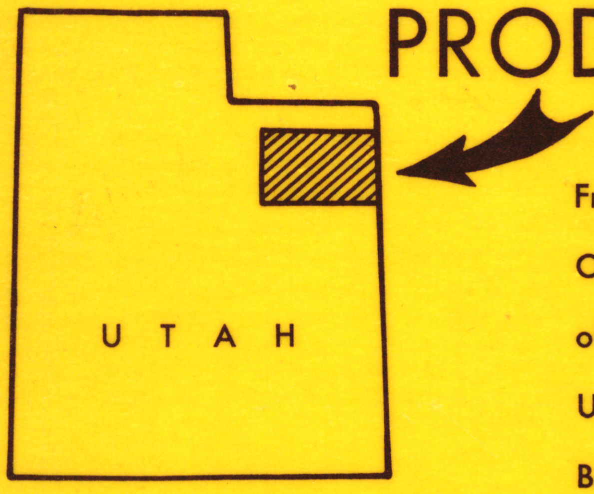
WATER-RESOURCES BULLETIN 1
1962

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
affiliated with
THE COLLEGE OF MINES AND MINERAL INDUSTRIES
UNIVERSITY OF UTAH

WATER PRODUCTION



From Oil Wells of the UINTA BASIN

Prepared by
THE U. S. GEOLOGICAL SURVEY
in cooperation with
THE UTAH OIL AND GAS CONSERVATION COMMISSION
and
THE STATE ENGINEER OF UTAH
Price $1.00

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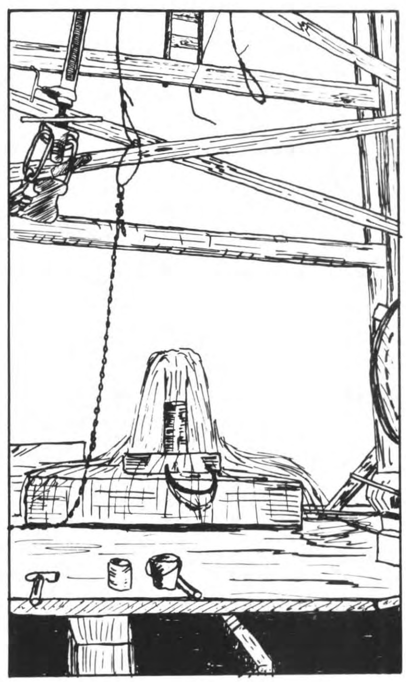
WATER-RESOURCES BULLETIN 1

WATER PRODUCTION FROM OIL WELLS OF THE UINTA BASIN UINTAH AND DUCHESNE COUNTIES, UTAH

by Harry D. Goode and Richard D. Feltis
Geologists, U. S. Geological Survey

Oil-test well in sec. 28, T. 3 S., R. 21 E., flowing water at rate of 10,000 barrels a day. (From photograph by E. W. Henderson, October 2, 1936)



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WATER PRODUCTION FROM OIL WELLS OF THE UINTA BASIN, UINTAH AND DUCHESNE COUNTIES, UTAH

By Harry D. Goode and Richard D. Feltis
Geologists, United States Geological Survey

ABSTRACT

Water production from individual oil wells in the Uinta Basin ranges from 0 to 2,920,000 barrels (about 380 acre-feet) per year. The total dissolved solids in the water ranges from 500 to 26,000 ppm (parts per million); thus some of the water is classified as fresh and can be used, whereas the highly mineralized water, a minor percentage of the total water produced in the Uinta Basin, must be disposed of to prevent pollution of local fresh-water supplies.

Oil-field-water production in the Uinta Basin annually exceeds 90 percent of the total production in the State, and of this amount about 99 percent is the combined production of the Ashley Valley, Red Wash, and Roosevelt oil fields. Most of the water is from the fresh-water-producing Ashley Valley field, whose production has increased over the years because its water-to-oil yield has increased. Continued development of the Red Wash field has increased production of highly mineralized water. The total annual water production in the Uinta Basin has increased from 700,000 barrels in 1952 to 20,500,000 barrels (2,600 acre-feet) in 1960.

The Ashley Valley oil field is the main water producer in the Uinta Basin. During 1960, more than 18,700,000 barrels (2,400 acre-feet) of water was obtained from 27 wells. The sum of the dissolved solids of the water ranges from 500 to 2,000 ppm. Although the water has a high sodium content, from 50 to 550 ppm, there is sufficient gypsum in the soil to offset the hazard of soil deflocculation, so that the water is used for irrigation in the vicinity of the field and eventually drains into the Green River.

Water production in the Red Wash oil field increased from 0.6 percent of the total Uinta Basin production in 1952 to 7.8 percent in 1960. This increase was the result of oil-field development. Total dissolved solids of the water range from 4,500 to 26,000 ppm, with sodium chloride the principal constituent. The water in the central part of the field is discharged into evaporation ponds, but in the western part of the field it flows into the natural drainage.

A pilot project of injection of the water into the producing formation to promote secondary recovery of oil was begun in February 1961, in the western part of the field. When this project is put into full operation, all water now produced by wells in the western part of the field will be re-injected into the producing formation.

The water production of the Roosevelt oil field has increased from 16,000 barrels in 1952 to 152,000 barrels in 1960, but its percentage of total basin production of water decreased from a high of 5.6 in 1953 to 0.7 in 1960. Total dissolved solids in the water range from about 9,000 to 11,000 ppm. The water is discharged into evaporation ponds.

Other oil fields in the Uinta Basin produce water, but commonly in amounts less than 5,000 barrels per year. These oil fields contain 1 to 4 wells, and evaporation ponds are used to dispose of the water.

Several oil-test wells, which have produced water that contains about 350 to 2,000 ppm dissolved solids, have been completed as water wells.

INTRODUCTION

The work included in this study was done as a cooperative project between the U.S. Geological Survey, the Utah State Engineer, and the Utah Oil and Gas Conservation Commission.

The area investigated includes about 4,000 square miles in Uintah and Duchesne Counties (pl. 1). In this area are most of the producing oil and gas wells of the Uinta Basin.

Purpose and Scope of the Study

This study was begun in 1958 to determine how much and what kinds of water are being produced by oil wells in the Uinta Basin. This information is needed by State authorities to determine usability of the water and by Federal and State authorities to determine what protective measures may be needed to prevent water of poor quality from polluting usable ground and surface water in the vicinity.

The work included collection and compilation of oil- and water-production data, chemical-quality-of-water data, and geologic information from well logs and published reports. About 30 samples of water were collected and analyzed for dissolved chemical content, and the results were compared with analyses of samples collected by others. The water-disposal systems were examined at Red Wash, Ashley Valley, and Roosevelt fields. Records of oil, gas, and water production of about 200 wells in the Uinta Basin were examined and compared with similar records of about 600 wells in other parts of the State.

The information compiled and collected indicated a wide variation in characteristics of the different oil fields. Water-to-oil ratios and quality-of-water data show that geologic structure and minerals in the rocks affect the quantity and quality of water produced. Future trends of water production probably can be predicted after study of the geology, past production trends, and production methods used in individual fields.

Acknowledgments

Most of the data on which this report is based were supplied by the Utah Oil and Gas Conservation Commission and by the Branch of Oil and Gas Operations of the U.S. Geological Survey.

The authors are grateful to the following oil and gas producers for help in collecting water samples from their wells and for permission to report on their operations: in the

Ashley Valley field, the Pan American Petroleum Corp., Equity Oil Co., Hollandsworth and Travis, and Robert F. Six, independent producer; in the Red Wash field, the California Oil Co.; and in the Roosevelt field, the Humble Oil and Refining Co.

The chemical analyses of water were made by the Geological Survey, Quality of Water Branch, Salt Lake City, and Branch of Oil and Gas Operations, Casper, Wyo.; and by the Utah State Department of Public Health.

Classification of Natural Water

Natural water can be classified arbitrarily as fresh, saline, or briny by its concentration of dissolved solids or specific conductance. In this report, the classification of water is that used by Robinove, Langford, and Brookhart (1958, p. 3) who state "Fresh water is classified as that containing dissolved solids of less than 1,000 ppm or having a specific conductance of less than 1,400 micromhos at 25°C. Saline water is classified as follows:

Class	Dissolved Solids (ppm)	Specific Conductance (micromhos at 25° C.)
Slightly saline	1,000 to 3,000	1,400 to 4,000
Moderately saline	3,000 to 10,000	4,000 to 14,000
Very saline	10,000 to 35,000	14,000 to 50,000
Briny	More than 35,000	More than 50,000"

DISPOSAL OF OIL-FIELD WATER

Water which is brought to the surface by oil wells in the same or different oil fields ranges widely in both quantity and quality, and therefore may be subject to varying degrees of control to prevent ill effects on existing local fresh-water supplies. There is no set standard by which to appraise adequately the interrelation of usable water and oil-field water that may act as a pollutant, but prudent investigation of the possible effects that oil-field water may have on usable supplies should suggest the courses to be followed in each individual case.

The Geological Survey and the Utah Oil and Gas Conservation Commission have nearly the same requirements in regard to pollution and surface damage in connection with oil and gas operations. The oil and gas operating regulations (30CFR 221.32) of the Geological Survey applicable to Federal and Indian lands, except the Osage Indian Reservation, state that the lessee or operator shall not pollute streams, damage the surface, or pollute the ground water of the leased or other land. The general rules and regulations (Rule C-17) of the Utah Oil and Gas Conservation Commission state that the owner or operator shall take all reasonable precautions to avoid polluting streams and ground water. If useless liquid products of wells cannot be treated or destroyed, or if the volume of such products is too great for disposal by usual methods without damage, then the requirement of both agencies is that it must be consulted and the useless liquids disposed of by some method approved by it.

The extent of compliance with Survey and Commission requirements, of the effectiveness and adequacy of the methods being utilized for disposal of useless liquids, and of any need for corrective action can be indicated by appraisals of problem areas to define local hydrologic and geologic situations and to evaluate the usability of the surface- and ground-water supplies. Water from oil fields not properly disposed of and which contains amounts of dissolved solids that would appreciably increase the concentration of dissolved solids in nearby ground water or surface water can force a change in use of the ground water or surface water. The relation of quality of water to use is discussed by Hem (1959, p. 237-254).

Water that is determined to be a hazard to usable supplies can be disposed of by (1) storage in evaporation ponds, (2) injection back into the producing formation, or (3) injection into another subsurface formation that contains water of similar chemical characteristics.

Evaporation ponds are satisfactory if constructed to prevent leakage into the ground.

Injection of the water into producing or other subsurface formations is a convenient method of disposal provided it is economically feasible. This process can aid in recovery of gas or oil where disposed water is injected into the producing formation.

GEOLOGY

All geologic data presented here, except the structure map, were taken from published sources; these sources are listed in the selected bibliography (p. 22) and are cited at appropriate places in the text and on the illustrations. The structure map was plotted from well logs supplied by oil and gas lessees and operators to the Branch of Oil and Gas Operations of the Geological Survey or to the Utah Oil and Gas Conservation Commission.

Stratigraphy

Rocks exposed within the area shown on the geologic map (pl. 2) range in age from Precambrian to Recent, but Tertiary sedimentary rocks so predominate in the central part of the Uinta Basin that wells 10,000 feet deep do not penetrate the Tertiary section completely.

The thickness, description, and water-bearing properties of the formations shown on the geologic map or penetrated by oil wells in the area studied are shown on table 1.

Structure

The Uinta Basin is an asymmetric downwarped intermontane syncline whose axis is concave southward and generally parallel to the eastward-trending Uinta Mountains to the north. Beds that form the north flank of the syncline dip steeply southward away from the flanks of the Uinta Mountains; beds that form the south flank dip only 1° to 3° northward toward the axis of the syncline. In detail this broad synclinal structure is complicated by local anticlines near and on both sides of the axis. The oil and gas of the principal oil fields discussed in this report, Ashley Valley, Red Wash, and Roosevelt fields, were trapped in these small anticlines. The structure map (pl. 3) shows the configuration of the central part of the Uinta Basin.

The Ashley Valley field is on a 300-foot structural closure on the axis of the westward-plunging Section Ridge anticline (pl. 3). Oil is produced from the Paleozoic Weber sandstone and Phosphoria formation from a depth of about 4,200 feet. A detailed structure map of the Weber sandstone in the field has been completed by Peterson (1957, p. 192).

The Red Wash field is on a gentle northwest-to-west-plunging anticline which is south of and parallel to the axis of the Uinta Basin. Oil production is principally from the Douglas

Creek and Garden Gulch members of the Green River formation, from depths of 5,000 to 6,000 feet. The oil is confined in stratigraphic traps of discontinuous lenticular bodies of sandstone.

The Roosevelt field is on another gentle westward-plunging anticline south of and parallel to the trend of the basin axis. This field is about 10 miles east of the deepest part of the basin. Wells penetrating oil shale in the basal part of the Green River formation produce oil from a depth of about 9,300 feet. An extensive fracture system provides a reservoir.

Data gathered during development of the other oil fields in the Basin have been insufficient to outline definite structural features or stratigraphic controls.

OIL-FIELD WATERS OF THE UINTA BASIN

Water is brought to the surface with oil in nearly all oil wells in the Uinta Basin. The quantity and quality of water produced varies from one well to another within an oil field and, to an even greater degree, between oil fields. The gas and oil fields within the area of this report are shown on plate 1.

Water production of the Uinta Basin oil fields annually exceeds 90 percent of the total State production (fig. 1). The Ashley Valley, Red Wash, and Roosevelt oil fields produce about 99 percent of the total basin production, and the remaining 1 percent is produced from the Brennan Bottom, Gusher, and Duchesne oil fields, which contain one to four wells each.

Yearly water production in the basin has increased from 700,000 barrels in 1952 to 20,500,000 barrels (2,600 acre-feet) in 1960 (fig. 2). This increase is the result of increased water-to-oil yield in the Ashley Valley field and of continuing oil-field development in the Red Wash area.

Chemical analyses of water from Uinta Basin oil fields were made from samples collected since 1930 (table 2). The water has a dissolved-solids content ranging from about 500 to 26,000 ppm, which classifies the water as fresh to very saline.

There is a noticeable difference in the quality of water from the Ashley Valley field and that from the other oil fields in the basin. The relative freshness of the Ashley Valley water is probably due to the hydraulics of the oil field and to the type of rocks that yield the water. These factors will be considered later in the report.

The present methods of disposal of saline oil-field water in the basin include the use of evaporation ponds or the natural drainage systems and the injection of the water back into the producing formation. The water from the Ashley Valley field is fresh enough to be used for irrigation in the area adjacent to the field.

Ashley Valley Field

Water production from the Ashley Valley field during 1960 accounted for about 91 percent of the total water produced from all Uinta Basin oil fields (fig. 1). The yield of water has increased from nothing in 1948 to more than 18,700,000 barrels (2,400 acre-feet) in 1960 (fig. 2). Twenty-seven of the 30 original wells of the field were producing oil and water in 1960, and the water yield from an

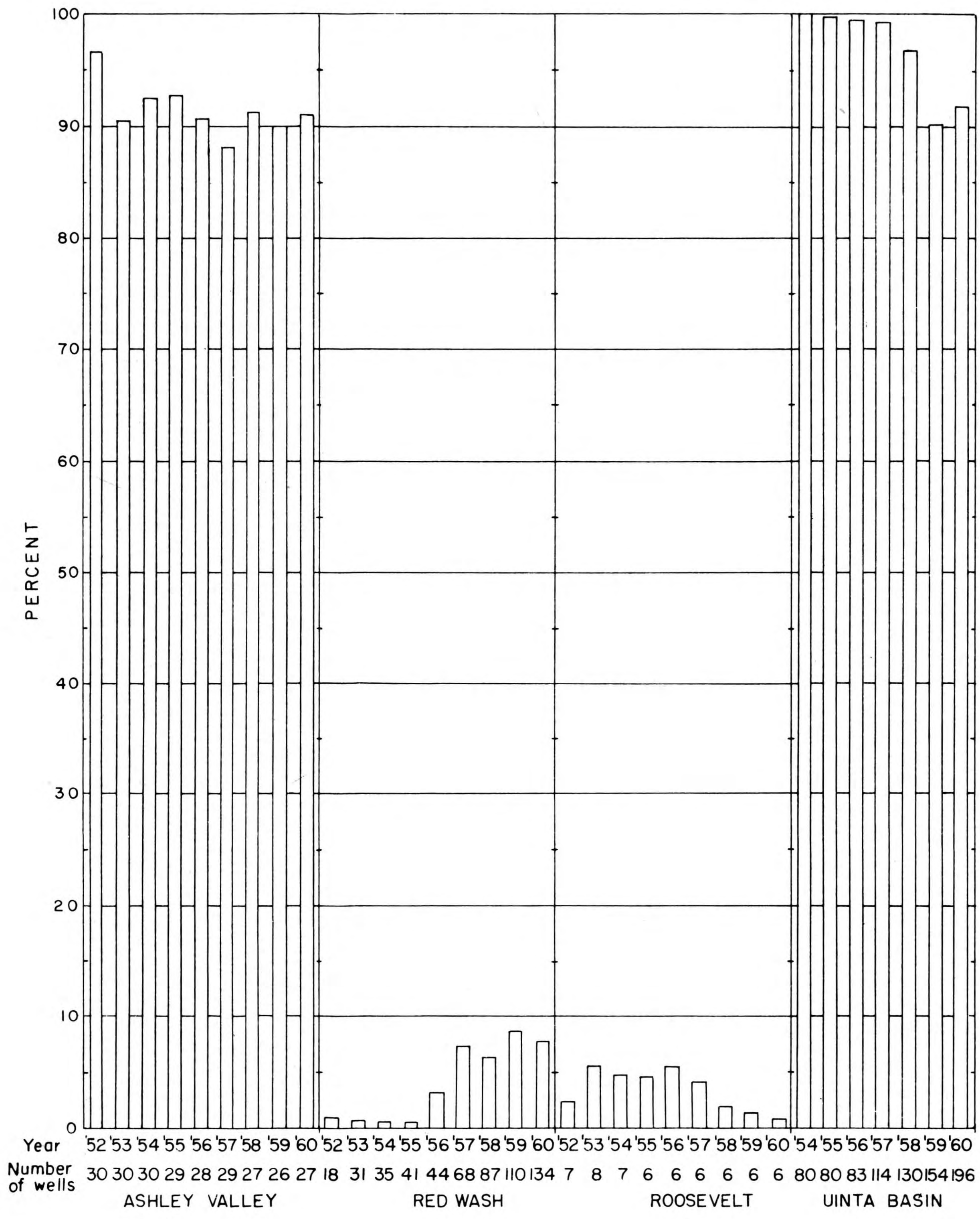

Figure 1.—Production of water from the Ashley Valley, Red Wash, and Roosevelt oil fields in percentage of production from the Uinta Basin, and production of water from all oil fields in the Uinta Basin in percentage of total water production from all oil fields in Utah, 1952-60

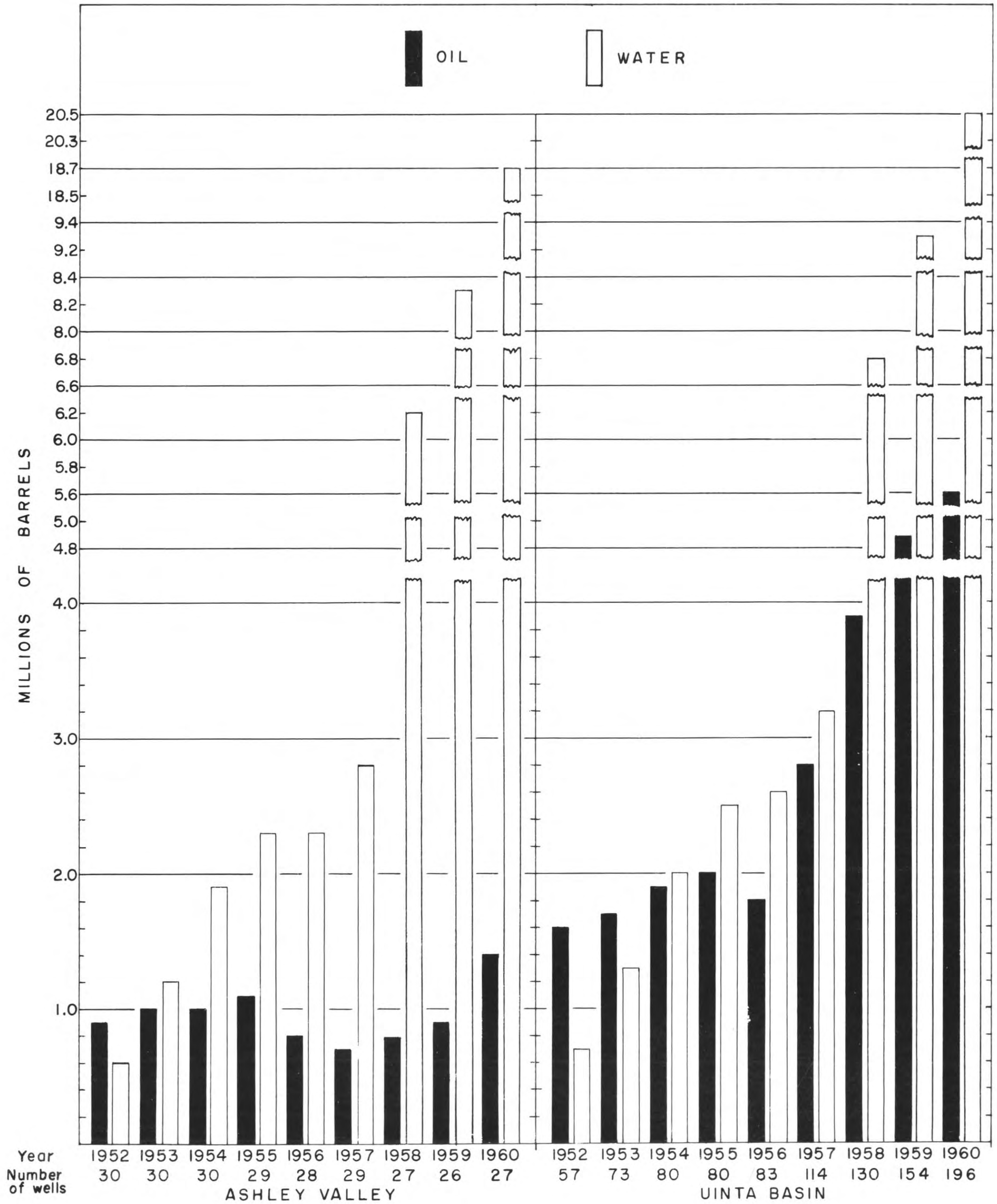

Figure 2.—Oil and water production from the Ashley Valley oil field, and from all oil fields in the Uinta Basin

individual well was as high as 2,920,000 barrels (about 380 acre-feet) per year. Since the field was fully developed in 1950, the oil production has remained between 730,000 and 1,400,000 barrels per year, although the ratio of water to oil has increased. In 1953 the water-to-oil ratio was 1.2 to 1, and by 1960 the ratio had increased to 13 to 1.

The Weber sandstone is the principal oil-producing formation; however, extensive fracturing in both the sandstone and the overlying Phosphoria formation extends the reservoir into the upper formation.

The hydrostatic pressure of the water-drive in the field is sufficient to maintain flowing wells, but pumps were installed on some wells in 1959 and 1960 to increase oil production. The effects of the pumps on water production are not presently known. The strong water-drive is probably sustained by surface recharge in outcrop areas north and east of the field. Possibly the water comes not only from the oil-bearing strata but also from a sequence of underlying limestones of Pennsylvanian and Mississippian age. Thomas (1952, p. 12), in describing springs that he observed in Split Mountain Canyon, said, "These springs rise from cavernous beds near the top of the Madison limestone, or possibly at the base of the Morgan formation." He considered these "to be artesian springs, dependent on this high outcrop area /In the Uinta Mountains/ for recharge."

In the Ashley Valley area these sources of water are about 2,000 feet deeper than the bottoms of the oil wells, but Peterson (1957, p. 191) described normal faults of 150 feet displacement that could form conduits between the oil-bearing rocks and the Madison limestone and Morgan formation. The water supplied to the recharge area probably moves through the subsurface structure to the Section Ridge anticline to be discharged through faults to the Ashley Valley wells in much the same way Thomas assumed the water to move to the Split Mountain anticline to be discharged in springs in Split Mountain Canyon.

The water in the Ashley Valley field has a dissolved-solids content ranging from about 500 to 2,000 ppm (table 2). The water is principally a calcium sodium sulfate type, having bicarbonate as an additional important constituent.

Analyses made of the water since 1949 have not been sufficient to determine a trend in dissolved solids. Only one of two wells sampled in 1949 could be resampled in 1959, but in the interim the well had been plugged back 59 feet so that the samples and resulting analyses are not comparable.

The U.S. Department of Agriculture (Wilcox, 1948) developed a diagram for classification of irrigation water which is based on percent sodium and specific conductance. The percent sodium and specific conductance of the samples of water from Ashley Valley oil field and vicinity are plotted on such a diagram in figure 3. Samples AV-1-59, AV-2-59, AV-6-59, AV-7-59, AV-10-60, AV-11-60, and AV-12-60 are rated as good to permissible; all other samples are rated as permissible to doubtful or doubtful to unsuitable. Sample AV-9-59, from Hollandsworth No. 1 well in sec. 23, T. 5 S., R. 22 E., shows that the water from that well is the least suitable for irrigation of all water sampled from the field. A slight improvement in the quality of the water in the ditch that drains that part of the field (sample AV-4-59 is from that ditch) might be expected if the water from the Hollandsworth well were not added to the ditch. However, the Hollandsworth well is one of the smallest water producers, about 140 bpd (barrels per day), and its contribution to the ditch is small. Sample AV-11-60 was taken from a ditch in which water was being diverted to irrigate a field and it includes

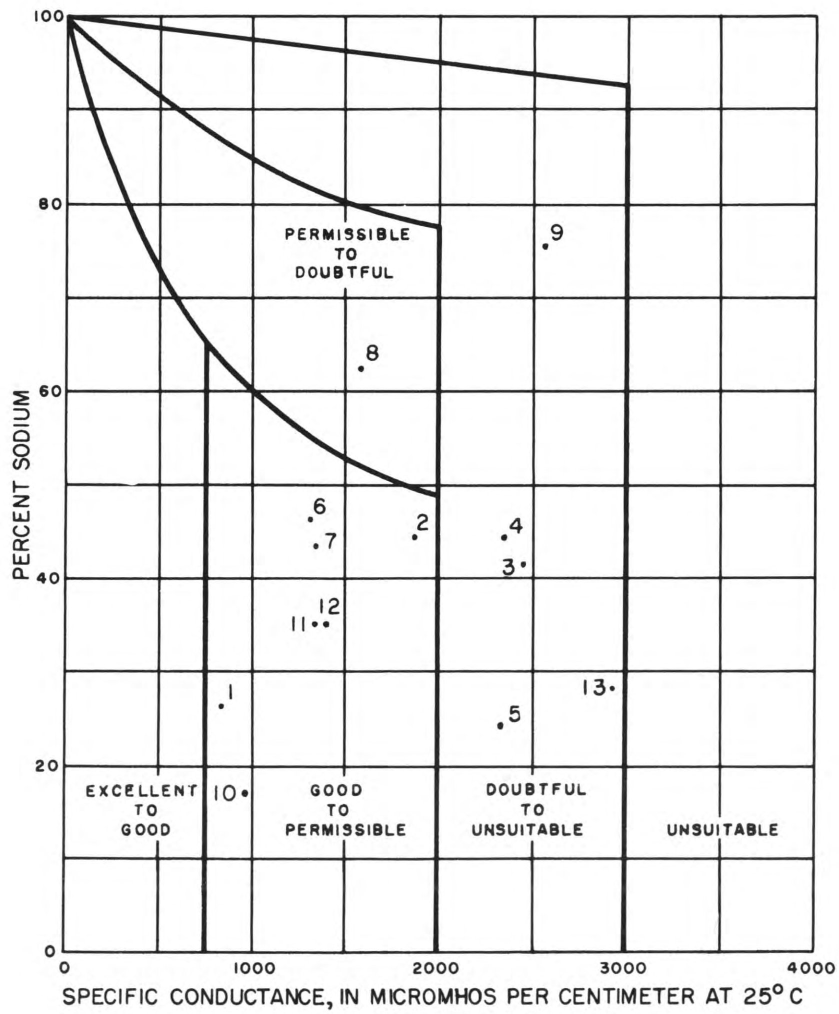

Figure 3.—Classification, for irrigation use, of water from Ashley Valley oil field. (Numbers refer to sample numbers AV-1-59 through AV-9-59 and AV-10-60 through AV-13-60 listed in table 2)

water produced by the well from which sample AV-10-60 was taken. Sample AV-13-60 was taken from the Union Irrigation Co. canal which contains a combination of water from Ashley Creek and from the oil field. The analysis of this water shows a higher dissolved-solids content than that of any of the oil-field samples.

A high sodium content is the principal reason that much of the water from the Ashley Valley field is classified as permissible to doubtful for irrigation use. Unless compensated for by gypsum in the soil or in the water, high sodium content in irrigation water causes clayey soils to deflocculate and to become hard and impermeable. Fortunately, in the Ashley Valley area gypsum derived from the Mancos shale makes it possible to use water of higher than normal sodium content. Analyses of soils of the area are not available, but analyses of the water of Ashley Creek (in table below) indicate that the stream picks up calcium, magnesium, and sulfate (derived from gypsum), presumably leached from the soils by irrigation water which returns to Ashley Creek as the stream flows through Ashley Valley.

ANALYSES OF WATER FROM ASHLEY CREEK BEFORE IT ENTERS ASHLEY VALLEY (NORTHWEST OF VERNAL) AND ABOUT 15 MILES DOWNSTREAM (NEAR JENSEN)

(Data from Connor, Mitchell, and others, 1958.)

Location	Date Collected	Specific conductance (micromhos at 25°C.)	Calcium (Ca)	Magnesium (Mg)	Sulfate (SO_4)	Dissolved solids	Percent Sodium
Northwest	3-14-56	335	45	13	40	197	2
of Vernal,	5-24-56	102	15	2.3	13	75	6
NE¼sec. 31,	8- 7-56	195	27	5	6.7	113	3
T. 3S., R. 21E.	9-17-56	224	24	8.2	-	141	5
Near Jensen,	3-14-56	2,000	227	117	940	1,670	18
NE¼sec. 26,	5-25-56	581	61	26	182	413	15
T. 5S., R. 22E.	8- 7-56	5,300	361	376	3,130	5,500	33
	9-18-56	4,385	326	311	2,560	4,580	31

Thus the high-sodium water from the oil wells, whether mixed with the high-calcium magnesium sulfate water from Ashley Creek or used directly on the local soils that contain gypsum, should not cause deflocculation.

Red Wash Field

Production of water in the Red Wash oil field from 1952 through 1960 ranged between 0.6 percent (1954) and 7.8 percent (1960) of the total Uinta Basin production (fig. 1). During this period the water yield increased from 6,000 to 1,610,000 barrels, and oil production increased from 466,000 to 4,100,000 barrels (fig. 4). This represents an increased water-to-oil ratio from 0.01 to 1 in 1952 to 0.4 to 1 in 1960. There were 18 producing wells in 1952 and 134 in 1960.

Continued development of the oil field is the cause of increased production of both oil and water. Water yield is greatest in the western half of the field, where the average production from individual wells ranges from about 100 to 11,000 barrels of water per month, in contrast to the eastern half of the field, where average monthly production from individual wells ranges from 0 to about 2,000 barrels.

The reason for the variation may stem from the character of the producing intervals of the Garden Gulch and Douglas Creek members of the Green River formation. These intervals form a network of poorly interconnected sandstone lenses, one or a group of which may act as a unit containing either oil, water, gas, or a combination thereof. Picard (1957, p. 183) described the structural-stratigraphic relationship of the lenses as follows:

> "The productive interval at Red Wash-Walker Hollow may be characterized as a lenticular sandstone network * * * blanketing a part of a relatively large, northwest- to westerly-plunging anticlinal nose. * * * Due to the development of stratigraphically different (although approximately equivalent in age) sand lenses in the northeastern part of the field, water-bearing sandstone beds are found higher structurally than productive sand lenses to the southwest. On the southwestern edge of the field (Shell Oil Company, Gov't. 33-4) the upper sandstones are absent and the lower ones are water bearing because of their low structural position. On the western edge of the field stratigraphically younger (Garden Gulch member) sand lenses are productive and the lower principal productive zone (Douglas Creek member) is water bearing. Porosity and permeability changes have also affected fluid content and migration in individual sandstone zone networks. Most sand lenses, or connected sandstone lens networks, pinch out to the southeast."

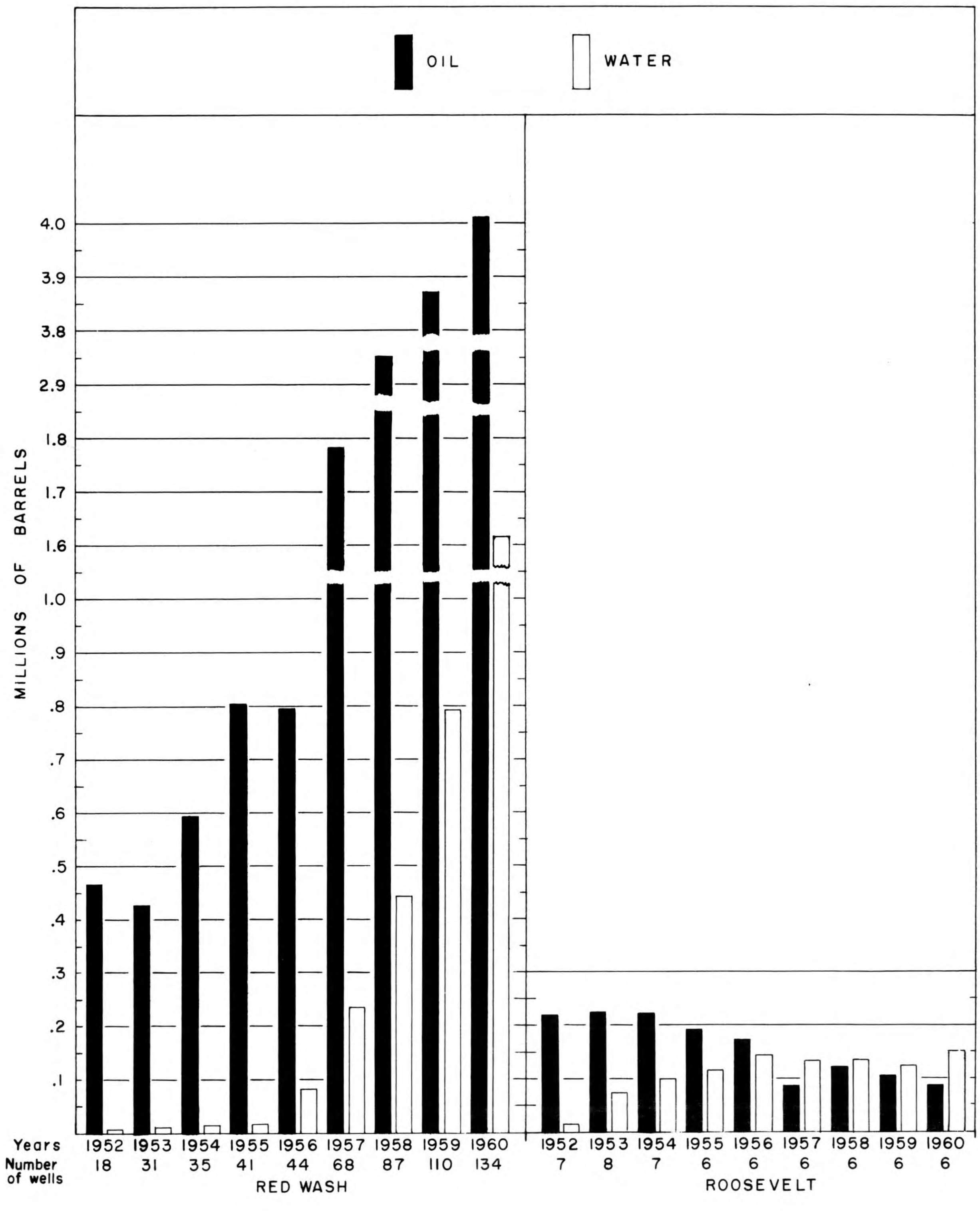

Figure 4.—Oil and water production from Red Wash and Roosevelt oil fields

The dissolved-solids content in water samples from the Red Wash field ranges from about 5,000 to 26,000 ppm (table 2). The water is principally a sodium chloride type having high concentrations of bicarbonate and a wide range in sulfate. The analyses indicate that the water from the east end of the oil field, R. 24 E., is moderately saline and water from the west end of the field, R. 22 E., is very saline. Analyses of water from the center of the field show both moderately and very saline water.

The water is turned into the natural drainage system, is injected back into the producing formation, or is disposed of in evaporation ponds.

Water from the west end of the field, T. 7 S., R. 22 E., is allowed to flow on the surface whence it sinks into the ground or runs into the natural drainage system that leads to the Green River, which is about 7 miles west of the field. This disposal into the natural drainage system probably presents little hazard to the usable water supply, however, because the water production of the whole field during 1960 was about 1,610,000 barrels, and it is unlikely that any of this water actually reached the Green River. Rather, this water sank into the ground and slowly percolated to the water table, which is probably several hundred feet below the land surface. In either case, the slow release of this saline water into the natural surface- and ground-water systems probably will have little ill effect on the natural systems.

A pilot water-injection project for secondary recovery of oil was begun in this area during February 1961, using one injection well. All water produced in the area is, or soon will be, re-injected into the producing formation, and any hazard of pollution of surface and ground water by saline water should be eliminated.

When the West End Water Injection Project is in full operation, the only remaining water being disposed of on the surface will be about 425 barrels per day of moderately saline water from the central and eastern sectors of the field, T. 7 S., Rs. 23 and 24 E. This water is now piped to evaporation ponds. Alternatives for efficiently using this water by re-injecting into the producing zone are being considered by the California Oil Co. (California Oil Co., written communication, June 21, 1961).

Roosevelt Field

The greatest water production in the central Uinta Basin is in the Roosevelt field. In 1960 this field contained 6 producible wells of an original 8 and produced the least amount of oil and water of the three largest fields in the basin.

Although water production from the Roosevelt field increased from 16,000 barrels in 1952 to 152,000 barrels in 1960 (fig. 4), the contribution of this field to the total water produced in the basin declined from 5.6 percent in 1953 to 0.7 percent in 1960 (fig. 1), because the water production by Ashley Valley and Red Wash fields was proportionately greater.

Analyses of water samples from the field indicate the water to be moderately to very saline. The water is a sodium chloride type with appreciable amounts of bicarbonate and sulfate.

Water from oil wells in the Roosevelt field is separated from the oil by treaters and drained into evaporating ponds. When the area was visited by the senior author in November 1959, some water from a well in sec. 13, T. 1 S., R. 1 W., was leaking from the evaporation pond, and a trickle of water was running over the land surface. This well was producing about 1 gpm of saline water containing about 7,800 ppm dissolved solids (table 2, sample R-2-59).

The small amount of water produced in this area, even though it is high in dissolved solids, probably has little effect on the quality of natural waters of the vicinity.

Other Areas

Oil production in the remainder of the area has been from fields that contain one to four wells. During 1960 there were five of these fields, two of which were abandoned. The fields and their record of water production are given in the following table:

WATER PRODUCTION, IN BARRELS, 1953-60

Year	Brennan Bottom (4 wells)	Duchesne (2 wells)	Gusher (2 wells)	Rock Creek (1 well)	Starr Flat (1 well)
1953		37,424	Shut-in		
1954	1,803	35,857	"		
1955	647	41,274	"		
1956	1,699	9,794	"		
1957	4,818	2,420	254		
1958	6,977	86 1/	141		
1959	3,884	364	135		33
1960	4,007	199	210	2,095 2/	4,575 2/

1/ Original two wells abandoned 1957; new well in 1958 and 1959.

2/ Field abandoned September 1960.

Exploration has continued throughout the basin during 1960. Gas wells have been completed but are shut in in the area south of the Red Wash oil field, in Ts. 8, 9, and 10 S., and east of the Green River. Production from the area will likely begin after sufficient reserves of gas are proven. Because large quantities of water have not commonly accompanied gas production in the basin, it is doubtful that a water problem will exist in this area. 1/

1/ In September 1961, the authors learned that the Shamrock Oil and Gas Corp. had reported completion of a well in sec. 13, T. 11 S., R. 23 E., both as a gas and water well, with gas being produced from a depth of about 4,400 feet and artesian water from about 675 feet, and had reported artesian water at about 1,275 feet in another well in sec. 8, T. 11 S., R. 24 E. The water in both wells was coming from the Green River formation, and the completed well was yielding about 70 gpm. A preliminary analysis of water sampled from the well in sec. 8 showed that the conductivity of the water was 1,820 micromhos. Such water is classed as moderately saline and may be considered for use for irrigation or stockwatering if a more complete analysis shows that it contains no ingredients that would be harmful if the water were so used.

Oil-Test Wells Completed as Water Wells

Seven oil-test wells in the basin have been completed as water wells. The water is produced from the Weber sandstone in three wells, from the Navajo sandstone in three wells, and from the Duchesne River(?) formation in one well. Results of analyses of water from three of the wells (sample nos. 3, 5, and 6) are listed in table 2. Water production of 6,900, 10,000, and 34,000 barrels per day has been reported from three wells in the Weber sandstone. Two wells produce 2,000 barrels of water per day per well from the Navajo sandstone. (See tabulation below.) The water from all these wells is used for agriculture.

OIL TEST WELLS COMPLETED AS WATER WELLS

Location	Well no.	Producing formation	Depth of producing interval (feet)	Depth of well (feet)	Production (bpd)
NE$\frac{1}{4}$NW$\frac{1}{4}$SE$\frac{1}{4}$ 28 3S 21E	1	Weber sandstone		2,552	10,000
SE$\frac{1}{4}$SE$\frac{1}{4}$SW$\frac{1}{4}$ 30 3S 21E	2	Weber sandstone	1,100 to 1,200		6,900
NE$\frac{1}{4}$NW$\frac{1}{4}$NE$\frac{1}{4}$ 12 4S 20E	1	Navajo sandstone	84 to 590	590	2,000
NW$\frac{1}{4}$NW$\frac{1}{4}$NE$\frac{1}{4}$ 12 4S 20E	1-A	Navajo sandstone	95 to 1,200	2,314 plugged back to 1,200	2,000
NE$\frac{1}{4}$ lot 3 1 6S 23E	1	Weber(?) sandstone	2,447 to 2,650	2,650	34,000
(Uinta Special Meridian)					
NE$\frac{1}{4}$SW$\frac{1}{4}$SE$\frac{1}{4}$ 18 2N 1E	1	Navajo sandstone	80 to 952	952	
SE$\frac{1}{4}$SE$\frac{1}{4}$NE$\frac{1}{4}$ 29 1S 1E	1	Duchesne River(?) formation		330	

CONCLUSIONS AND RECOMMENDATIONS

The water produced from the several oil fields in the Uinta Basin ranges widely in quantity and quality. The water from the Ashley Valley field is being used for irrigation and probably can be used for that purpose as long as production continues. Water from the Red Wash and Roosevelt fields is too highly mineralized for agricultural or domestic purposes, but possibly it could be injected into the producing horizons to increase the recovery of oil if field conditions are found to be favorable for such an operation.

The present system of disposal of useless water appears to afford adequate protection against pollution of natural surface- and ground-water supplies, but where evaporating ponds are used, periodic inspections can be made to insure that these ponds do not leak brines over or into the ground where they might pollute supplies of usable surface water or ground water.

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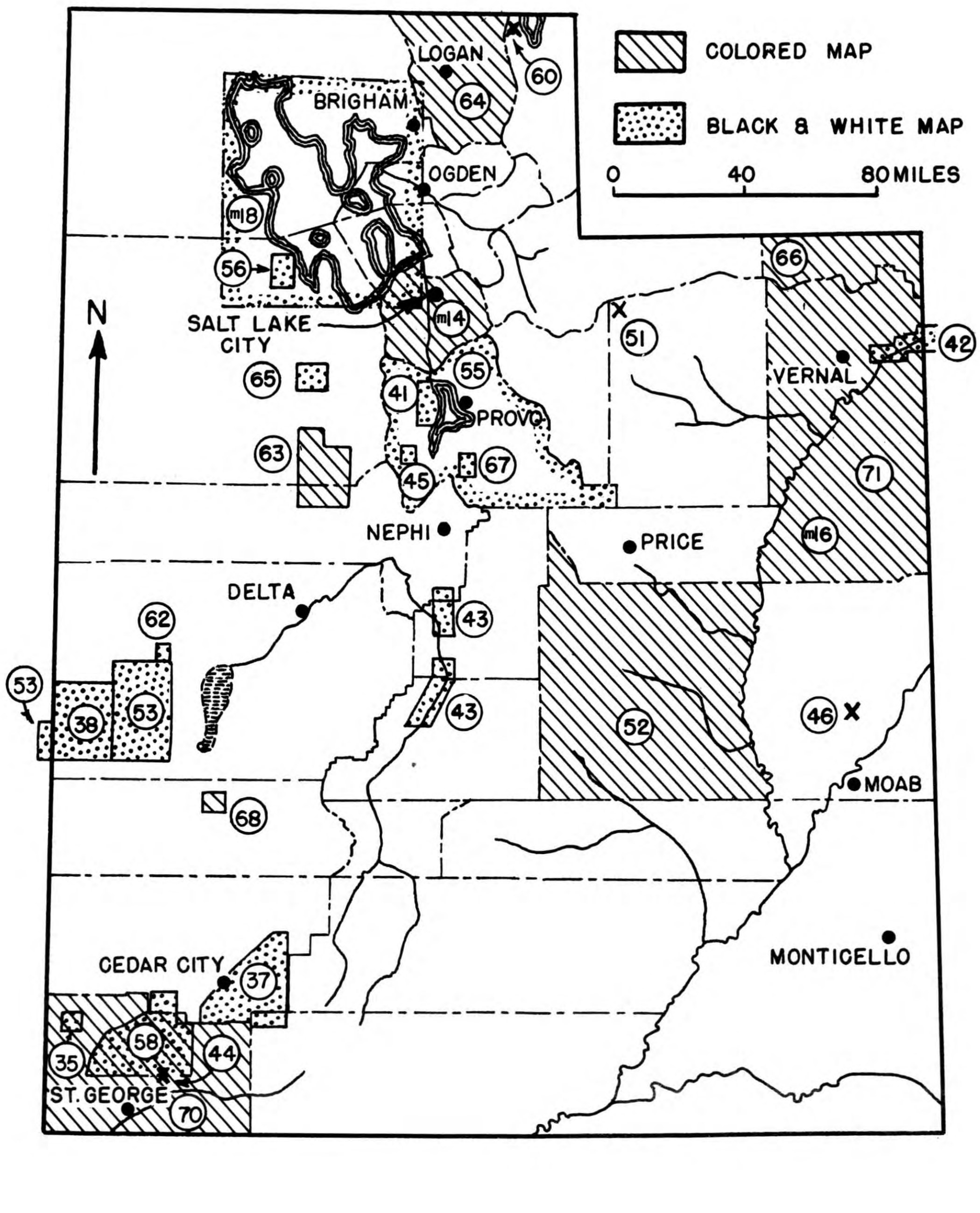
INDEX MAP TO PUBLICATIONS OF THE UTAH GEOLOGICAL AND MINERALOGICAL SURVEY



PUBLICATIONS OF THE UTAH GEOLOGICAL SURVEY

Water-Resources Bulletins

1 - Water Production from Oil Wells of the Uinta Basin, Uintah and Duchesne Counties, Utah, by Harry D. Goode and Richard D. Feltis, 1962, 32 p., 3 pls., 4 figs., 2 tables ______ $1.00

****

Bulletins

24 - Tungsten Reserves Discovered in the Cottonwood-American Fork Mining District, Utah, by Arthur L. Crawford and Alfred M. Buranek, 1944, 56 p., 6 figs. (formerly RS-55) ______ $ .50

25 - Tungsten Deposits of the Mineral Range, Beaver Co., Utah, by Arthur L. Crawford and Alfred M. Buranek, 1945, 48 p., 5 figs. (formerly RS-56) ______ $ .50

35 - Halloysite of Agalmatolite Type, Bull Valley District, Washington County, Utah, by Arthur L. Crawford and Alfred M. Buranek, 1948, 12 p. ______ $ .10

36 - Directory of Utah Mineral Resources and Consumers Guide, by Alfred M. Buranek and C. E. Needham, 1949, 95 p., 1 pl. ______ $1.00

37 - The Geology of Eastern Iron County, Utah, by Herbert E. Gregory, 1950, 153 p., 53 plates and photographs, 1 map ______ $1.50

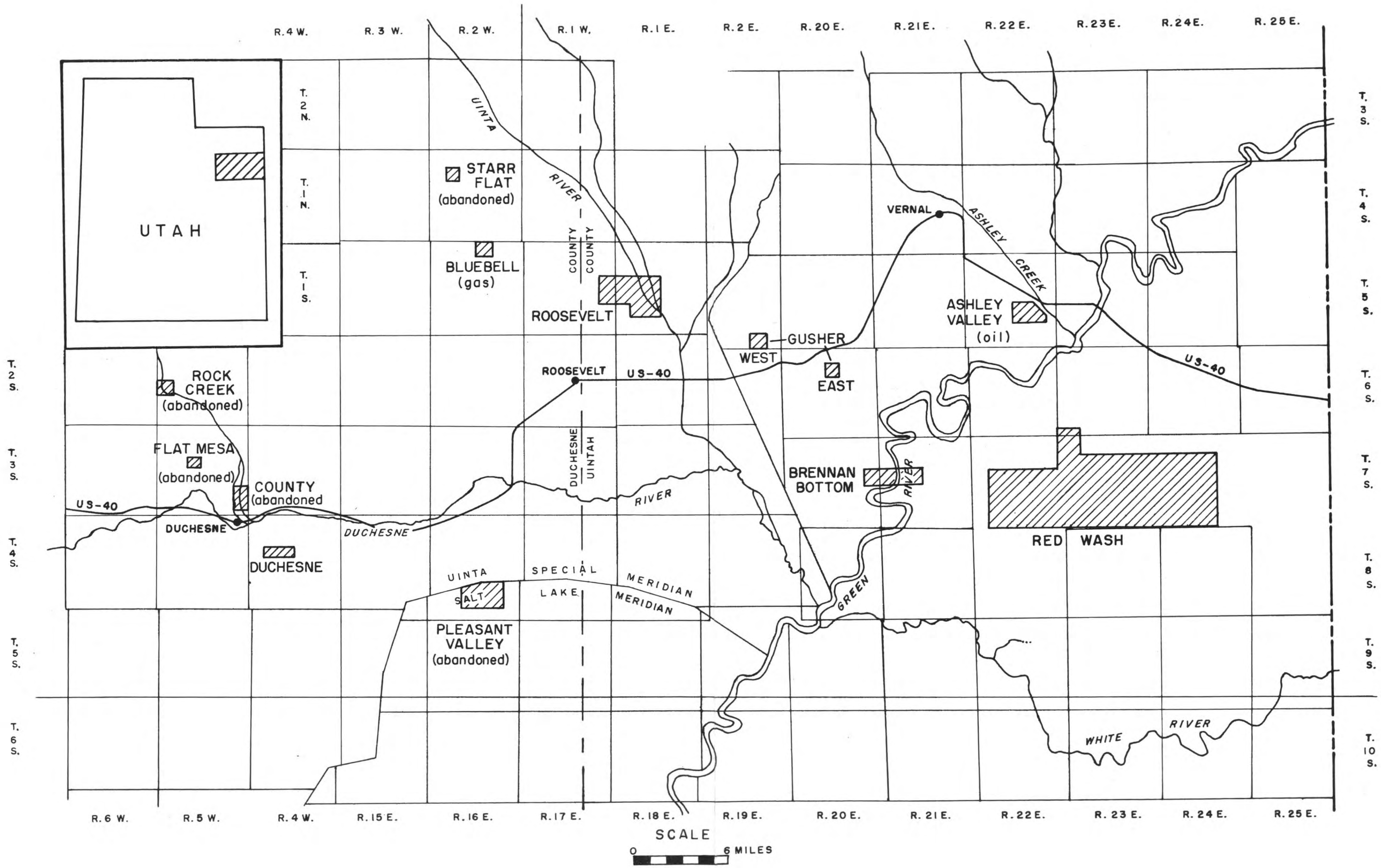
38 - Stratigraphy of the Burbank Hills, Western Millard County, Utah, by Richard W. Rush, 1951, 24 p., 6 figs. ______ $1.00

39 - Lower Ordovician Detailed Stratigraphic Sections for Western Utah, by Lehi F. Hintze, 1951, 99 p., 4 maps, 7 illustrations ______ $1.50

40 - Bibliography of Utah Geology to December 31, 1950, by Walter R. Buss, 1951, 219 p. ______ $4.00

41 - Geology of Lake Mountain, Utah, by Kenneth C. Bullock, 1951, 46 p., 7 pls., 3 tables ______ $1.00

42 - Geology of Dinosaur National Monument and Vicinity, Utah-Colorado, by G. E. and B. R. Untermann, 1954, 225 p., 3 pls., 10 figs., 51 photographs ______ $2.50



Base map from U.S. Geological Survey map of Utah

PLATE I — INDEX MAP OF PART OF NORTHEASTERN UTAH SHOWING THE LOCATION OF OIL AND GAS FIELDS. Fields produce both oil and gas, unless shown otherwise

43 - Eastern Sevier Valley, Sevier and San Pete Counties, Utah--With Reference to Formations of Jurassic Age, by Clyde T. Hardy, 1952, 95 p., 9 pls., 4 figs., 1 table ______ $1.00

44 - Geology and Ore Deposits of the Silver Reef (Harrisburg) Mining District, Washington County, Utah, by Paul Dean Proctor, 1953, 169 p., 11 pls., 13 figs., 8 tables ______ $2.00

45 - Geology of the Selma Hills, Utah County, Utah, by J. Keith Rigby, 1952, 107 p., 6 pls., 21 figs., 3 tables ______ $1.50

46 - Uranium-Vanadium Deposits of the Thompsons Area, Grand County, Utah--With Emphasis on the Origin of Carnotite Ores, by W. L. Stokes, 1952, 51 p., 2 pls., 12 figs., 1 table ______ $1.50

47 - Microfossils of the Upper Cretaceous of Northeastern Utah and Southwestern Wyoming, by Daniel Jones, David Gauger, Reed H. Peterson, and Robert R. Lankford, 1953, 158 p., 16 pls., 8 figs., 4 tables ___ $2.00

48 - Lower Ordovician Trilobites from Western Utah and Eastern Nevada, by Lehi F. Hintze, 1952, 249 p., 28 pls. ______ $4.00

50 - Drilling Records for Oil and Gas in Utah, by George H. Hansen and H. C. Scoville, 1955, 110 p., 30 illustrations, 1 table ______ $5.00

51 - The Rocks and Scenery of Camp Steiner, Summit and Wasatch Counties, Utah, by Daniel Jones, 1955, 30 p., 13 pls. ______ $ .25

52 - Geologic Atlas of Utah, Emery County, by Wm. L. Stokes and Robert E. Cohenour, 1956, 92 p., 38 colored geologic map plates ______ $5.00

53 - Silurian Rocks of Western Millard County, by Richard W. Rush, 1956, 66 p., 12 figs. ______ $1.50

55 - Clays of Utah County, Utah, by Edmond P. Hyatt, 1956, 83 p., 22 figs., 4 tables ______ $2.00

56 - Geology of the Southern Lakeside Mountains, Utah, by John C. Young, 1955, 108 p., 3 pls., 2 figs. ___ $1.50

57 - Middle Ordovician Detailed Stratigraphic Sections for Western Utah and Eastern Nevada, by Gregory W. Webb, 1956, 77 p., 12 figs. ______ $1.50

58 - Geology of the Pine Valley Mountains, Utah, by Earl F. Cook, 1957, 111 p., 52 figs. ________ $2.00

59 - Phosphate in Utah, by Thomas Cheney, 1957, 54 p., 3 pls., 12 figs., 3 tables ________ $1.50

60 - The Rocks and Scenery of Camp Hunt, Rich County, Utah, by Clyde T. Hardy, 1957, 26 p. $ .25

61 - The Oquirrh Formation, Stratigraphy of the Lower Portion in the Type Area and near Logan, Utah, by Paul W. Nygreen, 1958, 67 p., 4 pls., 5 figs., 3 tables $2.00

62 - Notch Peak Intrusive, Millard County, Utah, by Harry M. Gehman, Jr., 1958, 50 p., 4 pls., 12 figs., 3 tables ________ $1.50

63 - Geology of the Sheeprock Mountains, Tooele County, Utah, by Robert E. Cohenour, 1959, 200 p., 15 pls., 6 figs., 3 tables ________ $5.00

64 - Geologic Atlas of Utah, Cache County, by J. Stewart Williams, 1958, 98 p., 13 pls., 2 figs., 13 colored geologic map plates ________ $5.00

65 - Geology of the Stansbury Range, by John S. Teichert, 1959, 75 p., 2 pls., 12 figs. ________ $1.50

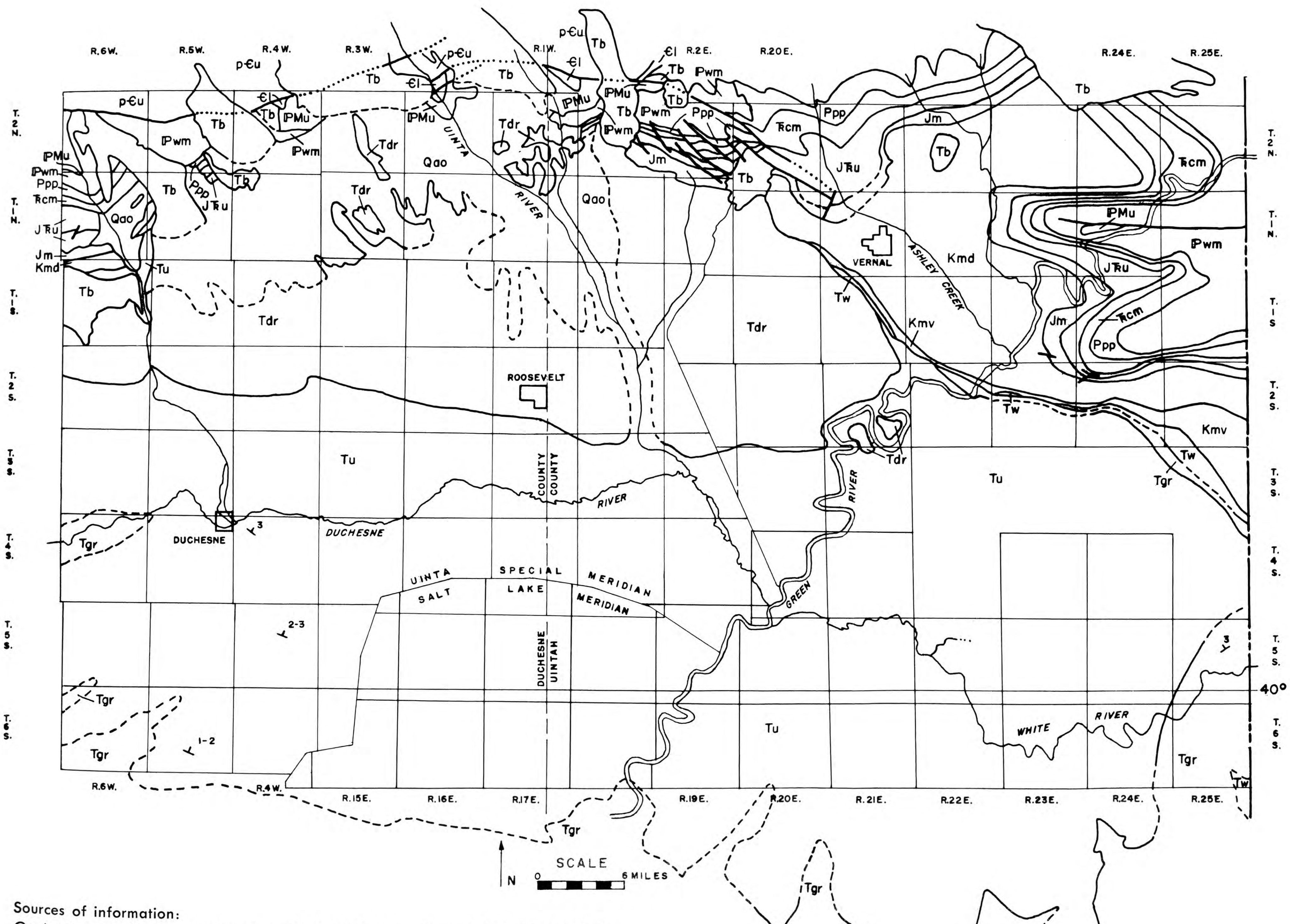
66 - Geologic Atlas of Utah, Daggett County, by Howard R. Ritzma, 1959, 111 p., 4 pls., 10 figs., 8 colored geologic map plates ________ $5.00

67 - The Rocks and Scenery of Camp Maple Dell, Utah County, Utah, by J. Keith Rigby, 1959, 55 p., 5 pls., 16 figs. ________ $ .25

68 - Beaver Lake Mountains, Beaver County, Utah, by Patrick J. Barosh, 1960, 88 p., 5 pls., 17 figs. $2.00

70 - Geologic Atlas of Utah, Washington County, by Earl F. Cook, 1960, 119 p., 16 pls., 8 figs., 19 photographs, 8 colored geologic map plates ________ $5.00

71 - The Mineral Resources of Uintah County, Utah, by Robert G. Pruitt, 1961, 101 p., 11 pls., 19 figs. __ $2.00



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EXPLANATION

QUATERNARY
- Qao — Alluvium and outwash gravel

TERTIARY
- Miocene(?) — Tb — Bishop conglomerate
- Eocene or Oligocene(?) — Tdr — Duchesne River formation
- Eocene — Tu — Uinta formation
- Eocene — Tgr — Green River formation
- Eocene — Tw — Wasatch formation

CRETACEOUS
- Upper Cretaceous — Kmv — Mesaverde formation
- Lower(?) and Upper Cretaceous — Kmd — Mancos shale and Dakota sandstone

JURASSIC
- Upper Jurassic — Jm — Morrison formation

TRIASSIC AND JURASSIC
- Upper Triassic(?) and Jurassic, Middle and Upper Jurassic — JRu — Jurassic and Triassic undivided (Probably includes Curtis formation, Entrada sandstone, Carmel formation, and Navajo sandstone)

TRIASSIC
- Lower, Middle(?), and Upper Triassic — Rcm — Chinle and Moenkopi formations

PERMIAN
- Ppp — Park City and Phosphoria formations

CARBONIFEROUS
- PENNSYLVANIAN — Pwm — Weber sandstone and Morgan formation
- MISSISSIPPIAN AND PENNSYLVANIAN — PMu — Pennsylvanian and Mississippian undivided (Probably includes rocks equivalent to Manning Canyon shale, Humbug formation, Deseret and Madison limestones)

CAMBRIAN
- Upper Cambrian — Cl — Lodore formation

PRECAMBRIAN
- pCu — Uinta Mountain group

Geologic contact, dashed where inferred

Strike and dip of beds

Fault, dotted where concealed

PLATE II — GEOLOGIC MAP OF PART OF NORTHEASTERN UTAH

MAPS

Maps of the Utah Geological Survey

1 -	Reconnaissance Geologic Map of Eastern Iron Co., Utah, by Herbert E. Gregory (formerly RS-37; plate II from Bull. 37)	$ .50
2 -	Geologic Map of Dinosaur National Monument and Vicinity, by G. E. and B. R. Untermann (formerly RS-42; plate II from Bull. 42)	$ .50
3 -	Colored Relief Map of Utah (formerly RS-22)	$ .50
4 -	A Correlation Chart of Formations in Utah (formerly RS-25)	$ .50
5 -	Geology of the Egnar-Gypsum Valley area, San Miguel and Montrose Counties, Colorado (formerly RS-27)	$ .50
6 -	Geology of the West-Central part of the Gunnison Plateau, Utah, by Clyde T. Hardy and Howard D. Zeller (formerly RS-33a)	$ .25
7 -	Index to Unpublished Geologic Thesis Mapping in Utah (formerly RS-58)	$ .25
8 -	Colored Geologic Map of Utah, from Guidebook to Annual Brigham Young University geology field trip (see reprint 57, formerly RS-57a)	$ .15
9 -	Physiographic Map of Utah (formerly RS-78)	$ .15
10 -	Geologic Index Map of Utah, showing U.S. Geological Survey publications in Utah (formerly RS-28)	Free
11 -	Geologic Index Map of Utah, showing other than U.S. Geological Survey publications in Utah (formerly RS-29)	Free
12 -	Colored Geologic Map of Cache County, Utah, by J. Stewart Williams (formerly RS-64)	$ 1.00
13 -	Colored Geologic Map of Daggett County, Utah, by Howard R. Ritzma (formerly RS-76)	$ 1.00
14 -	Colored Geologic Map of Washington County, by Earl F. Cook (formerly RS-84)	$ 1.00
15 -	Colored Geologic Map of Salt Lake County, Utah (formerly RS-84)	$ 1.00
16 -	Colored Geologic Map of Uintah County, Utah, in two halves (formerly RS-90)	$ 1.50
17 -	Mineral Resources Map of Uintah County, by Robert G. Pruitt	$ .35
18 -	Earthquake Fault Map of a Portion of Salt Lake County, Utah	Free

Maps Available through the Survey

The Great Salt Lake, Utah, by Armand J. Eardley (formerly RS-88)	$ .50
Wildcat Map of Utah (42" x 50"), by Utah Oil Report--kept up to date	$10.00

Various plates from Utah Geological Society and Intermountain Association of Petroleum Geologists' Guidebooks

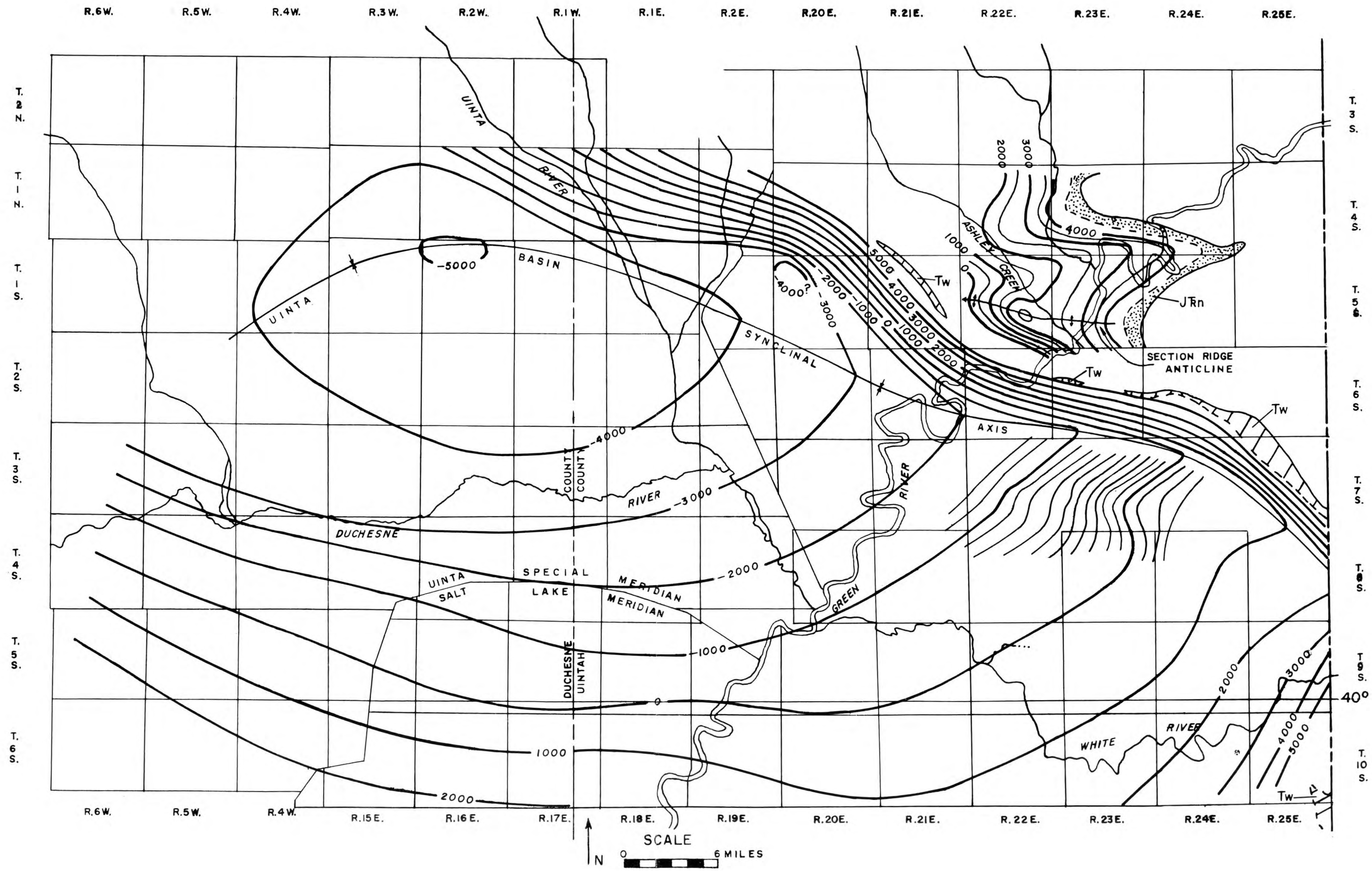


PLATE III — STRUCTURE MAP OF THE CENTRAL PART OF THE UINTA BASIN

Contours are drawn on top of the Wasatch formation at 1,000-foot intervals, except in the northeastern part of the map where they are drawn on top of the Navajo sandstone at 500-foot intervals. Datum is mean sea level. Outcrops of Wasatch formation labeled Tw; Navajo sandstone labeled JŦ.

PUBLICATIONS HANDLED THROUGH THE UTAH GEOLOGICAL SURVEY

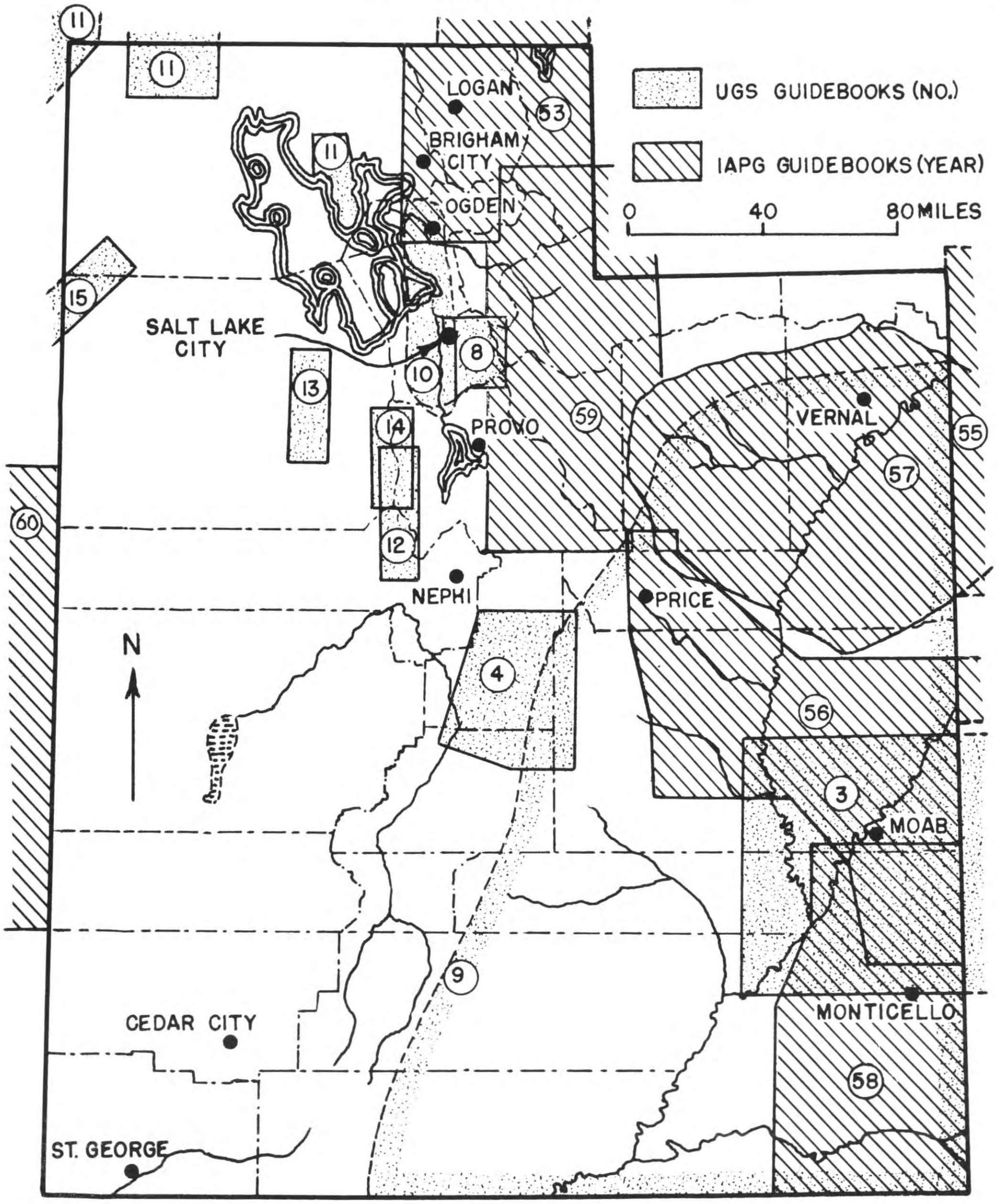
Utah Geological Society — Guidebooks

3 -	Geology of the Utah-Colorado Salt Dome Region, with emphasis on Gypsum Valley, Colorado, 1948	$ 2.50
4 -	The Transition between the Colorado Plateaus and the Great Basin in Central Utah, 1949	$ 3.00
6 -	Geology of the Canyon, House, and Confusion Ranges, Millard County, Utah, 1951	$ 4.00
8 -	Geology of the Central Wasatch Mountains, Utah, 1952	$ 3.50
9 -	Uranium Deposits and General Geology of Southeastern Utah, 1954	$ 3.00
10 -	Tertiary and Quaternary Geology of the Eastern Bonneville Basin, 1955	$ 4.00
11 -	Geology of Parts of Northwestern Utah, 1956	$ 4.00
12 -	Geology of the East Tintic Mountains and Ore Deposits of the Tintic Mining Districts, 1957	$ 4.00
13 -	Geology of the Stansbury Mountains, Tooele County, Utah, 1958	$ 4.00
14 -	Geology of the Southern Oquirrh Mountains and Fivemile Pass--Northern Boulter Mountains Area, Tooele and Utah Counties, Utah, 1959	$ 4.00
15 -	Geology of the Silver Island and Adjacent Areas in the Great Salt Lake Desert Northeast of Wendover, Utah, 1960	$ 4.00
16 -	Geology of the Bingham Mining District and Northern Oquirrh Mountains, 1961	$ 6.00

Intermountain Association of Petroleum Geologists — Guidebooks

1951 -	Geology of the Canyon, House, and Confusion Ranges, Millard County, Utah	$ 4.00
1952 -	Cedar City, Utah to Las Vegas, Nevada	$ 4.00
1953 -	Geology of Northern Utah and Southeastern Idaho	$ 7.50
1954 -	Geology of the High Plateaus, Central and South Central Utah	$ 7.50
1955 -	Geology of Northwest Colorado	$ 7.50
1956 -	Geology and Economic Deposits of East-Central Utah	$ 7.50
1957 -	Guidebook to the Geology of the Uinta Basin	$ 7.50
1958 -	Guidebook to the Geology of the Paradox Basin	$11.00
1959 -	Guidebook to the Geology of the Wasatch and Uinta Mountains Transition Area	$12.00
1960 -	Guidebook to the Geology of East Central Nevada	$12.00
1961 -	Oil and Gas Fields of Utah--Symposium	$10.00

INDEX MAP SHOWING AREAS TREATED BY THE GUIDEBOOKS OF THE UTAH GEOLOGICAL SOCIETY AND BY THE INTERMOUNTAIN ASSOC. OF PETROLEUM GEOLOGISTS



Have you used the Utah Geological Survey's Library of Samples for Geologic Research?

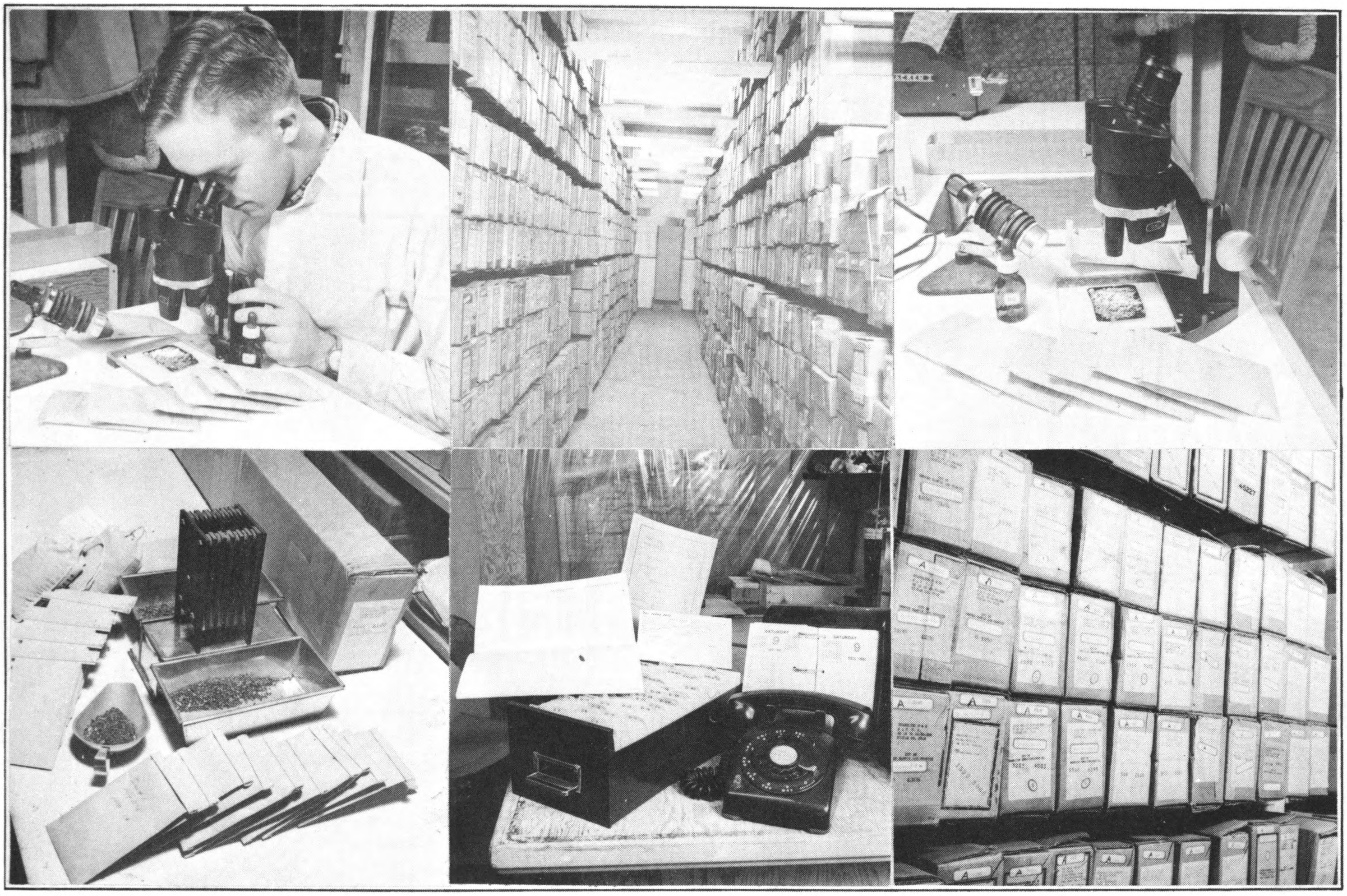


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Table 1 — Generalized description and water-bearing properties of rocks in central and eastern parts of Uinta Basin, Utah

Sources: Abbott, Ward, 1957; Kay, J. L., 1934; Kinney, D. M., 1949 and 1955; MacLachlan, M. E., 1957; Sanborn, A. F., Darrow, D. L., and Liscomb, R. L., 1957; Stokes, W. L., 1952 and 1957; and Walton, P. T., 1957.

System	Series	Formation	Map symbol	Thickness (feet)	Description	Distribution and structure	Water-bearing properties
Quaternary	Recent and Pleistocene	Alluvium and outwash gravel	Qao	1 - 200	Gravel, sand, and silt; generally unconsolidated	Outwash gravel prominent along Uinta River drainage. Recent alluvium occurs in most stream valleys	Probably will supply water to shallow wells wherever it is more than 20 feet thick
Tertiary	Miocene(?)	Bishop conglomerate	Tb	1 - 800	Conglomerate of rounded to subangular boulders in sandstone matrix	South slope of Uinta Mountains dipping gently away from mountains	Unknown
	Oligocene or Eocene	Duchesne River formation	Tdr	50 - 300	Mudstone, siltstone, sandstone in beds 2 to 6 ft thick, commonly separated by unconsolidated beds of similar material	Underlies surface over northern and eastern parts of basin. Normally flat lying; maximum dips 2° - 4°	Probably poor
	Upper Eocene	Uinta formation	Tu	1,500±	Green to reddish shale capped in places by 30 to 50 ft of sandstone in beds a few inches to a few feet thick	Underlies surface over southern half of basin; underlies Duchesne River formation elsewhere. Normally flat lying; maximum dips 2° - 4°	Probably poor except that sandstone cap may supply small quantities of water to wells
	Eocene	Green River formation (divided into Evacuation Creek, Parachute Creek, Garden Gulch, and Douglas Creek members)	Tgr	About 1,500 ft where exposed; as much as 4,000 ft in subsurface (5,600 ft recorded in one well)	Black shale, sandstone, and oolitic limestone. Oil- and gas-producing sandstone and shale	Underlies entire basin but is several thousand feet below surface along axis of basin	Water occurs with oil in sandstone lenses, but it is generally too highly mineralized for use
	Lower Eocene	Wasatch formation	Tw	1,500 - 5,000	Mudstone, sandstone, conglomerate, and minor amounts of limestone; predominantly fluviatile red beds	Underlies entire basin - is more than 10,000 ft below surface at deepest part. See figure 3 for structure. May include older rocks	Unknown
Tertiary and Cretaceous	Paleocene and Upper Cretaceous	North Horn formation	Not shown on map	500 - 1,600	Interbedded sandstone conglomerate, shale, and limestone	Probably does not crop out within area of this report. May occur in the subsurface	Unknown
Cretaceous	Upper Cretaceous	Mesaverde formation	Kmv	400 - 1,200	Fine- to medium-grained sandstone, dark-gray shale, lignitic shale and lignite. Sandstone predominates in lower half of formation, and lignitic shale and lignite are present only in upper part	Crops out at eastern end of basin. Probably underlies entire basin	Probably can supply small quantities of water to wells from sandstone
		Mancos shale (includes rocks equivalent to Emery and Ferron sandstone members and Frontier sandstone member, and intertonguing sandstone lenses of the Mesaverde formation)	Kmd	3,500 - 5,000	Gray marine mudstone with eastward-thinning sandstone lenses	Crops out northeast of basin. Probably underlies entire basin	Sandstone lenses may supply water, which is likely of poor quality because enclosing shale contains gypsum, to wells
		Dakota sandstone (included with Mancos shale on generalized map)		50 - 90	Conglomeratic sandstone that represents advance of Cretaceous sea; transects time lines	Crops out north and northeast of basin. Probably underlies entire basin	Rock is probably too dense to supply water to wells in quantity
	Lower Cretaceous	Cedar Mountain formation (includes Buckhorn conglomerate member; Stokes 1952)	Not shown on map		Green, purple, and maroon mudstone with discontinuous conglomerate and conglomeratic sandstone at base	Probably underlies entire basin; thickens to southwest	Unknown
Jurassic	Upper Jurassic	Morrison formation (probably mostly equivalent to the Brushy Basin shale member of southeastern Utah)	Jm	800 - 1,000	Varicolored mudstone and claystone	Crops out north and northeast of basin. Probably underlies entire basin	Probably poor
		Curtis formation	JTRu	250 - 300	Fossiliferous, glauconitic sandstone, shale, and sandy limestone	do.	Do.
		Entrada sandstone		100 - 175	Principally crossbedded eolian sandstone	do.	Can supply small quantities of good water to wells
	Upper and Middle Jurassic	Carmel formation		125 - 170	Red sandstone, shale, and siltstone	do.	Probably poor
Jurassic and Triassic(?)		Navajo sandstone		700 - 900	Crossbedded calcareous sandstone	do. See figure 3 for structure	Can supply moderate quantities of good water to wells near outcrop area on south slope of Uinta Mts. Quality of water may be poor where Navajo is 2,000 - 3,000 feet or more below surface
Triassic	Upper Triassic	Chinle formation (includes Shinarump member)	TRcm	250	Basal sandstone or conglomerate overlain by red-orange, purple, or green claystone to conglomerate. Conglomerate of Shinarump member fills channels in Moenkopi formation	Crops out north and northeast of basin. Probably underlies entire basin	Probably poor except in Shinarump
	Middle(?) and Lower Triassic	Moenkopi formation (included with Chinle formation on map)		700 - 800	Red beds of unfossiliferous sandstone, siltstone, and claystone both above and below a middle fossiliferous limestone member	do.	Probably poor
Permian		Park City formation	Ppp	200±	Thick limestone with intercalated quartzite and sandstone	do.	Supplies water from springs in Ashley Creek valley north of Vernal and in Whiterocks River valley
		Phosphoria formation (included with Park City formation on map)		40 - 60	Phosphatic shale with thin limestone beds	Reported as a separate unit only in well logs	Water reported from Phosphoria may come from underlying Weber sandstone or deeper limestone
Pennsylvanian		Weber sandstone	ℙwm	1,000 - 1,200	Massive, crossbedded, fine- to coarse-grained sandstone	Crops out north and northeast of basin. Probably underlies entire basin	In Ashley Valley field water produced from 4,000 ft below surface is usable for irrigation
		Morgan formation (included with Weber sandstone on map)		1,100 - 1,300	Thick-bedded, cherty, fossiliferous limestone in lower member and red sandy shale, buff and red crossbedded sandstone, and thin beds of gray to pink cherty limestone in upper member	do.	Probably poor
Pennsylvanian and Mississippian		Pennsylvanian and Mississippian rocks undivided. Probably includes rocks equivalent to Manning Canyon shale, Humbug formation, Deseret and Madison limestones	ℙMu	1,000±	Principally massive limestone with a black fissile shale unit at top	do.	May supply water from caverns or solution channels
Cambrian	Upper Cambrian	Lodore formation	€l	100 - 1,200	Thick-bedded, coarse-grained, arkosic sandstone and arenaceous shale	do.	Unknown
Precambrian		Uinta Mountain group	p€u	12,000 - 15,000	Red, pink, or white quartzitic sandstone, with thin shale partings, and thin-bedded sericitic and sandy shale interbedded with slabby sandstone	Forms core of Uinta Arch in eastern part of Uinta Mountains	Do.

Table 2 — Chemical analyses of water from selected sources in Uinta Basin, Utah
Analyses by the U.S. Geological Survey, Quality of Water Branch, Salt Lake City, unless otherwise noted.

Sample No.	Oil field or other source	Field operator or owner	Well No.	Location: Section	Location: T.	Location: R.	Location: Base and meridian	Producing formation	Depth to top of formation (feet)	Depth to bottom of formation (feet)	Total depth of well (feet) 2/	Perforations	Production of well when sampled (barrels per day): Oil	Production: Water	pH	Date of collection	Collection point	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 1/	Potassium (K) 1/	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Boron (B)	Dissolved solids (calculated)	Hardness as $CaCO_3$: Calcium and magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	Sodium-adsorption-ratio	Specific conductance at 25°C (micromhos)	Remarks
1 3/	Ashley Valley	Hollandsworth and Travis	1	NE¼SW¼NW¼ 26	5S	22E	Salt Lake	Phosphoria	4,265	4,393	4,393					5-23-49	Drill-stem test 4,272-4,393				56	23	78		293	60	33	21			416	234	0	42	2.2		
AV-1-59	do.	Pan American Petroleum Corp.	10	NE¼SW¼NE¼ 22	5S	22E	do.	Phosphoria Weber	4,210 4,328	4,328	4,330		17	1,820	8.1	11-3-59	Well bleeder pipe	112	19		85	27	52		238	0	227	4.0	0.5		532	324	129	26	1.3	829	
AV-2-59	do.	do.	1	NE¼SW¼NE¼ 23	5S	22E	do.	Weber	4,094		4,327 PB 4,278		506	3,050	7.9	11-3-59	Well head	120	20		155	38	198		340	0	519	108	3.3		1,210	544	265	44	3.7	1,860	
AV-3-49 3/	do.	do.	2	NW¼NW¼NE¼ 26	5S	22E	do.	do.	4,146		4,290					5-21-49	Drill-stem test 4,264-90				533	18	278		1,780		129	294			2,140	1,400	0	30	3.2		
AV-3a-49 3/	do.	do.	2	NW¼NW¼NE¼ 26	5S	22E	do.	do.	4,146		4,310 PB 4,251					5-22-49	Drill-stem test 4,290-4,310				107	34	95		622		37	46			628	407	0	34	2.0		
AV-3-59	do.	do.	2	NW¼NW¼NE¼ 26	5S	22E	do.	do.	4,146		4,310 PB 4,251		90	1,890	8.0	11-3-59	Well-head bleeder	115	22		242	56	261		317	0	874	162	4.1		1,780	834	574	41	3.9	2,460	
AV-4-59	do.	See "Remarks"		NE¼ 26	5S	22E	do.								7.8	11-3-59	Drainage ditch		17		208	65	279		249	0	877	190	8.3		1,770	784	580	44	4.3	2,350	Sample from oil-field drainage ditch; flow, 2 to 3 cfs
AV-5-59	do.	Robert Six	1M	SW¼SE¼NE¼ 24	5S	22E	do.	Phosphoria	4,093	4,249	4,255		45	1,700	7.7	11-3-59	Bubbler pipe from treater		23		338	74	163		280	0	1,120	77	.3		1,930	1,150	920	24	2.1	2,340	
AV-6-59	do.	Equity Oil Co.	7	SW¼SE¼NW¼ 23	5S	22E	do.	Weber	4,152		4,230				8.5	11-3-59	Feeder pipe from well	112	21		112	30	158		260	20	379	76	.6		925	404	158	46	3.4	1,330	
AV-7-59	do.	do.	1-9	23	5S	22E	do.	See "Remarks"							8.4	11-3-59	Pipe to disposal pond		19		116	36	152		263	10	399	86	.0		947	438	206	43	3.2	1,350	A composite sample from Equity wells 1 through 9
AV-8-59	do.	do.	1	NE¼NW¼NE¼ 23	5S	22E	do.	Phosphoria Weber	3,990 4,138	4,138	4,152		30	1,400	8.6	11-3-59	Pipe from well	110	20		93	27	253		291	23	362	170	.5		1,090	344	68	62	5.9	1,590	
AV-9-59	do.	Hollandsworth and Travis	1	NW¼SE¼NE¼ 23	5S	22E	do.	Weber	4,076		4,130		475	140	8.0	11-3-59	Treater discharge		27		109	31	547		518	0	615	372	.5		1,960	400	0	75	12	2,560	
AV-10-60	do.	Pan American Petroleum Corp.	1	SE¼SW¼NE¼ 22	5S	22E	do.	Phosphoria Weber	4,126 4,277	4,277	4,301	4,266-4,273		3,700	7.8	11-4-60	Well bleeder pipe	115		0.34	103	28	38	20	386	0	244	104	3.2	0.28	731	372	55	17	.9	975	
AV-11-60	do.	See "Remarks"		NE¼NE¼ 22	5S	22E	do.	do.							7.7	11-4-60	Irrigation ditch		18	.03	128	31	117	23	256	0	441	72	.0	.26	956	446	236	35	2.4	1,340	Water sample from irrigation ditch in oil field; flow, 1 cfs
AV-12-60	do.	Pan American Petroleum Corp.	3	NW¼NE¼NW¼ 26	5S	22E	do.	Weber	4,146		4,287			6,670	7.4	11-4-60	Well bleeder pipe	120	20	.05	192	43	171	27	270	0	681	116	.2	.44	1,380	656	435	35	2.9	1,830	This well produces the greatest amount of water in the oil field.
AV-13-60	See Remarks	Union Irrigation Co.		SE¼SE¼NW¼ 25	5S	22E	do.								8.0	11-4-60	Canal culvert at county road		10	.01	293	172	263	9.3	322	0	1,590	72	19	.57	2,590	1,440	1,170	28	3.0	2,940	Sample is a combination of water from the Ashley Valley field and Ashley Creek; flow, 3-4 cfs
2 3/	Brennan Bottom	Gulf Oil Co.	3	C NE¼SE¼ 17	7S	21E	do.	Green River Wasatch	3,412 6,940	6,940	7,070 PB 7,030	6,635-7,010	Initially 87	38		9-10-57	Treater				3,480	746	13,200		376		45	28,400			46,100	11,800	11,400				Water probably is not true formation water--probably is spent acid water.
3	Cliff Creek	Bureau of Land Management (drilled by R. D. Garner)	1	NE¼ lot 3 1	6S	23E	do.	Weber(?)	1,995 and 2,447 (fault at 2,012)		2,650	2,077 (in the Moenkopi formation) 2,560-2,650		34,000	7.6	6-25-57		110	24	.00	367	69	91	23	139	0	1,150	78	1.1	.30		1,200	1,090	14	1.1	2,200	Probably Weber formation water, although hole is slotted at Moenkopi formation. Nothing definite from this area with which to correlate. Completed as a water well.
3a 3/	do.															9-10-57	Leak at well head				321	51	140		81		1,090	81			1,720	1,010	944	23	1.9		
4 3/	Gusher	Caldwell and Covington (now Barson Bros.)	3	W½NW¼NE¼ 10	6S	20E	do.	Green River	4,728	8,161	8,633 PB 8,124	7,748-7,856 7,976-7,985	75	3 to 6		9-10-57	Storage tank				104	68	6,080		1,120		151	8,990			15,900	540	0	96	115		
5 3/	Neal Dome	Bureau of Land Management (drilled by Maude Ellen Oil Co.)	1	NW¼SE¼ 28	3S	21E	do.	Weber								8-6-30	Between 6¼" and 8¼" casing				70	31	9.2		225		132	1			353	302	118	6	.3		Completed as a water well. Water from 1,575 to ?
5a 3/	do.	do.	1	NW¼SE¼ 28	3S	21E	do.	do.								8-6-30	Inside 6¼" casing				70	33	7.8		215		145	1			362	310	134	5	.2		Water from 1,865-2,147
5b 3/	do.	do.	1	NW¼SE¼ 28	3S	21E	do.	do.								8-29-30	Casing head				70	31	19		230		149	1			382	302	113	12	.5		Water from 1,575-1,595
5c 4/	do.	do.	1	NW¼SE¼ 28	3S	21E	do.	do.			2,552					12-11-51			11		88	26	9.2		247		134	1.8			5/ 416	326	124	6	.2		Also 0.8 ppm fluoride
6	Neal Dome	Uintah-Neal Dome Oil Co.	2	SE¼SE¼SW¼ 30	3S	21E	Salt Lake	Weber						10,000	7.3	10-22-57	Well discharge pipe	63	9.1		88	29	13		224	0	174	2.0	0.2		425	340	156	7	0.3	653	Completed as water well.
6a	do.	do.	2	SE¼SE¼SW¼ 30	3S	21E	do.	do.						6,900	7.7	10-8-58	do.	62	10		95	28	9.0		224	0	176	3.5	.1		432	352	168	5	.2	654	
7 3/	Red Wash	California Oil Co.	23	C NE¼SW¼ 14	7S	23E	do.	Green River	2,960		5,835	5,489-5,808	27	138		9-10-57	Pump bleeder						2,490		6,350		1	191			5,860	58	0	99	143		
8 3/	do.	do.	14	C SW¼SW¼ 18	7S	23E	do.	do.	3,177	6,154	6,359	5,104-5,148 5,660-5,688	69	54		9-10-57	Treater				2	1	2,000		4,240	168	8	421			4,710	9	0	100	290		
9 3/	do.	Humble Oil Co.	2	C SW¼NE¼ 8	7S	24E	do.	do.	2,860	5,607	5,640	5,447-5,486	168	5		9-10-57	do.				3	2	2,660		5,710	1	2	704			6,210	16	0	100	290		
10 3/	do.	California Oil Co.	32	C SW¼NE¼ 22	7S	22E	do.	do.	3,002	6,155	11,288	5,430-38; 5,562-95; 5,719-42	105	81		9-10-57	Storage tank						5,980		2,660	266	188	7,230			15,000	4	0	100	1,300		
RW-1-59	do.	do.	12 23 32	C SW¼NW¼ 22 C NE¼SW¼ 22 C SW¼NE¼ 22	7S 7S 7S	22E 22E 22E	do. do. do.	do. do. do.	2,967 3,072 3,002	 6,155	5,875 PB 5,740 5,860 11,288 PB 5,745	5,678-94 5,698-5,705 See "Remarks" 5,430-48; 5,562-95; 5,700-42			8.4	11-3-59	Collection tank See "Remarks"		0.4		23	16	5,730		3,890	86	610	6,110		2.6	14,500	125	0	99	223	21,000	A composite sample from the central collection tank of three wells. Perforations: well no. 23, 5,508-26; 5,634-50; 5,662-70; 5,766-84; 5,788-95; 5,800-14.
RW-1a-59	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			8.3	11-4-59	do.		0.4		33	12	5,950		3,750	78	636	6,510		16	15,100	131	0	99	226	21,800	
RW-1-60	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			8.7	5-4-60	do.		0.0		10	15	6,110	26	4,250	391	485	5,760	5.3	36	14,900	86	0	99	286	21,600	
RW-2-59	do.	do.	12 23 43	C SW¼NW¼ 29 SW¼NE¼SW¼ 30 N½NE¼SE¼ 30	7S 7S 7S	23E 23E 23E	do. do. do.	do. do. do.	3,029 2,947 2,905	6,091 6,027 	6,154 PB 6,063 6,053 PB 5,898 5,966 PB 5,896	See "Remarks" do. do.			8.9	11-3-59	Collection tank See "Remarks"		1.7		12	7.1	8,220		1,870	545	775	10,400		10	20,900	58	0	100	467	32,200	A composite sample from the central collection tank of three wells. Perforations: well no. 12, 4,977-91; 5,005-16; 5,076-98; 5,112-36; 5,553-65; 5,615-29; well no. 23, 4,930-36; 5,062-82; 5,529-30; 5,801-06; well no. 43, 4,887-4,917; 4,919-29; 4,989-5,009; 5,473-80; 5,531-49; 5,865-77.
RW-2-60	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			9.2	5-4-60	do.		2.7	.08	5.6	3.3	8,680	29	1,730	623	444	11,100	5.8	45	21,800	28	0	100	720	31,900	
RW-3-57 3/	do.	do.	41 14	C NE¼NE¼ 21 C SW¼SW¼ 15	7S 7S	24E 24E	do. do.	do. do.	2,550 2,592	5,348 5,340	5,400 PB 5,375 5,625	5,260-95; 5,332-43 5,308-19	34 37	13 37		9-10-57	Treater				2	2	2,970		5,640	770	9	380			6,960	13	0	100	360		A composite sample from the central collection tank of two wells.
RW-3-59	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			9.2	11-3-59	Storage tank		2.3		6.0	.5	2,720		5,040	984	4.9	109		3.1	6,310	17	0	100	287	9,250	
RW-3-60	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			9.1	5-4-60	do.		0.1		11	2.7	2,830	9.2	5,320	811	6.6	135	1.1	6.6	6,420	38	0	99	200	8,730	
RW-4-59	do.	do.	14 43	C SW¼SW¼ 14 NE¼NE¼SE¼ 15	7S 7S	22E 22E	do. do.	do. do.	2,962 2,918	 6,150	5,734 PB 5,720 6,218	5,634-43; 5,669-78; 5,694-5,701 See "Remarks"			8.3	11-4-59	Collection tank See "Remarks"		16		57	29	9,830		1,070	48	1,960	13,200		21	25,700	261	0	99	265	37,300	A composite sample from the central collection tank of two wells. Perforations: well no. 43, 5,596-5,618; 5,626-42; 5,646-56.
RW-4-60	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			8.4	5-4-60	do.		9.4		23	20	7,290	29	3,110	181	1,170	7,980	4.8	35	18,300	139	0	99	269	25,900	
RW-5-60	do.	do.	12 14 23 32 41 43	C SW¼NW¼ 28 C SW¼SW¼ 28 C SE¼SW¼ 28 W½SW¼NE¼ 29 C NE¼NE¼ 29 C NE¼SE¼ 29	7S 7S 7S 7S 7S 7S	22E 22E 22E 22E 22E 22E	do. do. do. do. do. do.	do. do. do. do. do. do.	3,052 2,800 		6,450 PB 6,315 6,000 PB 5,914 5,961 PB 5,940 5,975 6,010 PB 5,905	5,630-5,897 5,834-5,866 5,672-5,931 5,753-5,952 5,798-5,876			8.6	5-4-60	Discharge pipe to disposal pond		0.0	.29	19	15	9,620	57	5,310	446	1,340	10,300	6.3	43	24,500	106	0	99	405	33,500	A composite sample from a central collection point of six wells.
RW-6-60	do.	See "Remarks"		34	7S	22E	do.								8.5	5-4-60	See "Remarks"		0.0		48	319	4,590	12	3,550	196	813	4,780	4.3	20	12,500	1,430	0	87	53	17,800	Sample is surface flow from evaporating pond in central Red Wash field about 3/4 mile south of central battery.
R-1-59	Roosevelt	Humble Oil Co.	1 2	C NW¼SW¼ 21 C NW¼SE¼ 21	1S 1S	1E 1E	Uinta Special Meridian do.	do. do.	5,785 do.		9,392 9,393				8.5	11-5-59	Evaporation pond		10		14	3.6	4,500		2,590	137	1,050	4,520	10		11,500	49	0	100	279	17,900	A composite sample of two wells.
R-1-60	do.	do.	do.	do.	do.	do.	do.	do.	do.		do.				8.6	5-4-60	do.				12	6.6	4,570	53	2,660	421	432	4,560	5.3	48	11,400	57	0	99	263	16,800	
R-2-59	do.	do.	1	C SW¼SW¼ 13	1S	1W	do.	do.	6,040	10,187	10,276	9,825-9,935 10,070-10,190			8.5	11-5-59	Drain pipe into evaporation pond		27		13	5.4	3,100		2,100	93	56	3,440	10		7,780	54	0	99	183	13,000	
R-2-60	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.	do.			8.5	5-4-60	do.		23		27	10	3,670	47	2,320	147	17	4,100	5.4	29	9,210	110	0	98	152	14,600	

1/ Sodium, potassium calculated as sodium (Na)
2/ PB preceding number indicates well plugged back to indicated depth
3/ Analysis by U.S. Geological Survey, Branch of Oil and Gas Operations, Casper, Wyo.
4/ Analysis by Utah State Department of Health, Salt Lake City.
5/ Residue at 180°C.

COLORED

GEOLOGIC MAP OF UTAH

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NORTHEAST QUARTER

Project of the

COLLEGE OF MINES AND MINERAL INDUSTRIES
UNIVERSITY OF UTAH

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