DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE STATES OF ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING

HYDROLOGIC INVESTIGATIONS
ATLAS HA-477 (SHEET 2 OF 2)

CHEMICAL QUALITY OF GROUND WATER

DISSOLVED SOLIDS

Most of the ground water in the basin contains moderate to large amounts of dissolved solids; fresh water occurs locally in deep bedrock aquifers. In general, shallow aquifers that have a high hydraulic conductivity, especially those in geohydrologic units 1 and 2, yield water with the smallest dissolved-solids content (less than 500 mg/l [milligrams per liter] in most areas). Deep bedrock aquifers in geohydrologic units 3 and 4 generally yield water with 500 to 3,000 mg/l of dissolved solids. Shale strata of geohydrologic unit 4, and deeply buried marine sedimentary rocks where ground water circulation is poor, yield water with the largest dissolved-solids content (more than 3,000 mg/l locally). Locally, however, oil tests have penetrated fresh-water aquifers (water containing less than 1,000 mg/l of dissolved solids) underlying saline-water aquifers at depths of several thousand feet.

The fresh-water aquifers apparently have good hydraulic connection with recharge areas on the flanks of the higher mountain ranges, and the fresh water moves rather freely from the recharge areas downdip into the aquifers. Such deep fresh-water aquifers are known to occur in the Weber Sandstone, Morgan Formation, Madison Limestone, and sandstone members of the Mancos Shale in the Uinta and Green River Basins and in the High Plateaus of Utah. (See Goode and Feltis, 1962; Feltis, 1966; and Welder, 1968.)

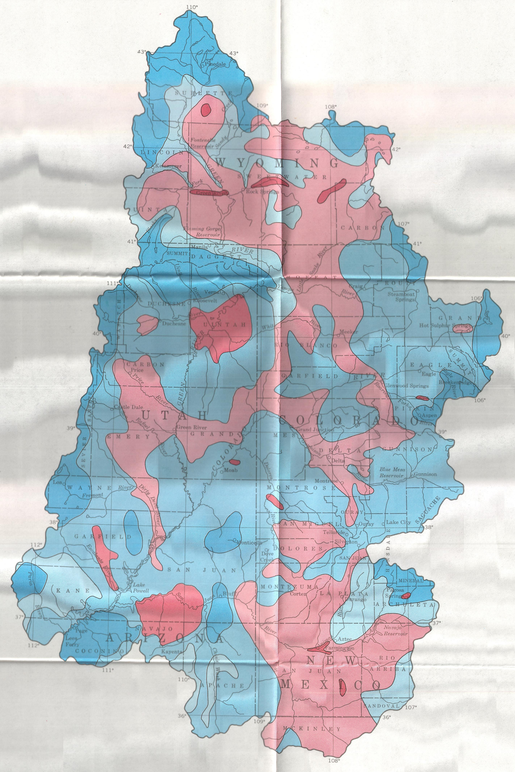
EXPLANATION

Areas where at least one aquifer should contain water with concentrations of dissolved solids generally within the limits shown below; other aquifers in the area probably would contain more highly mineralized water, based in part on geology.

Dissolved solids, in milligrams per liter

- Less than 500 — *Less than 250 in some mountainous areas*
- 250 to 1000
- 500 to 1000
- 1000 to 3000
- 500 to 3000 — *More than 2000 locally*
- More than 2000

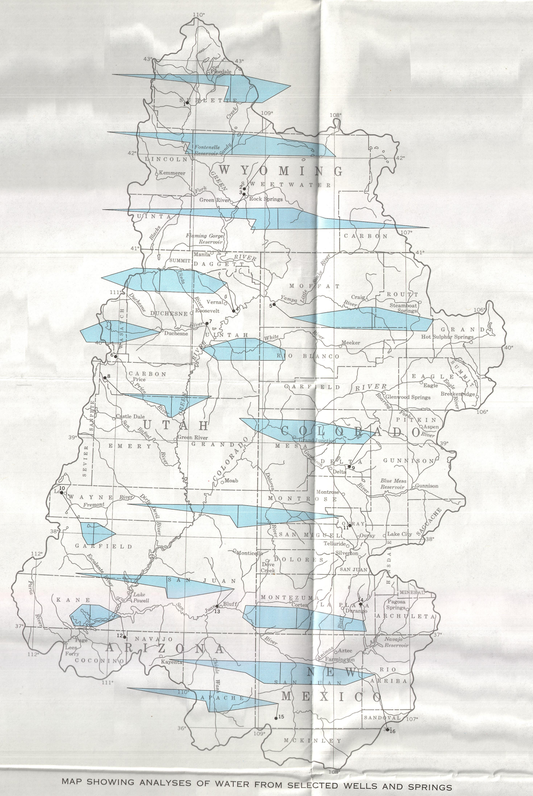
Basin boundary



MAP SHOWING DISSOLVED-SOLIDS CONTENTS IN WATER FROM PRINCIPAL AQUIFERS

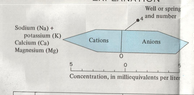
SELECTED CHEMICAL ANALYSES

Selected analyses of water from various aquifers indicate that the water is chiefly of the calcium bicarbonate or sodium bicarbonate type. However, a detailed study probably would show that ground water in the basin ranges considerably in type from place to place depending chiefly on the rock source and depth.



MAP SHOWING ANALYSES OF WATER FROM SELECTED WELLS AND SPRINGS

EXPLANATION



Map No.	Water-bearing formation	Depth to water-bearing zone (feet)	Dissolved solids (milligrams per liter)
1	Wasatch Formation	790	646
2	Alluvium	59	1,180
3	Wasatch Formation	190	1,340
4	Phosphoria Formation	4,266	731
5	Weber Sandstone	30	667
6	North Horn Formation	1,825	310
7	Weber Sandstone	1,500	448
8	Mancos Shale (Ferron Sandstone Member)	3,865	311
9	Mancos Shale	Spring	734
10	Volcanic rocks	220	173
11	Dakota Sandstone	562	608
12	Wingate Sandstone	1,000	223
13	Glen Canyon Group	825	491
14	Mesaverde Group	2,875	786
15	Menefee Formation and Point Lookout Sandstone	1,448	452
16	San Jose Formation	Spring	960

SALINE GROUND WATER

Saline ground water is an important resource in the basin. Slightly to moderately saline water containing 1,000 to about 10,000 mg/l of dissolved solids constitutes an important segment of the total water resource in the Upper Colorado River basin. In some areas this water is the only source of supply and in a large part of the basin it is in relatively shallow aquifers that have moderate to high hydraulic conductivity. Continued river improvement or the use of demineralization of water should eventually make withdrawal and use of some of this water economically feasible. The largest quantities of near-surface saline water are in the Wyoming Basin and Navajo sections of the Upper Colorado River basin.

SALINE WATER RESOURCES

Areas where large volumes of mineralized water are stored; uncolored areas do not contain large volumes of mineralized water

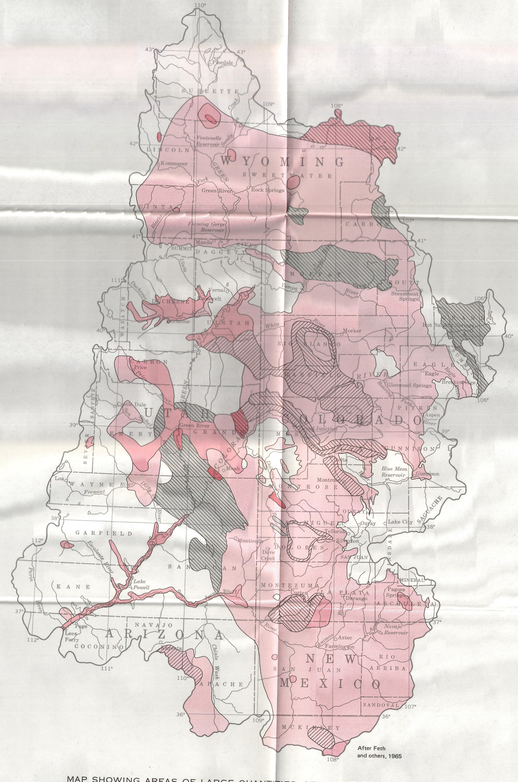
Dissolved solids, in milligrams per liter

- 1000 to 3000
- 3000 to 10,000
- 10,000 to 35,000
- More than 35,000

Inferred to contain mineralized water by analogy with other areas where geologic and hydrologic conditions are comparable

Depth, in feet below land surface, to shallowest zone that contains mineralized water

- Less than 500
- 500 to 1000
- More than 1000



After Feth and others, 1966

MAP SHOWING AREAS OF LARGE QUANTITIES OF SALINE GROUND WATER

CHEMICAL QUALITY OF SURFACE WATER

DISSOLVED SOLIDS

Streams with headwaters in areas underlain by rocks of geohydrologic unit 4 contribute the largest amount of dissolved solids to the Colorado River. The headwaters of most of the streams in the basin generally contain water with less than 100 mg/l of dissolved solids. Those streams which head in the higher mountain areas underlain by resistant rocks of geohydrologic units 2 and 5 generally maintain a relatively low dissolved-solids content (less than 500 mg/l) even in their lower reaches. The smaller tributary streams that head in areas underlain by less resistant shale strata of geohydrologic unit 4 dissolve minerals rapidly and contain water with 500 to 2,000 mg/l of dissolved solids. Thus they contribute to the mineral gain in the Colorado River and its main tributaries.

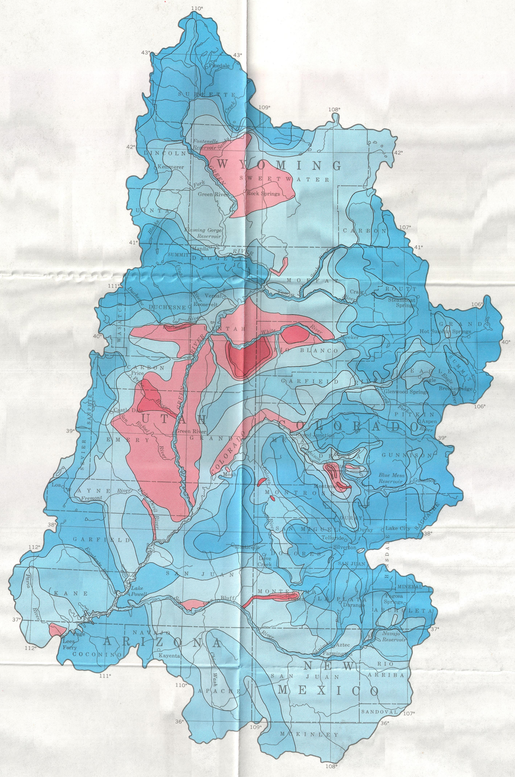
Return irrigation flow and inflow of saline ground water rising along faults also contribute heavily to the mineral content of the streams.

EXPLANATION

Weighted-average concentration of dissolved solids, in milligrams per liter

- Less than 100
- 100 to 250
- 250 to 500
- 500 to 1000
- 1000 to 2000
- 2000 to 3000
- More than 3000

In areas of few or no sampling sites, the weighted-average concentrations of dissolved solids were estimated from data observed in adjacent areas of similar geology and topography. Data from these areas of few or no sampling sites should be used with discretion



MAP SHOWING WEIGHTED-AVERAGE CONCENTRATION OF DISSOLVED SOLIDS

SULFATE

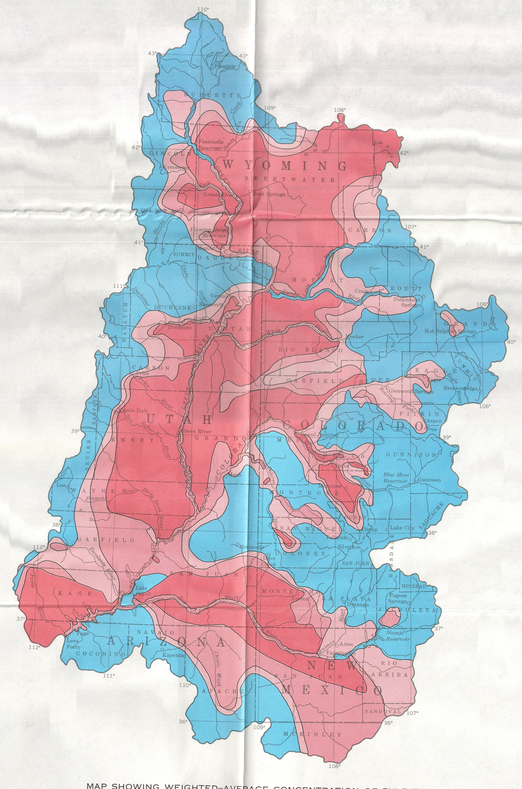
One of the principal dissolved constituents is sulfate which is dissolved chiefly from the shale strata and exceeds 250 mg/l in many areas.

EXPLANATION

Weighted-average concentration of sulfate, in milligrams per liter

- Less than 50
- 50 to 100
- 100 to 250
- More than 250

In areas of few or no sampling sites, the weighted-average concentrations of sulfate were estimated from data observed in adjacent areas of similar geology and topography. Data from these areas of few or no sampling sites should be used with discretion



MAP SHOWING WEIGHTED-AVERAGE CONCENTRATION OF SULFATE

Base from U.S. Geological Survey, 1961

SELECTED HYDROLOGIC DATA IN THE UPPER COLORADO RIVER BASIN

By
Don Price and K. M. Waddell

UNIVERSITY OF UTAH
RESEARCH INSTITUTE
EARTH SCIENCE LAB.

SCALE 1:2 500 000

50 0 50 100 150 200 250 MILES

50 0 50 100 150 200 250 KILOMETERS

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