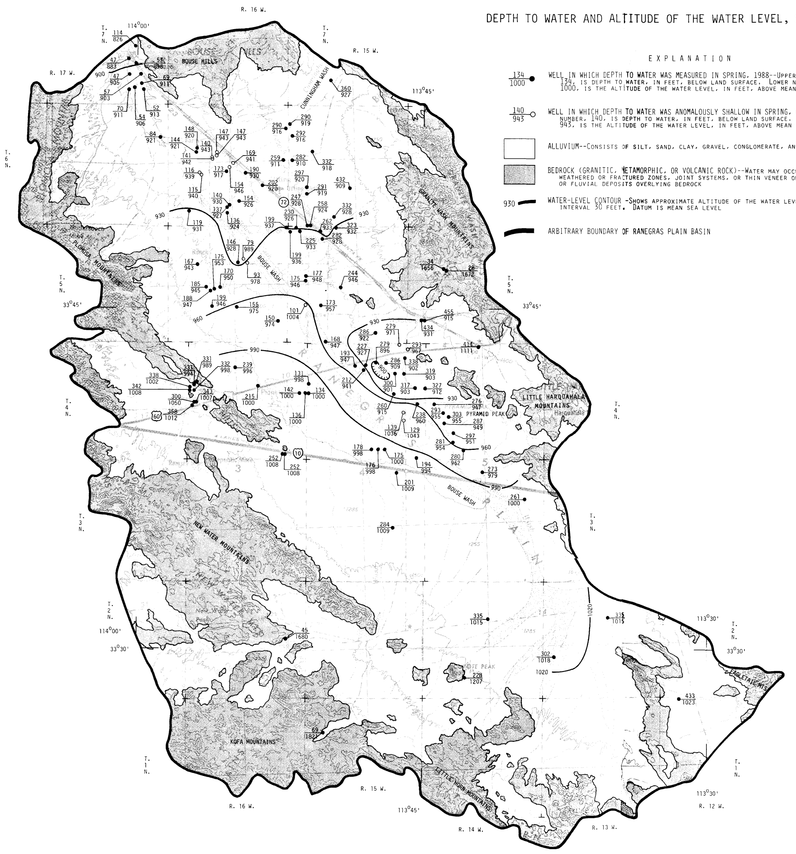
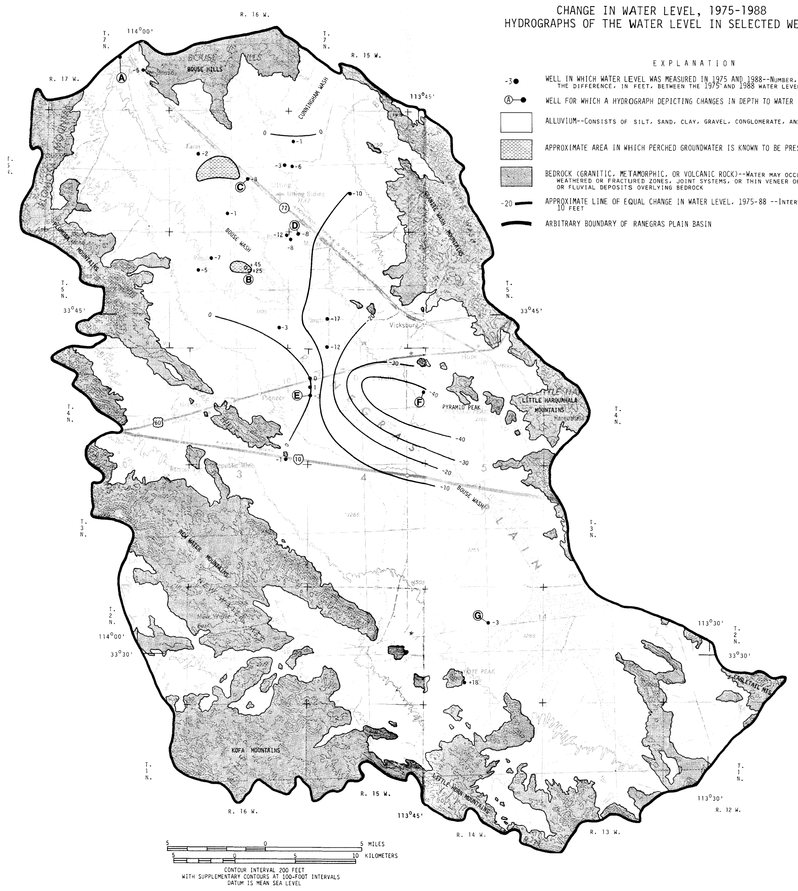
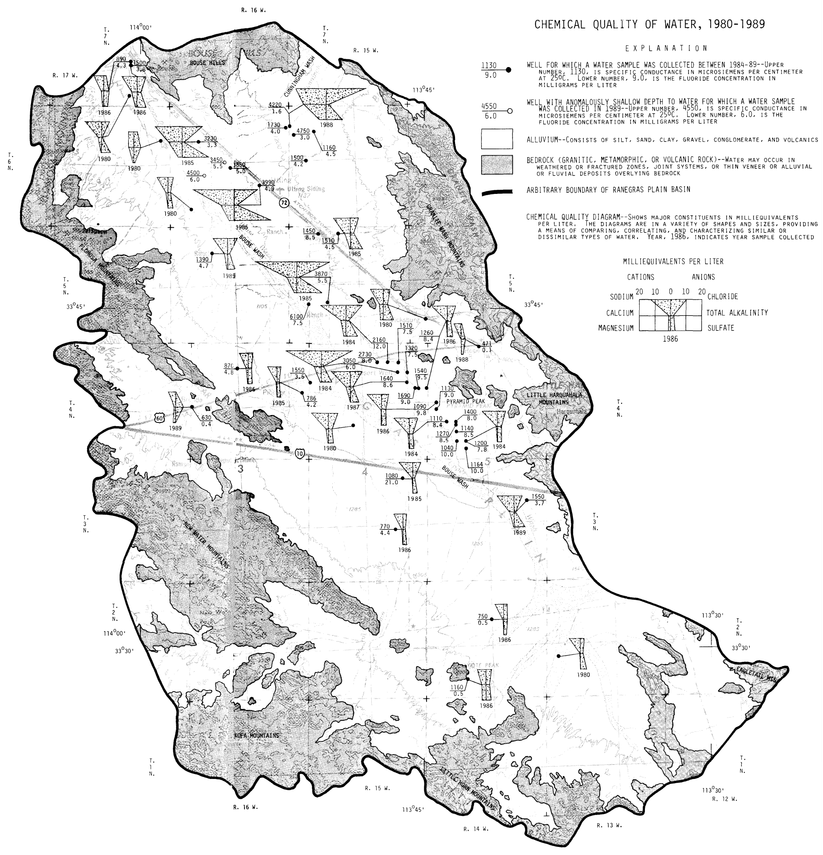
DEPTH TO WATER AND ALTITUDE OF THE WATER LEVEL, SPRING 1988



CHANGE IN WATER LEVEL, 1975-1988
HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS



CHEMICAL QUALITY OF WATER, 1980-1989



INTRODUCTION

The Ranegras Plain basin, located in western Arizona about 100 miles west of Phoenix, is a northwest-trending alluvial basin that encompasses approximately 900 square miles. It is bounded on the north by the Bouse Hills, on the east by the Granite Wash and Little Harquahala Mountains, on the south by the Eagletail and Little Horn Mountains, and on the west by the New Water and Plomosa Mountains. Drainage of the gently sloping plain is accomplished by Bouse Wash, an ephemeral stream, which heads in the adjacent Harquahala Irrigation Non-Expansion Area (INA) to the southeast and exits the basin to the northwest near the Town of Bouse.

The climate in the Ranegras Plain basin area is arid, and the average precipitation is about 5.5 inches per year. April, May and June are the driest months, with an average combined total of about 0.35 inches of precipitation. The average daily maximum temperature for the Town of Bouse is about 87°F and the average daily minimum temperature is about 52°F. The highest recorded temperature was 123°F in July, 1958. The lowest recorded temperature was 11°F in January, 1974 (Sellers and others, 1985, p. 88, 91, 100, 103). The dominant indigenous vegetation in the basin is the creosote bush, typical of the Lower Sonoran Desert Section of the Basin and Range Physiographic Province (Hunt, 1967,p. 328). Because of the arid conditions and lack of a surface water supply, the limited agriculture in the area is dependent upon the use of groundwater for irrigation.

GROUNDWATER OCCURRENCE

Groundwater in the Ranegras Plain basin primarily occurs in Tertiary and Quaternary alluvium as described by Metzger (1957, p. 11-14). The Tertiary alluvium is composed mostly of clay, volcanics, conglomerate, and smaller amounts of sand and gravel. It constitutes the principal aquifer in the basin. Yields from wells that are developed in Tertiary alluvium are generally low due to the large amounts of clay, but it is a productive aquifer in some areas. The Tertiary alluvium may be of lacustrine origin; however, some doubt exists as to the actual mechanism of deposition. The thickness of the Tertiary alluvium is unknown, but examination of driller's logs reveals that it may exceed 1,493 feet in section 18, T.5N., R.15W. The Quaternary alluvium was deposited by ephemeral streams that formed alluvial fans and contains less clay than the Tertiary alluvium; sand and gravel are the major constituents. Coarser material was generally deposited near the mountain fronts and the finer material deposited toward the center of the basin. The thickness of the Quaternary alluvium generally does not exceed a few hundred feet. Little is known of the lithology of the basin south of Interstate 10 due to the paucity of wells and logs in this area. In the spring of 1988, depth to water in wells throughout the basin ranged from 28 feet to 455 feet below land surface. Groundwater in the basin generally flows to the northwest toward the Town of Bouse. Due to large groundwater withdrawals for agricultural use, groundwater also flows toward a cone of depression in the Pyramid Peak area, in the northeast corner of T.4N., R.15W. Hargis and Associates (1988, p. 8) estimates that the amount of groundwater in storage within the basin is between 15.4 and 22.2 million acre-feet.

Perched groundwater conditions have been identified in two locations in the basin. In a small area of the central portion of T.6N., R.16W., water-levels are 10 to 20 feet shallower than those in the surrounding area. Another area of perched groundwater was identified by Briggs (1969, p. 21) in sections 9 and 10 of T.5N., R.16W. In 1988, water levels in the two wells in section 10 were 50 to 60 feet higher than those in the surrounding area. Other areas of perched groundwater may exist where anomalously shallow water levels have been observed (map 1), but more data are needed to clearly demonstrate if perched groundwater conditions exist.

Discharge measurements from irrigation wells performed by the U.S. Geological Survey in 1983 ranged from 85 gallons per minute to 3,310 gallons per minute. Specific capacity is a measure of yield per unit of drawdown, usually expressed as gallons per minute per foot of drawdown, and is useful in evaluating the ability of a well to produce water. Briggs (1969, p. 3) noted that specific capacities of wells within the basin ranged from 3 to 10 gallons per minute per foot of drawdown. According to more recent data, specific capacities in the basin may range up to 57 gallons per minute per foot of drawdown. Wells exhibiting lower specific capacities are located in the northern portion of the basin and the higher values in the Pyramid Peak area. Generally, the best yielding wells in the basin are those that are developed in conglomerate.

Metzger (1951, p. 16) estimated that total recharge to the basin may be approximately 5,000 acre-feet per year. Recharge to the basin is accomplished primarily from runoff that is carried through Bouse Wash, Cunningham Wash and along the base of mountain fronts. In addition, approximately 32.5 miles of the Central Arizona Project (CAP) Canal is located in the northeastern portion of the basin. Based on percolation rate estimates through the wetted surface of the concrete liner by the Central Arizona Water Conservation District, 2,000-3,000 acre-feet of water may be recharged to the basin annually (Robert Madler, Central Arizona Water Conservation District, oral commun., 1990). As such, the CAP Canal constitutes a major recharge source. Secondary sources of recharge include groundwater flow from Butler Valley basin in T.7N., R.15W., and the western section of the Harquahala INA in T.2N., R.13W., and T.3N., R.13W. These secondary sources likely contribute less than 500 acre feet per year each. Deep percolation from irrigation may also contribute, but is probably not significant.

WATER-LEVEL CHANGES

From 1950 through 1988, approximately 657,000 acre-feet of groundwater was pumped from the Ranegras Plain basin. (Alice Konieczki, U.S. Geological Survey, oral commun., 1989). Since 1975, water-level changes have ranged from a rise of 1 foot to a decline of probably more than 40 feet (hydrograph F). Water-level changes for those wells in perched areas and outside of the main basin ranged from a rise of 45 feet to a decline of 64 feet. The change in water levels in wells in the Pyramid Peak area is based on data from 1983 through 1988, although agricultural development in this area began in the early 1980's. Thus, water levels probably have declined more than 40 feet in this area since 1975. The amount of irrigated acreage in the basin has fluctuated over the years. In 1949, when irrigation was introduced to the basin, approximately 1,000 acres of land was cultivated. Annual pumpage reached a peak of 50,000 acre-feet in the basin in 1981 (table 1) when approximately 12,600 acres of land was irrigated (U.S. Geological Survey, 1986, sheet 1). Approximately 7,300 acres of land, mostly located in the Pyramid Peak area, was irrigated in 1988, and much of that acreage has since been taken out of production. With the decrease in the demand of groundwater for agricultural purposes, water levels should start to rebound in this area. The rebound will not represent net groundwater recharge to the basin, but will reflect the filling of the cone of depression from the surrounding area.

WATER QUALITY

During the period 1984-1989, 48 wells were sampled and analyzed for specific conductance and fluoride. Specific-conductance values ranged from 471 to 6,100 microsiemens per centimeter (uS/cm). Dissolved-solids concentrations may be approximated by multiplying specific-conductance values by 0.6, which is the approximate ratio of dissolved solids (in mg/L) to specific conductance (in uS/cm). According to the U.S. Environmental Protection Agency's secondary drinking-water standards, the maximum contaminant level (MCL) for dissolved solids is 500 mg/L (833 uS/cm). Only 5 of 48 wells sampled exhibited dissolved-solids concentrations below the MCL; all were predominantly located on the west side of the basin. If the dissolved-solids concentration exceeds 1,000 mg/L (1,667 uS/cm), the water may have adverse effects on many crops and may cause physiological effects on humans and animals (U.S. Environmental Protection Agency, 1986a). Of the 48 wells sampled, 14 exceeded a dissolved-solids concentration of 1,000 mg/L. Areas having the highest concentrations of dissolved solids are in T.5N., R.15W.; T.6N., R.15W.; and T.6N., R.16W.

Fluoride concentrations from wells sampled in the basin ranged from 0.1 to 21.0 mg/L. The MCL for fluoride has recently been set at 4.0 mg/L (U.S. Environmental Protection Agency, 1986b, p. 11396-11397; Arizona Department of Environmental Quality, 1989, p. 7). Of the 48 sampled wells, 37 exceeded the MCL. The area where the majority of the sampled wells exceeded the MCL is located just west of Pyramid Peak in T.4N., R.14W., and T.4N., R.15W.

Detailed analyses of 39 of the sampled wells were conducted to show selected constituents of the groundwater. The analyses revealed unusually high concentrations of some inorganic substances. Two substances that may present a health risk are hexavalent chromium and selenium. The aforementioned substances, when present in high concentrations in groundwater, can be toxic or carcinogenic. They can also be absorbed by plants, making them toxic to humans and animals when ingested. Thirteen of the sampled wells, predominantly south of U.S. Highway 60, exceed the MCL for hexavalent chromium of 0.05 mg/L. Hargis and Associates (1988, Fig. 12) found four wells, distributed throughout the basin, that exhibited selenium concentrations in excess of the MCL of 0.01 mg/L (table 2). The high concentrations of fluoride, hexavalent chromium and selenium in the Pyramid Peak area may be associated with Tertiary volcanics. However, most of the wells within the basin have large perforated intervals, and specific zones have not been isolated and sampled to determine where the above contaminants originate.

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ESTIMATED GROUND-WATER PUMPAGE IN THE RANEGRAS PLAIN BASIN

TABLE 1

YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET
1950	2
1951	5
1952	15
1953	22
1954	19
1955	16
1956	16
1957	9
1958	10
1959	10
1960	11
1961	12
1962	15
1963	17
1964	7
1965	6
1966	7
1967	12
1968	15
1969	16
1970	15
1971	15
1972	19
1973	19
1974	22
1975	13
1976	6
1977	13
1978	12
1979	14
1980	10
1981	50
1982	40
1983	26
1984	38
1985	21
1986	31
1987	23
1988	28
TOTAL:	657

INDEX MAP SHOWING AREA OF REPORT (SHADED)

WELLS WITH CONCENTRATIONS OF HEXAVALENT CHROMIUM OR SELENIUM ABOVE THE MAXIMUM CONTAMINANT LEVEL

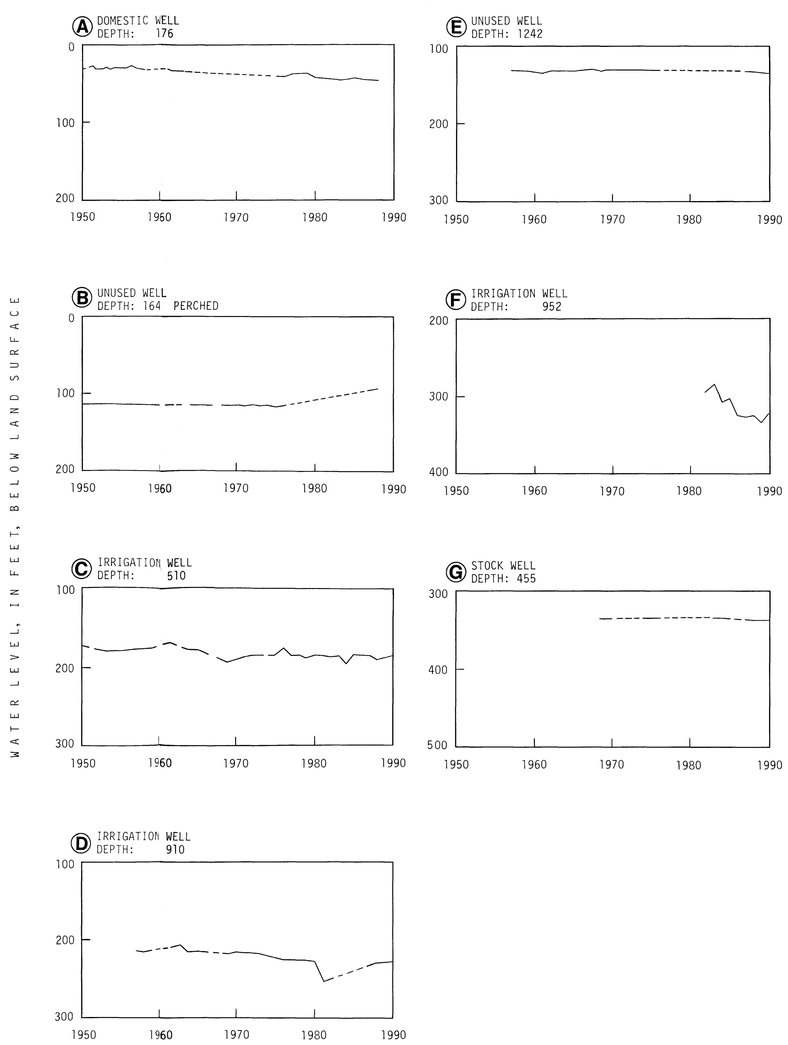
TABLE 2

WELL LOCATION	HEXAVALENT CHROMIUM (mg/L)	SELENIUM (mg/L)
NWNESE S.02, T.3N.,R.15W.	0.080	
NWSESE S.02, T.3N.,R.15W.	0.055	
NENENE S.30, T.4N.,R.14W.	0.350	
NENENE S.32, T.4N.,R.14W.	0.280	
SENENW S.09, T.4N.,R.15W.	0.090	
NENENE S.10, T.4N.,R.15W.	0.220	
NENESW S.11, T.4N.,R.15W.	0.240	0.013
NESENE S.13, T.4N.,R.15W.	0.210	
NWNWSE S.13, T.4N.,R.16W.	0.054	
NWSWNE S.06, T.5N.,R.15W.		0.011
NENENW S.21, T.5N.,R.15W.	0.060	
NENESE S.29, T.5N.,R.15W.		0.016
NESESW S.33, T.6N.,R.15W.	0.060	
NESESW S.08, T.6N.,R.16W.	0.053	
NESENE S.22, T.6N.,R.16W.		0.013
NENENE S.33, T.6N.,R.16W.	0.060	
U.S. ENVIRONMENTAL PROTECTION AGENCY MAXIMUM CONTAMINANT LEVELS	0.05	0.01

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 unit	By	To obtain metric unit
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
acre	0.4047	square hectometer
acre-foot	0.001233	cubic hectometer
gallons per minute	0.06309	liters per second
gallons per minute per foot	0.2070	liters per second per meter

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



BASE FROM U.S. GEOLOGICAL SURVEY
PHOENIX, AZ., 1957, REV. 1969, 1:250,000
SALTON SEA, CALIFORNIA; ARIZONA, 1954, REV. 1969, 1:250,000

DEPTH TO WATER AND ALTITUDE OF THE WATER LEVEL, SPRING 1988 CHANGE IN WATER LEVEL, 1975-1988, HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELLS, AND CHEMICAL QUALITY OF WATER, 1984-1989

MAPS SHOWING GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN BASIN, LA PAZ AND YUMA COUNTIES, ARIZONA--1988

BY

B.J. JOHNSON

These hydrologic maps are available upon request from the Department of Water Resources, Basic Data Section, 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, Arizona, 85701, and 1545 West University, Tempe, Arizona, 85281.