat
Iowa School
Marin School
Laguna Lake
Laguna School
Union School
Chileno Valley
Windmill
Tower
Lakeville School
Dunham School
Bloomfield
Americano Creek
Stemple Creek
Petaluma River
Adobe Creek
Carriger Creek
Rodgers Creek
Sonoma Mountain
Petaluma Sky Ranch
Two Rock Ranch Station Military Reservation
Chileno Creek
Tolay Creek
San Antonio Creek
Cotton Creek
Bennett Valley
Santa Rosa Creek
Mark West Creek
Russian River
Napa River
Sonoma State Home
Sanitarium
Lake Hennessey
Oakville
Rutherford
Yountville
State Veterans Home
Mt St John
Bald Mountain
Mt Veeder
Devils Canyon
Pickle Canyon
Mont La Sierra School
Milliken Peak
Sebastopol
Graton
Forestville
Healdsburg
Fitch Mountain
Alexander Valley
Franz Creek
Redwood Creek
Mirabel Mine
Palisade Mine
Aetna Mine
Twin Peaks Mine
Oat Hill Mine
Corona Mine
Helen Mine
Pine Mtn
Burdell Mtn. Fault
Tolay Valley Fault
Petaluma Valley Fault
Rodgers Creek Fault
Sonoma Valley Fault
Southern Pacific
Abandoned Railroad
PLATE 5
EARTHQUAKE and EPICENTER MAP
1 inch = 4 miles



From CDM&G S.P. #120 Geology for Planning in

REFERENCES

Aerial photographs: BW SON 23-12,13; CI SON 23-12,13

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United States Department of Agriculture, Soil Conservation Service, May 1972, Soil Survey Sonoma County, California