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R 290
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Table 1.--Description of geologic units known to underlie parts of the lower Dirty Devil River basin area--Continued

Eratem	System	Series	Geologic unit	Character of material	Hydrologic characteristics
MESOZOIC (200MSZC)	Jurassic (220JRSC)	Middle Jurassic	Carmel Formation (221CRML)-- Continued		Water in the Carmel Formation in the easternmost part of the area ranges from fresh to slightly saline and consists of mixed types. In the central and western parts, the water ranges from slightly saline to very saline. Brine probably occurs locally in the northwestern part, as at petroleum test (D-25-5)14dbb-2 (table 8). In most of the water, sulfate is the dominant anion, but some of the moderately to very saline water is of the sodium chloride type.
		Lower Jurassic	Navajo Sandstone (220NVJO)	White, tan, and buff thickly and intricately crossbedded very fine to fine-grained eolian sandstone (fig. 7). Locally light-orange or yellow. Grain size may be slightly greater in eastern part of area. Calcareous cement in some outcrops but poorly to well-cemented with silica where deeply buried. (See Hood and Danielson, 1979, for description of character in T. 28 S., Rs. 7 and 8 E.) In eastern part of area, Baker (1946, p. 68) found thin lenticular beds of red to purplish shale and occasional lenses of light-brown limestone as much as 6 feet thick. The shale beds were found in test hole (D-27-11)34ddb-1D (tables 6 and 10); they apparently diminish in occurrence where the formation is thicker to the west. Limestone lenses also were noted by Gilluly (1929, p. 98) in the San Rafael Swell. Such limestone was found at the bottom of well (D-26-8)6aab-1. In addition to the shale at the base of the Carmel Formation, a second shale or shaly sandstone zone was found 60 to 90 feet below the first; the second shale marker also persists through much of the area. Thickness ranges from about 450 feet near the Green River to about 1,100 feet in the western mountains. (See fig. 8.)	Very low to moderate permeability. Undisburbed, unfractured, and unleached parts of formation have a K of about 0.5 ft/d. (See Hood and Danielson, 1979.) Fracturing where formation is folded or faulted has effectively increased K, but areas of higher K are erratically distributed. In the Red Desert, the average K is 1.7 ft/d. At two wells in T. 29 S., R. 4 E. (table 2), K is estimated to be 11 to 60 ft/d in an area where the sandstone stands nearly on edge at a fault zone. Large yields can be obtained from the formation where it is fully saturated, thick, and under confined conditions. Well (D-28-8)33bbb-1 discharged 2,800 gal/min for 35 days, with a total drawdown of 512 feet. At test holes drilled by the Geological Survey, the yields by air-lift pumping were estimated to be 200 gal/min, the maximum that the air pressure and volume would yield (see table 6). Chemical quality of water in most of the sandstone ranges from freshwater of mixed types to moderately saline water, also of mixed types. A sodium chloride brine was found in test hole (D-27-7)7bcc-2.
		Triassic(?)	Kayenta Formation (231KYNT)	Irregularly interbedded red, reddish-brown, buff, gray, and lavender shale, siltstone, and fine- to coarse-grained sandstone, in part conglomeratic, with minor beds of limestone. Contact with overlying Navajo Sandstone is transitional in some areas. 180 to 350 feet thick, increasing from northwest to southeast. Shale diminishes southeastward.	Very low(?) to low(?) permeability. Formation is a confining bed of lower permeability relative to the adjacent sandstone aquifers. Leakage through the formation is probably where it is sandiest or fractured. Springs or seeps occur near the contact with the Navajo Sandstone in the bottoms of canyons tributary to the Dirty Devil and Green Rivers. Water sample from spring (D-27-16)20bdc-S1 was fresh, but the formation, where deeply buried, probably contains saline water.
		Upper Triassic(?)	Wingate Sandstone (231WNGT)	Reddish-brown, buff, and grayish-orange very fine to fine-grained thickly crossbedded calcareous eolian sandstone. Formation is poorly to well-indurated. Most exposures are vertical cliffs (fig. 9) with dark-brown desert varnish on weathered surfaces. 270 to 400 feet thick, increasing from west to east.	Very low to moderate(?) permeability. Based on single sample (table 11), K may be 10 to 20 times lower than most permeable samples of Navajo Sandstone tested. Permeability can be inferred to be low to moderate where formation is strongly jointed or fractured (fig. 10). Yields small quantities of fresh to moderately saline water to a few springs where rock is jointed. Because of low permeability, the sandstone, where buried, probably contains water more saline than that in the Navajo.
		Triassic	Church Rock(?) Member (231CCRK) Owl Rock Member (no code assigned) Petrified Forest Member (231PFDF) Moss Back Member (231MBCK) Monitor Butte Member (231MNRB) Shinarump Member (231SRMP) Temple Mountain Member (231TMPM)	Seven members or lithologic equivalents mostly of fluvial and lacustrine origin; not all members present in any given locality. Mudstone, siltstone, sandstone, and some conglomerate in various shades of purple, red, and brown. See also Stewart and others (1972) and Williams and Hackman (1971, sheet 1). Moss Back Member: Yellowish-gray fine- to medium-grained lenticular conglomeratic sandstone; minor mudstone seams, limestone conglomerate, and coaly material. Shinarump Member: Light-gray to yellow fine- to coarse-grained sandstone and conglomerate sandstone with minor mudstone lenses and plant remains. In vicinity of Capitol Reef National Park, thickness ranges from 0 to 90 feet, and locally the member consists of discontinuous channel fillings (Smith and others, 1963, p. 16-20).	Very low to low(?) permeability. Most of formation is too fine grained to accept much recharge; conversely, it enhances surface runoff and contributes much sediment to surface water. May yield small amounts of water to seeps. Water recovered from two petroleum-test wells ranged from moderately saline of the sodium bicarbonate type to very saline with chloride being the dominant anion.
		Chinle Formation (231CHNL)	Total thickness of Chinle Formation is 215 to 550 feet, increasing from northeast to southwest.		
		Middle Triassic(?)	Upper part of Moenkopi Formation	Reddish-brown even-bedded fissile mudstone and siltstone and fine-grained sandstone with thin layers and veins of gypsum and anhydrite. Locally petroliferous. 200 to 775 feet thick.	Moenkopi as a whole has very low to low(?) permeability. Sandstone(?) units in and near outcrop areas yield small quantities of fresh to slightly saline water. Well (D-24-9)7dab-1S (table 6) indicates same is probably true for higher areas of outcrop in the San Rafael Swell and mountainous areas. Records from petroleum-test wells show that the formation, where deeply buried, yields moderately to very saline water of mixed types.
		Lower Triassic	Sinbad Limestone Member (237SNBD)	Yellowish-gray and tan thin- to medium-bedded oolitic dolomite and limestone with minor amounts of siltstone and sandstone. 12 to 200 feet thick.	Probably very low permeability in most areas; where the limestone is near the surface or has been strongly fractured, ground-water circulation probably has caused cavernous development and thus enhanced the permeability. The estimated K at well (D-29-5)32bad-1 is 10 ft/d (table 2). Samples from petroleum-test wells indicate the limestone, where deeply buried, contains moderately to very saline water.