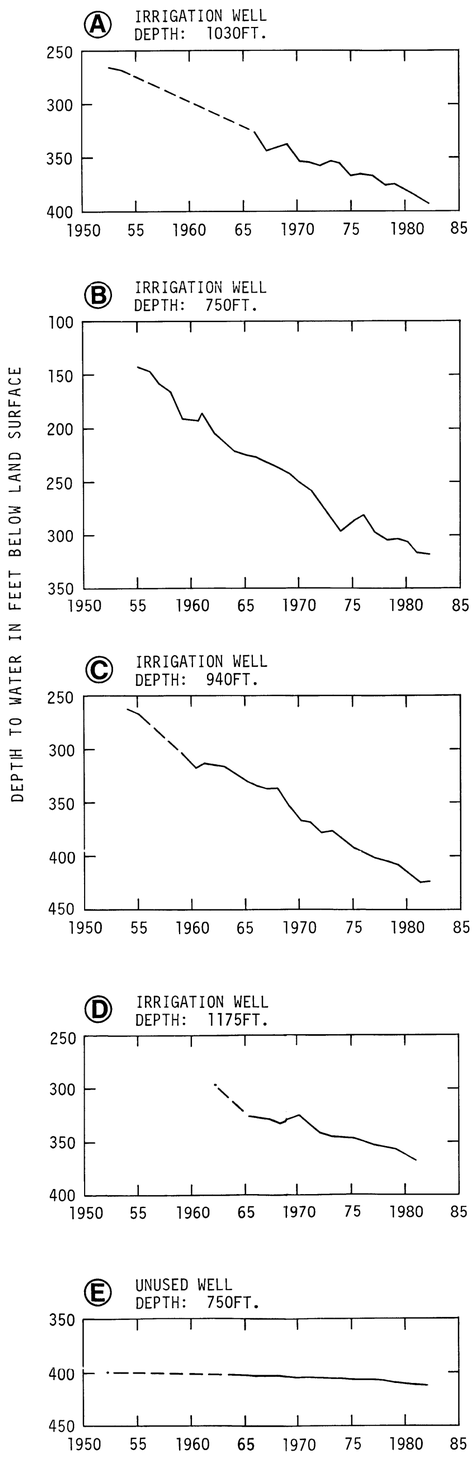
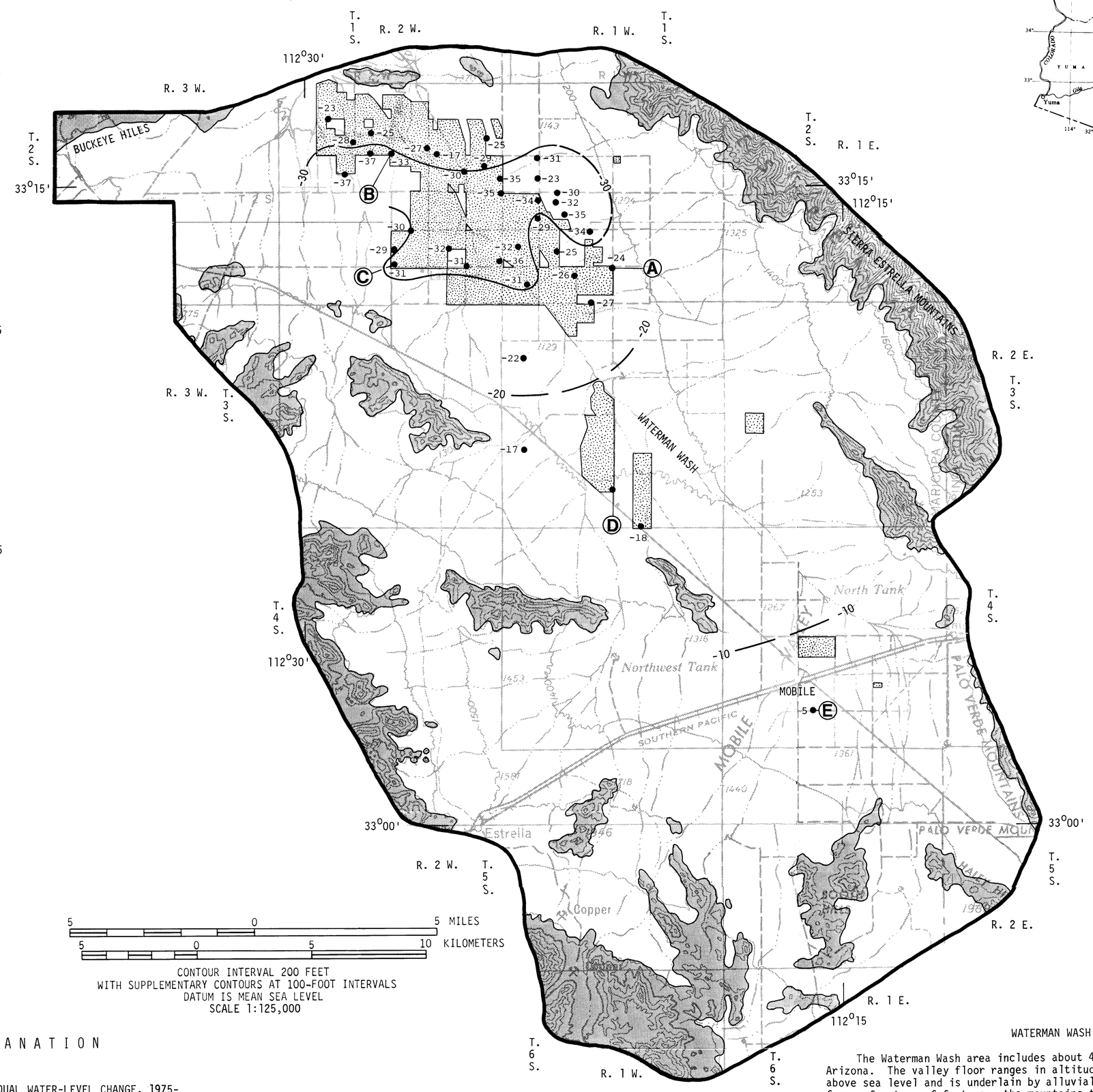
HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS SHOWN ON THE MAP
(Dashed line indicates inferred water levels)

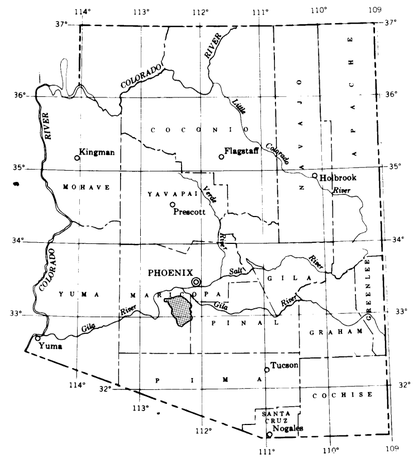


CONVERSION FACTORS

For readers who prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound	By	To obtain metric unit
square mile (mi^2)	2.590	square kilometer (km^2)
foot (ft)	0.3048	meter (m)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
acre (ac)	0.004047	square kilometer (km^2)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)
feet per mile (ft/mi)	0.19	meters per kilometer (m/km)





INDEX MAP SHOWING AREA OF REPORT (SHADED)

EXPLANATION

-30 — APPROXIMATE LINE OF EQUAL WATER-LEVEL CHANGE, 1975-82--Interval 10 feet. Dashed where inferred

-35 ● WELL IN WHICH DEPTH TO WATER WAS MEASURED IN 1975 AND 1982--Number, -35, is the difference in feet between the 1975 and 1982 measurements

Ⓐ ● WELL FOR WHICH A HYDROGRAPH IS SHOWN

IRRIGATED AREA AS OF JUNE 1981--Land under cultivation or that prepared for cultivation was considered irrigated

BEDROCK (VOLCANIC, GRANITIC, OR METAMORPHIC ROCK)--Water may occur in weathered or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying consolidated rocks. Based on Wilson and others, 1959

ARBITRARY BOUNDARY OF GROUNDWATER AREA

ESTIMATED GROUNDWATER PUMPAGE IN THE WATERMAN WASH AREA

YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET	YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET
1940	*	1961	65
1941	*	1962	50
1942	*	1963	50
1943	*	1964	50
1944	*	1965	45
1945	*	1966	45
1946	*	1967	52
1947	*	1968	54
1948	1	1969	60
1949	1	1970	55
1950	5	1971	55
1951	10	1972	57
1952	17	1973	55
1953	28	1974	69
1954	30	1975	64
1955	40	1976	70
1956	40	1977	72
1957	40	1978	54
1958	45	1979	67
1959	50	1980	65
1960	60	1981	65
		TOTAL:	1,586

* Pumpage less than 500 acre-feet per year.

WATERMAN WASH AREA

The Waterman Wash area includes about 450 square miles in south-central Arizona. The valley floor ranges in altitude from about 1,000 to 1,500 feet above sea level and is underlain by alluvial deposits that range in thickness from a few tens of feet near the mountains to more than 2,000 feet in the central part of the area (Wilson, 1979, p. 16). The mountains that surround the area are composed principally of crystalline and metamorphic rocks and rise to altitudes of as much as 4,000 feet above sea level. The area is drained by Waterman Wash, which heads in the southeastern part of the area, flows northwestward through the valley, leaves the area between outliers of the Sierra Estrella Mountains and the Buckeye Hills at the northwestern end of the area. Waterman Wash flows only in direct response to precipitation and is not a significant source of water in the area.

The main source of water in the Waterman Wash area is groundwater that occurs under mostly unconfined conditions in the alluvial deposits that underlie the area. These deposits consist mainly of unconsolidated to moderately consolidated clay, silt, sand, and gravel. Yields of wells in the alluvial deposits range from a few gallons per minute for domestic and stock wells to more than 2,000 gal/min for irrigation wells. Wilson (1979, p. 20) estimated that the 1,500 feet of saturated deposits below the water-table contain slightly more than 10 million acre-feet of recoverable groundwater.

The primary use of groundwater in the area is for irrigation of approximately 16,000 acres of agricultural crop land. Pumpage for agricultural use in the Waterman Wash area has increased from about 5,000 acre-feet in 1950 to a high of 72,000 acre-feet in 1977; the total withdrawal of groundwater from 1940 through 1981 was about 1.6 million acre-feet.

The withdrawal of groundwater has resulted in a general decline in water levels throughout much of the Waterman Wash area. Since the early 1950's, when most groundwater withdrawal began, water levels have declined about 200 feet in the center of the irrigated area and about 12 feet near Mobile. During the period 1975 to 1982, water levels in the center of the irrigated area declined as much as 35 feet and about 5 feet near Mobile which indicates an average annual decline during this period of about 5 feet and 1 foot, respectively. Long term water-level declines have been accompanied by decreasing well yields. Comparison of well discharge and pumping level data from 1965 to 1981 indicates about a 35 percent reduction in specific capacity values. Specific capacity of a well is the discharge in gallons per minute per foot of drawdown caused by pumping and is an indication of the water-yielding ability of the materials penetrated by the well.

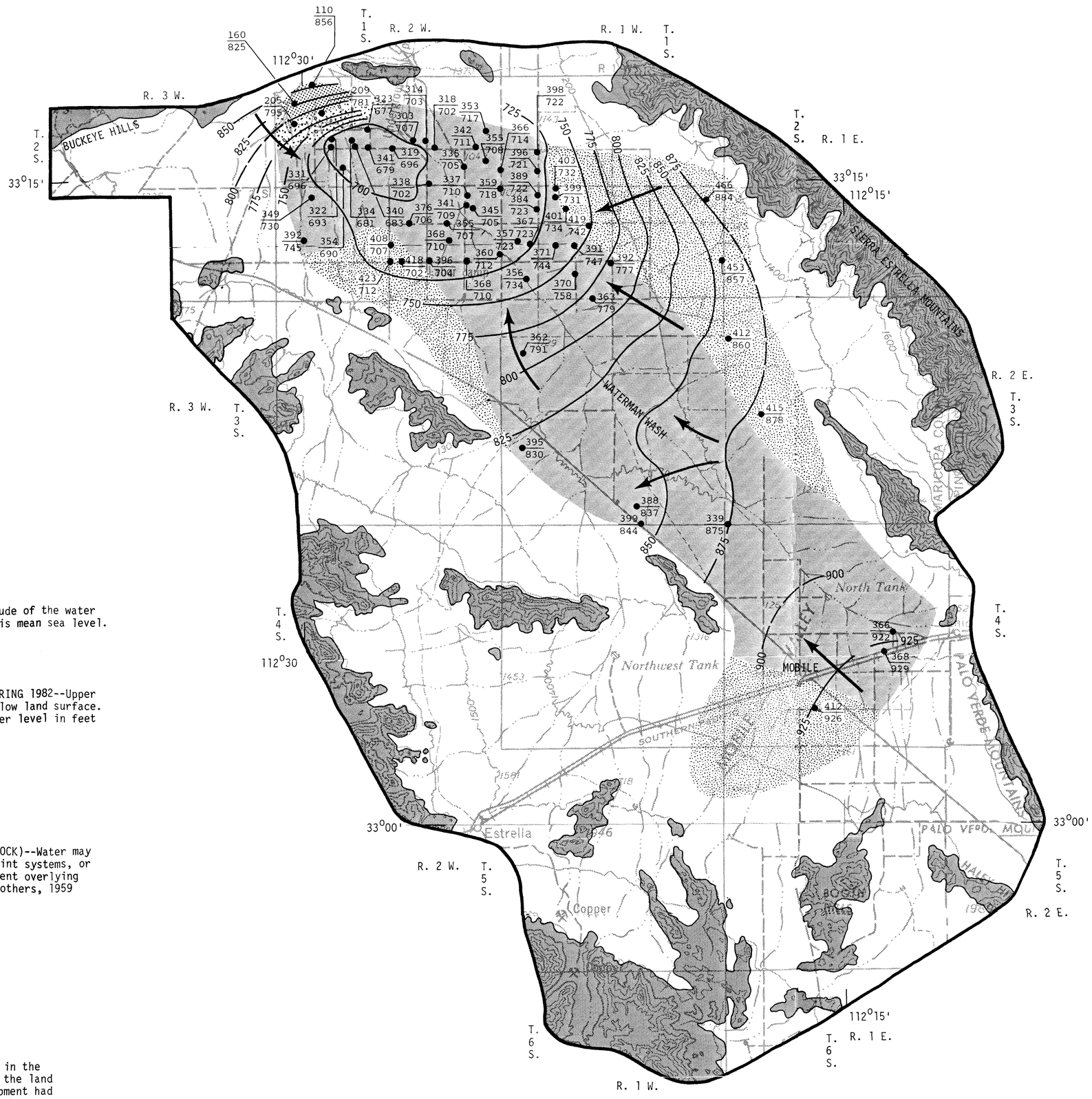
BASE FROM U.S. GEOLOGICAL SURVEY
AJO 1:250,000, 1953 AND PHOENIX
1:250,000, 1954

CHANGE IN WATER LEVEL, 1975-82, IRRIGATED AREA, AND HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS MAPS SHOWING GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA--198

BY

R. S. STULIK

These hydrologic maps are available upon request from the Department of Water Resources, Basic Data Unit, 2810 South 24th Street, Suite 122, Phoenix, Arizona, 85034. The hydrologic data on which these maps are based are available, for the most part, in computer-printout form and may be consulted at the Department of Water Resources and at the U.S. Geological Survey offices located at: Federal Building, 301 West Congress Street, Tucson, and Valley Center, 241 North Central Avenue, Suite 1880, Phoenix, Arizona.



EXPLANATION

DEPTH TO WATER IN FEET BELOW LAND SURFACE

- Less than 200
- 200 to 300
- 300 to 400
- Greater than 400
- Insufficient data

875 — WATER-LEVEL CONTOUR--Shows approximate altitude of the water level. Contour interval 25 feet. Datum is mean sea level. Dashed where inferred

339 / 875 ● WELL IN WHICH DEPTH TO WATER WAS MEASURED DURING 1982--Upper number, 339, is depth to water in feet below land surface. Lower number, 875, is altitude of the water level in feet above mean sea level

GENERALIZED DIRECTION OF GROUNDWATER FLOW

BEDROCK(VOLCANIC, GRANITIC, OR METAMORPHIC ROCK)--Water may occur in weathered or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying consolidated rocks. Based on Wilson and others, 1959

ARBITRARY BOUNDARY OF GROUNDWATER AREA

Prior to extensive goundwater withdrawals, groundwater movement in the Waterman Wash area probably conformed, in general, to the gradient of the land surface. In 1952, although only a small amount of groundwater development had taken place, groundwater was moving from nearly all directions toward the center of pumping. By 1966 groundwater was still moving toward the center of the irrigated area from every direction but most notably from the southeast (Denis, 1968, p. 8). The average slope of the groundwater surface from south to north along the central part of the irrigated area had increased from about 7 feet per mile in 1961 to 11 feet per mile in 1966 (Denis, 1968, p. 8).

In 1982 groundwater continues to move toward the center of the irrigated area from nearly all directions. The average slope of the groundwater surface from the southeast to the northwest along the central part of the irrigated area has increased to about 15 feet per mile. The configuration of the 850-foot contour in the southeast part of T. 3 S., R. 1 W. is probably the result of a small cone of depression forming in this part of the area.

Depth to water is about 100 feet at the northwest end of the basin and more than 450 feet in the northeast part of the area in 1982. In most of the irrigated parts of the area the depth to water is from 300 to 400 feet below land surface.

5 0 5 MILES
5 0 5 10 KILOMETERS

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
DATUM IS MEAN SEA LEVEL
SCALE 1:125,000

BASE FROM U.S. GEOLOGICAL SURVEY
AJO 1:250,000, 1953 AND PHOENIX
1:250,000, 1954

DEPTH TO WATER AND ALTITUDE OF THE WATER LEVEL, 1982

MAPS SHOWING GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA--1982

BY

R. S. STULIK

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DATUM IS MEAN SEA LEVEL
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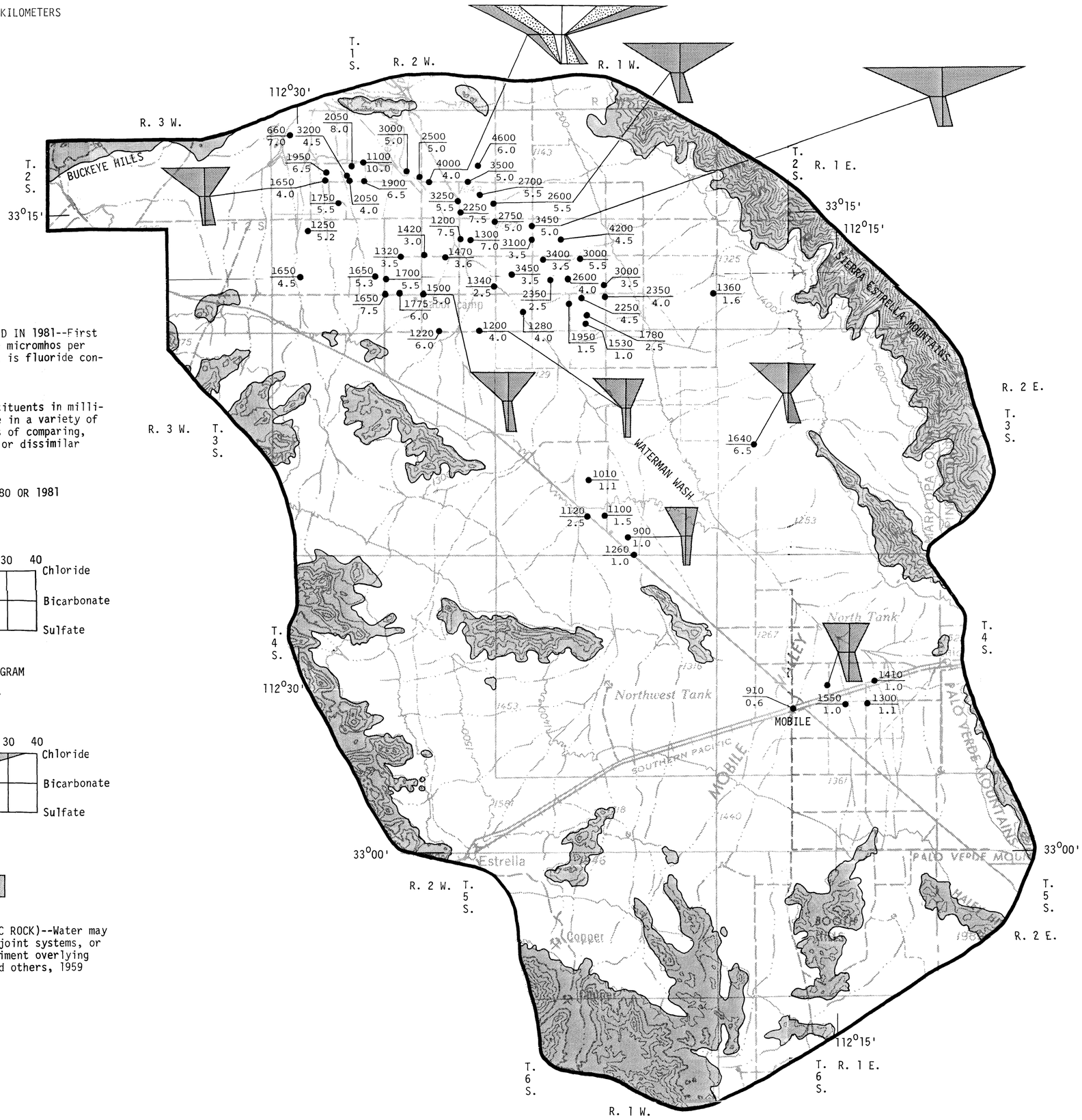


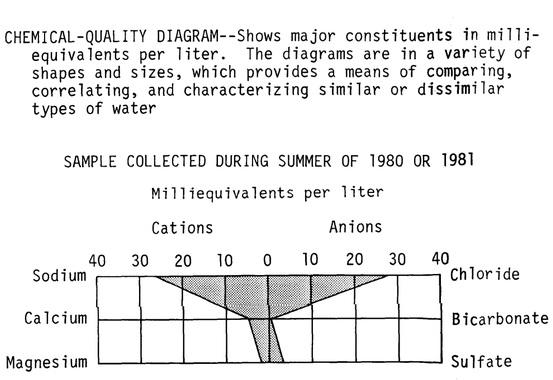
EXPLANATION

1650 / 4.5 — WELL FROM WHICH A WATER SAMPLE WAS COLLECTED IN 1981--First number, 1650, is specific conductance in micromhos per centimeter at 25°C. Second number, 4.5, is fluoride concentration in milligrams per liter

CHEMICAL-QUALITY DIAGRAM--Shows major constituents in milliequivalents per liter. The diagrams are in a variety of shapes and sizes, which provides a means of comparing, correlating, and characterizing similar or dissimilar types of water

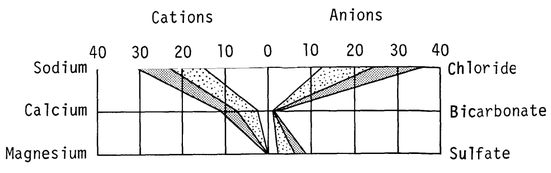
SAMPLE COLLECTED DURING SUMMER OF 1980 OR 1981

Milliequivalents per liter



COMPOSITE CHEMICAL QUALITY DIAGRAM

Milliequivalents per liter



YEAR SAMPLE WAS COLLECTED

1966 1974 1980

BEDROCK (VOLCANIC, GRANITIC, OR METAMORPHIC ROCK)--Water may occur in weathered or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying consolidated rocks. Based on Wilson and others, 1959

ARBITRARY BOUNDARY OF GROUNDWATER AREA

Specific conductance values for groundwater in the Waterman Wash area during 1981 ranged from about 660 to 4,600 micromhos per centimeter at 25°C. Specific conductance varies with the concentration of ions in solution; an estimate of the dissolved-solids concentration may be obtained by multiplying the specific conductance by 0.6. Nearly all specific conductance values observed in the heavily irrigated northern part of the area, particularly on the east side of Waterman Wash, represent water-quality conditions that could have adverse effects on many crops. Comparison of 1966 and 1981 specific conductance values for groundwater in the irrigated part of the area suggests an increase inaion concentration with time and/or increasing depth to water.

The following guidelines for dissolved solids and specific conductance values for irrigation water are modified from the National Academy of Sciences and National Academy of Engineering (1973, p. 335):

Classification	Dissolved solids (milligrams per liter)	Specific conductance (micromhos)
Water for which no detrimental effects are usually noticed	Less than 500	Less than 830
Water that can have detrimental effects on sensitive crops	500 - 1,000	830 - 1,670
Water that can have adverse effects on many crops; require careful management practices	1,000 - 2,000	1,670 - 3,330
Water that can be used for tolerant plants on permeable soils with careful management practices	2,000 - 5,000	3,330 - 8,330

The chemical-quality diagrams throughout the area indicate the principal ions in solution in the water are sodium and chloride. The diagram for water from a well in sec. 11, T. 2 S., R. 2 W. illustrates the change in concentrations of principal ions from 1966 to 1981 in the water from that well.

The quality of water in the Waterman Wash area ranges from suitable to unsuitable for human consumption. In general, most of the groundwater south of T. 2 S. is suitable to marginal on the basis of fluoride and dissolved-solids concentrations; water in T. 2 S., R. 1 W. and R. 2 W. is unsuitable.

The maximum acceptable concentration of fluoride in public water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). The amount of water consumed by humans, and therefore the amount of fluoride ingested, depends partly on air temperature. Excessive concentrations of fluoride in drinking water can cause mottled enamel in teeth and skeletal effects, particularly in children. In the Waterman Wash area the maximum acceptable concentration of fluoride is 1.4 mg/L (milligrams per liter). Fluoride concentrations in T. 2 S. range as high as 10.0 mg/L and most are more than 4.0 mg/L. Fluoride concentrations in groundwater south of T. 2 S. are mostly less than the maximum acceptable concentration of 1.4 mg/L.

The maximum acceptab elconcentration of dissolved solids in public water supplies is 500 mg/L, as proposed in the secondary drinking-water regulations of the U.S. Environmental Protection Agency (1977b, p. 17146) in accordance with provisions of the Safe Drinking Water Act (Public Law 93-523). The U.S. Environmental Protection Agency (1977a, b) has established standards in the national regulations and guidelines for the quality of water provided by public water systems. The standards are either primary or secondary. Primary drinking-water standards govern constituents in drinking water that have been shown to affect human health. Secondary drinking-water standards apply to constituents that affect esthetic quality. The primary standards are enforceable either by the Environmental Protection Agency or by the States; in contrast, the secondary standards are not Federally enforceable. The secondary standards are intended as guidelines for the States. The dissolved-solids concentrations as indicated by specific conductance data in the Waterman Wash area range from about 400 mg/L to about 2,800 mg/L.

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BASE FROM U.S. GEOLOGICAL SURVEY
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CHEMICAL QUALITY

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