UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

WATER-RESOURCES RECONNAISSANCE OF THE BADGER PASS SKI AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

Prepared in cooperation with
the National Park Service

ADMINISTRATIVE REPORT
For U.S. Government use only

Sacramento, California
1965

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Memorandum

To: Superintendent, Yosemite

From: Acting Chief, Division of Land and Water Rights, Western Region

Subject: Ground and surface water reports by USGS

Enclosed are four copies each of the reports listed below:

1. Water-Supply Reconnaissance, Hodgdon Meadow, Yosemite National Park, California by S. E. Rantz, Administrative Report, Menlo Park, December 1964.

2. Effect of Water-Supply Development on the Sequoias of Mariposa Grove, Yosemite National Park, California by S. E. Rantz, Administrative Report, Menlo Park, November 1964.

3. Water Resources Reconnaissance of the Badger Pass Ski Area, Yosemite National Park, California, by Hugh T. Mitten, Administrative Report, Sacramento, 1965.

(Sgd) Manuel Morris

Manuel Morris

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ODC (2) w/c each report
Naturalist, WRO w/c Mariposa Grove

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WATER-RESOURCES RECONNAISSANCE OF THE BADGER PASS SKI AREA, YOSEMITE NATIONAL PARK, CALIFORNIA

By Hugh T. Mitten

INTRODUCTION

The Badger Pass ski area, Yosemite National Park (fig. 1), secs. 21 and 22, T. 3 S., R. 21 E., Mt. Diablo base line and meridian, Mariposa County, Calif., supports a large visitor load during the winter ski season. To supply water to the area, the National Park Service has installed a system consisting mainly of tanks that store water from springs. In dry years or when the ground freezes, because of a lack of snow cover, the water supply is insufficient to maintain reserve storage for periods of large visitor load.

The purpose of this report is to provide the National Park Service with data that will assist them in the development of an additional water supply that can be used when the existing system furnishes less than the required amount of water. The scope of this report includes: (1) Preparation of a reconnaissance geologic map of the Badger Pass ski area, (2) an evaluation of the hydrologic properties of each geologic unit, and (3) an estimate of the quantity and extent of available water.

The field investigation was made on September 15 and 16, 1964. Messrs. Preston, Allcock, Moe, Brown, and Cottrell of the National Park Service provided information during the investigation. The study was made by the U.S. Geological Survey, Water Resources Division, under the direction of Fred Kunkel, district geologist in charge of ground-water investigations in California.

GEOGRAPHIC AND GEOLOGIC FEATURES

The altitude of the Badger Pass ski area ranges from about 7,000 to 7,770 feet above sea level (fig. 2). The area is bounded on the east, west, and south by rounded hills and ridges (fig. 3). Several small intermittent streams drain into Monroe Meadows which forms the headwaters of Grouse Creek.

Monroe Meadows probably was the site of a small snow or ice-field that quarried the rock to form a small ice-gouged basin. A small lake or pool may have filled the basin for a short time after the snow or icefield disappeared, but now the basin contains only a marsh.

Igneous rock of pre-Tertiary age and alluvium of Recent age crop out in the Badger Pass area. The igneous rock is gray, fine- to medium-grained granodiorite, probably the Sentinel Granodiorite. It crops out along Glacier Point Road and at the tops of the hills and ridges in the Badger Pass area. The granodiorite is fractured, at least near the surface (fig. 4). Locally, these fractures probably contain water. However, for practical purposes, the granodiorite can be considered a non-water-bearing rock.

Most of the Badger Pass area that is underlain by granodiorite is covered with brown soil, made up of silt and very fine to fine sand. Near the tops of the hills and ridges, the soil contains fragments of granodiorite and fine- to medium-grained fragments of minerals derived from the granodiorite. The soil probably has low to medium permeability. The thickness of the soil ranges from 0 feet near the crests of the ridges to about 20 feet in the gullies; the soil grades into and merges with the alluvium that underlies the meadows.

The alluvium overlies the granodiorite in Monroe Meadows and in small meadows in the minor tributaries. An 8-foot section of the alluvium was exposed in a pit, dug for a fuel tank, near the base of the ski lift directly south of the lodge. As indicated by this exposure, the upper 2 to 4 inches of the section is a dark-brown-to-black, organic soil. Underlying the soil to a depth of 4 to 5 feet is dark-brown, very fine grained silt and organic matter and plant roots. Gray, fine-grained, poorly sorted sand derived from the granodiorite underlies the brown, very fine grained layer. The sand probably has moderate permeability. When observed in September 1964 the entire exposed section was moist, and water was seeping slowly into the pit. However, only a few shallow puddles were in the bottom of the pit. Therefore, the water table in the vicinity of the pit is deeper than 8 feet.

On the basis of the physiography, the maximum thickness of the alluvium in Monroe Meadows is estimated to be 40-80 feet. Probably the rock basin is deepest and the alluvium is thickest south of the lodge. The alluvium in the small meadows has a maximum thickness of about 20-30 feet. The yield of wells cannot be predicted without drilling and testing. A test well in the alluvium in Monroe Meadows probably would yield 5-10 gpm (gallons per minute), and not more than 25 gpm.

EXISTING WATER SUPPLY AND DRAINAGE SYSTEM

Three springs occur in the Badger Pass area (fig. 2). On September 15 and 16, 1964, the estimated yield each, from springs at points 1 and 3 was 3 to 6 gpm and the yield from the spring at point 2 was 4 to 8 gpm. The ground was damp, but there was no standing or flowing water at points 4 and 5.

The eastern end of a small meadow, about 1,000 feet east of the water tanks, contained as much as 1 inch of standing water in September 1964. Also, a large part of Monroe Meadows either was damp or contained standing water. The eastern part of Monroe Meadows contained the largest quantity of water, and in places the standing water was 1 or 2 inches deep. Several small streams meander from the eastern end of the meadow toward Grouse Creek (fig. 5). Grouse Creek, just downstream from Monroe Meadows, had an estimated flow of 2 cubic feet per second.

The main water-supply system includes 2 springs and 2 water tanks. Water is collected at the springs (points 1 and 2 on fig. 2) in two concrete reservoirs, each 4 feet by 5 feet by $3\frac{1}{2}$ feet. The water moves through pipes by gravity flow into two water tanks, as shown on figure 6. A supplemental water supply is derived from a drainage network and sump in Monroe Meadows.

The supplemental water supply is derived from a sandpit, 6 feet by 6 feet by 4 feet, and about 150 feet of perforated drain tile near the base of the eastern ski lift. Surface water enters this system and flows to a 500-gallon storage sump under the lodge, from which it is pumped for emergency use.

The water used, the visitor load, the yield of the springs to the water system, and the yield of the supplemental water supply were recorded by the National Park Service December 29, 1960-January 4, 1961 (tables 1 and 2). The yield of the springs was measured at the 20,000-gallon tank during the winter of 1960-61. That winter, the discharge from the springs was less than normal, due to weather conditions.

Table 1.--Water used and number of visitors at Badger Pass December 29, 1960-January 2, 1961

[Data from National Park Service]

Day	Water used, in gallons		Number of visitors
	24 hours to 5 p.m.	10 a.m. to 5 p.m.	
Thursday	12,400 4.1 gal/vis	8,100 2.8	2,940
Friday	9,000 3.5	7,500 2.9	2,570
Saturday	12,000 4.5	8,000 3.0	2,640
Sunday	12,100 4.0	8,600 2.8	3,030
Monday	10,900 5.7	5,800 3.0	1,920
Average	11,280 4.3	7,600 2.9	2,620

Table 2.--Yield of two springs and the supplemental supply at Badger Pass on January 4, 1961

[Data from National Park Service]

Source	Yield	
	Gallons per minute	Gallons per day
Spring 1	3	4,320
Spring 2	3.3	4,752
Supplemental supply	6.9	9,936

The area south and southeast of the lodge is a marsh drained by a network of tiles. While the extent of this system is not known, a surface intake is located southeast of the lodge (fig. 6) where about 2 to 4 gpm of surface water was entering on September 15-16, 1964. The system drains westerly toward the edge of the meadow near Grouse Creek. This water is unused at present but could be developed as a nonpotable supply.

PROBABLE EXTENT OF GROUND WATER

The water in the springs in the eastern part of the area comes from soil and alluvium and probably also from fractures in the granodiorite in the upstream channels. The water emerges as springs probably because the granodiorite is close to the surface and thereby reduces the cross-sectional area of the alluvium at the springs. Small quantities of water may be in the soil underlying the gullies to the north, south, and west, but there was little evidence of water in these gullies.

Ground water probably underlies Monroe Meadows. The soil and very fine-grained deposits may hinder downward percolation of water. However, the water in storage beneath the meadow probably is adequate to supply the area, and recharge of water to the meadow probably can maintain the supply. Some of the ground water probably is lost to Grouse Creek through the alluvium and through fractures in the granodiorite.

SUGGESTED WATER SUPPLIES

The eastern end of the small meadow, about 1,000 feet east of the water tanks, is the most promising area for an additional supply of surface water that can move by gravity flow. An estimated 5 to 15 gpm could be obtained.

During the investigation, not all the water in the springs was being captured. An additional 1 to 3 gpm might be developed at each of the three springs.

The eastern end of Monroe Meadows has surface water that can be developed. However, this water would have to be pumped from storage sumps. If the existing supplemental water supply (table 2) indicates the yield of surface water in the meadow, additional development should furnish 6 to 7 gpm.

The largest supply of water available to the Badger Pass ski area probably is ground water that underlies Monroe Meadows. This potential supply inherently has the added advantage of not freezing during periods of peak demand in the skiing season. The yield to wells cannot be determined without a test well, but about 5 to 25 gpm might be obtained from this source. Therefore, if ground water is wanted, exploration should begin by drilling a test well, not less than 6 inches in diameter, through the entire thickness of the alluvium. The well should be drilled where the basin is deepest and the alluvium is thickest. A suggested site is shown on figures 5 and 6.

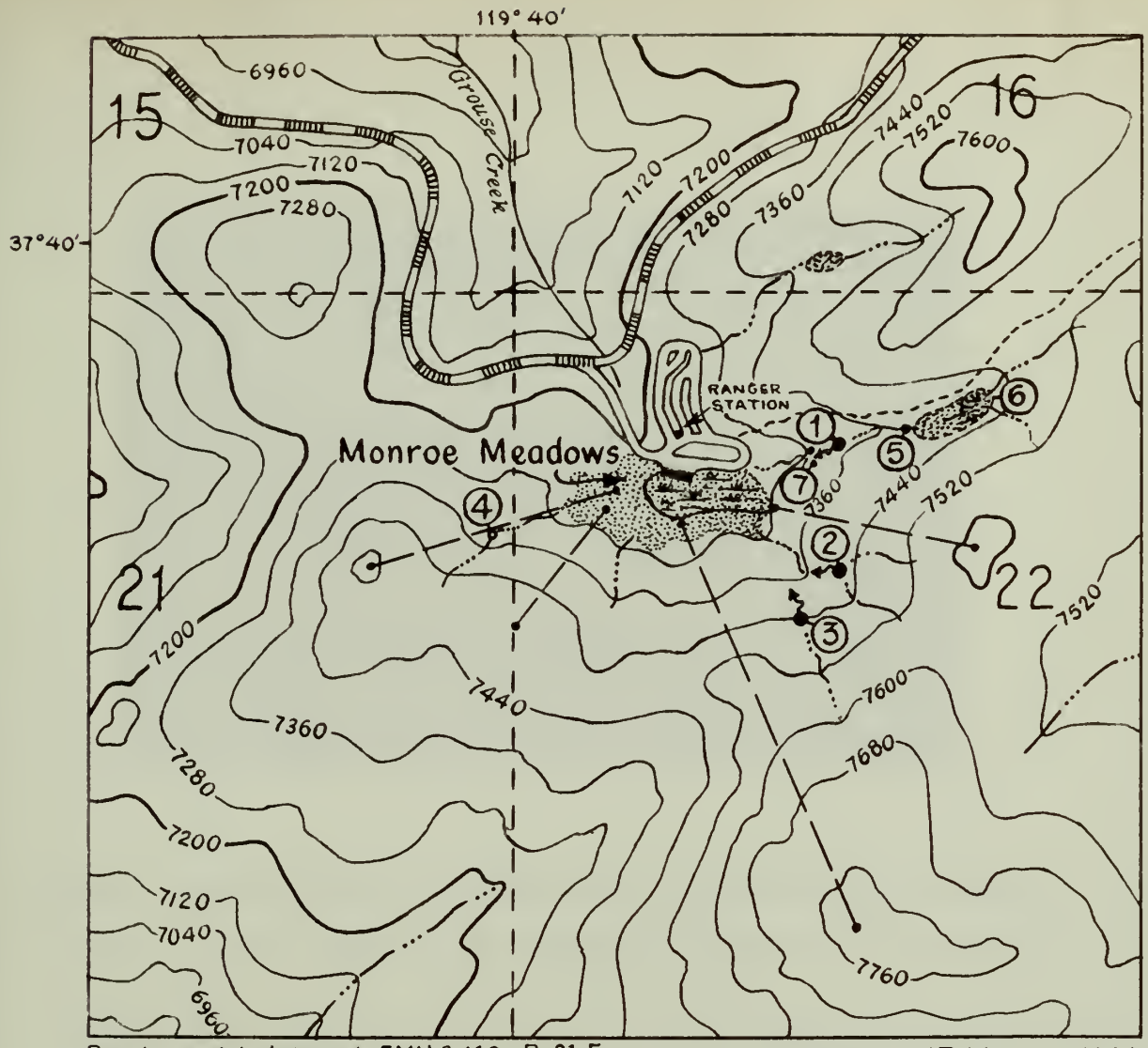
The flush toilets in the lodge and in the rangers' cabin discharge to septic tanks in the Grouse Creek drainage below the meadow. Therefore, the present and proposed water supplies are not likely to be polluted.

SUMMARY

The largest supply of water available to the Badger Pass ski area probably is ground water that underlies Monroe Meadows. Recharge to the ground water probably can maintain this supply. If ground water is wanted, exploration should begin with a test well southeast of the lodge (figs. 5 and 6). An estimated 5 to 25 gpm can be obtained from this source.

Several surface-water supplies are available to the ski area; however, most of these supplies are subject to freezing. An estimated 5 to 15 gpm of surface water can be obtained by gravity flow from a small meadow east of the water tanks. An additional 1 to 3 gpm probably can be obtained by gravity flow from each of the three springs in the eastern part of the area. Also, an additional estimated 6 to 7 gpm of surface water could be obtained from the eastern end of Monroe Meadows. This water would have to be pumped from sumps.

INDEX MAP OF
Yosemite National Park, California



Based on aerial photograph EMH-2-160 and U.S. Geological Survey 7½-minute topographic quadrangle: Yosemite, Calif., 1956

Geology by H.T. Mitten, 1964

EXPLANATION

Alluvium of Recent age

Granodiorite of pre-Tertiary age

Spring
Arrow shows direction of flow

① Spring No 1
② Spring No 2
③ Spring No 3
④ Wet ground
⑤ Wet ground
⑥ Marshy part of meadow
⑦ Water tanks

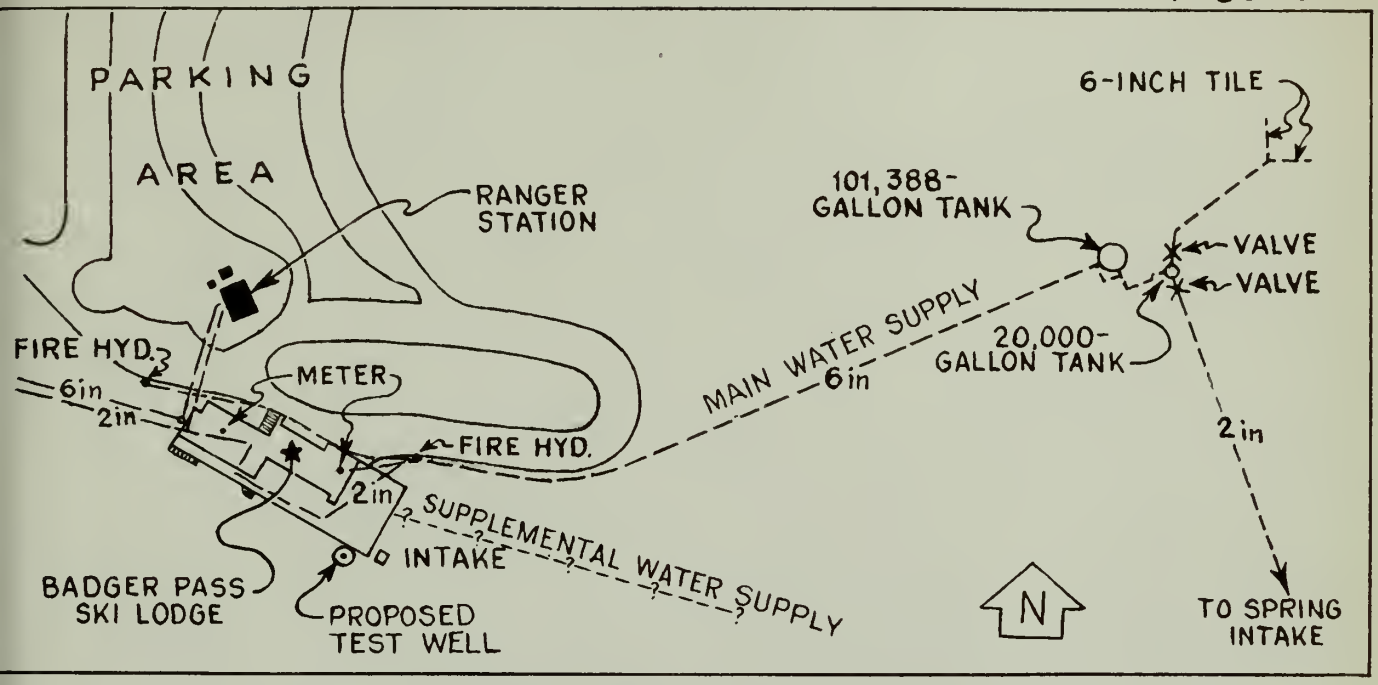
Ski tow

Figure 2.—Reconnaissance geologic map of Badger Pass Ski area, Yosemite National Park, California

Figure 3.--Rounded hills and ridges that rise abruptly from Monroe Meadows. Green plants in the foreground are near the wet part of this meadow.

Figure 4.--Fractured granodiorite on Glacier Point Road, west of the entrance to the Badger Pass ski area.

Figure 5.--View looking northwest at Monroe Meadows. Green shrubs and grass in the lower right-hand corner (eastern end of meadow) indicate marshy conditions. The thin lines in the meadow in front of the lodge are meandering streams that drain into Grouse Creek in the left center of the photograph. The X marks the suggested location of a test well, if ground water is wanted.



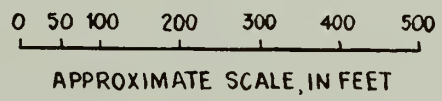


Figure 6.— Map of Badger Pass Ski-Lodge area.

Map modified from National Park Service drawing NP-YOS 2263, June 1962