DEPARTMENT OF THE INTERIOR
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PREPARED IN COOPERATION WITH THE
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

MISCELLANEOUS FIELD STUDIES
MAP MF -453

SOURCES OF EMERGENCY WATER SUPPLIES IN NAPA VALLEY, CALIFORNIA

By D. A. Webster

INTRODUCTION

Many water-supply systems in the San Francisco Bay region are vulnerable to failures resulting from earthquakes, nuclear explosions, floods, or acts of civil disorder. Yet few, if any, of the water-supply agencies maintain adequate standby sources of water, or have prepared detailed plans that consider alternative sources of water supply. It is the purpose of this report to present sufficient information for Napa Valley to facilitate the development by local officials of an emergency water-supply plan for that area. The report presents general criteria for sources of emergency water supply and data for selected wells in Napa Valley. The need for obtaining similar data for other parts of the bay region is recognized, but cannot be accomplished under the present series of planning studies. Nevertheless, this report may serve as a guide for similar studies elsewhere.

The report was prepared by the U.S. Geological Survey in cooperation with the Department of Housing and Urban Development as part of the San Francisco Bay Region Environment and Resources Planning Study. This investigation was made in the spring of 1972 under the general supervision of L. R. Peterson, district chief in charge of water-resources investigations in California, and under the immediate supervision of L. E. Young, chief of the Menlo Park subdistrict.

PRINCIPAL SOURCES OF EXISTING WATER SUPPLY

The water supplies for the majority of the residents in Napa Valley are obtained from surface-water sources. The city of Napa obtains its water from Lake Hennessey, from Milliken Reservoir, and from the Putah South Canal terminal reservoir near Cordelia. Yountville obtains its water from Rector Reservoir, and St. Helena obtains its water from Bell Canyon Reservoir and from an unnamed reservoir on a small tributary of York Creek. Calistoga obtains its water from a reservoir formed by Kimball Canyon Dam and from a municipal well (number 23 on map and in the table).

Small towns, unincorporated communities, and persons living outside of municipal water-service areas depend chiefly upon wells to supply water for domestic, stock, and other uses.

CRITERIA FOR SOURCES OF EMERGENCY WATER SUPPLY

Surface-water supplies from reservoirs, lakes, or streams can be readily destroyed, contaminated, or otherwise rendered unusable as a result of a disaster. In contrast, ground water cannot be lost suddenly, and water in deeper aquifers cannot be readily contaminated by a disaster. Wells drawing their water supplies from other than shallow aquifers, therefore, generally provide a satisfactory and reliable source for an emergency water supply.

The suitability of a well for inclusion in an emergency water-supply plan depends on the intended use of the water and on several characteristics of the well. For emergency domestic use, such factors as well yield, construction, source of power, accessibility, and water quality are important. For general-utility use, such as for washing, flushing, or firefighting, little or no importance may be associated with the construction and water-quality characteristics.

Well yield.--The yield of a well is useful for determining the volume of water that can be pumped during a specific period of time and for estimating the number of people that can be supplied from the well. For example, a well pumping 100 gpm (gallons per minute) over a 12-hour period will yield 72,000 gallons of water. This amount is more than adequate for supplying the minimum daily drinking water requirement (1 quart per person per day) of the valley's present population. A realistic emergency water-supply plan, however, should include sufficient water to meet cooking and cleansing requirements (drinking, cooking, and cleansing needs were estimated by U.S. Office of Civil Defense Mobilization at 5-15 gpm per person per day), plus additional water to meet general utility needs.

Construction.--Good well construction provides sanitary protection and guards against the introduction of contaminants into the well and aquifers. Thus, it is important to apply protective measures in constructing all wells. Although it is impractical to establish fixed well specifications that fit every local situation, there are fundamental principles that can assure a sanitary installation at reasonable cost. Those wells constructed to, or closely to, the following standards, which largely follow those set forth by the California Department of Water Resources (1968), have greatest potential as sources of emergency domestic supply.

A well should be drilled on ground higher than nearby sources of contaminants and the well casing should terminate above ground. Where necessary, the ground surface at the well site should be built up with a gently sloping surface of several yards radius to facilitate the drainage of surface water away from the well in all directions. This precaution would have particular importance during a period of rain following a nuclear explosion for any contaminants would then tend to move away from the wellhead before entering the soil.

The space between the well casing and the wall of the drilled hole (annular space) should be sealed to a depth of about 50 feet to protect against contamination by the downward movement of surface water, contaminated ground water, or other undesirable fluid through the annular space to the intake part of the well. As a general rule, wells without surface or sanitary seals and wells that obtain water from depths less than about 30 feet below land surface should not be used until the water has been tested and declared safe for human consumption. In Napa Valley the thickness of the seal appears to be less critical, for many domestic-supply wells of the area have been sealed only to depths of 20 to 30 feet below land surface and apparently yield water satisfactory for drinking.

In addition, the well should be constructed so that it denies entry to any contaminated or undesirable water contained in the water-bearing deposits.

Minimum distances from a well to possible sources of contamination should be great enough to provide reasonable assurance that subsurface seepage of contaminated water will not reach the well. The following minimum distances [recommended by the California Department of Water Resources (1968, p. 171) are typical of good practice.

Sewer, watertight septic tank, or pit privy	50 feet
Subsurface sewage leaching field	100 feet
Cesspool or sewage pit	150 feet

Barnyards, feedlots, and animal-holding areas should be downslope from the well and at least 100 to 200 feet away, depending upon drainage conditions.

Source of power.--There is a probability that electric power may fail following some types of disasters. Consequently, it is desirable when formulating emergency plans to consider the inclusion of wells equipped with internal combustion engines. Even with a power outage, however, any pump powered by electricity may be made operable by connecting a portable gasoline plant of appropriate phase and capacity to the pump motor. Those wells pumped by electrically-operated turbines may also be made serviceable by changing the pump heads to permit operation of the turbine by either belt-drive or direct-drive internal combustion engines, such as those that power tractors.

Accessibility.--Ideally, wells selected as sources of emergency supply should be accessible at all times of the year. Generally, in Napa Valley, wells located along paved roads meet this criterion. Some irrigation wells along unpaved roads may be relatively inaccessible, particularly following a prolonged period of rain, but would otherwise be acceptable sources of supply. Such wells should not necessarily be excluded from consideration, for if high-pressure fire hoses, portable irrigation pipe, or steel pipelines are available, water can be transmitted from these wells to more convenient locations.

Water quality.--Water for emergency domestic use should not contain bacteria or dissolved substances in sufficient concentration, nor emit radiation at a sufficient rate, to be harmful to the human body. In Napa Valley, water from most deep wells seems to meet this requirement.

SOURCES OF EMERGENCY WATER SUPPLY

Following a field inspection in Napa Valley, 32 moderate- to large-capacity wells that appear suitable for sources of emergency water supply are proposed herein, subject to the owners' approval, if an emergency plan is implemented. Of these wells, 23 are operated by electric motors, seven are operated by diesel-powered engines, and two are operated by natural gas-powered engines. The location of these wells is shown on the accompanying map and pertinent data about them are summarized in the accompanying table. Data for other wells in the Napa Valley area, information about the geology and hydrology of the water-bearing rocks, and data on the chemical quality of ground water may be found in reports by Bryan (1932) and Kunkel and Upson (1960). Additional information on wells, ground-water levels, and chemical and bacteriological analyses of water can be obtained from published and unpublished records in the files of the California Department of Water Resources, California Department of Public Health, U.S. Public Health Service, and the U.S. Geological Survey. Information on the natural levels of radioactivity of ground water in the Napa Valley area is not available.

Following the selection of wells to be used in an emergency, measurements of natural radioactivity should be made of water samples collected from wells to establish a standard of comparison for use after a nuclear explosion; a significant increase in radioactivity would indicate contamination of water from the wells.

Many of the wells listed in the table seem to be suitable for domestic supply during most conceivable emergencies. Following some types of disasters, however, some of the wells may yield water of degraded quality if contaminants enter the well. Therefore, cautions on the use of water from these wells are given in the table under "Use of Water," subsection "Emergency."

Of the wells listed, nearly all have been constructed with casing or cement pads extending above ground surface. The wells at the Chimney Rock Golf Course (wells 14, 15, and 16 on map and in the table) are an exception, but are not likely sources of contamination. The ground surface at none of the wells has been specifically graded for drainage, although cement pads and pumphouses at many wells afford a degree of protection from contaminants contained in surface water.

Surface or sanitary seals are reported to have been emplaced in 14 of the wells and are probably present in four others. Wells properly sealed should yield water of satisfactory quality despite their being drilled in proximity to possible sources of contamination; thus, well 2 is located at a sewer outfall structure, but draws water from a deep aquifer separated from the surface by two confining beds and a thick sanitary seal; similarly, well 22 yields water from an aquifer underlying a shallow stratum reported to be contaminated by septic tank effluent. Following an earthquake, however, the water supplied by either well might be contaminated if the seal or casing is damaged. The absence of a seal does not mean that water from the well is unsuitable for drinking, but only that the well is accessible to contaminants. If the intake part of an unsealed well is relatively deep and the well is not near houses, roads, sewage facilities, surface water, or other sources of contamination, the prospects for yielding water free of contaminants are very good. Such unsealed wells as 23, 26, and 27 probably yield water of satisfactory bacterial quality in view of their location away from local sources of contamination. Following a disaster which brings contaminants to the wellhead, however, water from such unsealed wells should be checked before drinking to assure fitness for human consumption. The bacterial quality of water from wells 29 and 30, about 700 feet south of the St. Helena sewage pond, is not known. Even though this distance probably is adequate to filter any leakage through the subsurface, it may be desirable in an emergency to limit the supply of water from these wells to uses other than drinking until determined to be safe. Water from unsealed irrigation wells drilled very close to rivers or ponds may be useful primarily for augmenting the water supply for firefighting and uses other than drinking; such wells as 10, 11, 12, 25, and 31 may be included in this category.

In addition to the wells listed, a number of minor sources of water supply are also available and worthy of brief mention for consideration by planners or householders. These include three lakes (Lakes Camille, Louise, and Marie, east of Napa State Hospital) which may be usable except following a nuclear explosion, the numerous domestic wells of comparatively small yield in both urban and rural areas, springs, water held in storage tanks, condensate of the steam emitted by the so-called geyser near Calistoga, and the water contained in virtually every home in hot-water heaters, plumbing systems, and toilet flush tanks.

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DATA FOR EMERGENCY WATER-SUPPLY WELLS

State well number: Each well is identified according to its location in the rectangular system for the subdivision of public land. For example, in the number 5N/4W-34H1, the part of the number preceding the slash indicates the township (T. 5 N.) north of the Mt. Diablo base line, and the number between the slash and the hyphen indicates the range (R. 4 W.) west of the Mt. Diablo meridian; the number between the hyphen and letter indicates the section (sec. 34), and the letter (H) indicates the 40-acre subdivision of the section as shown in the accompanying diagram. The final digit is a serial number for each well in a 40-acre subdivision. The location of the well is shown on the map by a number as indicated below.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

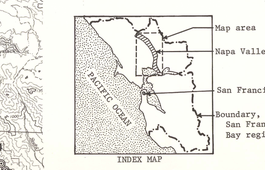
Type of pump: S, submersible; T, turbine

Well-construction data:
Surface seal: No; yes; U, unknown; P, unknown but probable

Source of power:
Voltage requirement: s, single-phase source; t, three-phase source

Use of water: *Water from wells that have not been pumped for an extended period of time should be boiled, chlorinated, or otherwise treated if used for domestic purposes.*
Existing: A, agricultural; D, domestic; In, industrial; Ir, irrigation; PS, public supply; U, unused
Emergency:
1 Water from well seems suitable for all uses in most conceivable emergencies.
2 Water from well may not be suitable for domestic water source after an earthquake if the well seal or casing is damaged.
3 Water from well may not be suitable for domestic use after a nuclear explosion, or after flood if the floodwater inundated the well.
4 Water from well may not be suitable for domestic use after a nuclear explosion or flood unless artesian water is flowing from casing after disaster.
5 Water from well probably is not suitable for domestic use because well casing is unsealed or existence of seal is unknown, and source of potential contamination is nearby.

Map well number	State well number	Owner or manager	Type of pump	Well yield (gpm)	Well-construction data: Surface seal	Well-construction data: Depth to intake part of well (feet)	Well-construction data: Reported depth of well (feet)	Source of power: Connected to public-utility power system	Source of power: Voltage requirement	Accessibility	Use of water: Existing	Use of water: Emergency	Remarks
Pumps operated by electric motors													
1	5N/4W-32A1	Carneros Elementary School	S	30	Yes	....	260	Yes	220,s	In unfenced area beside pumphouse, adjacent to Los Carneros Avenue.	PS	1	Water chlorinated and stored in 1,000-gallon tank inside pumphouse.
2	5N/4W-34H1	Sanitation District, City of Napa	S	300	Yes	220	500	Yes	220,t	In fenced enclosure. Access by unpaved road.	In,PS	2	
3	5N/4W-26B1	Basalt Rock Co., Inc., Napa	T	700	U	....	1,440	Yes	440,t	In open area about 0.1 mile west of State Highway 12 and 29. Access by unpaved road.	In,PS	3	Also known as "Adams & Forbes No. 8." Water pumped to a 35,000-gallon tank.
4	5N/4W-26E1	do.	T	250	Yes	391(?)	806	Yes	440,t	In large, fenced enclosure at Kaiser Steel Corporation Yard.	In,PS	1	Also known as "Adams & Forbes No. 7." Casing cemented to a depth of 391 feet.
5	5N/4W-23F1	Napa College, Napa	T	300-350	P	....	323	No	440,t	In pumphouse about 200 feet south of Streblow Drive.	U	4	Also known as "Smith-Brown No. 1"; has served as source of supply for Napa State Hospital. Flowing at less than 1 gpm, 2-29-72. Water is warm (80°F), but satisfactory for domestic use.
6	5N/4W-14P1	do.	T	400-500	P	160	600	No	440,t	In pumphouse northwest of Napa College parking lot. Access by unpaved road.	U	4	Also known as "Big Garden Well"; has served as source of supply for Napa State Hospital. Flowing at less than 1 gpm, 2-29-72. Water is warm (83°F), but satisfactory for domestic use. Gives off hydrogen sulfide odor and occasional bubbles of gas. High-voltage line and new transformers about 50 feet north of well.
7	5N/4W-14L1	Napa State Hospital, Napa	T	400	P	....	525	No	440,t	In pumphouse on west side of State Highway 12 and 29. Access by unpaved road.	U	3	Also known as "Little Garden Well"; has served as source of supply for Napa State Hospital. Water is warm (82°F), but satisfactory for domestic use.
8	5N/4W-12H1	Mt. George Union Elementary School	S	35	P	....	478	Yes	220,s	In pumphouse north of school buildings and 20 feet west of Second Avenue.	PS	1	Water chlorinated and stored in tank outside pumphouse.
9	6N/4W-23J2	Silverado Country Club, Napa	T	600-800	Yes	170	850	Yes	440,t	In open area on east side of Atlas Peak Road.	U	1	
10	6N/4W-23J3	do.	T	1,200	U	....	....	Yes	440,t	In open area on small island.	Ir	5	
11	6N/4W-24Q2	do.	T	1,000	U	....	....	Yes	440,t	In open area near test young.	Ir	5	
12	6N/4W-25Q2	do.	T	1,000	U	....	....	Yes	440,t	In open area beside pond.	Ir	5	
13	6N/4W-22B4	Soda Canyon Elementary School	S	....	Yes	....	284	Yes	220,t	In pumphouse southwest of school building.	PS	1	Water chlorinated and stored in 1,000-gallon tank inside pumphouse.
14	6N/4W-4P1	Chimney Rock Golf Course, Napa	S	100-250	U	20	320	Yes	440,t	In open area bout 60 feet east of No. 3 green.		3	Plumbing extends only a few inches above land surface; not readily visible.
15	6N/4W-7B1	do.	S	100-300	Yes	20	335	Yes	440,t	In open area about 115 feet northwest of No. 7 green.	Ir	1	Wellhead and plumbing at land surface; not readily visible.
16	6N/4W-9B2	do.	S	100-300	Yes	20	460	Yes	440,t	In open area bout 160 feet west-southwest of No. 8 green.	Ir	1	Well covered by 2-foot square wooden cover set at land surface; not readily visible.
17	6N/4W-6D1	St. Joan of Arc Church, Yountville	T	400-700	Yes	40	300	Yes	440,t	In open area 0.4 mile north-east of church, on north side of paved road.	Ir	1	Two other large-yield wells with electrically-operated turbine pumps are located on south side of road.
18	7N/5W-23C1	Edward Bernard, Rutherford	T	980	Yes	50	390	Yes	440,t	In open area, on east side of Money Road about 500 feet north of intersection with Oakville Cross Road.	A	1	
19	8N/4W-25K1	Harold Varozza, St. Helena	S	140	Yes	65	270	Yes	220,t	In open area behind residence at 492 Pratt Avenue	D,Ir	1	
20	8N/4W-15G2	Pacific Gas and Electric Co., St. Helena	S	70	Yes	20	80	Yes	220,t	In fenced area adjacent to south side of building	PS,Ir	1	Well flows at low rate during period of non-use.
21	8N/4W-5P1	Sterling Vineyards, Calistoga	S	200	Yes	44	300	Yes	440,t	In open area at base of hill and about 100 feet north of paved road to vineyard office.	A	1	Three other wells owned by Sterling Vineyards are located 0.3 to 0.4 mile east, on north side of road. Wells are equipped with submersible pumps, do not have surface seals, and yield 100, 150, and 200 gpm.
22	9N/7W-36M1	Mt. St. Helena Golf Course, Calistoga	S	5-40	Yes	....	....	Yes	110,s	In open area on golf course and near north bank of Napa River.	PS,Ir	2	Auxiliary power available at fairgrounds. Water reported warm. Several wells have been drilled at golf course and fairground, but all other wells are reported to terminate in the first aquifer and yield water contaminated by septic-tank effluent.
23	8N/7W-2G1	Calistoga Water Department, Calistoga	S	100-150	Yes	240	350(?)	Yes	220,t	In open area. Access by unpaved road.	PS	1	Water chlorinated and pumped to 1 million-gallon storage tank at the well. Water used seasonally in conjunction with reservoir water. Second well drilled nearby, but not equipped with a pump as of February 1972.
Pumps operated by diesel-powered engines													
24	6N/4W-17C4	Trefethen Vineyards, Napa	T	500	No	61	203	No	--	In pumphouse north of vineyard office. Access by unpaved road.	A	3	Several other wells equipped with electrically-operated turbine pumps are located in vineyard.
25	6N/4W-8L1	Vinifera Development Corp., Rutherford	T	1,500	U	....	....	No	--	In open area beside south bank of unnamed stream channel. Access by unpaved road.	A	5	
26	7N/5W-34J1	Gladys Beard, Yountville	T	3,200	No	....	222	No	--	In open area. Access by unpaved road.	A	3	
27	6N/5W-1D1	Edward Bernard, Rutherford	T	3,500	No	190	496	No	--	In fenced enclosure. Access by unpaved road.	A	4	Water has sulphurous taste. Reported to flow at 100 gpm during slack irrigation season.
28	7N/5W-5A7	Christian Brothers, St. Helena	T	3,200	No	81	546	No	--	In pumphouse in vineyard. Access by unpaved road from Zinfandel Lane.	A	3	
29	8N/5W-32J1	do.	T	1,500	No	26	458	No	--	In pumphouse beside White Lane (unpaved).	A	5	City of St. Helena sewage pond is located about 700 feet north. Water may require boiling or chlorination before public use.
30	8N/5W-32Q1	do.	T	800	No	55	435	No	--	do.	A	5	Do.
Pumps operated by natural gas-powered engines													
31	7N/5W-9J1	Elwood Mees, Rutherford	T	800-1,200	No	110	459	No	--	In pumphouse beside levee along south bank of Napa River. Access by unpaved road from Mees Lane.	A	5	
32	8N/5W-33N3	Freemark Abbey Winery, St. Helena	T	1,100	No	100	350	No	--	In pumphouse. Access by unpaved road from Zinfandel Lane.	A	3	



INDEX MAP

EXPLANATION

Water wells equipped with electric motors:

- Water suitable for domestic use
- Water suitable for nondomestic use only

Water wells equipped with diesel- or gas-powered engines:

- Water suitable for domestic use
- Water suitable for nondomestic use only

Number identifies well in accompanying table.

Base from U.S. Geological Survey
San Francisco Bay Region
1:125,000, 1970, sheet 2

SCALE 1:125 000

1 0 1 2 3 4 5 6 7 8 9 10 MILES
5000 0 5000 10000 15000 20000 25000 30000 35000 40000 45000 FEET
1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS

CONTOUR INTERVAL 200 FEET
DOTTED LINES REPRESENT 40-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET--DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 4 TO 7 FEET

LOCATION OF EMERGENCY WATER-SUPPLY WELLS

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