Water-Supply Possibilities at Capitol Reef National Monument, Utah

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HYDROLOGY OF THE PUBLIC DOMAIN

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ABSTRACT

A water supply of 50 gpm (gallons per minute) is estimated to be sufficient to supply the present and future water demand at the monument. The Coconino sandstone of Permian age seems to be capable of yielding this quantity to a well between 1,500 and 2,700 feet deep in the vicinity of Fruita. Recharge to this aquifer probably is principally from the Fremont River. Water derived from the Coconino sandstone should be of potable quality. A water supply of suitable chemical quality also could be obtained directly from the Fremont River.

INTRODUCTION

PURPOSE OF THE INVESTIGATION

The purpose of this investigation was to evaluate the possibility of obtaining an adequate water supply for the headquarters area of Capitol Reef National Monument from a ground-water source. The National Park Service could then compare the cost of obtaining an adequate ground-water supply for the monument with the cost of an adequate surface-water supply.

LOCATION OF THE AREA

Capitol Reef National Monument is in Wayne County, Utah and occupies parts of Tps. 28, 29, and 30 S., Rs. 5, 6, and 7 E. of the Salt Lake baseline and meridian. However, the present headquarters, and the area where most of the future development will take place, is in the vicinity of the town of Fruita, principally in secs. 14 and 15, T. 29 S., R. 6 E. (pl. 15). This is the area covered by this investigation.

MAP COVERAGE AND PREVIOUS INVESTIGATIONS

Topographic-map coverage of Capitol Reef National Monument on a scale of 1 : 62,500 is complete. Parts of the monument appear on the Fruita, Notom, and Torrey quadrange maps of the U.S. Geological

Survey. Preliminary geologic maps completely cover the area of this investigation and are on a scale of 1:24,000. Several publications that discuss the stratigraphy and structure of the monument and nearby areas are listed in "Selected references" at the end of this report. These reports, however, have few or no references to the ground-water resources of the area.

CLIMATE

The climate at Fruita is warm and dry. The following table shows the annual precipitation at Fruita since the station was established in 1943.

Annual precipitation at Fruita, 1943–58

[From records of U.S. Weather Bureau]

Year	Precipitation (inches)	Year	Precipitation (inches)	Year	Precipitation (inches)
1943	8.46	1949	9.48	1954	4.11
1944	8.43	1950	3.91	1955	5.22
1945	8.20	1951	11.79	1956	4.08
1946	----------	1952	6.18	1957	13.78
1947	8.64	1953	4.89	1958	4.83
1948	6.26				

WATER USE AND FUTURE WATER NEED

About 16,000 persons visited the monument in 1957. Water was stored in two storage tanks near the superintendent's residence for both household and campground use.

In connection with plans formulated under the Mission 66 program, the Park Service estimates that the peak demand for all purposes except irrigation will be about 30,000 gpd (gallons per day) in 1966, and, if sufficient storage facilities are provided, a water supply of about 50 gpm (gallons per minute) should be satisfactory.

GEOLOGY

Geologic formations in the headquarters area of Capitol Reef National Monument range in age from Permian to Recent but Cretaceous and Tertiary formations are absent. The generalized section of the geologic formations in the headquarters area of the monument is shown on table 1. Plate 15 is a geologic map of the same area. The structure in the headquarters area is that of a simple monocline dipping 10° to 13° NE. Plate 16 is a geologic section through Fruita parallel to the general dip of the formations.

WATER RESOURCES

SURFACE WATER

The Fremont River is the principal stream of the area, and its flow is perennial. Its flow is derived chiefly from melting snow on the Fish Lake plateau about 30 miles west of Fruita. Chemical analyses of water from the Fremont River are given in table 2. With proper precautions against bacterial contamination, this water probably could be taken directly from the river for use as a public supply.

The town of Fruita has no municipal water supply, but individual households obtain water for domestic use from the Fremont River and store it in cisterns. The water is chlorinated before use.

Sulphur Creek (pl. 15) is a perennial creek whose source is near the base of Thousand Lake Mountain, about 13 miles northwest of Fruita. Throughout much of its course this creek flows over the Moenkopi formation and as a result its water has a high sulfate content and is very hard. The chemical quality of water from this creek makes it undesirable for domestic use (table 2).

SPRINGS

Dewey Gifford Spring issues from the Moenkopi formation in the NW¼ sec. 23, T. 29 S., R. 6 E. and is reported to flow 10 gpm. A chemical analysis of the water from this spring is given in table 2. Another spring issues from the Navajo sandstone in the NW¼ sec. 14, T. 29 S., R. 6 E. It is likely that other small springs issue from the Navajo sandstone. No springs are known to issue from the Coconino sandstone in this area.

WELLS IN ALLUVIUM

Alluvium occurs along Sulphur Creek and along the Fremont River in the vicinity of Fruita. This alluvium consists principally of fine-grained detritus derived from the shales of the Moenkopi and Chinle formations. Some boulders and gravel occur in the alluvium, but these are mixed with the finer grained material. It is unlikely that an adequate water supply for the monument could be developed from this body of alluvium owing to its fine-grained character. However, there are no wells in the alluvium, and its water-bearing properties perhaps should be tested before other sources of water are investigated. Water occurring in the alluvium along Sulphur Creek would probably be unsuitable in chemical quality (table 2); however, water occurring in the alluvium below the junction of Sulphur Creek and the Fremont River may be acceptable for a public supply.

TABLE 1.—*Generalized section of the geologic formations and their water-bearing properties in the headquarters area, Capitol Reef National Monument, Utah*

[Adapted from Luedke (1953, 1954) and Smith and others (1957a, b)][1]

System	Series	Formation		Approximate thickness (feet)	Physical character	Water-bearing properties
Quaternary	Recent and Pleistocene	Undifferentiated deposits		<50	Alluvium, terrace gravel, pediment gravel.	Alluvium along parts of the Fremont River might supply limited amounts of water to shallow wells. Other Quaternary deposits are commonly not saturated.
			Unconformity			
Jurassic		Glen Canyon group	Navajo sandstone	750	White to yellow fine-grained sandstone.	Supplies large quantities of water to wells in some parts of the Colorado Plateau.
Jurassic (?)		Glen Canyon group	Kayenta formation	245	Irregularly bedded white to reddish-brown siltstone, conglomerate, and very fine to medium-grained sandstone.	The fine-grained character of this formation makes it unlikely that large water supplies could be developed from it.
Triassic	Upper Triassic	Glen Canyon group	Wingate sandstone	320	Fine-grained reddish-brown cliff-forming sandstone, massive and crossbedded.	Jointing makes this formation permeable and enables wells to derive moderate to large quantities of water from it.
			Unconformity			
Triassic	Upper Triassic	Chinle formation		510	Variegated claystone, pale-red and greenish-gray limestone, very fine to medium-grained sandstone, and lenses of conglomerate near base.	Some water might be produced from the conglomerate at the base, but it would likely have a high content of chemical constituents.

		Unconformity			
	Lower and Middle(?) Triassic	Moenkopi formation	950	Reddish-brown and some yellow thin-bedded siltstone, claystone, and fine-grained sandstone and gypsum; yellowish-gray limestone and dolomite; chert-pebble conglomerate locally at base.	The fine-grained character of most of this formation makes it unlikely that large water supplies could be developed from it. Water from this formation would likely have a high sulfate content.
		Unconformity			
Permian		Kaibab limestone	185	White calcareous siltstone and silty limestone containing chert layers and nodules; thin crossbedded white fine-grained sandstone and some dolomite.	Small water supplies might be developed from fractures and solution cavities in this formation.
		Coconino sandstone	[2] 800+	Yellowish very fine to fine-grained sandstone.	Development of about 50 gpm, principally from fractures in this formation, should be possible.

[1] Luedke, R. G., 1953, Stratigraphy and structure of the Miners Mountain area, Wayne County, Utah: U.S. Geol. Survey open-file report, 94 p.
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——— 1957b, Preliminary geologic map of the Notom 2 SE quadrangle, Utah; U.S. Geol. Survey Mineral Inv. Field Studies Map MF 107.

[2] Base concealed; actual thickness 1,231 ft in oil-test well, 8 miles west-southwest of headquarters.

Table 2.—*Chemical analyses of water from selected sources in the headquarters area, Capitol Reef National Monument, Utah*

[Chemical constituents in parts per million]

Source and location	Date of collection	Specific conductance, in micromhos at 25° C	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	
Fremont River near Fruita	July 1, 1949	760	------	------	77	26	30	7.8
Do	July 22, 1949	710	------	------	75	27	28	9.0
Do	Aug. 31, 1949	720	------	------	74	25	28	10
Do	Oct. 3, 1951	680	39	2.1	108	18	32	
Do	Sept. 25, 1958	686	29	------	79	27	32	
Sulphur Creek near Fruita	Aug. 31, 1949	3,400	------	------	369	150	142	70
Sulphur Creek near Park headquarters	Sept. 25, 1958	2,780	23	------	371	182	125	
Dewey Gifford Spring near Fruita	Oct. 3, 1951	1,275	43	.2	215	32	70	

Source and location	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved soilds	Hardness as $CaCO_3$		pH	Analyzed by—
							Calcium, magnesium	Noncarbonate		
Fremont River near Fruita	186	198	23	------	.2	------	299	17	------	Atomic Energy Commission.
Do	184	188	23	------	.4	------	298	16	------	Do.
Do	172	197	24	------	.1	------	288	17	------	Do.
Do	165	203	23	.4	1.1	526	350	------	8.2	Utah State Department of Public Health.
Do	194	183	19	------	.8	465	307	148	7.3	U.S. Geological Survey.
Sulphur Creek near Fruita	175	1,890	111	------	.4	------	1,540	------	------	Atomic Energy Commission.
Sulphur Creek near Park headquarters	197	1,640	55	------	.8	2,490	1,680	1,510	7.6	U.S. Geological Survey.
Dewey Gifford Spring near Fruita	232	513	35	.5	1.8	1,050	680	------	7.8	Utah State Department of Public Health.

WELLS IN BEDROCK

No wells have been drilled into the bedrock within the area of this investigation. Outside of the area most of the deep wells were drilled as tests for oil and gas and do not yield significant information about the quantity or quality of water reached. On the basis of the surface geology and hydrologic conditions, the Coconino sandstone might be expected to yield about 50 gpm—the quantity of water desired. Although it is very fine to fine grained, and hence of low primary permeability, the Coconino sandstone is fractured in many places (J. F. Smith, Jr., written communication, 1959), with the result that it may be relatively permeable. At the town of Fruita, the depth to the top of the Coconino sandstone should be about 1,370 feet below the surface, and it should have a thickness greater than 800 feet and perhaps as much as 1,230 feet (pl. 16). The water level in a well at this location should be near the land surface. The well may even flow naturally.

If a test well is drilled into the Coconino sandstone, the overlying Kaibab limestone should be tested by the same well. It is unlikely that the Kaibab limestone alone would yield sufficient water to supply the monument. However, water from the Kaibab limestone might make a significant addition to a supply developed primarily from the Coconino sandstone.

The principal recharge to this aquifer probably comes from the Fremont River and to a smaller extent from Sulphur Creek. Both streams flow across extensive areas in which the Coconino sandstone forms the streambed (pl. 15). J. F. Smith, Jr., who was in charge of the geologic mapping of this area for the U.S. Geological Survey, reports (written communication, 1959) that fractures in the Coconino sandstone are particularly numerous along the Fremont River canyon west of Fruita. The presence of fractures should facilitate any recharge from the Fremont River into the Coconino sandstone in this area.

The quality of water from the Coconino sandstone in this area is unknown. However, the chemical analyses of the two recharge sources (Fremont River and Sulphur Creek) are given in table 2. The Coconino sandstone is not as extensively exposed in the streambed of Sulphur Creek as it is in the streambed of the Fremont River. Therefore, the Fremont River should be a more important source of recharge than Sulphur Creek, and the quality of the water from the Coconino sandstone, except as it is modified by passing through the formation, should be more nearly like that of the Fremont River than that of Sulphur Creek. A chemical analysis of a representative rock sample of the Coconino sandstone showed that its composition was as follows:

Chemical analysis of sample of the Coconino sandstone

[Source: J. F. Smith, Jr. (written communication, 1959)]

	Percent		Percent		Percent
SiO_2	98.4	CaO	0.04	P_2O_5	0.02
Al_2O_3	1.0	Na_2O	.12	MnO	.00
Fe_2O_3	.12	K_2O	.08	H_2O	.25
FeO	.00	TiO_2	.04	C_2O	.05
MgO	.06				

Water passing through rock of this composition from the Fremont River to Fruita, a distance of 1 to 2 miles, should remain reasonably potable. It is recommended that a test-well site be selected in Fruita rather than at the monument headquarters. The Fruita vicinity is directly downdip from the Fremont River, and recharge is more apt to come from the Fremont River than from Sulphur Creek.

CONCLUSIONS

Two feasible sources of water for the headquarters area at Capitol Reef National Monument are: (a) the Fremont River and (b) a well between 1,500 and 2,700 feet deep to obtain water from the Coconino sandstone. A favorable area for the location of a test-well site is shown on plate 15. Because no wells in this area tap the Coconino sandstone, neither the yield nor the quality of the water from such a well can be predicted accurately. However, it is estimated that the Coconino sandstone is capable of yielding about 50 gpm of water of relatively good quality to a well drilled in the Fruita vicinity.

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