UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

POTENTIAL POTABLE-WATER SUPPLIES IN REDWOOD NATIONAL PARK, CALIFORNIA

Open-File Report 78-970

Prepared in cooperation with the

National Park Service

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By. J. P. Akers

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Menlo Park, California
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CONVERSION FACTORS

The inch-pound system of units is used in this report. For readers who prefer to use the International System (SI) of units, the conversion factors for the terms used in this report are listed below:

Inch-pound units	Multiply by	Metric (SI) units
foot	0.3048	meter
gallon	3.785	liter
gallon per minute	0.0631	liter per second
inch	25.4	millimeter
mile	1.609	kilometer

For temperature values in table 1, use the following to convert degree Celsius (°C) to degree Fahrenheit (°F):

Temp °F = 1.8 temp °C + 32

Abbreviations used:
mg/L - milligrams per liter
μg/L - micrograms per liter

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ABSTRACT

An evaluation was made of the potential for potable-water supplies at 13 sites in or near Redwood National Park, Calif. The National Park Service is planning for the development of visitor facilities at these sites. At some sites, the report recommends using surface-water diversions. At other sites, locations are given for test-well drilling or springs are recommended for development. Chemical analyses of water are given for selected surface-water supplies and for some existing wells and springs. The chemical quality of the water is suitable at most of the sites, although concentrations of iron and chloride are excessively high in some areas.

INTRODUCTION

Long-range plans of the National Park Service include development of visitor facilities at 13 sites in or near Redwood National Park in Del Norte and Humboldt Counties, Calif. (fig. 1). Some of these sites, now in the California State Park System, may be incorporated into the National Park System at some later date. The development of facilities at these sites requires adequate potable-water supplies.

This study evaluates the potential for developing potable-water supplies at 13 sites selected and named by the National Park Service. Data were collected and evaluated on the elements that control the occurrence, movement, quantity, and quality of both ground water and surface water at each of the designated sites. The data included geology, ground-water levels, well logs, streamflow, spring discharge, and water analyses. A summary of the study at each site follows.

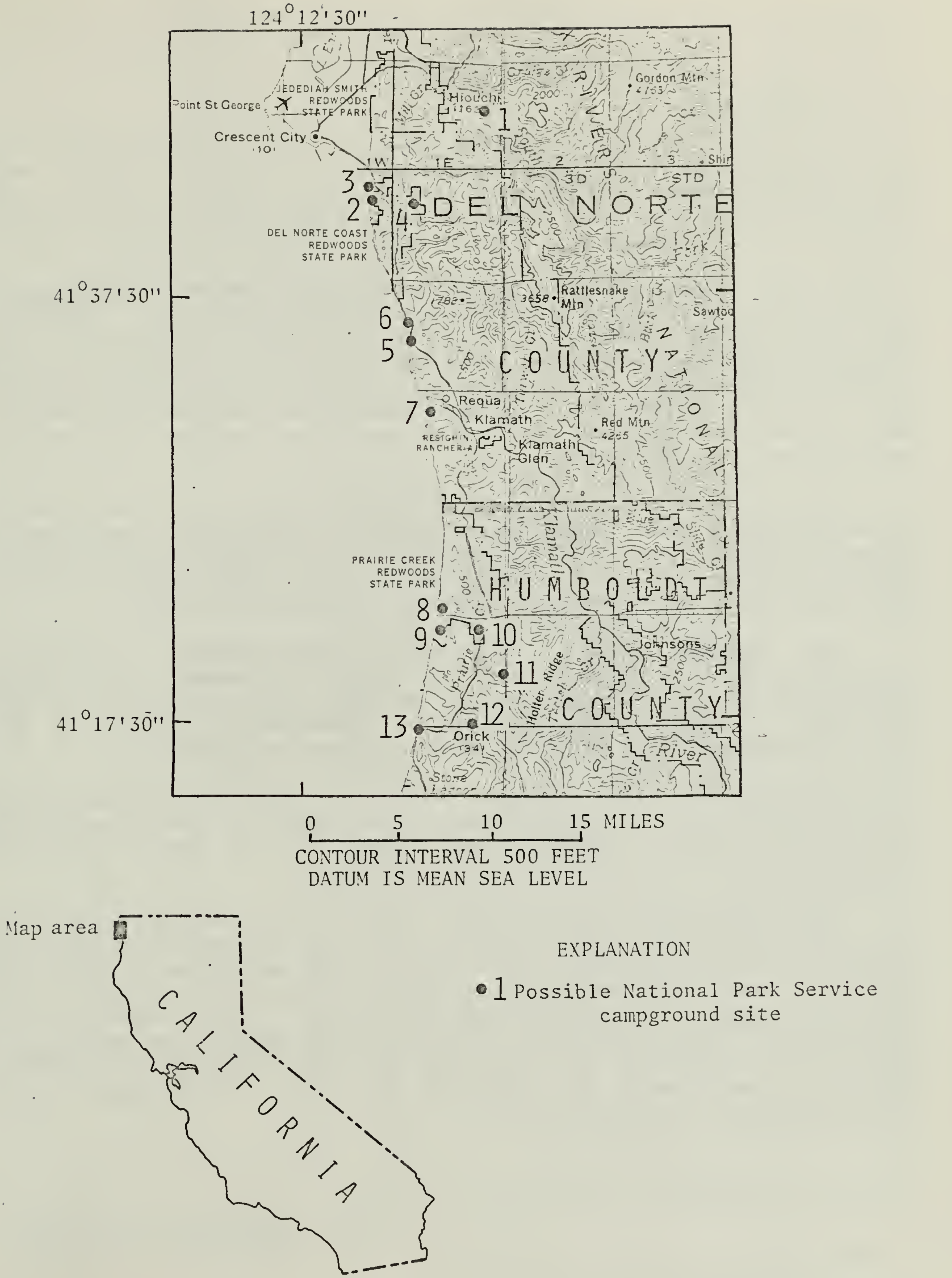


FIGURE 1.--Location of the study area and possible National Park Service campgrounds.

SITE 1.--LITTLE BALD HILLS

The Little Bald Hills site is about 2 miles south-southeast of the junction of the Smith and South Fork Smith Rivers (fig. 2). The area, mostly on a ridge extending northwestward from Bald Hill, includes several canyons draining northward into the Smith and South Fork Smith Rivers and southward into the upper reaches of Mill Creek (Mill Creek not shown on map).

The area is partly mantled by soil developed on ultrabasic, metamorphosed rocks of Mesozoic age. The bedrock yields little, if any, water. Rainfall in the area, however, averages about 85 inches per year, and the soil absorbs considerable quantities of water. The absorbed water is released as seeps and springs to sustain flow in the larger streams during part of the summer months. Early in April of 1978, after an about-average year of rainfall, nearly all the streams were flowing; it is not known how long this flow would be sustained into the dry season.

Only one dependable (but small) spring (S1, fig. 2) occurs within the Little Bald Hills area. Water from this spring emanates from a seep area in a grove of trees. The water is collected in a covered concrete sump and delivered through a pipe to an open cement trough. About three-fourths of a gallon per minute was discharging from the pipe on June 1, 1978.

With suitable storage, this spring should supply an average of 500 gallons of potable water per day during the summer visitor season. An analysis of the chemical quality of water from this spring is given in table 1. Before being used as a potable-water supply, the water should be analyzed for coliform bacteria and treated, if necessary.

Another spring (S2, fig. 2) is within practicable piping distance of the Little Bald Hills site but is on National Forest lands. This spring has a larger discharge than spring S1; on June 1, 1978, the estimated discharge of S2 was 10 gallons per minute.

A well drilled at any convenient site within the area would have a 50-percent chance of obtaining 2 to 5 gallons per minute of water that probably would be potable. There is an area containing a fairly thick mantle of soil, and perhaps some shallow alluvium, just north of the northeast corner of sec. 22, T. 16 N., R. 1 E. (fig. 2), on U.S. Forest Service land. This is a grassy area which was probably a hay meadow in the past, as evidenced by an abandoned hay rake found at the site. A shallow, large-diameter well here (Ts-2 in fig. 2) might produce water of potable quality the year around.

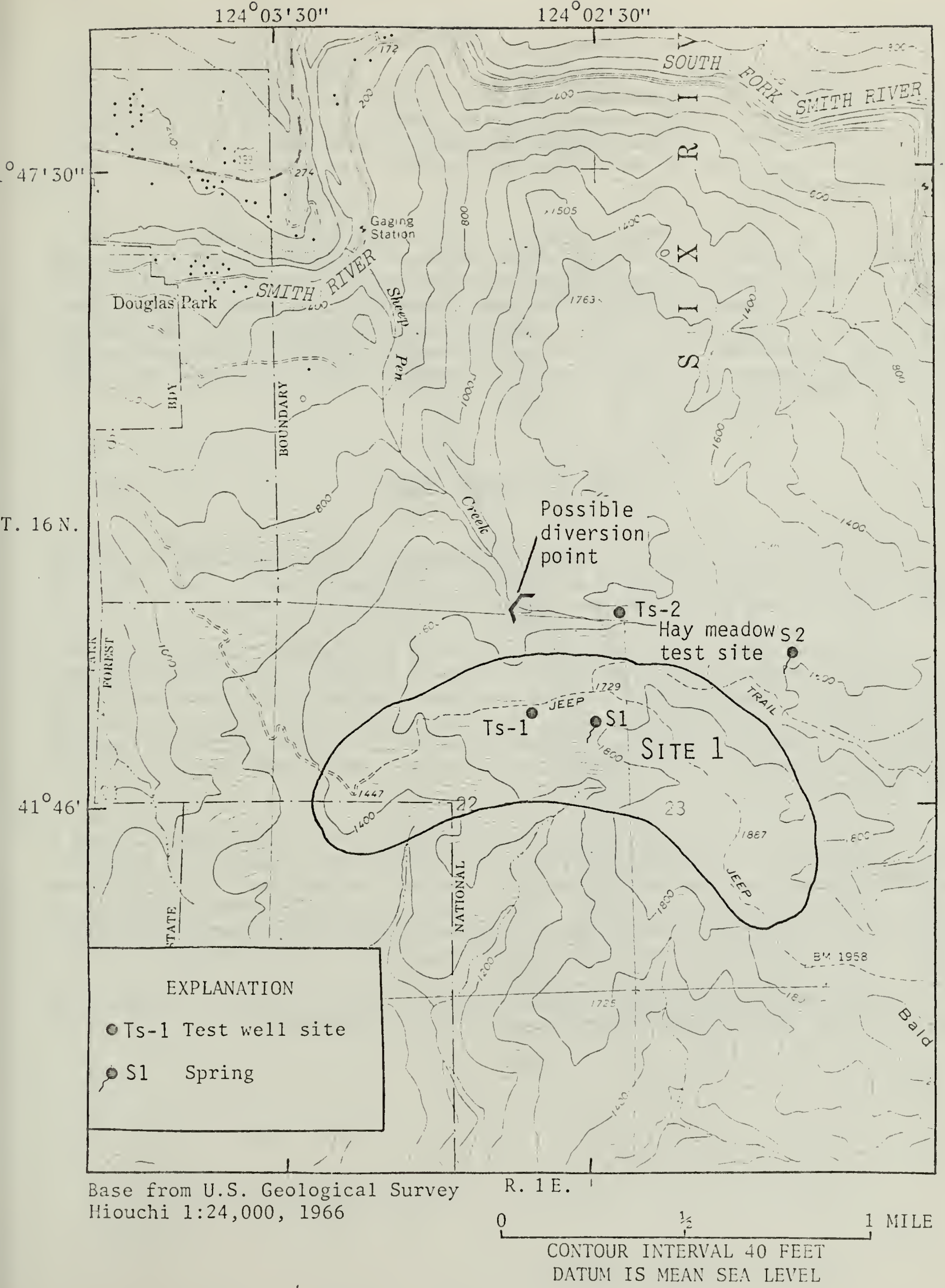


FIGURE 2.--Site 1, Little Bald Hills.

Of first priority for developing a small water supply in the Bald Hills area should be a test well 200 to 300 feet deep at the site designated Ts-1 in figure 2. The second priority would be a well about 200 feet deep in the meadow at the site Ts-2. This second well may obtain water at a depth less than 50 feet, but the bedrock also should be tested to a depth of 200 feet.

There is no dependable source of surface water within the area outlined in figure 2. However, water might be obtained by diverting and lifting water from the upper reaches of Sheep Pen Creek near the point indicated in figure 2. The creek was flowing an estimated 5 cubic feet per second in late April 1978. Before such a diversion is established, the creek should be visited in autumn before the rains begin to determine if it is flowing at that time. An analysis of water from the lower reaches of this creek is given in table 1.

SITE 2.--NICKEL CREEK

The site at the mouth of Nickel Creek (fig. 3), is underlain by channel gravel and by bedrock, mostly greenstone, of Jurassic age. Small areas of soil-covered, gravel terraces are on the north side of the creek.

Water for campsite use in this area could be diverted from Nickel Creek, or possibly obtained from a well in the gravel deposits at the site indicated in figure 3. A well at this site should have a better than 50-percent chance of obtaining enough potable water to supply the camp sites. It may be necessary to drill several small-diameter wells to locate the most favorable site for a production well. Test wells in this area should be no more than 100 feet deep.

The residence indicated on older topographic maps (from which figure 3 was reproduced) is no longer at the site. Vestiges of a system for diverting water from the creek are still apparent, however, and indicate that the stream was a dependable source of water. Such a system, though, would be subject to damage from floods and would yield sediment-laden water during high flows. Because of this, the test wells should be regarded as first priority.

An analysis of water from Nickel Creek is given in table 1. Water from shallow wells nearby should be of similar chemical quality.

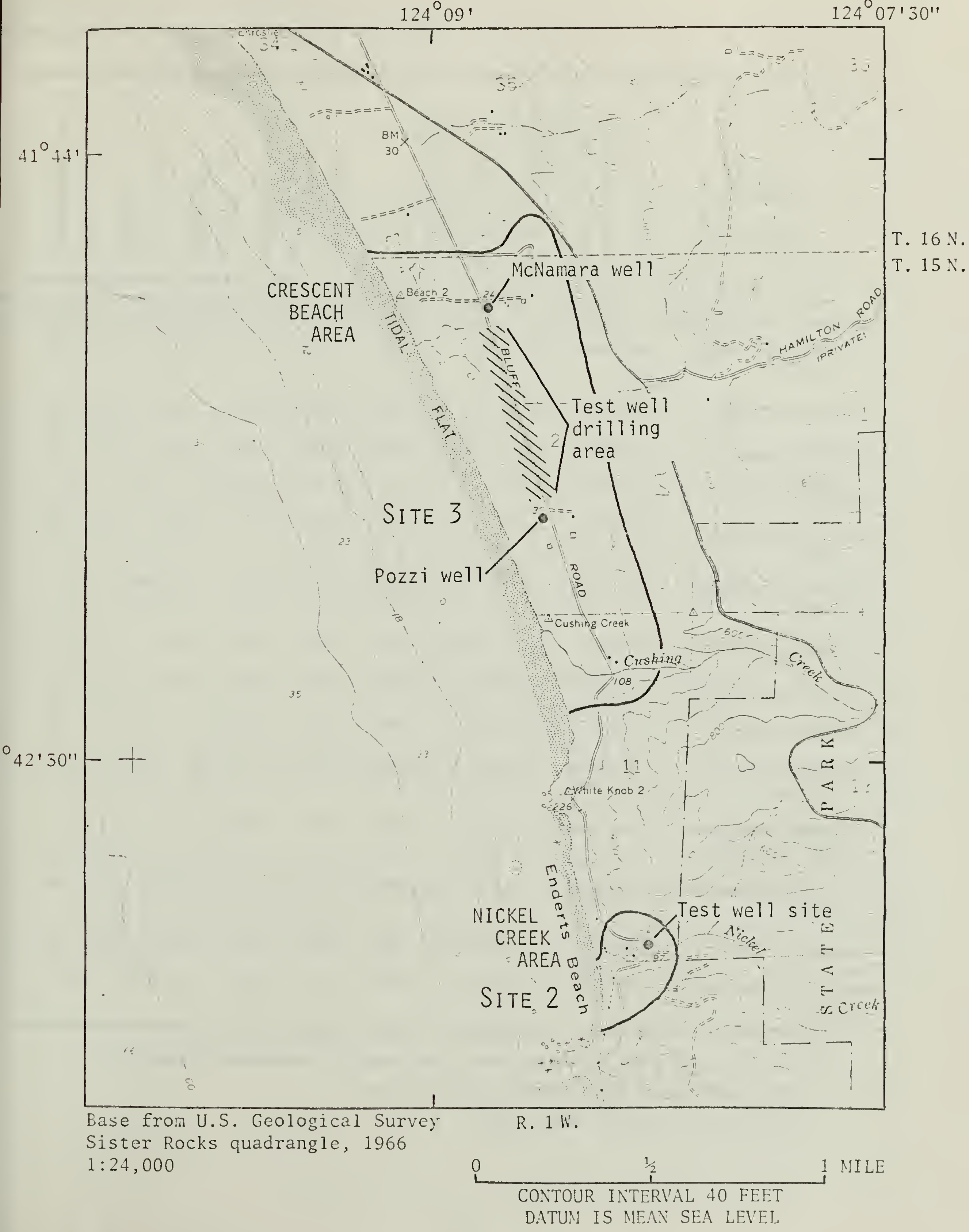


FIGURE 3.--Site 2, Nickel Creek, and Site 3, Crescent Beach.

TABLE 1.--*Chemical analyses of selected*

Source of sample	Date of collection	Water temperature (°C)	Silica (SiO_2) (mg/L)	Iron (Fe) (µg/L)	Calcium (Ca) (mg/L)	Magnesium (Mg) (mg/L)	Sodium (Na) (mg/L)	Potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)
Little Bald Hills spring	6- 1-78	10	20	0	1.3	27	2.3	0.0	130
Sheep Pen Creek	4-27-78	11	14	40	1.7	8.2	2.1	.0	46
Nickel Creek	4-27-78	10	8.0	50	3.7	1.6	6.2	.3	15
McNamara well	7-17-53	14	--	0	7.7	6.3	12	.4	41
West Branch Mill Creek	6- 5-75	15	7.3	10	3.8	1.5	3.5	.4	16
Del Norte County well[1]	8- 9-72	--	--	1,060	43	9.2	[2](167)		--
Wilson Creek	4-27-78	13	8.9	40	5.2	1.6	4.5	.4	21
Dads Camp spring	4-27-78	12	8.0	50	3.7	1.6	6.2	.3	15
Squashan Creek	4-27-78	10	16	230	4.4	4.4	11	.5	25
Well near Espa Lagoon	4-27-78	13	36	3,200	15	16	18	.9	91
Unnamed creek near Espa Lagoon	4-27-78	11	14	540	4.0	4.9	12	.6	23
Well near Prairie Creek[1]	1-22-73	--	14	1,600	4.7	7.7	8.4	.4	45
Lost Man Creek	4-27-78	10	8.3	90	3.8	1.7	4.9	.4	21
Orick firehouse well[1]	unknown	--	--	270	23	<.05	[2](2.1)		--

[1]Analysis performed by agency other than the U.S. Geological Survey.

[2]Value represents sum of sodium and potassium.

[3]Value is for nitrate (NO_3) only.

Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrite plus nitrate as N	Boron (B)	Dissolved solids, calculated sum	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance	pH
mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	%	micromhos at 25°C	units
--	2.4	3.9	0.0	--	0	121	110	8	4	206	7.6
--	3.2	3.7	.0	0.06	10	56	38	0	11	84	7.4
--	3.7	9.0	.0	.39	10	42	16	4	45	70	6.0
--	14	17	--	--	--	64	45	--	36	146	6.9
0	1.3	3.3	--	.03	--	--	16	3	32	47	5.9
--	5.2	316	--	--	--	--	146	--	--	1,085	7.4
--	4.5	5.2	.0	.27	20	40	20	2	33	57	6.9
--	3.7	9.0	.0	.39	10	42	16	4	45	70	6.0
--	6.1	19	.0	.13	30	75	29	9	45	105	7.0
--	11	39	.1	.01	20	184	100	29	27	289	7.0
--	9.3	18	.0	.60	50	77	30	11	46	117	6.7
0	5.5	28	.0	[3].12	120	86	50	--	--	98	6.9
--	3.4	6.2	.0	.04	10	39	16	0	39	56	6.9
--	14	7.0	--	--	--	--	66	--	--	141	7.1

SITE 3.--CRESCENT BEACH

The site is about 3 miles southeast of Crescent City along Bluff Road. The area is mantled mostly by soil developed on the Battery Formation of Pleistocene age, which consists largely of clay in the upper part and sand and gravel in the lower part. The Battery Formation is 20 to 50 feet thick in this area.

A test well, 25 feet deep, drilled several years ago by the Crescent City Water Co. just north of the site's north boundary penetrated a water-bearing gravel zone about 10 feet thick at the base of the Battery Formation. A well near the McNamara house (presently occupied by the Redwood National Park Superintendent) obtains water of good quality from gravel in the base of the Battery Formation (table 1). A well farther south (fig. 3), owned by Mr. Ben Pozzi, obtains 10-15 gallons per minute from a sandy zone in the base of the Battery Formation. The McNamara and Pozzi wells are both less than 50 feet deep.

A well drilled to a depth of about 50 feet at a convenient site between the McNamara and Pozzi wells along Bluff Road (cross-hatched area in fig. 3) should yield 10-20 gallons per minute of potable water. The well should be drilled no more than 100 feet east or west of the road and should not be deeper than 50 feet.

An analysis of water from the McNamara well is given in table 1. Similar water should be obtained in other wells along Bluff Road.

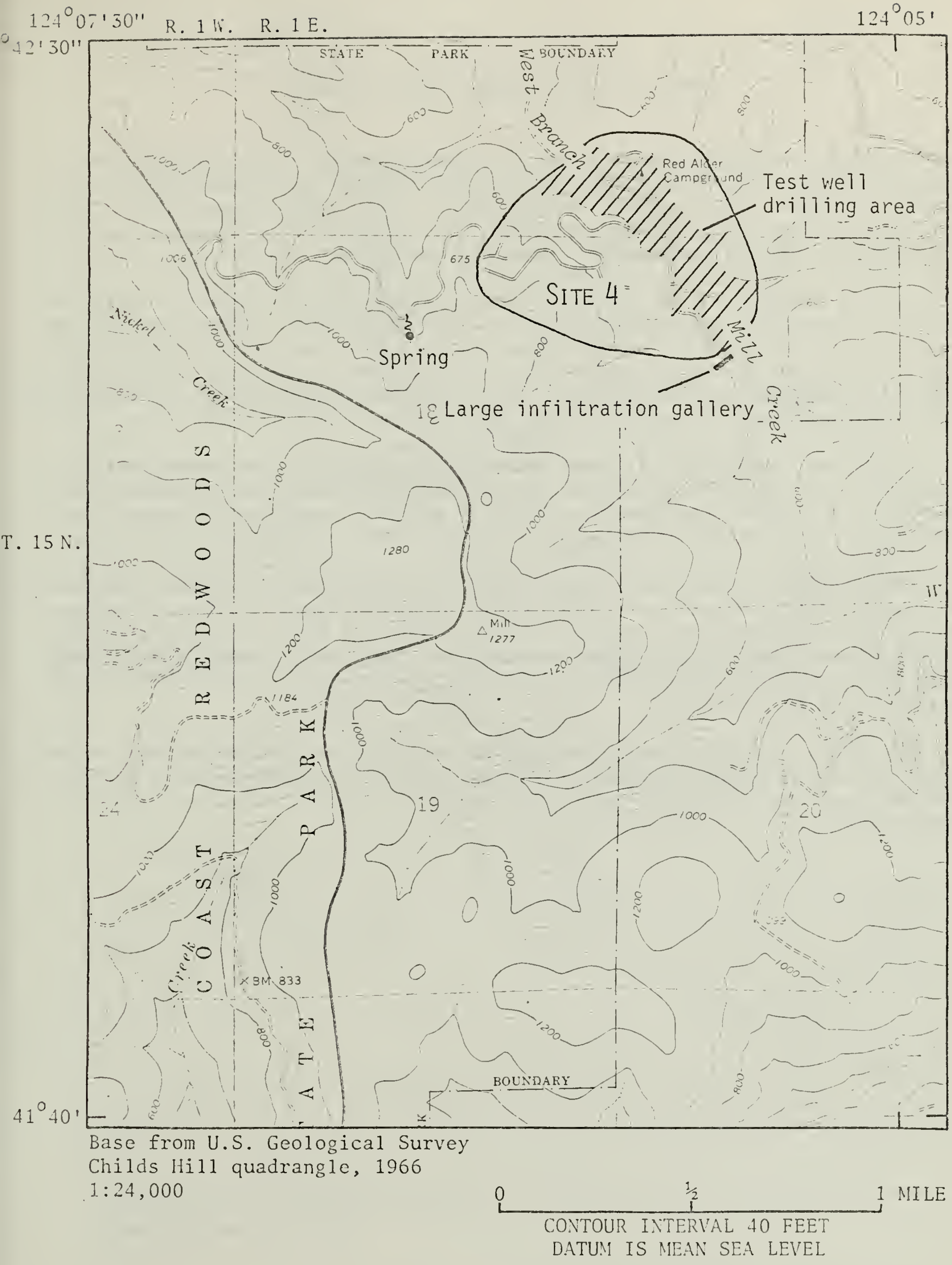
SITE 4.--MILL CREEK CAMPGROUND

The site at the State-owned Mill Creek (Red Alder) Campground (fig. 4), is mostly in alluvial material along Mill Creek. The alluvial material probably contains water in sufficient quantity and of suitable quality to satisfy most visitor-center and campground plans.

The present water supply for the State campground is adequate, even in dry years, to supply 145 campsites averaging 3.5 people per site during the peak summer season. The water-supply system consists of an infiltration gallery beneath West Branch Mill Creek (fig. 4), a 100,000-gallon redwood storage tank, and an 800-gallon pressure tank. Water is lifted from a standpipe at the west bank of the creek by two pumps into an 8-inch main with lines to all campsites.

Another infiltration gallery at a spring (fig. 4) furnishes water for two houses occupied by State Park personnel. This system is connected with the larger system described above.

Additional water, if needed in this area, could be developed from shallow wells (100 feet or less in depth) at almost any convenient location within the cross-hatched area shown in figure 4. The quality of water from such wells should be similar to that in West Branch Mill Creek (table 1).



Base from U.S. Geological Survey
Childs Hill quadrangle, 1966
1:24,000

FIGURE 4.--Site 4, Mill Creek Campground.
(Located in Del Norte State Park.)

SITE 5.--FALSE KLAMATH COVE (LOWER)

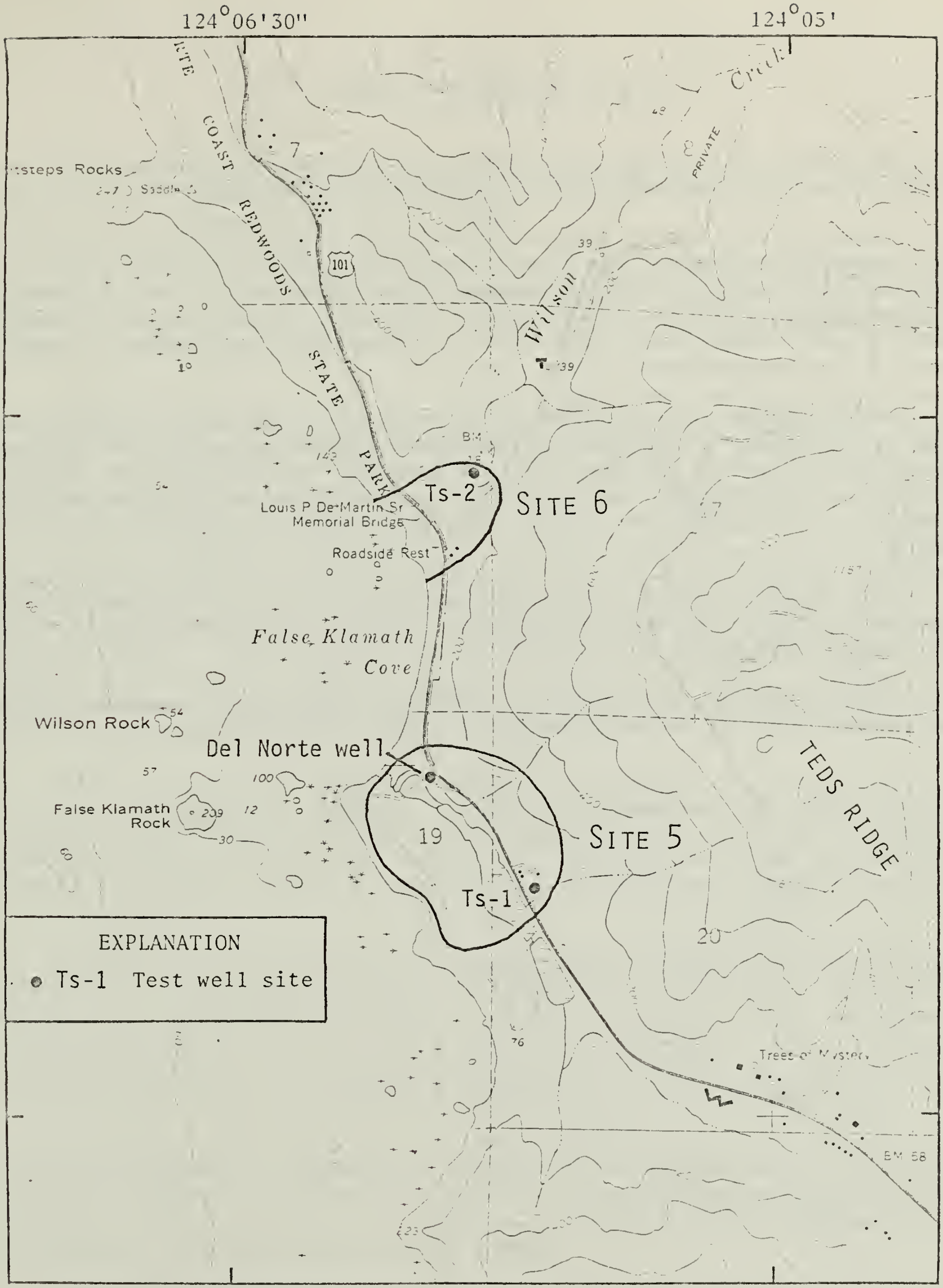
This site is near the north end of a lagoon that is near the south end of False Klamath Cove (fig. 5). It is presently a rest stop along U.S. Highway 101 that was formerly maintained by Del Norte County and is now maintained by the National Park Service. The site is in alluvium along what is probably an ancient, abandoned channel of the Klamath River.

A well drilled by Del Norte County in 1968 (fig. 5) presently supplies water for drinking and sanitary use at the rest stop. The water is of marginal chemical quality for drinking (table 1) because chloride concentrations exceed established criteria (National Academy of Sciences and National Academy of Engineering, 1973 [1974], Water quality criteria 1972: Washington, D.C., U.S. Government Printing Office, 594 p.).

Additional water of the same marginal quality could be developed from other wells nearby. Water of somewhat better quality might be obtained from a well drilled at the site shown in figure 5 as Ts-1. This site is farther from the ocean and receives recharge from streams that originate on Teds Ridge.

Another source of potable water might be springs east of Highway 101 near the summit of Teds Ridge. It is uncertain, however, whether these springs are on Park Service land, and the water from them would have to be piped in very steep terrain. Water might also be piped in from a well, about a mile away, suggested for the False Klamath Cove (Upper) site along Wilson Creek (described in next section).

The first priority should be drilling a well at site Ts-1; the second should be piping water from the well suggested along Wilson Creek in the next section; and the third should be developing the springs east of U.S. Highway 101.



Base from U.S. Geological Survey
Requa quadrangle, 1966
1:24,000

R. 1 E.

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 5.--Site 5, False Klamath Cove (Lower), and Site 6, False Klamath Cove (Upper).

SITE 6.--FALSE KLAMATH COVE (UPPER)

This site near the mouth of Wilson Creek along U.S. Highway 101 (fig. 5) is mostly in river-channel deposits and alluvium along the creek.

Water probably can be obtained from a well drilled in the alluvium at the site indicated in figure 5 as Ts-2. Test wells drilled near this site in 1968 indicated that several tens of gallons of water per minute could be developed from a gravel bed at a depth of about 40 feet. A well in this gravel bed could supply enough water to provide both proposed developments, upper and lower, in the False Klamath Cove area.

Another source of water for False Klamath Cove (Upper) would be a spring that now supplies water for the De Martin residence on the south side of Wilson Creek near U.S. Highway 101. This spring is reported by Mrs. De Martin to have been capable of supplying water for an 80-cow dairy operation and two families. The spring has not failed in the 60 years of Mrs. De Martin's memory.

The quality of water from a well drilled at site Ts-2 probably would be similar to that in Wilson Creek (table 1), but the water may contain a higher concentration of dissolved chloride.

The first priority at this site should be drilling the suggested well and the second should be improving the spring for campground use.

SITE 7.--DADS CAMP AREA

This site (fig. 6) is partly in alluvium along the south side of the mouth of the Klamath River and partly in impermeable rocks of the Franciscan Formation of Cretaceous and Jurassic age.

Wells drilled in the alluvium along the mouth of the Klamath River in the past have yielded brackish water. The various camp sites and residences presently in the area obtain potable water from springs emanating from the slopes of Flint Ridge (fig. 6).

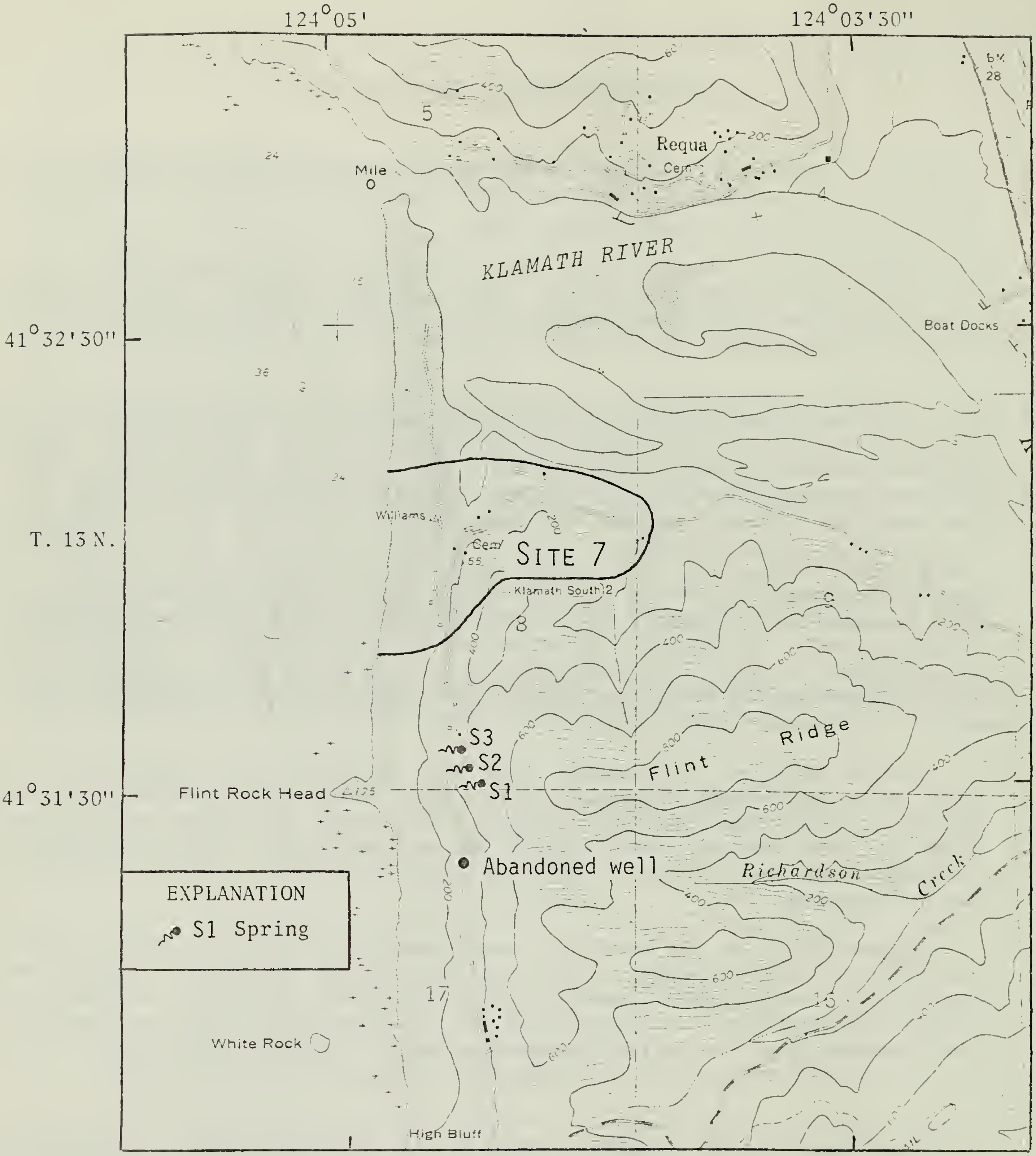
Probably the best source of water for this area would be springs on the west side of Flint Ridge on a parcel of land recently acquired by the Park Service. This parcel (designated Rocca 03-137 in the Park Service files) contains several springs, three of which were in use in 1970 to supply water for the property formerly used by Mr. Lawrence Crivelli and now used by a National Park Service ranger. The main spring (S1 in fig. 6), the only one now used for domestic supply, is in a general seep area within a grove of alder trees. Water from this spring emanates from humus and soil at the base of a large alder tree. The water is collected in a small sump and delivered to a redwood storage tank 6 feet in diameter and 8 feet high (capacity about 1,700 gallons). The spring was delivering about 3 gallons per minute to the storage tank in April 1970 and slightly more in April 1978. Probably twice this amount could be developed from the general seep area. An analysis of the water is given in table 1.

Spring S2 (fig. 6) emanates from soil and humus in a dense growth of fern, iris, and skunk cabbage. In 1970 the water was collected in a sump and was carried away through a 1-inch plastic pipe. The point of discharge from the pipe was not found during the current study, and the discharge, therefore, was not estimated. This spring probably has a smaller yield than the main spring.

Spring S3 is at the base of a small hummock overgrown by ferns, rushes, and irises. The discharge of this spring in 1970 was about 4 gallons per minute. A considerable quantity of the water, however, was lost to evapotranspiration at this site, and the yield probably could be improved. The discharge from the spring was reported by Mr. Crivelli to fluctuate little during the year and, to his knowledge, the spring has never gone dry.

A shallow, small-diameter (5-inch) well was drilled years ago at the location indicated in figure 6. This well, no longer used, once supplied water for domestic use for an outpost of a nearby radar station that was operated after World War II. The yield of the well is unknown, but it probably would supply 2-5 gallons per minute.

The main priority at this site should be to develop springs S2 and S3 and design a system to deliver the water to the Dads Camp area.



Base from U.S. Geological Survey
Requa quadrangle, 1966
1:24,000

R. 1 E.

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 6.--Site 7, Dads Camp area.

SITE 8.--GOLD BLUFFS BEACH NEAR SQUASHAN CREEK

This site is in beach sand at the base of the Gold Bluffs, which are carved from a sand and gravel formation of Tertiary age.

Water is now supplied to Gold Bluffs Beach State Park from a diversion system on a small tributary to Squashan Creek (fig. 7). The diverted water is stored in a redwood tank with a capacity of about 15,000 gallon and is hand-chlorinated before it is distributed to the various camp areas. This system adequately serves the present State campground. It could be expanded by diverting more water from Squashan Creek or by drilling a well.

A well drilled at the site indicated in figure 7 would probably obtain considerable water from alluvial-fan materials deposited by Squashan Creek or from the sand and gravel formation that makes up the Gold Bluffs. A well at this site should be drilled to a depth of about 50 feet to test the alluvium. A well about 100 feet deep would test both the alluvium and the underlying sand and gravel formation of Tertiary age. Water in the underlying formation may, at this location, contain a higher chloride concentration than is desirable.

An analysis of water from the present system is given in table 1.

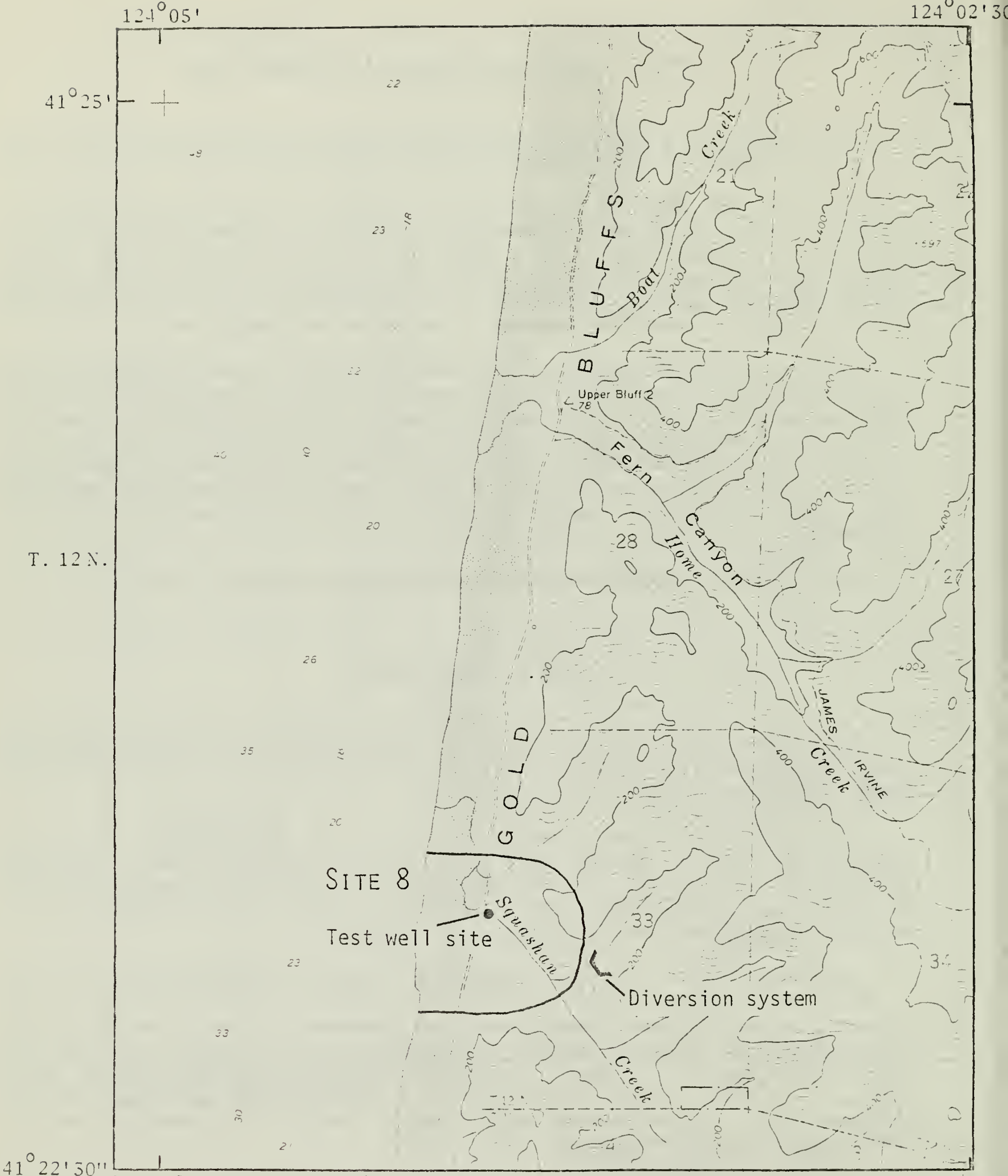
SITE 9.--ESPA LAGOON

Espa Lagoon site (fig. 8) is at the south entrance to Gold Bluffs Beach State Campground area. The site is in beach sand and a sand and gravel formation of Tertiary age.

Two State Park Service residences at the site are supplied with water from a well (fig. 8) 120 feet deep in the sand and gravel aquifer. The yield of this well is unknown, but even during the recent severe drought (1976-77) the well was adequate for the residences. The water contains iron in sufficient concentration to stain clothes (table 1).

Additional water could be developed at this site by drilling more wells in the sand and gravel formation in the cross-hatched area of figure 8 or by diverting water from an unnamed creek that empties into the ocean within the site area. This creek is perennial and obtains its base flow from the sand and gravel formation. A good site for the diversion would be about 200 yards north of the road to Gold Bluffs Beach. A good graveled road leads to this diversion site. An analysis of water from the creek at the proposed diversion point is given in table 1.

The main priority for developing more water in this area should be drilling additional wells at any convenient site within the cross-hatched area shown in figure 8. The new well or wells should be 120 to 200 feet deep, depending on the surface elevation.

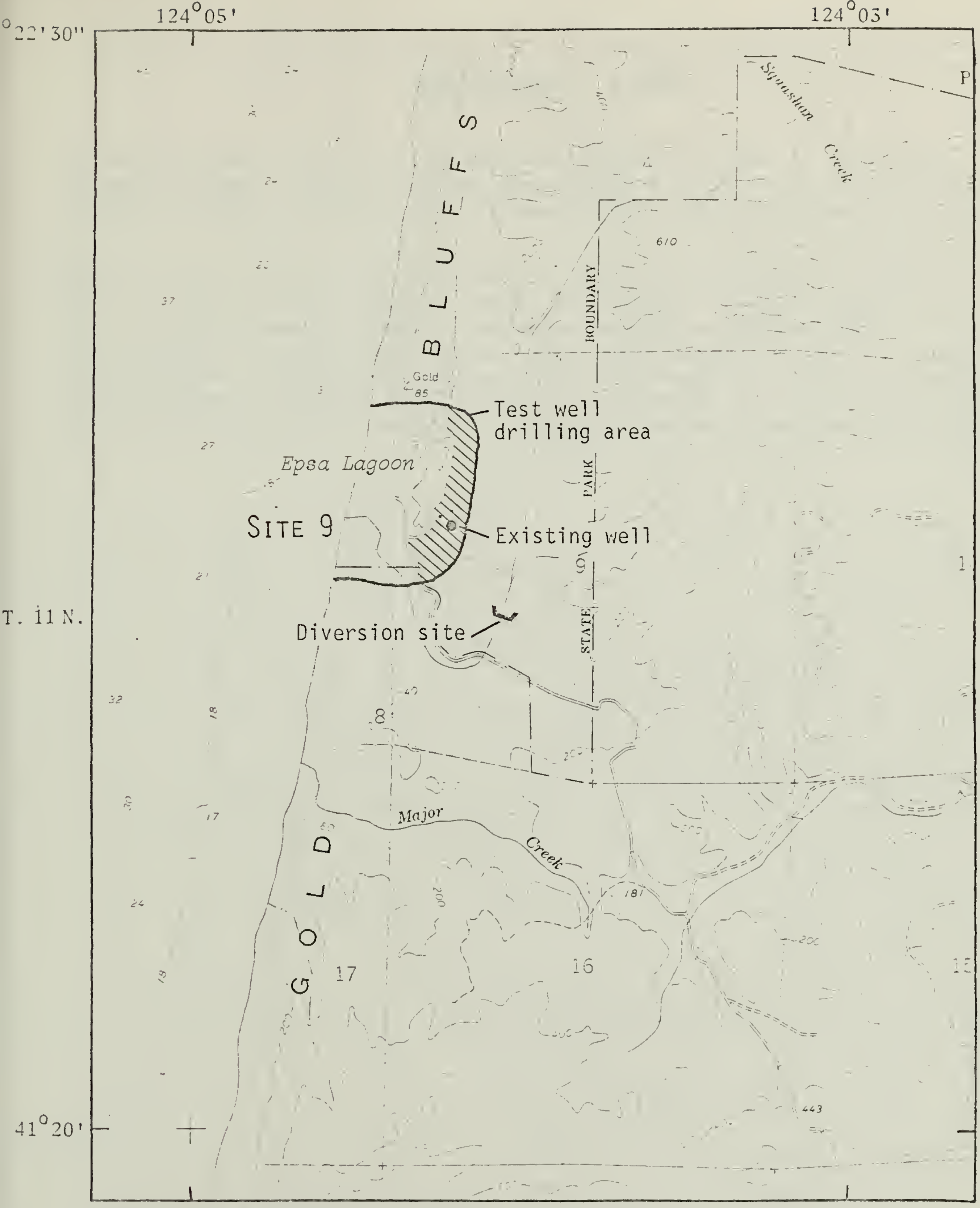


Base from U.S. Geological Survey
Fern Canyon quadrangle, 1966
1:24,000

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 7.--Site 8, Gold Bluffs Beach near Squashan Creek.



Base from U.S. Geological Survey
Orick quadrangle, 1966
1:24,000

0 ½ 1 MILE

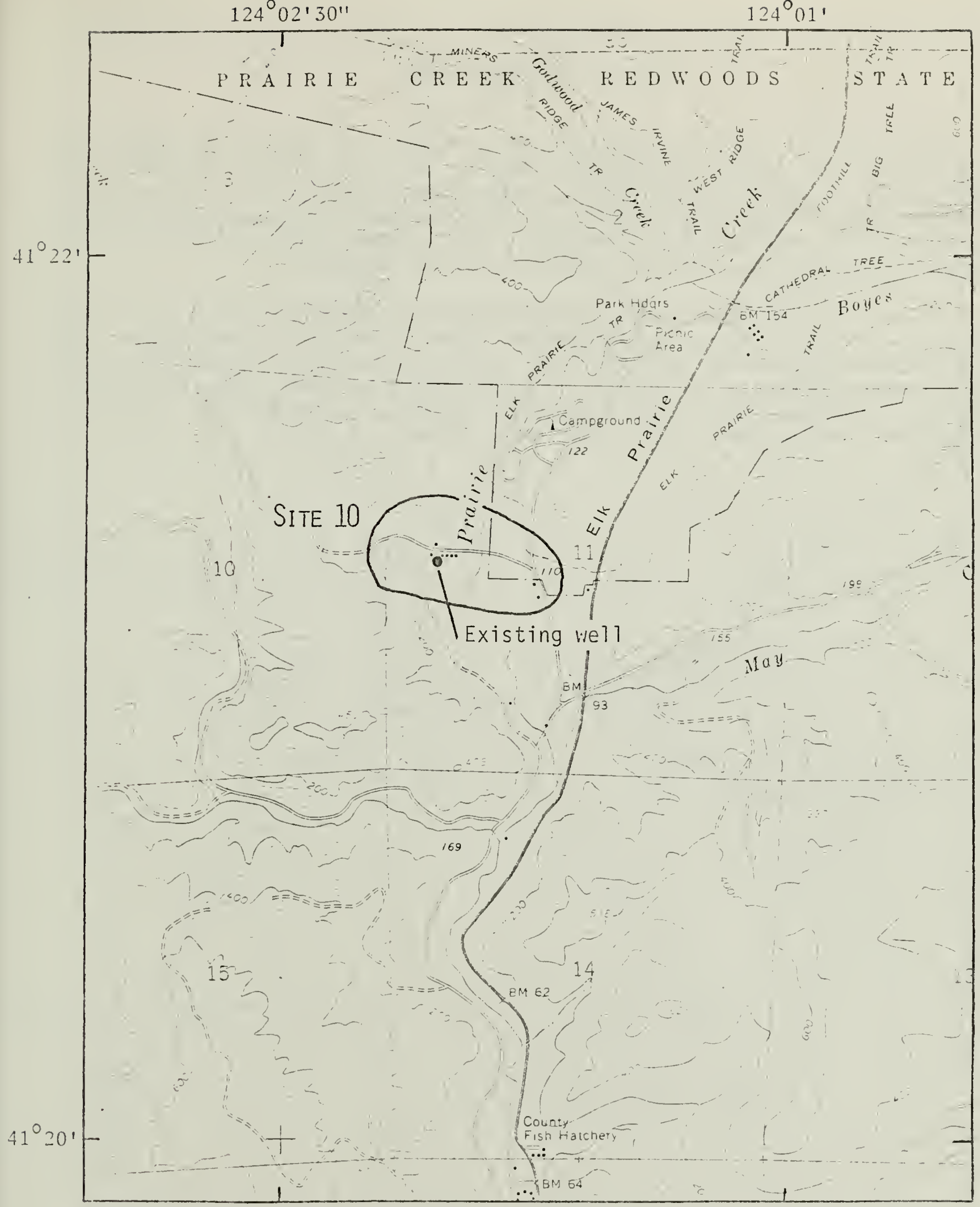
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 8.--Site 9, Espa Lagoon.

SITE 10.--PRAIRIE CREEK

This site is near the southwest edge of Elk Prairie (fig. 9) and is underlain by alluvium along Prairie Creek and by a sand and gravel formation of Tertiary age. Both the alluvium and the sand and gravel formation contain water at this site.

A well at a National Park Service residence at this site obtains enough water for domestic use. However, the water contains a concentration of iron (table 1) that exceeds established criteria (National Academy of Sciences and National Academy of Engineering, 1973, [1974] Water quality criteria 1972: Washington, D.C., U.S. Government Printing Office, 594 p.). More water of similar quality can be developed within this area from wells drilled at any convenient location. The wells should be drilled to a depth of about 200 feet.



Base from U.S. Geological Survey
Orick quadrangle, 1966 .
1:24,000

R. 1 E.

0 ½ 1 MILE

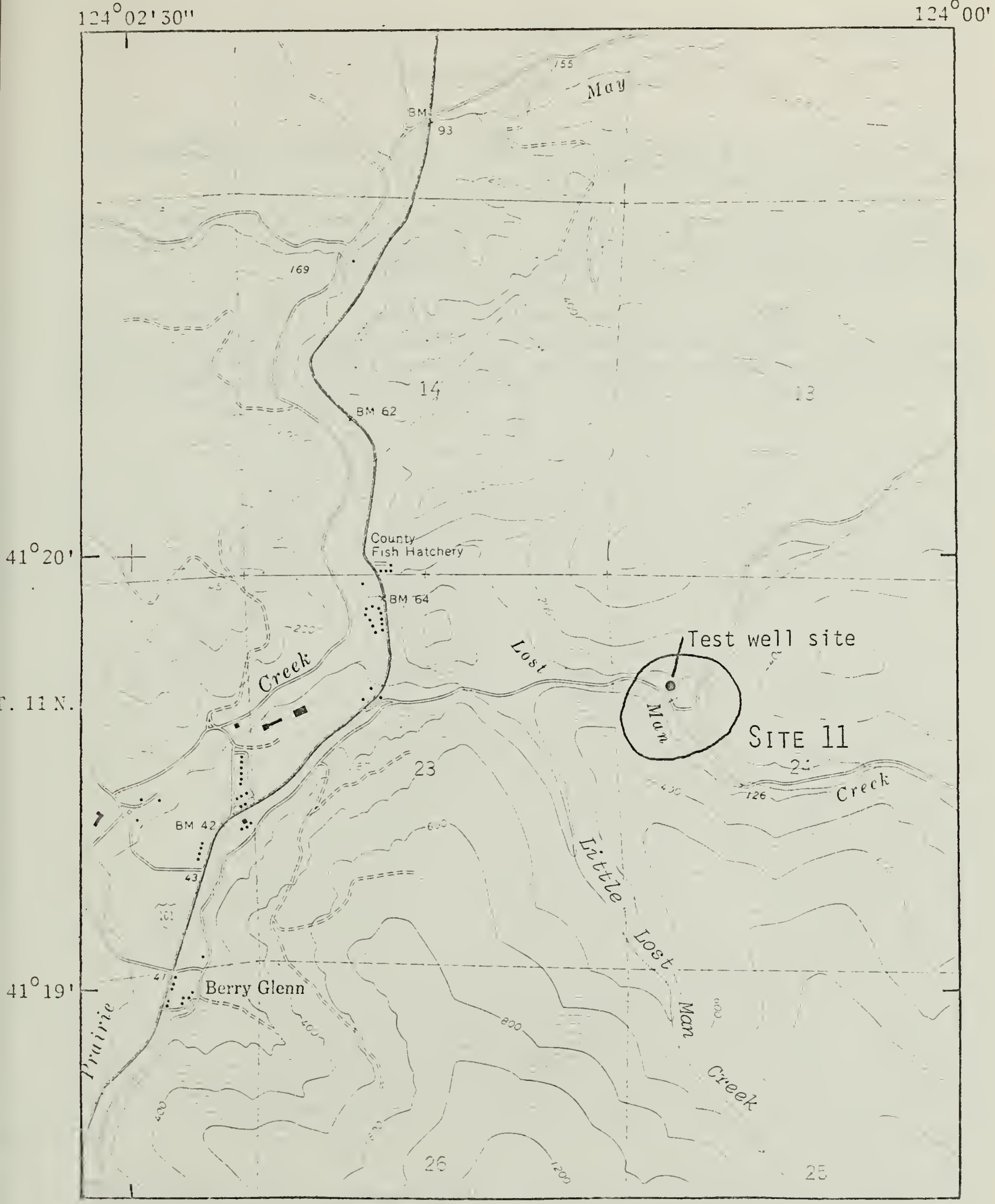
CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 9.--Site 10, Prairie Creek.

SITE 11.--LOST MAN CREEK

This site is near the junction of Lost Man and Little Lost Man Creeks (fig. 10). The site is underlain mostly by river-channel deposits; the remaining part is underlain by the Franciscan Formation of Cretaceous and Jurassic age. The river-channel deposits probably contain water that is hydraulically connected and chemically similar to that in the creeks. An analysis of water from Lost Man Creek is given in table 1.

Water can be developed at this site either by drilling a well at the site indicated in figure 10 or by diverting water from one of the creeks. The first priority should be drilling a well completely penetrating the river-channel deposits, which are probably not more than 75 feet thick. A diversion system, the second priority, would be subject to damage and sedimentation from floods during the rainy season.



Base from U.S. Geological Survey
Orick quadrangle, 1966
1:24,000

R. 1 E.

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

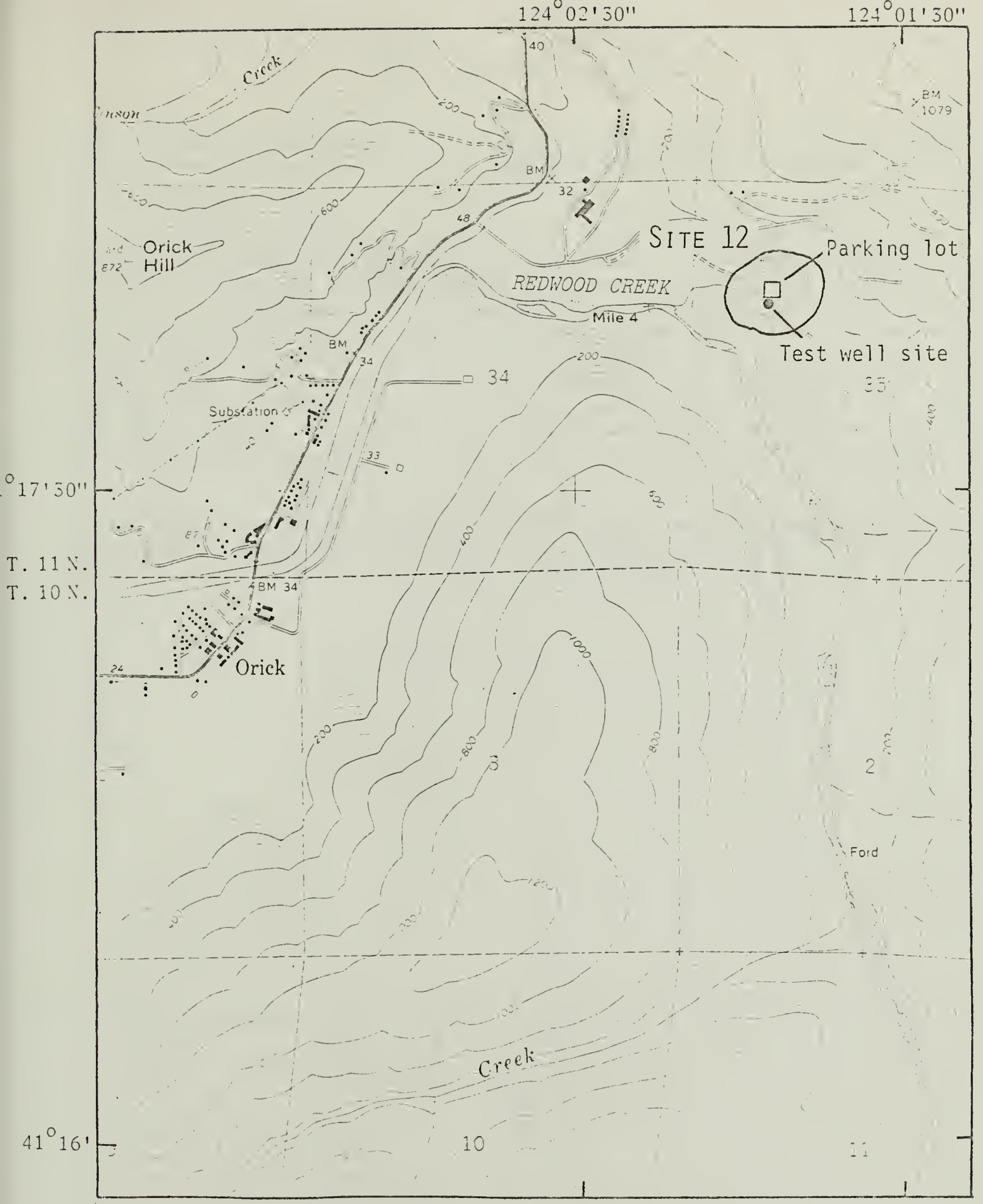
FIGURE 10.--Site 11, Lost Man Creek.

SITE 12.--REDWOOD CREEK

This site is in alluvium along Redwood Creek. The alluvium probably is hydraulically connected with the creek.

Water probably can be obtained at this site from a well drilled at the south edge of the parking lot (fig. 11) or can be diverted from a small, unnamed creek at the northeast boundary of the parking lot.

A well probably would be the most suitable and reliable supply of water at this site. Water in such a well would probably occur at about the level of Redwood Creek and should be about the same quality as that shown in table 1 for a well in the town of Orick. The well should be about 100 feet deep.



Base from U.S. Geological Survey
Orick quadrangle, 1966
1:24,000

0 ½ 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

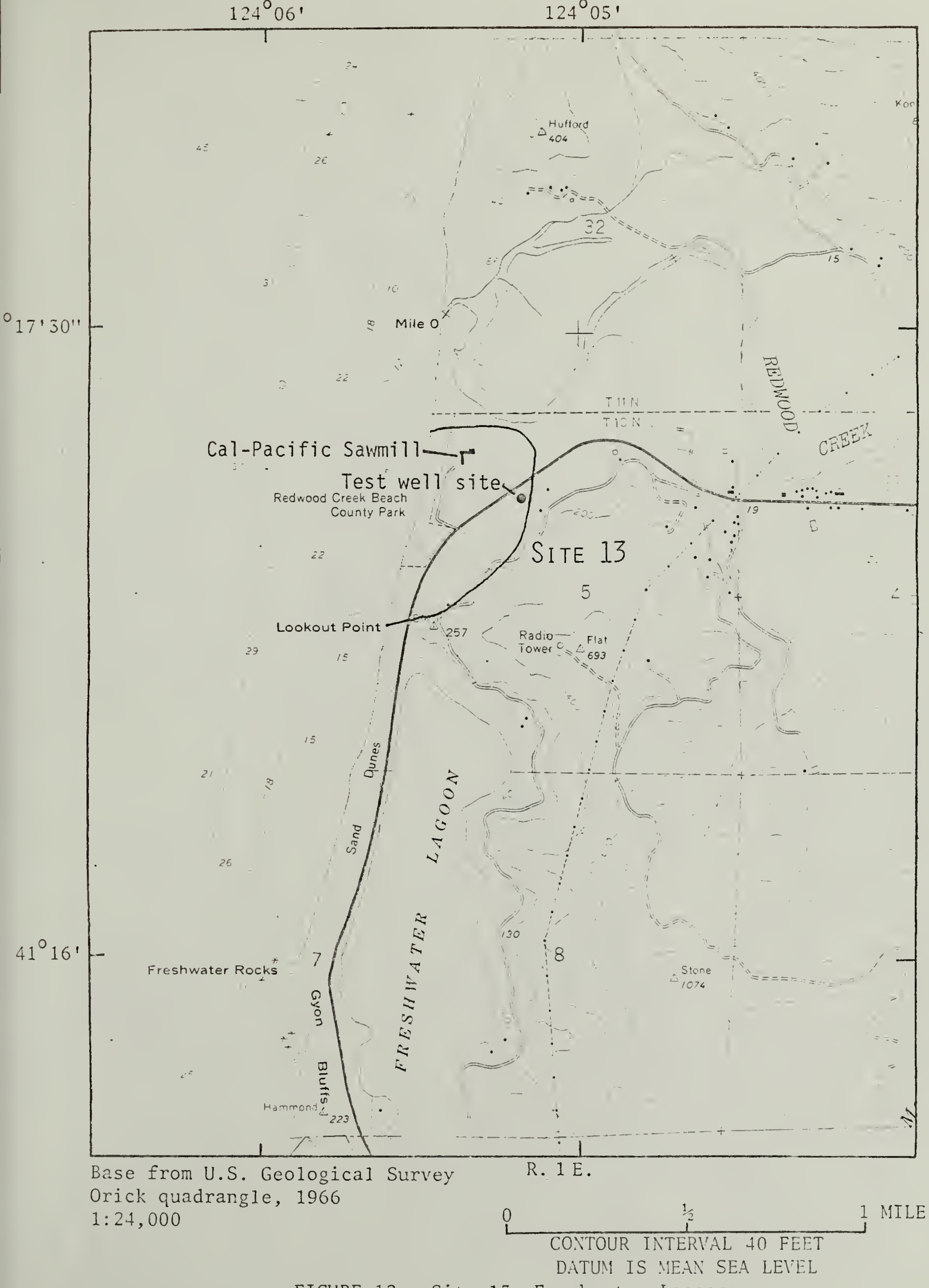
FIGURE 11.--Site 12, Redwood Creek.

SITE 13.--FRESHWATER LAGOON

This site is in beach sand which overlies metamorphic rock of pre-Cretaceous age in the old county park area near the Cal-Pacific sawmill (fig. 12).

The sawmill obtains brackish water for mill use from a shallow well on the Cal-Pacific property. This water is not potable. Water for flushing toilets at the site could be obtained from a well at nearly any convenient location within the outlined area in figure 12, but there is little potential for developing potable water in this area. There is a small chance that well water in the eastern part of the outlined area east of U.S. Highway 101 would be of marginal quality for drinking. The area east of U.S. Highway 101 is swampy, but a well in this area might obtain ground water that is partly from Redwood Creek or from the metamorphic rock forming the ridge at the east boundary of the area. Such water would be of better chemical quality than that nearer the beach.

Potable water might be piped into the park area from the nearby town of Orick (just east of area in figure 12). If this is impracticable, a test well should be drilled to a depth of 50 to 100 feet at the site indicated in figure 12.



Base from U.S. Geological Survey
Orick quadrangle, 1966
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FIGURE 12.--Site 13, Freshwater Lagoon.