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STATE OF ARIZONA

ENVIRONMENTAL SERVICES NEEDS STUDY

Cochise County

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STATE OF ARIZONA

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

1970 - 1990

Prepared by

PLANNING DIVISION

DEPARTMENT OF ECONOMIC
PLANNING AND DEVELOPMENT

November 1971

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SECTION I

CHAPTER I. INTRODUCTION AND SUMMARY

This study is the result of a financial assistance program administered by the Farmers Home Administration (FHA) to aid planning in small, rural areas. The report is organized on a county basis with FHA regulations providing the framework for selection of study areas within the county. The areas were not required to be incorporated municipalities, however, some semblance of community organization was required and the population could not exceed 5,500 persons.

The report is primarily concerned with the identification and evaluation of existing water systems and sewage and solid waste disposal facilities, and the projection of future needs for these facilities and services in rural areas of Cochise County. The projection of future needs is based upon an analysis of natural resources, social and economic conditions, present and future general land use patterns and existing environmental service facilities within the County. This projection is of a dual nature, focusing at both the community level and the county level. In reviewing environmental service needs, it is intended that this report will be of value as a preliminary study to other more specific planning and engineering studies, and eventually to the development of projects to meet these needs.

Water usage in Cochise County for domestic purposes is currently estimated at 8,553 acre-feet of water per year. Delivery of this water to the public is presently carried out in all parts of the County by 56 water utilities (TABLE II-10). Of these utilities 60 percent are investor owned and operated systems, which are primarily associated with private subdivision land development activities. The locations of existing water systems are noted on PLATE 5, CHAPTER II.

Future water supply demands which will be placed on these utilities, as purveyors of water, are estimated to range from 10,012 to 10,462 acre-feet per year by 1975; from 11,479 to 12,305 acre-feet per year by 1980; and from 13,812 to 16,988 acre-feet per year by 1990. These increasing demands will result, depending on rates of growth in respective areas, in varied modifications, expansions and incorporation of new water supply equipment in all utility systems found in the County.

Future water supply demands will correspondingly place increasing demands upon the available water resources of the County. Present water resources are estimated at 330,000 acre-feet per year of surface water. Ground water reserves for the area of the County contained within the Gila River sub-basin of the state are estimated to be about 58.3 million acre-feet This figure represents water contained in saturated levels of the major alluvial deposits to a depth of 1,200 feet below the ground surface. Reserves of water at depths to water equal to or less than 700 feet are estimated at 38.8 million acre-feet and reserves at depths to water equal to or less than 200 feet are estimated 4.7 million acre-feet.

Considering the above along with factors of climate, topography and soil characteristics in general, water resources appear adequate to meet the future domestic water demands of the County. It should be noted that no effort has been made to define or assess the water needs of agricultural or industrial interests within the County, whose demands exceed domestic demands by a sizeable margin. The availability, as well as the quantity, of water resources should also be considered. Such factors as topography and dropping water tables will present problems to water utilities trying to augment their existing supplies with new well or surface water sources. In the past ten years water tables have dropped 20 to 30 feet in the areas of urban and agricultural development. Further increases in the depth to water will have a corresponding influence on the economic aspects of developing new water sources.

Corresponding with the increase in domestic water demands will be the increased production of sewage wastewaters. At present, the smaller rural areas of the County have marginal needs for centralized sewage collection and disposal facilities. However, as these rural areas develop there will be more need for such systems.

Currently sewage wastewaters are generated at an estimated rate of 6,070 acre-feet per year. Approximately 66 percent of this quantity of sewage is provided with some form of treatment prior to discharge to stream beds or intermittent washes of the County. The remaining portions of these wastewaters is treated by septic tank systems. Ultimate disposal of these wastewaters is achieved through percolation and seepage into underlying groundwater reservoirs.

TABLE II-12 provides an inventory of existing wastewater treatment facilities in Cochise County. The larger communities will experience the earliest need for expansion and/or modification of existing treatment

facilities as the result of increasing sewage flows (PLATE 3). Sewage production levels are projected to range from 6,913 to 7,439 acre-feet per year in 1975; from 7,968 to 8,535 acre-feet per year in 1980; and from 11,124 to 11,877 acre-feet per year in 1990. It is estimated by 1990 that 70 percent of the sewage wastes will originate in communities having centralized sewage collection and disposal facilities.

The production levels of refuse, garbage and other forms of solid waste will increase as a result of population growth in Cochise County. Currently solid waste materials are produced at an estimated rate of 49,537 tons per year. The largest part of this tonnage finds its way to dumpsites located in the county (PLATE 3.)

The primary method of waste control at all but three dumpsites is open burning. The remaining three dumpsites are operated as sanitary landfills on a full-time basis. These dumpsites receive periodic maintenance by county road crews and often maintenance is provided on a sporadic, or as the need arises, basis. This type of management may be sufficient for the present, but full-time management of solid wastes disposal sites will become increasingly important in future years.

Solid waste production levels will range from 62,285 to 65,047 tons per year in 1975; from 75,791 to 81,286 tons per year in 1980; and from 115,906 to 124,841 tons per year in 1990. Solid waste production at these levels suggests that the citizens of Cochise County would be benefited by a coordinated county-wide program of solid waste management. This would involve the establishment of regional sanitary landfill sites with regularly scheduled inspections and maintenance. Planning for regionally located sanitary landfills with associated salvage operations serving all areas of the county would be basic to an effective solid waste management program. It is estimated that 165,000 to 180,000 cubic yards of sanitary landfill volume will be required to satisfactorily dispose of the high solid waste production levels in 1990.

Review of solid waste production levels indicates that by 1990, the major bulk of solid waste will originate in the larger communities and developed rural areas of the county. In 1975 approximately 54 percent of the solid wastes produced in the county will originate within major urban centers. By 1990, 76 percent of the solid waste produced will originate in these areas of major urban development. This suggests that solid waste production will become more "localized" and, as a consequence, generate an advantageous situation for establishment of centralized sanitary landfill sites.

Review of the information contained in this report leads to the general conclusion that Cochise County will have problems related to the proper and timely development of environmental services. This appears evident from the standpoint of existing needs, and more specifically from the projected rate of growth for the County. Assuming that problems will occur with respect to providing future environmental services and that these problems are best handled on a local level, the creation of a separate County agency or department, having jurisdiction over the development and control of all environmental services would facilitate the development of such services. Such an agency would also simplify the administrative procedures and problems inherent in the development of environmental services projects in the future.

A County Agency could possibly be financed by reallocation of certain County revenues. Also such an agency would be eligible for Federal grants to finance additional planning studies. The advantages to be gained would be orderly and timely construction of future environmental services facilities on a schedule coinciding with future demands.

CHAPTER II. COUNTY PROFILE

This chapter presents a profile of the physical characteristics, social and economic conditions, and land use and ownership patterns of Cochise County. The physical structure of the County is discussed in terms of topography, geology, vegetation and climate. Natural resources are considered with respect to their supply, accessibility and quality. The review and analysis of social and economic condition includes projections of population growth. Land use and ownership patterns are analyzed in order to estimate future use patterns and areas of growth. Data developed on population and economic growth for the County as a whole are then utilized in the projection of environmental services needs of the county, and of the individual communities outlined in CHAPTER III. Concluding this chapter is a summary of the environmental services needs presented in Chapter III.

HISTORICAL PROFILE

Cochise County is located in the southeastern corner of Arizona in an area which was originally part of Pima County. The County was established in 1881 and named after Cochise, the Chiricahua Apache Indian Chief.

Much of Arizona's colorful early history took place in Cochise County. The area originally known as Apache Pass was the location of the only trail through the Chiricahua Mountains, which at the time was the stronghold of the Apache Indians. In the mid-1850's the Butterfield Overland Stage Company asked that the Federal Government build a fort to provide protection for their passengers against Apache raiding parties. Fort Bowie, established in 1862, was the result of this request. Census figures on the area first appeared in 1870 and in 1880 the Post Office name for the sparsely settled land was changed from Apache Pass to Fort Bowie.

Mining has been important in Cochise County since the early days. Recently, agriculture and the cattle industry have also become economically important to the County.

Tombstone was the County Seat until 1929 when, for economic reasons, the seat was changed to Bisbee where it has remained to the present.

PHYSICAL CHARACTERISTICS

Topography and Geology

Cochise County is within the physiographic province known as the Basin and Range Lowlands. The province extends across southern and western Arizona covering approximately 45 percent of the state (FIGURE II-1).

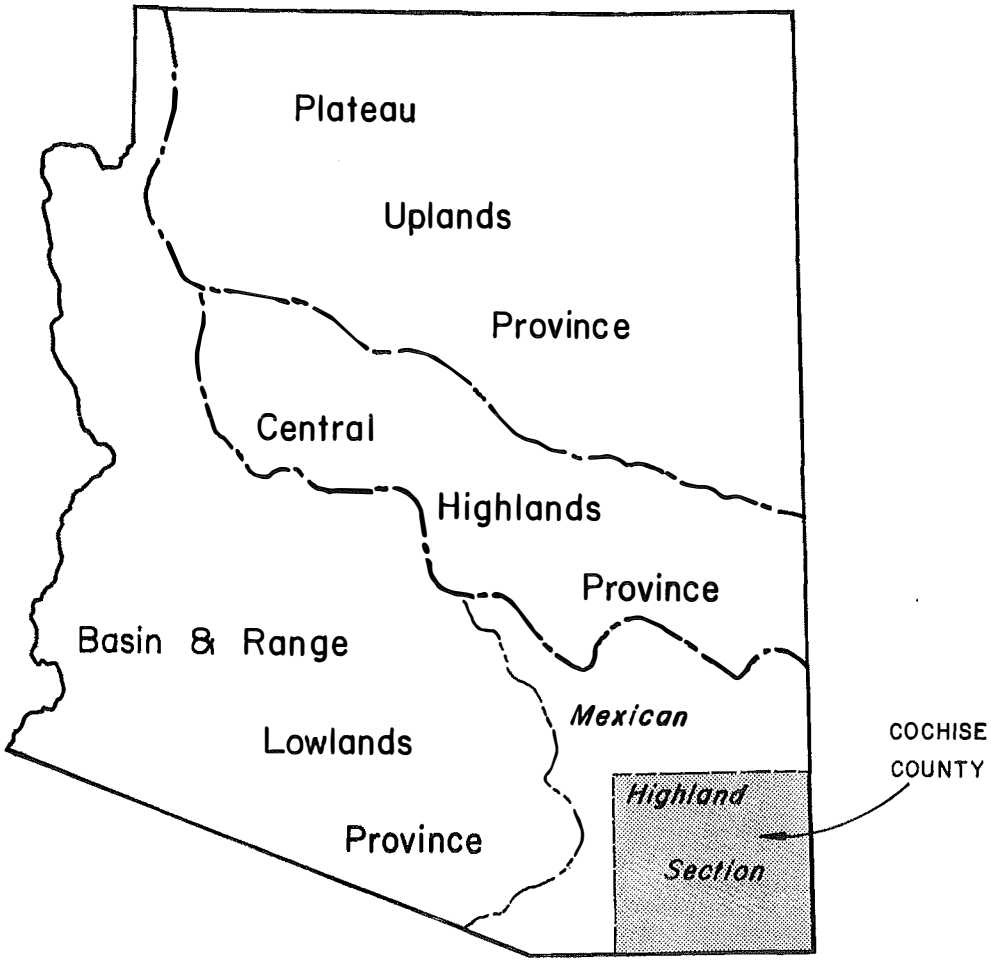


FIGURE II-1. PHYSIOGRAPHIC PROVINCES OF ARIZONA

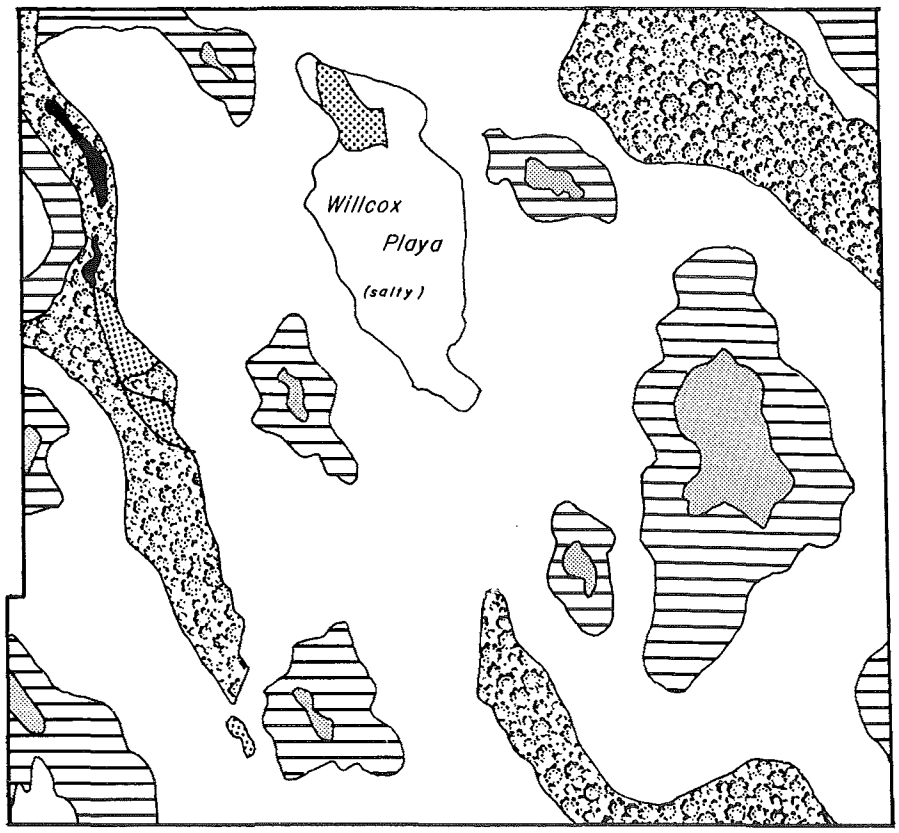
Mountain ranges with peaks between 6,000 and 10,000 feet protrude above wide alluvial plains and valleys. The Chiricahua and Pedregosa Mountain Ranges, extending north and south across the eastern end of the County are composed primarily of Tertiary to Triassic volcanic rocks. These are mostly basaltic in composition with inclusions of Cambrian and other Paleozoic sedimentary rocks. In general, mountains to the west are composed of fine to coarse-grained intrusive igneous rock and Older Precambrian rock-types such as schist and gneiss.

The San Pedro River, the principal river in the County, flows northward across the county to the Gila River. Alluvial slopes extend from the mountains to the watercourse and are composed of interbedded layers of gravel, clay, sand and other unconsolidated or weakly consolidated deposits. Developed soils from mixed alluvium exist along the eastern and western borders. Shallow soils on basalt, schist and granite parent rock are also abundant. Saline-alkali soils are found on the Willcox Playa in northern Cochise County.

Natural Vegetation

Vegetative cover and range conditions vary greatly within the boundaries of Cochise County.

Forests consist primarily of Ponderosa and Yellow Pine and are located near Bisbee, Benson, Willcox and most extensively, in the Chiricahua Mountains at elevations of 8,000 feet and above. Chaparral and oak woodland forest-types are scattered throughout the County, although the greatest concentrations are found around the above-mentioned areas. Grasslands consisting primarily of mesquite and other desert grasses cover the lower hills and valley areas between the mountains and desert regions. Grasses cover approximately 50 percent of the County and grazing conditions range in general from fair to excellent. Desert vegetation is predominately creosote bush, sage and salt brush and is found in the northeastern corner of the County and around Douglas, along the southern Arizona Border. Cholla, Yucca and Ocotillo cacti are also found within the county's desert regions generally at elevations below 4,000 feet (FIGURE II-2).



L E G E N D

Forest trees, mainly yellow pine

Chaparral and oak woodland

Desert grass

Mesquite and salt-bush bottoms

Creosote bush, salt brush

Irrigated lands

FIGURE II-2, VEGETATION OF COCHISE COUNTY

Climate

In general, Cochise County experiences mild winter and moderate summer temperatures. The western portion of the county including the San Pedro River, Sierra Vista and Bisbee is known for its semi-arid climate on the valley floors and its semi-humid climate in the mountain plateaus. Average January temperature is 45 degrees. There is a late

spring and summer daily temperature variation of approximately 40 degrees. July temperatures average 80 degrees and the area has a frost-free period of 223 days. Average annual precipitation is 15 inches with very little snow.

The central portion of the county records average January and July temperatures of 43 degrees and 77 degrees respectively. Most of the area's precipitation falls during the summer months. Average annual rainfall is 14.6 inches, with the higher elevations receiving heavy snowfalls during the winter months.

The eastern portion of Cochise County experiences relatively wet summers, as 45 percent of the average annual precipitation of 12 inches falls during July and August. The area has approximately 194 frost-free days each year and registers an average monthly temperature of 41 degrees for January and 79 degrees for July. The area includes the communities of Bowie and San Simon as well as the Chiricahua Mountains and a large portion of the Coronado National Forest. TABLE II-1 shows average annual precipitation as well as mean monthly temperatures for selected communities in Cochise County.

TABLE II-1

CLIMATOLOGICAL DATA FOR SELECTED COMMUNITIES IN COCHISE COUNTY

Community	Elevation (feet)	Average Monthly Temp. (^{o}F)	Average Annual Precip. (inches)
Benson	3,575	62.8	11.09
Bisbee	5,440	61.4	18.44
Bowie	3,756	64.3	9.84
Douglas	3,973	62.8	12.25
Ft. Huachuca	4,664	61.7	16.45
Tombstone	4,540	62.1	14.45
Willcox	4,190	58.7	11.76

Source: "Arizona Climate" University of Arizona Press, Tucson, Arizona, 1964.

NATURAL RESOURCES

Mineral Resources

Most mining activity in Cochise County involves the production of copper, silver, gold, lead, sand and gravel.

The town of Bisbee is actively engaged in copper mining and smelting operations and is the center for most of the county's mining activity. The original mining claim was made in 1880 and the mine was named the Copper Queen. Ore from this mine was 23 percent copper during the first five years of operation and is still one of the principal copper producers in the state.

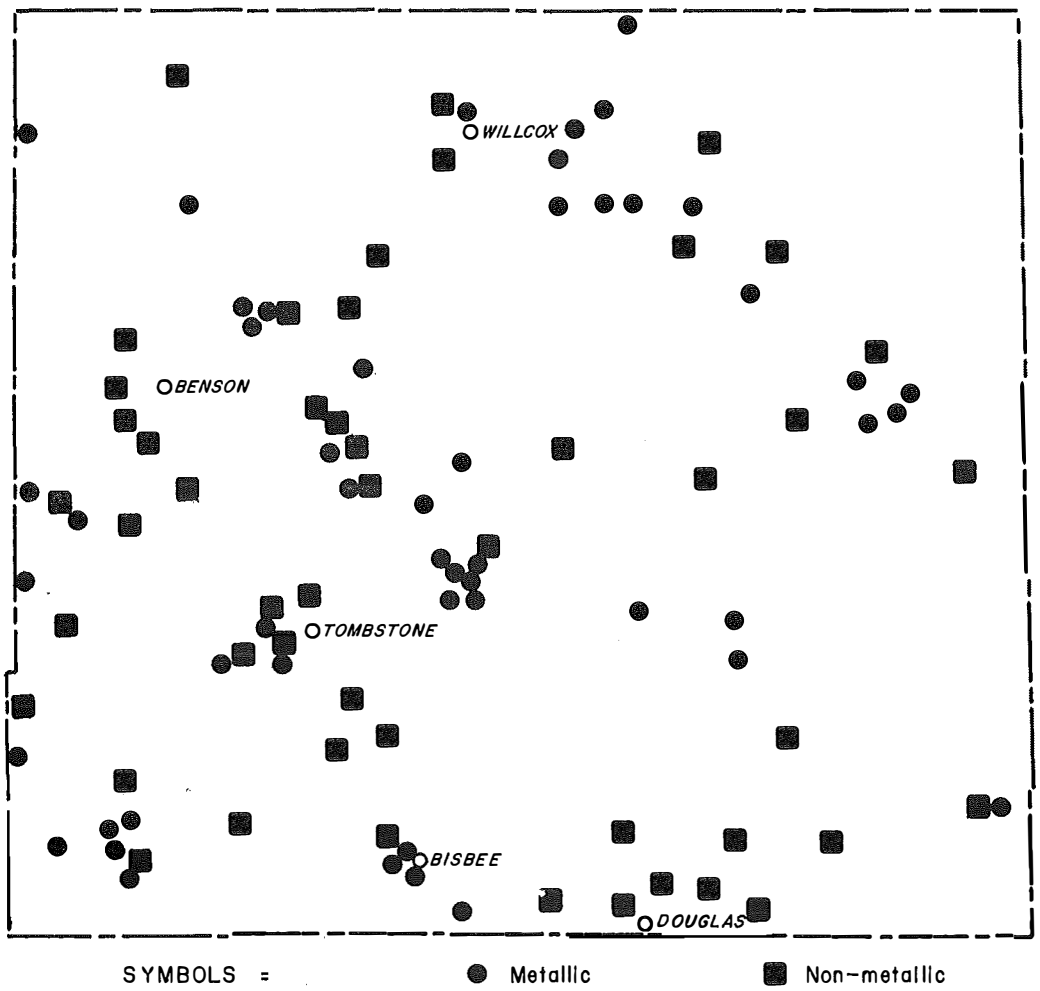


FIGURE II-3, METALLIC AND NON-METALLIC MINERAL RESOURCES LOCATION - COCHISE COUNTY

Gold is located in the southeast corner and north-central portions of the county, near Dos Cabezas. The metal is found in siliceous base-metal vein deposits and base-metal sulfide replacement deposits. These types of deposits produce approximately 20 percent of the gold in Arizona.

Lead and silver deposits are scattered throughout the county. Molybdenum, titanium and zinc can be found in the northwest and central parts of the county.

Minor metals found in Cochise County include bismuth, arsenic, cadmium (a byproduct of zinc ore processing) and beryllium. Occurrences of vein-type uranium, vanadium, zircon and tungsten have also been located within the boundaries of the county. FIGURE II-3 indicates the areas where metallic and non-metallic extraction activities occur in the county.

Water Resources

Cochise County, located in the Basin and Range Lowlands, contains portions of three major drainage areas: The San Pedro River Area (32%*), The Sulphur Springs Area (40%), and The Upper Gila River Area (28%) (FIGURE II-4).

An accurate appraisal of water resources within a region necessitates at least a general understanding of the climate, terrain and geologic characteristics of the area, since these are the factors which determine the occurrence and availability of water. For this reason the brief analysis of these factors in the following sections should be kept in mind while considering the water resources of the area.

Groundwater. Groundwater is a transitory phase of the hydrologic cycle wherein water percolates downward over long periods of time through consolidated and unconsolidated rock and is stored below the land surface. The occurrence of groundwater in Cochise County is directly related to the geologic history of the area. Several stages of erosion, probably during mesozoic times, filled valleys with materials which now form the major aquifers in the area. These alluvium units which cover more than half the county area, consist of sand, clay, gravel and silt and generally store large quantities of water readily accessible through wells. FIGURE II-4 shows the areas of major alluvial deposits in Cochise County as well as the depth to water in these basins.

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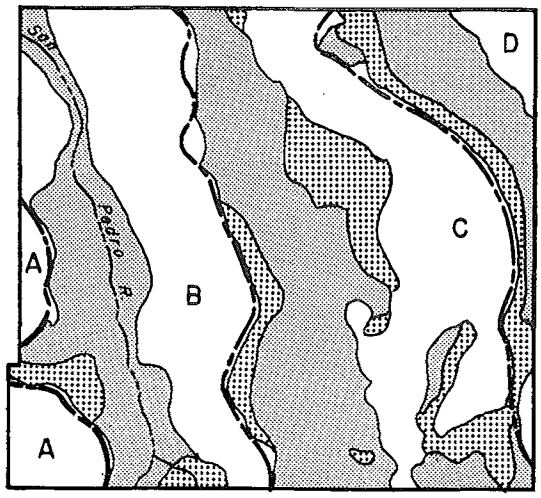
*Percentage figures represent approximate portions of the county within a drainage area.



L E G E N D

LESS THAN 200 FT.
FROM 200 TO 500 FT.
ALLUVIAL DEPOSITS

MOUNTAINOUS OR INSUFFICIENT DATA TO DELINEATE

A. SANTA CRUZ RIVER AREA
B. SAN PEDRO RIVER AREA
C. SULPHUR SPRING VALLEY AREA
D. UPPER GILA RIVER AREA

FIGURE II-4, DRAINAGE BASINS, ALLUVIAL DEPOSITS AND DEPTH TO WATER IN COCHISE COUNTY

Groundwater reservoirs in the county receive recharge from three sources: (1) runoff from precipitation in the mountains; (2) underflow from outside the sub-basins and (3) direct penetration of precipitation. 1/ Although computation of the total quantity of water available in the groundwater basins of the county is not feasible at this time, it is possible to estimate the quantity of water made available to the county as a result of precipitation. Based on an average annual precipitation of 15 inches, the county receives approximately 5,004,800 acre-feet of precipitation per year. However, about 97 percent of this water is lost through evaporation and transpiration and only one to three percent of this total precipitation contributes to annual groundwater recharge.

In addition to evaporation, there is the problem which occurs as a result of pump draft. Groundwater, which provides most of the water for Cochise County, is being withdrawn faster than it can be replenished. It is estimated that since large-scale pumping began in the area in the 1940's, over 3,000,000 acre-feet of groundwater have been withdrawn from the alluvial deposits in the county. 2/ Wells in Cochise vary in depth from

50 to 2,200 feet. The capacities for most wells in the county are less than 1,000 gpm (gallons per minute), although wells in the Douglas Basin are capable of yields of over 2,500 gpm and south of Bowie the wells drilled in the older alluvial deposits yield from about 1,000 to 3,000 gpm. 3/ Large groundwater withdrawals have caused declines in the water table of between 25 and 75 feet in most areas. However, declines ranging between 200 and 500 feet have been found in the northern portion of the county. 4/ Since continual overdraft will eventually cause serious problems for the area, it is certain that future water needs for the county will have to be met by supplemental sources.

Surface Water. Water which is found on the surface of the earth exists either as runoff or as storage. Runoff can be defined as "that part of precipitation which appears in surface streams." 5/ Storage is water which has been artificially impounded in surface or underground reservoirs or water which is naturally detained in a drainage basin.

TABLE II-2

STORAGE RESERVOIRS AND LAKES
COCHISE COUNTY

Reservoir or Lake	Use	Height (feet)	Capacity (acre-ft.)	Surface Area (acres)
Herb Martyr	Recreation	16	--	0.2
Creighton Detention Dam	Flood Control	48	2,870	205.0
Parker Canyon Dam	Fish/Wildlife/ Recreation	88	3,710	133.0
Rucker Canyon	Fish/Wildlife/ Recreation	28	40	3.0

Source: "Water Resources - State of Arizona, "Arizona Interstate Stream Commission, 1967.

Principal storage reservoirs and lakes (most of which are earth-filled structures) in Cochise County are listed in TABLE II-2. In addition to those sites listed is the Charleston Reservoir on the San Pedro River. Potential impoundment sites are analyzed in TABLE II-3. The facility is scheduled for completion sometime prior to 1980 and will have a capacity of 238,000 acre-feet. Its uses will include flood control, irrigation, recreation and fish and wildlife management and preservation.

TABLE II-3

INVENTORY OF POTENTIAL IMPOUNDMENT SITES
COCHISE COUNTY

Name	Stream	Surface Ac. Min.	Surface Ac. Max.	Capacity Ac./Ft. Min.	Capacity Ac./Ft. Max.	Drainage Area Sq. Mi.	Land Status
Paradise Lake	East Turkey	25	40	300	800	40	Pat.
Babocomari Lake	San Pedro	59	152	940	3,565	275	State
Babocomari Lake	San Pedro	317	710	5,360	12,820	283	St., Pat., BLM
Emerald Lake	San Pedro	92	92	1,840	1,840	31	BLM
Greenbush Draw Lake	San Pedro	160	160	2,130	2,130	46	Pat.
Leslie Canyon Lake	Leslie	120	200	2,500	4,000	85	State, Pat.
Pack Saddle Lake	Big Bend	35	62	700	1,100	13	FS
Bear Cave Lake	Bear	150	212	3,000	4,800	14	FS, Pat.
Guadalupe Lake	Guadalupe	120	150	2,400	3,500	50	State, BLM
Douglas Lake		60	80				
Tombstone Lake		92	80				
San Simon Wildlife Area		10	40				

Source: Soil Conservation Service.

Water made available as surface water in the county is difficult to measure. High temperatures and low humidity produce ideal conditions for extremely high evaporation rates and enable only a small portion of the precipitation which falls to become runoff. The communities of Douglas and Naco, near the southern border of the county (elevation 3,970 feet), receive an average of 12 inches of precipitation per year and have a potential evapo-transpiration rate of 36 inches. Average annual runoff for Cochise County is approximately one inch, compared to the national average of 9.4 inches. Average annual lake evaporation in the county ranges from 62 to 64 inches. TABLE II-4 provides a summary of the county's surface water resources as recorded at selected gaging stations in the area.

TABLE II-4

SURFACE WATER RECORDS - COCHISE COUNTY

Gaging Station*	Altitude (ft.)	Drainage Area (sq. mi.)	Average Dischg. (cfs)**	Dischg. ac.-ft. per yr.	Avge.Yrly. Runoff (1,000 ac-ft)
4705 - San Pedro River @Palominas	4,187	741 (649 in Mexico)	32.0	23,180	23.0
4710 - S.P.R. @Charleston	3,954	1,219 (696 in Mexico)	61.8	44,770	39.6
4720 - S.P.R. @Redington	2,930	2,939 (696 in Mexico)	46.7	33,830	38.4
5370 - Whitewater Draw near Rucker	--	40	7.61	5,510	--
5875 - Whitewater Draw near Douglas	3,990	1,023	10.8	7,820	8.3

*Gaging station numbers are those used in USGS publications of surface water records.

**cfs = cubic feet per second.

Sources: "Cooperative Water Resource Inventory - Arizona," Vol. II, Bureau of Reclamation, 1965; Bulletin 180, Arizona Bureau of Mines, Tucson, Arizona, 1969; Water Resource Data for Ariz.-Vol I, USGS, 1969.

Water Quality and Use. In Cochise County, the quality of raw water at its source varies from soft to highly mineralized to completely impotable. Most of this variety is the result of natural chemical changes in the land areas over which the water travels. In addition to nature, however, industrial and agricultural uses of water frequently cause drastic changes in the quality of water in underground reservoirs and surface waterways.

Sub-surface soil salinity is increasing in the county due to the use of water for crop irrigation; however, this condition is not a serious problem in most parts of the county. The majority of the waters used for irrigation purposes in the county still exhibit low to medium salt content and favorable calcium-sodium ratios, and contain less than 1,000 ppm (parts per million) of total dissolved solids. Currently, there are approximately 114,000 acres of land under irrigation in Cochise County (San Pedro River Basin - 7 percent, Upper Gila area - 17 percent, Sulphur Springs Basin - 76 percent).

Mean annual discharge-weighted suspended-sediments concentrations for streams within the county range between 15,000-28,000 milligrams per liter (mg/l) in the eastern one-third of the county and 1,950-6,300 mg/l in the western two-thirds of the county (FIGURE II-5). The higher concentration occurs as a result of the high-intensity storms common during the summer months and watershed characteristics such as sparse vegetation and relatively unconsolidated soil deposits.

Sediments can seriously impede the use of surface waters. The costs for removing sediments can be high, particularly if the waters are to be used for domestic purposes. Sediment-laden waters also decrease the serviceable depth of the storage reservoirs they enter.

Although the quality of water to be used for industry or agriculture may vary greatly with respect to chemical composition and physical properties, the same variance is not possible where domestic use is concerned. All water sources developed for domestic uses myst comply with the 1962 U.S. Public Health Service Drinking Water Standards. These standards, which set concentration limits for chemical parameters present in the water sources, are summarized in TABLE II-5.

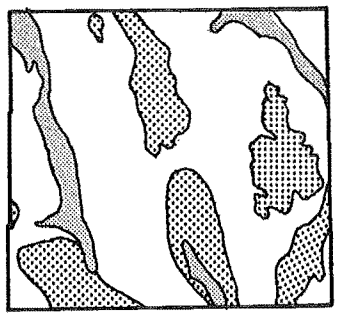
TABLE II-5

WATER QUALITY STANDARDS FOR DOMESTIC WATER SOURCES
U. S. PUBLIC HEALTH SERVICE

Chemical Parameter	Recommended Limiting Concentration milligrams/liter
Arsenic	0.01
Chloride	250.0
Copper	1.0
Cyanide	0.01
Fluoride	0.6-.8*
Iron	0.3
Manganese	0.05
Nitrate	45.0
Phenols	0.001
Sulfate	250.0
Total Dissolved Solids	500.0
Zinc	5.0

*dependent upon ambient temperature.

Source: U. S. Public Health Service.



L E G E N D

0.5 – 1.0 Acre feet per square mile per year

0.2 – 0.5 Acre feet per square mile per year

< – 0.2 Acre feet per square mile per year

FIGURE II-5, MEAN ANNUAL SEDIMENT DISCHARGES

POPULATION AND ECONOMIC PROFILE

In order to make projections of future water requirements and to plan for sewage and solid waste management systems, it is essential to have growth and locational information on both the population and industry in Cochise County.

Data are presented in this section on pertinent demographic characteristics of the county such as present and future centers of population density along with projections of population through 1990. Relevant economic facts are presented for each industry in the county including past trends in employment, labor earnings and unique factors which may affect economic development. Employment projections on a broad industry basis are made for 1990 to aid in determining future water needs.

Population Growth and Projections

Cochise County, with a 1970 population of 61,910, ranks fourth in terms of population among the state's counties. Its land area of 6,256 square miles gives Cochise a population density of 9.9 persons per square mile, but, in actuality, nine of the state's counties have lower population densities.

Most of the people live in the southern part of the county in Douglas, Bisbee and the Sierra Vista - Fort Huachuca area. These three areas account for 71 percent of the county's population. Benson, the largest community in the northern section of Cochise County, had a population of 2,389 in 1970. Willcox, with a 1970 population of 2,568, is also located in the northern section. Several smaller farming communities are located throughout the county including Bowie, San Simon and Elfrida. The historic town of Tombstone, with a 1970 population of 1,241, is located north of Bisbee.

FIGURE II-6 shows the county's past population figures and projections to 1990. Prior to 1950, the data indicate that Cochise County was decreasing in population; however, this trend was reversed in 1950 and since then the population has increased each year.

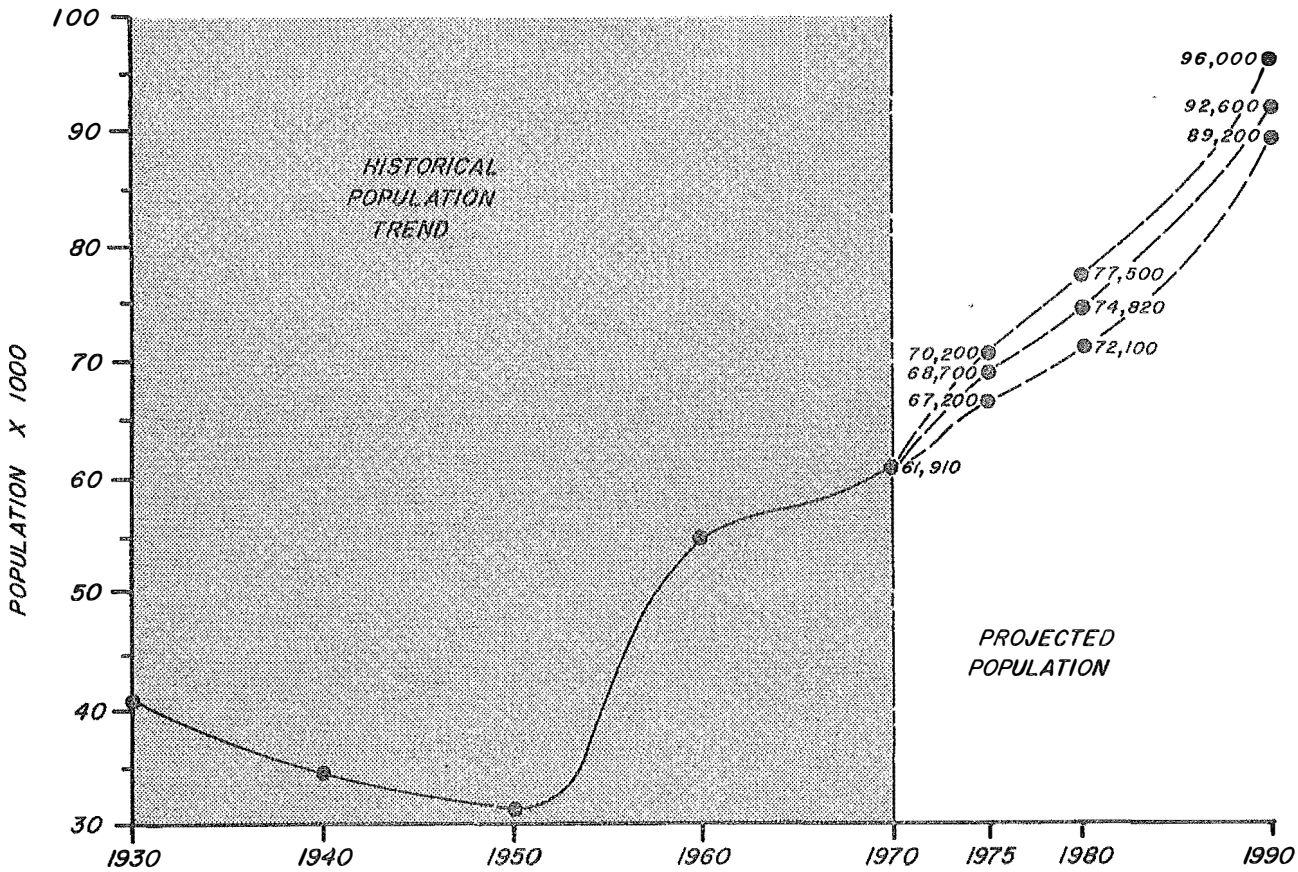


FIGURE II-6, POPULATION OF COCHISE COUNTY AND PROJECTIONS TO 1990

The population is projected to grow to 68,700 by 1975, 74,800 by 1980 and 92,600 by 1990. This is the median projection and is considered the most probable. Low and high projections are also shown in FIGURE II-6. All of the projections are based upon the long-term relationship between the county and state populations and assume that Cochise County's share of the state population will decline in the future as it has in the past.

The southern section of the county will probably continue to be the region of highest population density. A large part of the projected increase in population in the coming year will undoubtedly occur in the region around Fort Huachuca. Douglas, Benson and Willcox are also expected to expand while Bisbee may decline in population.

The income to support this growth in population will come in part from the expansion of Fort Huachuca's operations. The expansion will increase the payroll of the Fort and total consumer expenditures in the county. Construction activity is also expected to expand to meet additional housing demands. These factors will result in new income to the area and an additional capacity to support new industrial growth. Retail trade, services, finance, insurance, real estate, construction, transportation, communication and public utilities should all be expected to expand as a result. In other areas of the county, increased income will probably come from new manufacturing activity, additional construction and increased retail trade and services.

Employment, Industry Analysis and Labor Earnings. Cochise County had a civilian work force averaging 20,650 persons during 1970. Annual average employment was estimated to be 19,900. This results in a 3.6 percent unemployment rate, slightly lower than the state rate of 4.1 percent.

TABLE II-6 gives labor earnings by source for Cochise County in selected years from 1950 through 1968. Government payrolls account for over half of labor earnings. The reason for this is the presence of Fort Huachuca in the southern section of the county. Government is also the largest civilian employer in the county, employing 31 percent of those working in 1970. This is shown in TABLE II-7 which gives Cochise County's labor force and employment by broad industry group for 1967 through 1970 with a projection for 1990. The projected figures indicate a decline for agriculture and mining in relative importance and a relative increase for manufacturing, government, trade, services and contract construction. The relative gain in manufacturing, trade and services supports the higher labor force participation rate used for 1990, since employment opportunities in these sectors should draw more women into the labor force.

In the sub-sections below, the factors influencing growth in each industry are delineated along with past trends in employment and earnings.

Agriculture. Agricultural activities in Cochise County include both cattle ranching and crop raising. In the past, more land area was devoted to cattle raising than to crops, but this situation has gradually reversed itself. At present 118,590 acres are formed making Cochise the fourth largest county in terms of crop acreage in the state. The principal crop is sorghum, with wheat and chili peppers also of importance in the county. Fruits, lettuce and other vegetables are raised in the Willcox-Bowie area, but the risk of frost and the high costs associated with growing these crops have contributed to a decline in the acres devoted to some of the crops and a less than optimistic picture for the others.

TABLE II-6

COCHISE COUNTY LABOR FORCE AND EMPLOYMENT
ANNUAL AVERAGE, 1967 - 1970
WITH A PROJECTION FOR 1990

	1967	1968	1969	1970	1990
Civilian Work Force	20,975	20,325	20,725	20,650	32,410
Unemployment	800	625	650	750	972
Percent Unemployment	3.8	3.3	3.1	3.6	3.0
Total Employment	19,450	19,250	20,075	19,900	31,438
(a) Non-agricultural Wage-Salary	14,900	14,700	15,450	15,320	27,193
Manufacturing	1,100	1,225	1,425	1,550	4,086
Non-Manufacturing	13,800	13,475	14,025	13,775	23,106
Mining & Quarrying	1,465*	1,775*	1,950*	1,800*	1,100
Contract Const.	225	300	250*	400*	1,100
Trans., Comm., & Public Utilities	825	825	825	850	1,415
Trade	2,275	2,275	2,400	2,600	4,717
Finance, Insurance & Real Estate	350*	375*	400	375	628
Services	1,450	1,325	1,300	1,500	2,829
Government	7,200	6,600	6,900	6,250	11,317
(b) All Other Non-Agricultural Employment	2,350	2,350	2,250	2,325	2,420
(c) Agriculture	2,200	2,200	2,375	2,250	1,760

*Estimated by Department of Economic Planning and Development.

Source: Employment Security Commission of Arizona, Unemployment Compensation Division.

TABLE II-7
LABOR EARNINGS BY SOURCE
COCHISE COUNTY
($000)

	1950	1962	1966	1967	1968
Total Earnings	30,603	106,655	119,307	131,526	116,544
Farm Earnings	449	9,657	992	207	6,278
Total Non-Farm	30,154	36,998	118,315	131,319	160,266
Government Earnings	4,052	40,339	50,989	69,724	90,271
Total Federal	2,422	31,262	38,242	55,422	75,060
Federal Civilian	2,239	12,940	17,552	21,930	24,716
Military	183	18,322	20,690	33,492	50,344
State and Local	1,630	9,077	12,747	14,302	15,211
Private Non-Farm	26,102	56,659	67,326	61,595	69,995
Manufacturing	3,317	8,541	9,130	8,042	9,998
Mining	7,787	16,799	19,741	13,826	18,459
Contract Construction	1,213	2,552	1,954	1,815	2,609
Trans. Comm. & Public Utilities	3,290	5,804	6,818	6,909	7,216
Trade	4,931	10,288	12,294	12,940	13,361
Fire	1,135	1,995	2,454	2,704	2,906
Services	4,311	10,161	14,341	14,820	14,966
Other	118	519	594	539	480

Source: Office of Business Economics, U. S. Department of Commerce

The role for agriculture in the future of Cochise County is dim. The increasingly high cost of water and the continued subdividing of land portend some decrease in agricultural activity during the future. Given these facts, agricultural employment is projected to decrease to approximately 1,760 by 1990. As noted earlier, this represents a relative decrease in importance for the sector from its 1970 status.

Mining. There is considerable mining activity in the southern part of the county at present. Employment has ranged from seven to nine percent of total employment over the past four years. Most employment has been in the copper mines at Bisbee which are gradually being closed down. The Lavendar Pit Mine, an open pit operation, has been scheduled to close by 1972. The underground mine, the Copper Queen, will be phased out over the next three years.

Labor earnings from mining which have grown at nearly five percent per year since 1950, will drop considerably with the closing of these mines. Other mining operations, all on a much smaller scale, include a lime quarry and some sand and stone quarries. With only these mining activities in operation, mining will offer little in the way of employment opportunities over the next two decades unless new deposits are developed or technological innovations make it feasible to reopen the Bisbee mines. Employment is projected to be lower in 1990 than it is at present even if Bisbee mines are reopened, for technological innovations will require less manpower. The estimate is that approximately 3.5 percent of total employment will be in mining in 1990 as compared to nine percent in 1970.

Contract Construction. While employment in this sector has been small in the past, it is expected to expand in the future. Earnings have grown at a rate of 4.3 percent per annum over the past two decades. This rate of growth should be at least matched in the coming years.

Support for this rate of growth will come from several areas. Highway construction will include an extension of U.S. Highway 80 north of Benson, completion of a freeway bypass at Benson, construction of another at Sierra Vista and roadwork within Douglas. A new large rest stop is planned for the Agriculture Inspection Center at San Simon. Considerable home construction is expected in the Sierra Vista area to meet the increased housing demands created by the moving of the Army Intelligence School to Fort Huachuca. Other areas of future construction include the retirement communities of Sunizona and Sunsites in the central part of the county, similar planned communities at Coronado Lake and La Costa in the south and a Central Arizona Project dam near Charleston.

On the basis of these plans, it would appear that contract construction will be one of the expanding segments in the Cochise economy. TABLE II-6 shows that it is projected to increase absolutely from 400 in 1970 to 1,100 in 1990 which is a relative increase from 2.0 percent to 3.5 percent of total employment.

Manufacturing. Manufacturing is not well developed in Cochise County. Although employment has increased in each of the past four years only seven percent of total employment in the County in 1970 was in this sector. Of these workers over 40 percent worked at the copper smelter in Douglas.

The only other significant manufacturing activities in the County at present are a lime plant near Douglas, a clothing manufacturer in Douglas and an explosives plant near Benson. However, several areas in the county have a good potential for development. Willcox is one of the most promising areas. A plastics firm is just beginning operation there and if successful, other firms may be attracted there. Douglas, too, has a good potential for further development as the Twin Cities program may draw in new firms. Bisbee, with the closing down of its mines, will be seeking new industries and will undoubtedly try to attract some manufacturers.

Based on these potential developments, manufacturing employment is projected to expand to approximately 4,086 by 1990. This represents an increase in relative importance for manufacturing of 5.3 percent in relation to total employment from 7.7 percent of total employment in 1970 to 13 percent in 1990.

Wholesale and Retail Trade. The second largest employment sector in Cochise County is wholesale and retail trade. Employment has increased in each of the past four years and is projected to continue the trend over the next two decades. Employment is estimated to reach 4,717 in 1990, an increase of 2,117. This represents an increase in wholesale and retail trade employment from 13.0 percent of total employment in 1970 to 15.0 percent in 1990.

Presently, wholesale trade employment is centered in Willcox in farm and grain equipment. Most retail employment is in small food stores, restaurants and service stations. A large part of this trade is tourist oriented, designed to meet the needs of the highway traveler or the visitor to Tombstone and other historic sites in the county.

The labor earnings from wholesale and retail trade totaled $13,360,000 in 1968. This represented a 5.7 percent annual rate of growth since 1950, the fourth highest in the county. The rate of growth should be equaled in the future with the necessary demand coming from increased tourist traffic and the needs of local populations in expanding areas of the county.

Transportation, Communication and Public Utilities. This has not been a dominant sector in the economy of Cochise County. Labor earnings in this sector have been modest in comparison to other industries, comprising only four percent of total earnings in the county during 1968. An average growth rate of 4.5 percent per annum in labor earnings has been attained since 1950, one of the lowest rates of increase in the county.

From 1967 through 1970, employment in this industry group has remained fairly constant increasing only in the last year. The largest employer has been Mountain Bell with Sulphur Springs Valley Co-Op, Arizona Public Service, and the trucking companies at Sierra Vista also employing significant numbers of people.

The sector in general is projected to maintain its relative position in relation to total employment in the county through 1990. The actual projection is for employment to reach 1,415 by 1990. Trucking and warehouse activity growth will be centered in the Sierra Vista area while expansion in the public utilities will be in those areas of the county experiencing the greatest population growth.

Services. Labor earnings in this sector have grown at an annual average rate of 7.2 percent per year since 1950, the highest private nonfarm industry growth rate in the county. Tourist-oriented services account for part of the earnings, particularly in areas like Tombstone, while in other sections of the county, such as Bisbee and Benson, services are geared more to suit the needs of the local population.

Employment, after declining for three years, increased in 1970 to a level higher than that in 1967. The expansion of Fort Huachuca, the development of subdivisions in the center of the county and the growth of tourism should create a sufficient demand for new services in Cochise County to support continued growth in employment in the sector. Employment is projected to reach 2,829 by 1990. This, if realized, will represent a relative increase in importance for services from 7.5 percent of total employment in 1970 to 9.0 percent in 1990.

Government. Government has been the largest sector in Cochise County both in terms of employment and labor earnings. The main reason for this is Fort Huachuca, located in the southwestern section of the county. The Fort plays a dominant role in the economic life of the county. Its annual payroll in the last fiscal year was $69 million. In addition, $29 million were spent locally in the procurement of goods and services and ten million dollars were expended in travel reimbursement and moving expenses. Other federal employment in Cochise County is in customs operations, the National Park Service, the post office, Forest Service and the Department of Agriculture.

When combined with state and local employment, the government sector accounted for 31 percent of total civilian employment in the county in 1970. State government employment includes Cochise Junior College which is located between Bisbee and Douglas.

Both military and civilian employment within the government sector are expected to expand over the next two decades. Military employment will expand significantly in the next few years with the moving of the Army Intelligence School to Fort Huachuca. This school will have a faculty of 800 and peak enrollment of 1,400 to 1,800. Civilian government employment is projected to reach 11,317 by 1990. This will represent a relative increase from 31.4 percent of total employment in 1970 to 36.0 percent in 1990.

Finance, Insurance and Real Estate. Employment in this sector has averaged less than two percent of total employment in Cochise County in the past four years. Most of these services are located in the larger communities, particularly Douglas, Bisbee and Sierra Vista.

Although labor earnings in this sector have increased at a rate of 5.7 per year since 1950, they were only 1.7 percent of total labor earnings in the county during 1968. Both earnings and employment should continue to grow in the coming decades as facilities expand to meet the needs of a larger population. As shown in TABLE II-6, employment is projected to increase to approximately 628 by 1990, an increase of 253 from 1970 employment in the sector.

LAND OWNERSHIP AND LAND USE

Patterns of land use are the collective product of many influences, purposes and ideas as they are expressed by man in his development of individual parcels of land. The information in this study is assembled to

show a broad picture of the general development patterns and their interrelationships with the need for water, sewage and solid waste disposal systems in the rural areas of Cochise County.

Land Ownership

Land ownership is an essential part of any land use study in that it is a major determinant of where various types of land use appear. The intensive types of land use, i.e., urban uses, occur almost exclusively on private land while public domain lands are managed by the multiple use concept, as defined by the Bureau of Land Management and the U.S. Forest Service.

Cochise County has a total land area of approximately 4,004,000 acres (TABLE II-8). The State of Arizona owns the largest amount of land with 1,374,739 acres coming under their jurisdiction (PLATE 1). Approximately 99 percent of this land is classified as grazing and is leased for such purposes on an annual fee basis.

TABLE II-8

EXISTING LAND OWNERSHIP FIGURES FOR COCHISE COUNTY - 1971

Classification		Acres	% of Total Land Area
Federal Lands		963,753	23.6
National Forest	498,000		
Bureau of Land Management	348,753		
Other Federal Lands	117,000		
State of Arizona		1,375,000	34.3
Private & Local Government		1,682,000	42.1
TOTAL County Land Area		4,004,000	100.0

Sources: Bureau of Land Management, Coronado National Forest, Department of Property Valuation, State Land Department.

The Coronado National Forest and the Bureau of Land Management manage 51.7 percent and 36.2 percent of the 963,753 acres of federal land, respectively. Both of these agencies utilize the multiple use concept of land management which means that the land is used to its highest and best use as determined by public needs and the natural resources of the land.

The U. S. Department of Defense owns the majority of the federal land classified as "Other." This land is located in two areas: the Fort Huachuca Electronics Proving Grounds, and the Willcox Bombing Range, as shown on PLATE 1. These lands are utilized as military equipment proving grounds. The bombing range is inactive as a bombing range but is being used for aerial photography experiments.

The privately owned land accounts for 39.1 percent of the county land area. A substantial amount of this land is classified as grazing and is owned by a few large land and cattle corporations. Large sections of these grazing lands are being subdivided and sold on a small lot basis to individuals for speculative purposes. The future land development patterns of the county will largely be determined by the actions of these large land owners.

Present Land Use Patterns

Existing land use patterns influence and largely determine future land use patterns. There is a close and predictable relationship between the amount of land used for various urban purposes and the amount which will be required for future urban development. This relationship also has a direct bearing on the present and future needs for water and sewer systems.

Urban land uses are defined as those areas which have been classified for residential, commercial, and industrial purposes, in contradistinction to those lands which are either undevelopable or which are predominantly rural in character, i.e. agricultural and grazing lands. Urban land uses account for 4.1 percent of the land area of Cochise County (TABLE II-9).

The urban classification has been subdivided into four subclassifications as indicated by TABLE II-9. The preponderance of these land uses are concentrated in the urban areas as indicated on PLATE 2. The residential subclassification is the one exception to this in that large tracts of land have been subdivided into small residential home sites outside of the urban areas which have not been developed (TABLE II-10). These home sites are sold on a speculative basis to individuals who propose to either resell or develop the land at some date in the future.

TABLE II-9

EXISTING LAND USE, COCHISE COUNTY - 1971

Land Use Classification*		Acres	Percent of Total Area
Urban[1]		166,198.94	4.1
Residential	78,471.09		
Commercial	1,937.40		
Industrial	291.27		
Public & Quasi-Public	85,249.59		
Agricultural		185,577.54	4.6
Grazing & Ranching[2]		2,040,995.43	51.0
Mining[3]		25,906.25	.6
Desert & Mountainous Lands[4]		1,585,321.84	39.6
TOTAL		4,004,000.00	100.0

[1]Includes all urban uses, i.e., residential, commercial and industrial, except mining activities.

[2]Estimated from State Department of Valuation, Bureau of Land Management, State Land Department and U.S. Forest Service records.

[3]Estimated by using mineral patents which were recorded with the Cochise County Recorder.

[4]This classification includes all lands not found in all the other categories.

*Land Use classifications use State Dept. of Property Valuation definitions.

Sources: State Department of Property Valuation, U.S. Forest Service, State Land Dept., Cochise County Assessor & Bureau of Land Management.

Agricultural land uses are concentrated in the San Pedro River Valley and the Sulphur Springs Valley. This concentration of agricultural land uses is primarily due to the presence of sufficient water to support this activity. The San Pedro River Valley draws its water from the flow of the San Pedro River both underground flow and surface flow. The agricultural activity in the Sulphur Springs Valley is supported by the pumping of groundwater resources. Both areas raise primarily small feed grains, vegetables, alfalfa and cotton, most of which are high water users, but low value crops.

Grazing is the largest land use category encompassing 51 percent of the county land area (Coronado National Forest 330,000 acres; BLM 204,615 acres and State of Arizona 1,355,737 acres). There is no specific

TABLE II-10

NEW TOWNS AND PLANNED RESIDENTIAL DEVELOPMENTS OVER 1,000 ACRES*
COCHISE - 1971

Name	Total Acres	Ultimate Population	Type of Development	Facilities	Developer
Arizona Bell Ranch	10,000	--	Lot Sales	Minimal**	Southwest Prop., Inc.
Arizona Sunsites	16,000	30,000	P. R. D.***	Water. Elec, Pav.Rd.,Gas	Horizon Land Co.
Coronado Estates	10,000	20,000	Lot Sales	Minimal	Coronado Development Inc.
Coronado Lakes	6,000	--	Lot Sales	Minimal	Cochise College Park, Inc.
Desert Sky	2,000	--	Lot Sales	Minimal	Thunderbird,Inc.
Easy Acres	1,500	--	Res. Suburb	Minimal	---
Gayleville-Paradise Area	1,000	200	Lot Sales	Minimal	---
Golden Acres	1,000	8,000	Res.Sub. & Mob.Hm.Pk.	Comm. ctr., Grd.Rd.,Water	Risner Development Co.
La Costa	1,500	--	Lot Sales	Minimal	La Costa of Ariz.
Olympia Heights	10,000	90,000	New Town	All Util.****	Deree Company
Richland Ranchettes	1,000	--	Lot Sales	Minimal	---
Sunizona	8,000	15,000	P. R.D.	Pvd.Rd.,Water Elec.,Nat.Gas	Horizon Land Co.
Sunsite Hills	10,000	15,000	Lot Sales	Minimal	Horizon Land Co.
Tenneco West Prop.	7,000	35,000	New Town	All Util.	Tenneco West Co.
Willcox Lakes	3,000	--	Res. Sub.	Minimal	Renson

*Former land use classified as grazing
**Minimal means graded roads and those required by local planning authorities
***Planned residential development
****All Utilities means paved streets, water, sewers, electric and gas

pattern that this activity follows. The grazing of livestock usually occurs in the flat lands and rolling hills where the grasses are sufficient. This land use requires few improvements to the land and occurs throughout the county wherever the terrain and vegetation permit.

Mining in Cochise County supports much of its economy. The acreage in this classification is estimated from mining claims filed with the Cochise County Recorder's Office. Most of the activity is centered in the Bisbee and Douglas areas although there are many smaller mining operations scattered throughout the county. These small mining operations usually occur on public lands under the rights granted by the mineral patent laws.

The desert and mountain land classification covers those areas which are undevelopable for various reasons, i.e., steep slopes, lack of water, and rough terrain. These lands are along the mountain ranges and are almost exclusively within the Coronado National Forest lands.

Portions of the National Forest lands are used for recreational purposes as noted on PLATE 2, but this usuage is better assessed in terms of recreational participation than acreage. A comparison of TABLES II-11 and II-12 indicates that there has been an increase in outdoor recreation participation in Cochise County from 1969 to 1970 of over 45,000 visitor days. If this increase continues, it will assume a significant role in terms of environmental service facility needs.

TABLE II-11

RECREATION PARTICIPATION IN ARIZONA IN NATIONAL FORESTS-1969

County	Visitor-Days* Use (Thousands)	Percent of Total
Apache	583.3	8.6
COCHISE	229.1	3.3
Coconino	1,991.1	29.4
Gila	968.1	14.2
Graham	75.3	1.1
Greenlee	113.5	1.6
Maricopa	1,001.2	14.7
Mohave	1.8	.0
Navajo	186.5	2.7
Pima	616.5	9.1
Pinal	82.7	1.2
Santa Cruz	164.9	2.4
Yavapai	757.1	11.1
STATE TOTAL	6,771.1	100.0

*A visitor day is defined as any person participating in the recreation activity for twelve hours or twelve people participating in the same activity for one hour.

Source: United States Forest Service.

TABLE II-12

PARTICIPATION IN OUTDOOR RECREATION
CORONADO NATIONAL FOREST - COCHISE COUNTY
1970

Activity	Visitor Days (Thousand)	Percent of Total
Viewing Outstanding Scenery/ Unusual Environment	42.1	15.3
Scenic Drives	42.0	15.3
Hiking	16.3	5.9
Horseback Riding	.7	.2
Boating	3.6	1.3
Swimming	.5	.1
Fishing	6.8	2.4
Camping	92.5	33.7
Lodges and Summer Homes	19.8	7.1
Picnicking	25.3	9.2
Hunting	12.5	4.5
Nature Study	4.4	1.5
Other Activities	6.7	2.4
Total	274.4	100.0

Source: U. S. Forest Service

Generalized Future Land Use

A land use classification table is not available at this time for future land use. The county is in the process of developing a county land use plan and has not generated sufficient data on which to base acreage projections. This report will respect the county's right to develop local projections and will deal with future land use pattern in a generalized manner.

The county is predominately rural in its land use distribution. The urban land uses are clustered along the major highways and in the agricultural areas. Future urban land development is expected to continue at a rate greater than that experienced during the period between 1960 to 1970. This new development will probably concentrate in the western sector of the county with Fort Huachuca being the nucleus. New urban development is also anticipated to locate adjacent to existing urban centers as indicated on PLATE 2.

There is a great potential for large scale subdividing activity on a speculative basis to take place, but the planning officials are attempting to limit these activities to planned developments in areas which have a justifiable need.

The Charleston Reservoir project on the San Pedro River is considered an area of justifiable need for residential development. The lake formed by the Charleston Dam will be the ending reservoir for the Central Arizona Project and will contain 235,000 acre-feet of water (PLATE 2). The new development is expected to take place along the western and southern shore lines of the lake.

The amount of agricultural land is not expected to decrease appreciably during the next twenty years. Only a small amount of this land is in direct conflict with urban uses. The conflict arises over competition for water supplies.

The land used for livestock grazing will probably decrease but the amount will be insignificant compared to the total amount of acreage. The land which will be lost out of this classification will probably go into the residential classification due to subdivisions. These land use changes will be limited to the private lands and not to the public domain lands.

The mining activity of the county is temporarily slowing down due to insufficient deposits of high grade copper ore in the present mining areas. Exploration activities will continue with additional mineral claims being made as the remaining deposits become economically feasible to mine.

Small mining operations, especially in the Tombstone vicinity, will probably continue at present rates of operation. These deposits are small and mined on a part-time basis.

Those areas classified as desert and mountain lands may become more important as natural scenic areas and recreation demands increase. As the metropolitan area of Tucson grows and access to these isolated areas improves, their recreational potentials will be realized. These lands are presently part of the public domain and will probably remain so during the next twenty years.

COUNTY NEEDS FOR ENVIRONMENTAL SERVICES

This section provides a compendium of existing and projected environmental services needs for Cochise County. The information presented is a compilation of facts and calculations which are outlined individually in CHAPTER III of this report for the areas surveyed in the county. Opinions related to existing needs were based upon field survey leaders. Future needs projections were based upon methodologies discussed in SECTION III of this report and qualitative judgments as to life expectancies of existing facilities, if any.

Water Supply and Distribution Systems

Existing and future water supply and distribution needs for communities surveyed in Cochise County are outlined in TABLE II-13. The needs expressed in TABLE II-13 are categorized in terms of varied system modifications and/or expansions, water supply augmentation or additional engineering evaluation of existing or needed systems. Review of the Table indicates that seven of the eight areas noted have existing water supply system needs.

Future water supply demands for the rural communities of Cochise County are presented in TABLE II-14. The total demand data for the county include estimates for the communities of Bisbee and Douglas. The demands noted will result in the projected needs for the major water supply utilities serving the areas indicated in TABLE II-15. There are presently 56 water utilities in Cochise County of which approximately 60 percent are investor-owned operations.

The locations of these utilities are illustrated on PLATE 3. New systems would primarily be associated with private land development activities throughout the county.

Water resources for the county as a whole appear adequate to meet future domestic water needs which could conceivably reach an estimated 16,988 acre-feet in 1990. Present demands are estimated at 8,553 acre-feet per year. Groundwater and surface water supplies at the present are estimated at 58,300,000 and 330,000 acre-feet per year respectively. Groundwater reserves will undoubtedly decrease due to overdraft of available supplies related to agricultural or heavy industrial

TABLE II-13

EXISTING AND FUTURE* WATER SUPPLY AND DISTRIBUTION NEEDS IN RURAL COMMUNITIES OF COCHISE COUNTY

Community Or Developed Area	Existing Needs**					Future Needs														
						1975					1980					1990				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Tombstone	●	●				●					●					●				●
Willcox	●										●					●				
Benson	●					●	●							●		●				●
Huachuca City	●	●										●							●	●
Sierra Vista				●		●		●				●								●
Naco						●		●				●				●	●			
Bowie		●												●						●
San Simon	●		●	●							●						●			●

*Based on high population projection levels.

**Needs classifications:

1. Replacement and/or modifications (expansion) within distribution system.
2. Water storage or additional storage facilities.
3. Combining of water systems for more economical delivery of services or consideration of municipal ownership and operation of water supply systems.
4. Water supply augmentation.
5. Modification and expansion of equipment utilized in supplying water to distribution network (well motors, booster pumps, etc.).

Source: Staff estimates.

TABLE II-14

SUMMARY OF PROJECTED ANNUAL
WATER DEMANDS FOR COCHISE COUNTY
IN 1975, 1980 AND 1990
(Acre feet per year)

DEVELOPED AREA	PROJECTION YEAR	DOMESTIC WATER DEMANDS PROJECTION LEVELS* LOW	MEDIAN	HIGH
TOMBSTONE	1975	305	312	320
	1980	310	326	343
	1990	321	354	391
WILLCOX	1975	200	210	221
	1980	221	243	269
	1990	267	325	396
BENSON	1975	702	737	774
	1980	781	861	949
	1990	960	1169	1420
HUACHUCA CITY	1975	280	287	295
	1980	802	817	333
	1990	347	383	423
SIERRA VISTA	1975	3256	3312	3368
	1980	3629	3762	3908
	1990	4450	4853	5339
NACO	1975	76	81	89
	1980	91	101	121
	1990	135	166	197
ALL OTHER AREAS OF DEVELOPMENT**	1975	5193	5300	5395
	1980	6145	6298	6382
	1990	9332	9182	8822
COUNTY TOTAL	1975	10012	10239	10462
	1980	11479	11908	12305
	1990	15812	16432	16988

* Water demands are based on low, median and high population projection levels, as outlined in Section III of this report.

** All Other Areas of Development (AOAD) includes Bisbee and Douglas.

Source: Staff calculations.

TABLE II-15

TYPES OF WATER UTILITIES IN
COCHISE COUNTY - 1970

Type of Owner	No.
Investor	33
Municipal	5
Co-Op	2
State	14
County	2
TOTAL	56

Source: Arizona State Department of Health, Water Supply Div.

uses. The projected demands presented in TABLE II-14 do not contain estimates for agricultural or industrial water needs. These two categories of water use are considerable in relation to domestic water needs. Overdraft of groundwater supplies will result in further depression of water tables underlying the major water bearing aquifers of the county. In the last ten years, static water tables have dropped as much as 20 to 30 feet in the areas of agricultural or urban development. This trend is anticipated to continue.

Sewerage and Wastewater Treatment

Existing and future needs for sewage treatment facilities are presented in TABLE II-16. Most of the developed areas noted have an existing need for more detailed engineering studies related to future development of sewerage and treatment facilities. As of June 1971, there were twelve operating sewage collection and treatment systems in the county (PLATE 3 and TABLE II-17). Of these systems, two communities have needs related to expansion or modification of their sewage collection systems. Existing sewage treatment facilities need expansion in three communities.

Stabilization lagoons are the basic form of wastewater treatment facility found in the county. All remaining areas utilize the septic tank system of wastewater treatment.

TABLE II-16

EXISTING AND FUTURE* SEWERAGE AND WASTEWATER TREATMENT NEEDS IN RURAL COMMUNITIES OF COCHISE COUNTY

Community Or Developed Area	Existing Needs**				Future Needs**											
					1975				1980				1990			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Tombstone	●									●					●	
Willcox		●	●					●			●					
Benson	●		●	●		●				●					●	
Huachuca City		●			●		●			●					●	
Sierra Vista	●		●			●				●	●			●		
Naco	●					●				●					●	
Bowie				●				●	●					●	●	
San Simon				●				●				●	●			

*Based on high population projection levels.

**Needs classification:

1. Detailed engineering design study for future development of sewerage and treatment facilities leading to construction of needed systems.
2. Expansion and/or additions to sewage collection network.
3. Expansion and/or modification of treatment facilities.
4. a. Areas with centralized sewage treatment systems: Consideration of wastewater reclamation for agricultural or industrial uses should be reviewed.
   b. Areas utilizing septic tank disposal systems: Septic tanks and urban densities are compatible for time frames noted.

Source: Staff estimates.

TABLE III-17

WASTEWATER TREATMENT FACILITY INVENTORY
COCHISE COUNTY - JUNE 1971

Facility Location	Type Ownership	Type Treatment Facility
Benson	Municipality	Stabilization Lagoon
Bisbee (Downtown)	Municipality	Trickling Filter
Bisbee (Warren)	Municipality	Stabilization Lagoon
Bowie Compressor Station	Private	Evaporative Lagoon
Castles Motel (Tombstone)	Private	Stabilization Lagoon
County Hospital (Douglas)	County	Evaporative Lagoon
Douglas	Municipality	Trickling Filter
Ft. Huachuca	U. S. Army	Stabilization Lagoon
Hereford	Subdivision	Evaporative Lagoon
Huachuca City	Municipality	Stabilization Lagoon
Sierra Vista	Municipality	Stabilization Lagoon
Willcox	Municipality	Stabilization Lagoon

Source: Arizona State Department of Health.

Wastewater production levels within the county are presently estimated at 6,070 acre-feet per year. Projected future levels of sewage wastes that may be generated per year by 1990 are presented in TABLE II-18. Currently, approximately 66 percent of the sewage originates in the larger communities which have some form of wastewater treatment. By 1990, it is estimated that between 70 and 80 percent of sewage produced will receive treatment other than by septic tank systems. If such a high percentage of the sewage generated is provided treatment of a more sophisticated nature than septic tanks, this would suggest that long-range planning related to the ultimate re-use of reclaimed wastewater should be carried out. Using reclaimed sewage for irrigation or industrial applications is currently an accepted practice, provided modern forms of sewage treatment are utilized. Sewage reclamation could augment existing and future irrigation water demands in the region. This particular application should be of interest and value to the Benson-Willcox area of Cochise County.

Solid Waste Disposal Practices and Techniques

The production levels of refuse, garbage and other forms of solid waste materials will grow as population densities increase. Projected levels of solid waste production are presented in TABLE II-19. At

TABLE II-18

SUMMARY OF PROJECTED AVERAGE ANNUAL SEWAGE PRODUCTION LEVELS FOR COCHISE COUNTY IN 1975, 1980 AND 1990
(Acre-feet per year)

DEVELOPED AREA	PROJECTION YEAR	SEWAGE PRODUCTION PROJECTION LEVELS* LOW	MEDIAN	HIGH
TOMBSTONE	1975	213	218	224
	1980	217	228	240
	1990	225	248	273
WILLCOX	1975	140	147	155
	1980	155	170	188
	1990	187	228	277
BENSON	1975	482	507	532
	1980	538	593	654
	1990	661	805	977
HUACHUCA CITY	1975	183	188	192
	1980	196	206	216
	1990	225	248	274
SIERRA VISTA	1975	2121	2156	2192
	1980	2356	2442	2537
	1990	2886	3148	3463
NACO	1975	53	56	63
	1980	68	75	90
	1990	101	124	147
ALL OTHER AREAS OF DEVELOPMENT**	1975	3721	3797	3865
	1980	4438	4549	4610
	1990	6839	6729	6466
COUNTY TOTAL	1975	6913	7069	7439
	1980	7968	8263	8535
	1990	11124	11530	11877

* Sewage production levels are based on low, median and high population projection levels, as outlined in SECTION III of this report.

** All Other Areas of Development (AOAD) include the communities of Bisbee and Douglas.

Source: Project Staff Estimates.

present, solid wastes are generated in Cochise County at an estimated rate of 49,537 tons per year (1970). Levels of solid waste production in 1975, 1980 and 1990 are projected to increase 29, 59 and 143 percent, respectively, over the 1970 level of estimated production.

Solid waste materials are disposed of at ten (10) major dumpsites (PLATE 3). Control of accumulated wastes is accomplished by burning at seven of these sites. The facilities near Huachuca City, Willcox and Douglas are operated as sanitary landfills on a full-time basis.

Management of these facilities is carried out on a part-time basis by the County Health Department. Part-time maintenance and operation of dumpsites may be sufficient for the present, however, full-time management will become increasingly important in future years. A management program involving the development of sanitary landfill disposal sites with regularly scheduled inspections and maintenance would be of benefit to the citizens of Cochise County.

The development of regional landfill sites is in part supported by the information contained in TABLE II-19. Review of this table indicates that by 1990 the major bulk of solid waste materials will originate in the larger communities and developed rural areas surveyed in this report. The "All Other Areas of Development" (AOAD) category noted in TABLE II-19 amounts to 63,594 tons per year for the high projection level in 1990. It is estimated that 54 percent (34,276 tons) of the "AOAD" category will be generated in Bisbee and Douglas. Combining this 54 percent of the "AOAD" value with the cumulative total for rural communities in 1990 (high projection level) indicates that 94,423 tons of solid waste materials (76 percent) could be produced in established communities of Cochise County. The corresponding earlier figures in TABLE II-19 for 1975 indicate that 69,211 tons (60 percent) of the solid waste materials will be produced in established communities. Therefore, assuming that the county does continue the high level of population growth, solid waste production sources would seem to become more "localized."

Planning for site selection and development of centrally or regionally located sanitary landfills and the consideration of associated salvage operations serving all areas would be basic to an effective solid waste management program. Review of existing dumpsite locations and their relationship to projected land use patterns in the county suggests that possibly seven (7) regional sanitary landfills could serve the county in the future. Possible area locations for these facilities are: (1) Douglas (present site); (2) Bisbee-Naco; (3) Tombstone; (4) Sierra Vista-Huachuca City (present site); (5) Willcox; (6) Benson; and (7) Bowie-San Simon. Finalizations of actual site locations, land requirements and detailed design could be made a part of a regional plan developed by the county.

TABLE II-19

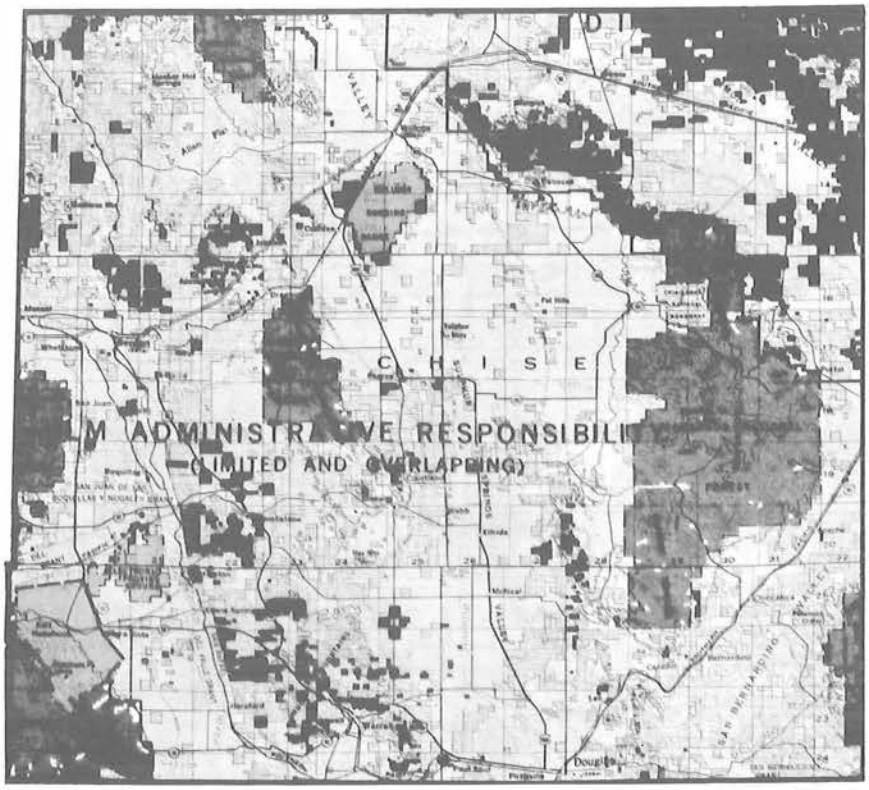
SUMMARY OF PROJECTED AVERAGE ANNUAL SOLID WASTES PRODUCTION LEVELS FOR COCHISE COUNTY IN 1975, 1980 AND 1990
(Tons per year)

DEVELOPED AREA OF COMMUNITY	PROJECTION YEAR	SOLID WASTES PRODUCTION PROJECTION LEVELS* LOW	MEDIAN	HIGH
TOMBSTONE	1975	1112	1150	1179
	1980	1240	1304	1372
	1990	1459	1611	1781
WILLCOX	1975	2440	2565	2693
	1980	2836	3130	3454
	1990	3684	4492	5465
BENSON	1975	2793	2934	3080
	1980	3362	3700	4088
	1990	4682	5698	6923
HUACHUCA CITY	1975	1646	1688	1730
	1980	1913	2040	2112
	1990	2486	2747	3030
SIERRA VISTA	1975	21417	21766	22134
	1980	25430	26360	27384
	1990	34897	38055	41869
NACO	1975	788	834	927
	1980	946	1051	1261
	1990	1429	1754	2049
ALL OTHER AREAS OF DEVELOPMENT**	1975	32089	32748	33304
	1980	40064	41064	41615
	1990	67269	66188	63594
COUNTY TOTAL	1975	62285	63685	65047
	1980	75791	78649	81286
	1990	115906	120545	124741

* Solid waste production is based on low, median and high population projection levels as outlined in SECTION III of this report.

**All Other Areas of Development (AOAD) include the communities of Bisbee and Douglas.

Source: Staff calculations.

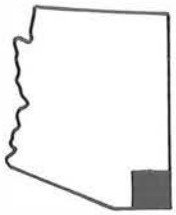


LEGEND

- BUREAU OF LAND MANAGEMENT
- NATIONAL FOREST
- MILITARY RESERVATION AND MILITARY WITHDRAWAL
- STATE TRUST LANDS
- PRIVATE LANDS

SCALE – MILES

0 10 20 30 40



ENVIRONMENTAL SERVICES NEEDS STUDY

PREPARED BY

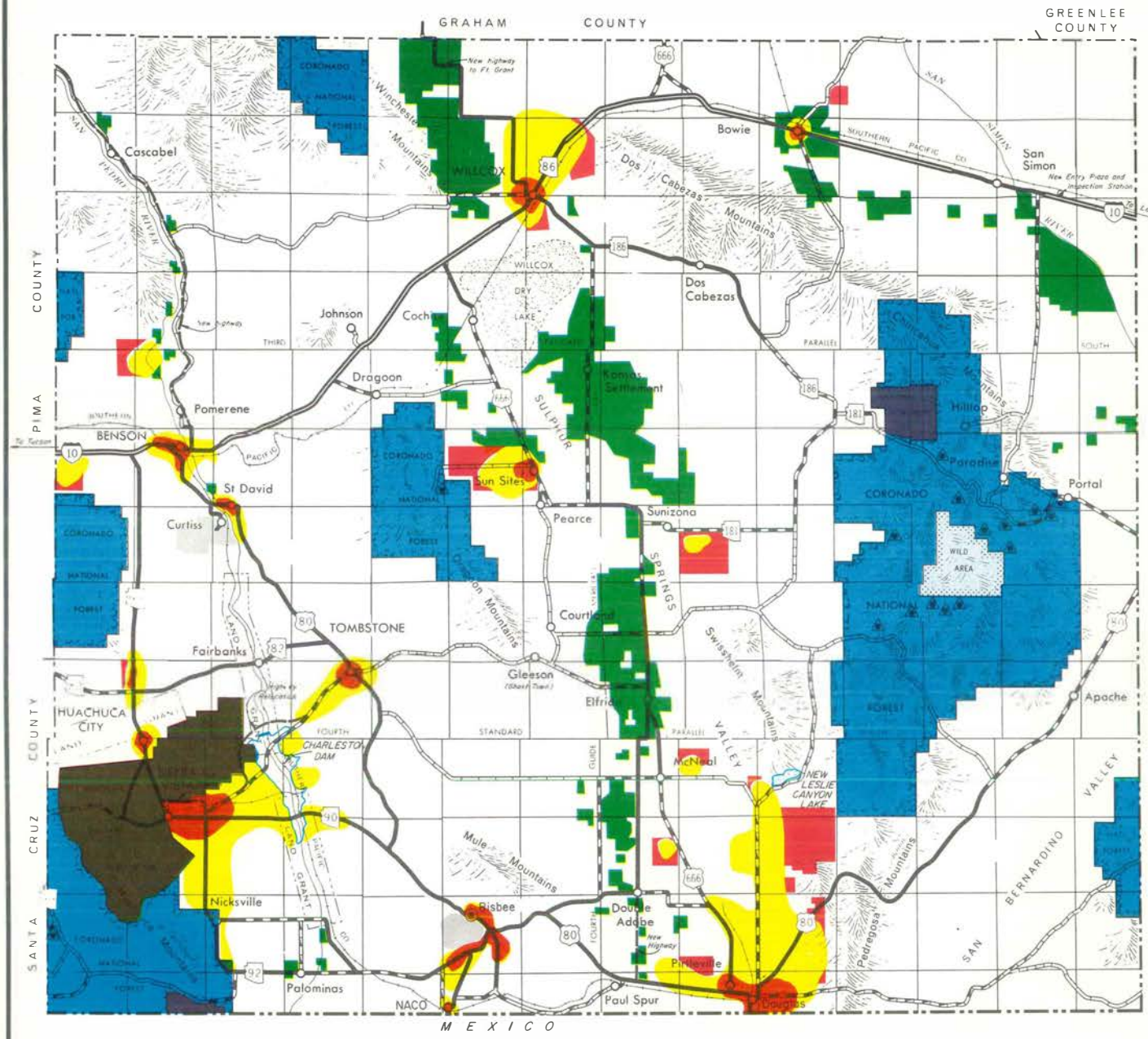
DEPARTMENT OF ECONOMIC
PLANNING AND DEVELOPMENT

COCHISE COUNTY, ARIZONA
LAND OWNERSHIPS

1971

N

PLATE I



SYMBOLS

- Recreation Sites
- City, Town, Settlement
- Interstate Highway
- U.S. Highway
- State Highway
- County Road (improved)
- County Road (unimproved)
- Railroad
- River, Washes
- County Line
- State Line
- U.S. Government Lands
- National Forest Boundary

LEGEND

- 1970 URBAN
- 1990 URBAN
- INDUSTRIAL
- AGRICULTURAL
- SUBDIVIDED LANDS
- WILDERNESS AREA
- NATIONAL FOREST
- NATIONAL MONUMENT
- MILITARY RESERVATION

SCALE—MILES

ENVIRONMENTAL SERVICES NEEDS STUDY

PREPARED BY

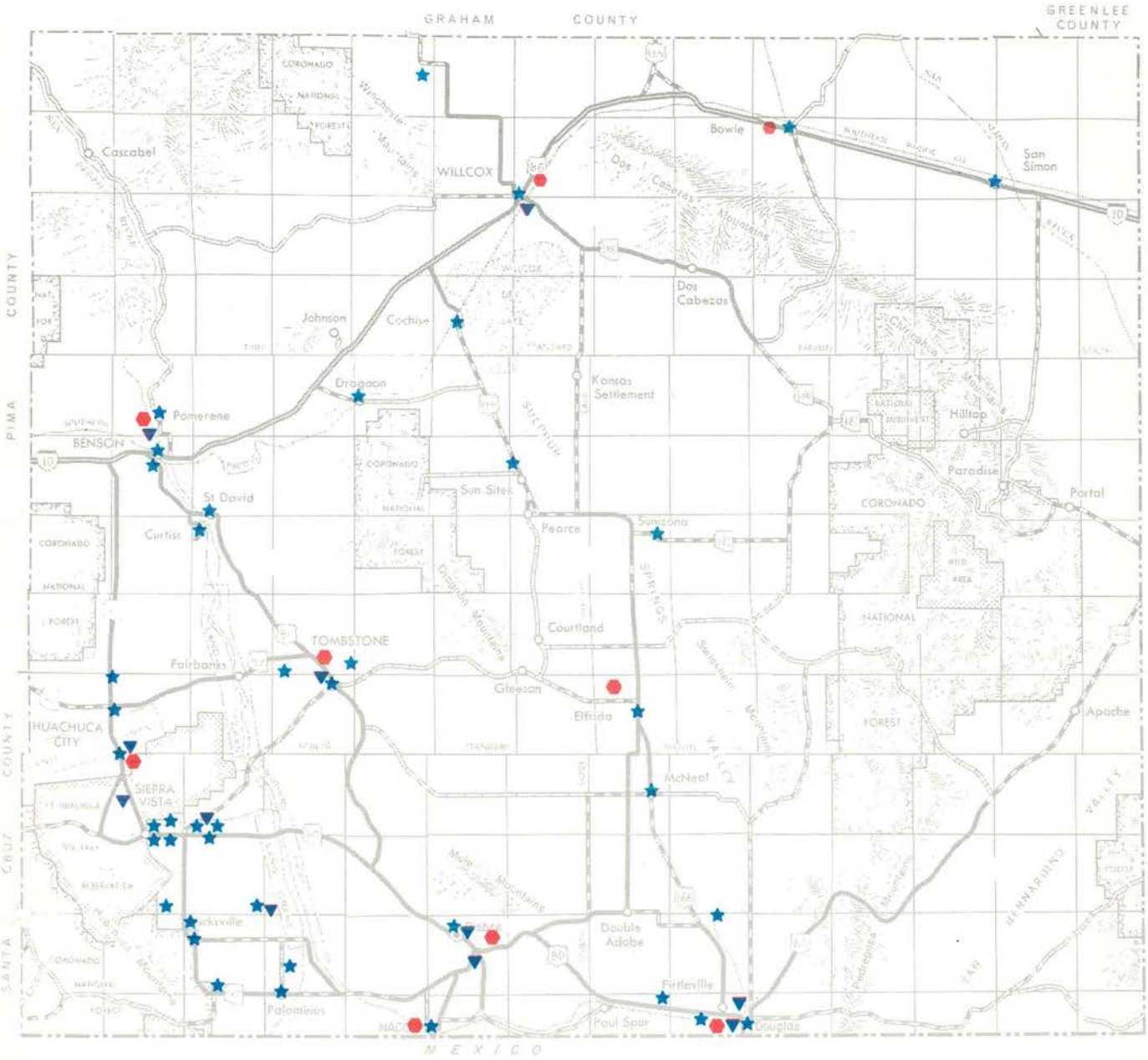
DEPARTMENT OF ECONOMIC, ESTIMATES AND DEVELOPMENT

COCHISE COUNTY, ARIZONA

1970-1990 LAND USE

N

PLATE 2



SYMBOLS

- Water Systems
- Sewer Systems
- Dumpsites
- City, Town, Settlement
- Interstate Highway
- U.S. Highway
- State Highway
- County Road (improved)
- County Road (unimproved)
- Railroad
- River, Washes
- County Line
- State Line
- U.S. Government Lands
- National Forest Boundary

SCALE - MILES

ENVIRONMENTAL SERVICES NEEDS STUDY

PREPARED BY

DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

COCHISE COUNTY, ARIZONA

WATER SUPPLY SYSTEMS, SEWAGE COLLECTION AND DISPOSAL SYSTEMS, SOLID WASTES DUMPSITES

N

PLATE 3

CHAPTER III. COMMUNITY PROFILES

This chapter presents detailed profiles and analysis, as far as feasible, of each of the rural communities in Cochise County. Each community's historical profile, physical characteristics, population, economic conditions, land use profiles, water systems, and sewage and solid waste disposal facilities are examined.

Existing environmental service needs are determined as well as future needs based on projections of population and economic growth.

COMMUNITY OF TOMBSTONE

HISTORICAL PROFILE

Tombstone was the result of rich gold and silver strikes which brought hoards of miners and prospectors to the area. The original claim was filed by Ed Schieffelin in 1870 and he named it Tombstone. The permanent community stands some three miles north of the Schieffelin Claim. In 1881, the town was incorporated and rich silver and gold discoveries eventually gave the town a population of 15,000 between 1880 and 1888. Tombstone at that time was larger than San Francisco and the cultural center of the Southwest. Then in 1888, the mines began to flood and by 1890 there were less than 2,000 people in the town. Subsequent attempts were made to pump out the mines but flooding was again the end result. Future plans to reopen the mines were abandoned as costs became prohibitive. Surprisingly, the town did not die but continued for many years almost as a ghost town. Recently the town has become a flourishing tourist attraction and is known as "the Town Too Tough to Die."

PHYSICAL CHARACTERISTICS

The community is located in the foothills of the Mule Mountains at an elevation of 4,540 feet above sea level (PLATE 4). The terrain of the surrounding region has a rolling character with many intermittent streambeds prevalent. Surface soils are shallow being basically alluvial and being calcareous and alkaline in nature. Sub-surface geologic formations are comprised mostly of densely consolidated limestone conglomerates to a depth of about 150 feet. Below this layer are silt and sediment deposits of moderate permeability.

West of Tombstone in the proximity of the San Pedro River water course groundwater levels range from less than twenty to about 85 feet below the land surface. However, as the community is situated at a higher elevation, depth to groundwater is greater by as much as 100 feet or more.

The climate of Tombstone is moderate with average maximum temperatures of 61° Fahrenheit and 92° Fahrenheit in winter and summer respectively. Average minimum temperatures are 35° Fahrenheit for winter and 64° Fahrenheit for the summer months. Average precipitation is near 15 inches per year.

SOCIO-ECONOMIC PROFILE

Tourism is the base of Tombstone's economy. Numerous antique stores and souvenir shops are located along the main street of the town. Historic spots and mementos have been turned into miniature museums and are a source of income to the town. Additional income is earned from the motels, restaurants and gas stations which service the tourist population. Other sources of employment in the town include municipal services, public utilities and the district's schools. A few members of the community commute to Fort Huachuca which is only 35 minutes away.

At present Tombstone survives by living off its past. It lacks any manufacturing or wholesale industry. Occasionally small silver mines are opened. There is a mill on the outskirts of Tombstone which processes ore for these small operations. The likelihood of any substantial increase in mining operations is low unless the price of silver jumps sufficiently to make it economically feasible to remove the water from some of the old mines. One possibility for development in Tombstone lies in expanding existing tourist facilities so that the area would be more of a resort area. At present, recreational facilities are limited and the average visitor is likely to stay in Tombstone only a day or two. With more diversified entertainment opportunities the town could probably capitalize on its existing historical attractions.

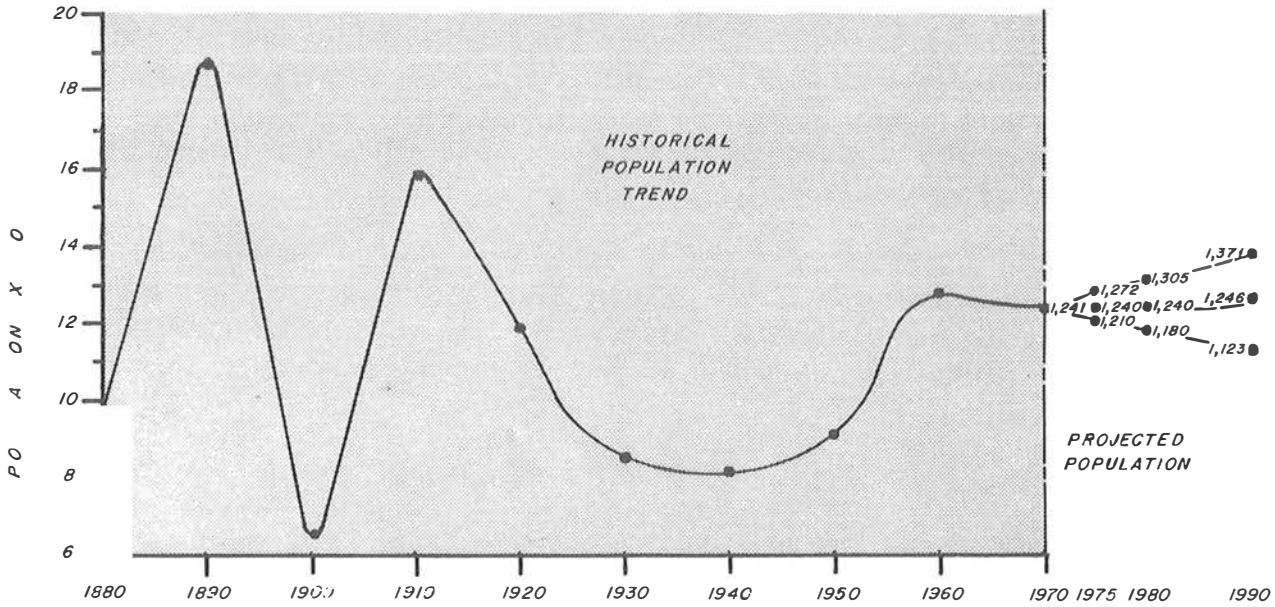


FIGURE III-1, POPULATION OF TOMBSTONE AND PROJECTIONS TO 1990

FIGURE III-1 shows the population projection for Tombstone. The median projection, which is most probable, assumes the population will remain at approximately its present level. A lake is proposed for Charleston, Arizona - midway between Tombstone and Sierra Vista. If plans materialize within the next twenty years, this could alter these projections. A more optimistic pattern of expansion might then be expected.

LAND USE

Present Land Use Patterns

Tombstone's physical growth pattern reflects its economic dependence upon the past in that the town has developed slowly around the historical sites.

Commercial land uses are clustered between Toughnut and Fremont Streets in the center of town (PLATE 5). The commercial establishments in this area are primarily small, specialized retail stores which are tourist oriented. Many of the buildings are the sites of famous historical events and have been preserved in their original style of architecture. The commercial uses indicated on PLATE 5 outside of the above area are those which utilize large street frontages or storage areas, i.e., motels, service stations, grocery stores and drive-in diners. These commercial uses are located within the residential area but do not necessarily constitute conflicting uses due to the smallness of the businesses and an adequate amount of screening between the uses. The industrial uses indicated on PLATE 5 are either machinery repair shops, open storage yards, or facilities related to mining activities with most of the mining facilities being located south of the city.

Public and quasi-public uses include the schools, city hall, the old county courthouse, parks, churches, historic sites and other uses of land for the public welfare. Some of the historic sites are classified as commercial uses. This is because they are owned and operated as businesses rather than as public attractions maintained on a donation basis.

Tombstone can be divided into four residential areas. The first area is west of U.S. 80 bounded on the south by the Charleston Road and on the east by the commercial district. The housing in this area is mixed in structure and quality. There are two trailer parks in this neighborhood, both of which were designed primarily for overnight trailer parking.

The second residential neighborhood is north of U.S. 80 and is characterized by a wide range of structural styles, property values, and a large number of vacant lots. Commercial uses are mixed in with the

residential uses, most of which are either resort lodges or motels. This area is composed of various forms of residential housing, i.e., mobile homes, large and moderate size single family dwelling units and apartments. The third residential area is south of U.S. 80, east of Ninth Street and is composed of moderately sized single family dwelling units. The homes are grouped together with open lots separating the groupings.

The fourth residential area is north of the city along Pearson Road. The original development activities in the area consisted of selling one acre or larger parcels while recent activities have taken the form of selling lots of less than one acre. The lots are developed individually making it possible for various forms of residential housing to occur.

Projected Land Use Patterns

Future development of Tombstone will probably be limited to three areas. The predominance of new commercial development is anticipated within the central business district (PLATE 6). The new development activity will primarily be in the form of remodeling existing structures and the locating of new tourist oriented businesses. Some of this commercial land development could carry up to and along Fremont Street.

The second and third areas of anticipated new land development will be residential in character. The area immediately east of Tenth Street and north of U.S. 80 is totally within a single subdivision of which about one-fourth of the lots have been improved. Most of the new residential construction has been concentrated within this subdivision and the area directly north of it along Pearson Road. New home construction in the past has been slow and on an as-needed basis. The second residential area, anticipated to receive much of the new development activity, is located north of the present community. The developer has almost completed the initial area of development and has started planning additional areas for residential development. Uncertainty is expressed about the amount of land in this area which is likely to be developed for residential uses by the end of the study period due to the anticipated rates of population growth. Dêvelopment rates are also difficult to assess due to the fact that a major portion of lot sales are to out-of-state residents.

A new park has been developed east of the community, but there appear to be no plans for the development of other additional public and quasi-public land uses. Any extension of public land uses will probably be limited to modernization of existing facilities and the development of historic sites for tourist purposes.

Industrial land use will continue to be more of the heavy commercial type of uses. The town has discouraged other types of industrial uses from locating in Tombstone.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

The existing water supply system is owned and operated by the municipality. The basic water distribution network was constructed in the 1880's with periodic expansion undertaken as the community grew. The initial distribution system was constructed of handmade malleable cast iron pipe manufactured in England. The pipe was shipped from England in 1879 around South America to San Francisco. From this point it was delivered by wagon to Tombstone in the latter part of 1880 for assembly.

Water Supply. The existing water supply is made up of artesian springs located in an abandoned mine in the Whetstone Mountains, 32 miles northwest of the community and the two wells located in town (PLATE 7). Well #1 is used as a standby source for emergency or auxiliary supply.

The springs are situated at an elevation of approximately 6,000 feet above sea level and produce water for about eight months of the year. Artesian pressures drop considerably in the late summer months with a corresponding decrease in flow from the springs. At this time Well #2 is used to augment the supply.

Spring water is transported to Tombstone via a seven-inch malleable cast iron pipeline. The 32-mile pipeline crosses the San Pedro River at an elevation of 3,500 feet above sea level and then terminates at an open storage reservoir at an elevation of 5,600 feet above sea level. This water flows by gravity to the community. Water pressure in the line at the San Pedro River crossing has been gaged as 1,740 pounds per square inch.

Well #2 is drilled to a depth of 605 feet and cased to a depth of 500 feet. The static water level is 300 feet below the surface and pumping capacity is rated at 425 gallons per minute. Water quality data for this well are noted in TABLE III-1. Water quality for Well #1 is similar with the exception of fluoride concentrations of 1.7 mg/liter. This value exceeds the 1962 U. S. Public Health Service drinking water standards for domestic water supplies. This well has a delivery capacity of 200 gallons per minute.

TABLE III-1

WATER QUALITY DATA FOR TOMBSTONE WELL #2

Parameter	Concentration (milligram/liter)
Total Dissolved Solids (TDS)	235.0
Total Hardness	182.0
Calcium	45.0
Magnesium	16.0
Sodium	8.0
Alkalinity	170.0
Chlorides	3.0
Fluorides	0.19
Nitrates	15.0
Sulphates	9.0

Source: Arizona State Department of Health, Water Supply Div.

Water Distribution. Two water storage reservoirs are contained in the distribution network (PLATE 7). These facilities are comprised of a 1,000,000 gallon open basin and a 100,000 gallon steel tank situated at elevations of 200 and 120 feet above that of the community respectively. Pressure reducers are used on the main leaving the large reservoir in order to maintain a constant line pressure of 60 pounds per square inch. Water entering the system is chlorinated at an estimated rate of 1 - 2 pounds of liquid chlorine per day.

Water Use. Water use data were not readily available as cumulative monthly or yearly totals are not kept. It is estimated that maximum daily use occurs in the month of June with peak demands equivalent to 500,000 gallons per day. Minimum monthly use occurs in January with estimated peak flows equivalent to 200,000 gallons per day.

The distribution system has 600 metered connections. Water service rates for residential classed users are $4.00 per month for a minimum of 5,000 gallons and an additional $.25 per 1,000 gallons above the minimum. Commercial rates are $12.50 per month for a minimum usage of 50,000 gallons and $.25 per 1,000 gallons above the minimum.

The water system originally built in Tombstone was owned and operated by the Huachuca Water Co, Incorporated, of Indianapolis, Indiana. This company was formed on March 17, 1881. A city ordinance passed at that time gave the Huachuca Water Company the right "to sell water at a cost not to exceed one dollar per gallon." Needless to say, water was gold in those days.

Future Needs

Water demands are at their greatest during the summer months when the artesian spring supply is drastically reduced. At this time Well #2 is used as the prime source of water which has a delivery capacity of 612,000 gallons of water per day. Should this level of daily demand be exceeded, Well #1 can be utilized to augment the supply.

Well #1 is not used except for emergencies due to the high fluoride content of the water. Use of this water diluted by the water obtained from Well #2 would give the community a daily water supply of about 900,000 gallons. Water demands which involved the use of Wells #1 and #2 would result in a water with an estimated maximum fluoride concentration of about 0.7 milligrams per liter (TABLE III-2). This water would be in compliance with the 1962 U.S. Public Health Service Drinking Water Standards.

TABLE III-2

FLUORIDE CONCENTRATIONS DURING SUMMER MONTHS FOR BLENDS OF WATER FROM WELL #1 AND WELL #2
(Well #2 Operating at Full Capacity)

Well #1 Operating Time (hrs.)	Fluoride Concentration mg/liter
0	0.19
2	0.25
4	0.30
8	0.41
12	0.48
16	0.58
20	0.62
24	0.67

Source: Staff Calculations.

The present well system is adequate to meet the projected average daily demand presented in TABLE III-3.

TABLE III-3

PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR TOMBSTONE IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet per Year
Summer	394,300		417,600		466,100		
HIGH		320		343		391	
Winter	178,100		195,750		233,100		
Summer	384,400		396,800		421,600		
MEDIAN		312		326		354	
Winter	173,600		186,000		211,000		
Summer	375,100		377,600		381,800		
LOW		305		310		321	
Winter	169,400		177,000		191,000		

Source: Staff calculations.

Improvements in the distribution system should be undertaken at this time, particularly with respect to the larger storage reservoir. This facility is an open, uncovered reservoir and, as such, constitutes a public health hazard. This problem can be resolved by installation of a new 1,000,000 gallon storage reservoir or modification of the existing facility.

SEWERAGE AND WASTEWATER TREATMENT

Existing Facilities

Residents of the incorporated area of Tombstone utilize the septic tank-leach field or seepage pit form of sanitary wastewater disposal. Surface soils are characteristically tightly cemented limestone conglomerates in the community. This situation makes the serviceable lifetime of septic

systems relatively short. Percolation rates are in the range of 30 minutes per inch or more. Larger commercial establishments with high water use rates have problems in disposing of wastewaters. A motel has a small stabilization pond for treating sewage. Effluent from this facility moves down an intermittent stream bed.

Future Needs

A sewage collection and disposal system is a major need for the community. Plans should be formulated for such a project in the near future. Estimated sewage flows which can be expected in the area are presented in TABLE III-4.

TABLE III-4

PROJECTED AVERAGE DAILY AND YEARLY SEWAGE FLOWS FOR TOMBSTONE IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet per year
Summer	256,300		271,440		303,000		
HIGH		224		240		273	
Winter	133,600		146,800		174,800		
Summer	249,860		257,920		274,000		
MEDIAN		218		228		248	
Winter	130,200		139,500		158,250		
Summer	243,800		245,400		248,200		
LOW		213		217		225	
Winter	127,000		132,800		143,300		

Source: Staff calculations.

SOLID WASTE DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

The residents of Tombstone are provided with a biweekly garbage and trash collection service which is operated by the municipality. Commercial and business establishments are served on a tri-weekly basis.

Collected waste materials are disposed of at the dumpsite noted on PLATE 3. The trench and fill technique is used with little burning carried out for control of accumulated wastes.

Future Needs

The present dumpsite is adequate to accommodate the levels of solid waste production noted in TABLE III-5.

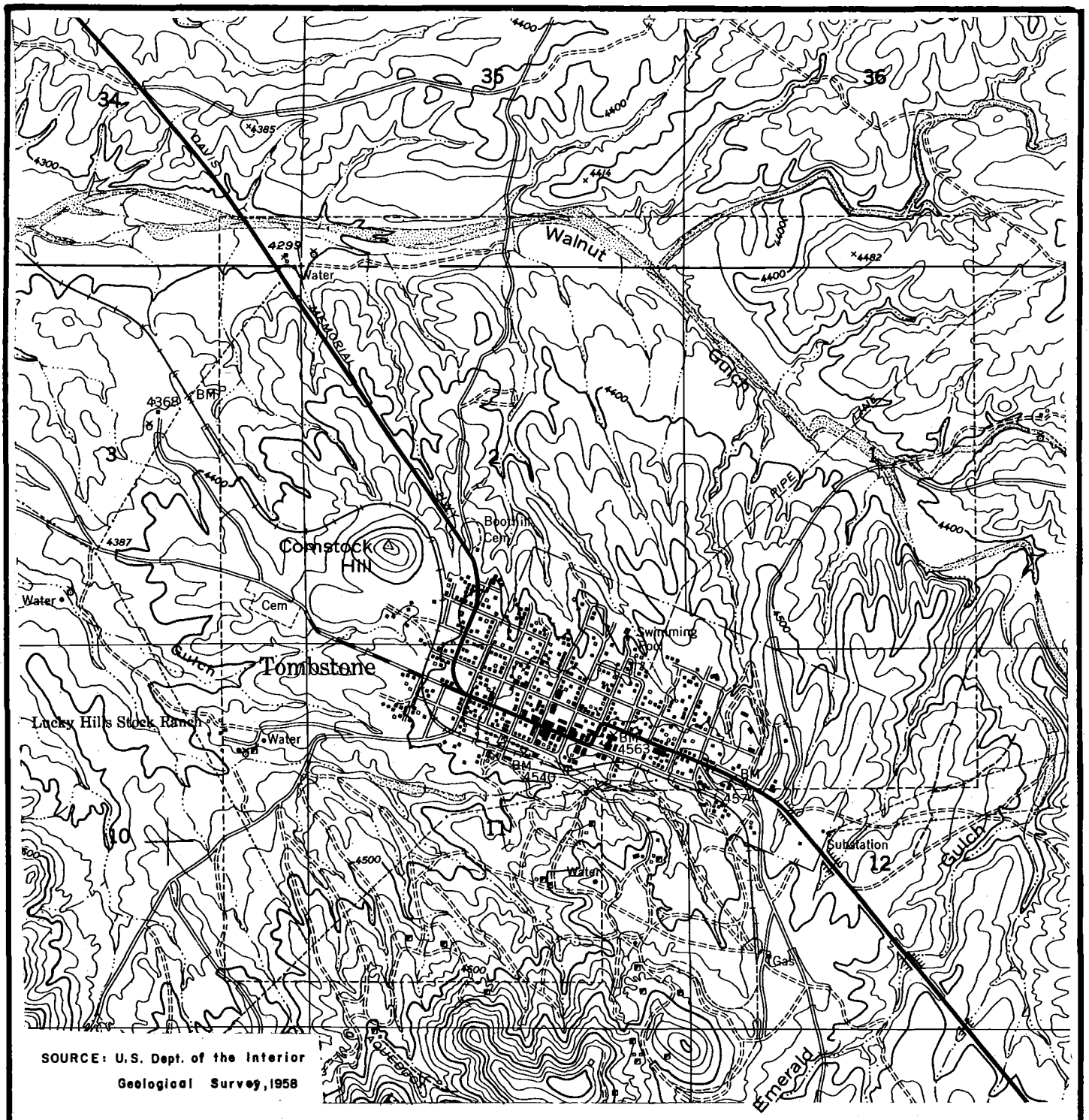
TABLE III-5

PROJECTED SOLID WASTES PRODUCTION LEVELS
FOR TOMBSTONE IN 1975, 1980 AND 1990
(Tons Per Year)

	Production Levels		
Year	Low	Median	High
1975	1,121	1,150	1,179
1980	1,240	1,304	1,372
1990	1,459	1,611	1,781

Source: Staff Calculations.

Operation and maintenance of the disposal site will require additional equipment in the next twenty-year period.



SCALE— FEET

1000 0 1000 2000 3000 4000 5000

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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TOMBSTONE, ARIZONA
TOPOGRAPHIC FEATURES

N

PLATE 4

LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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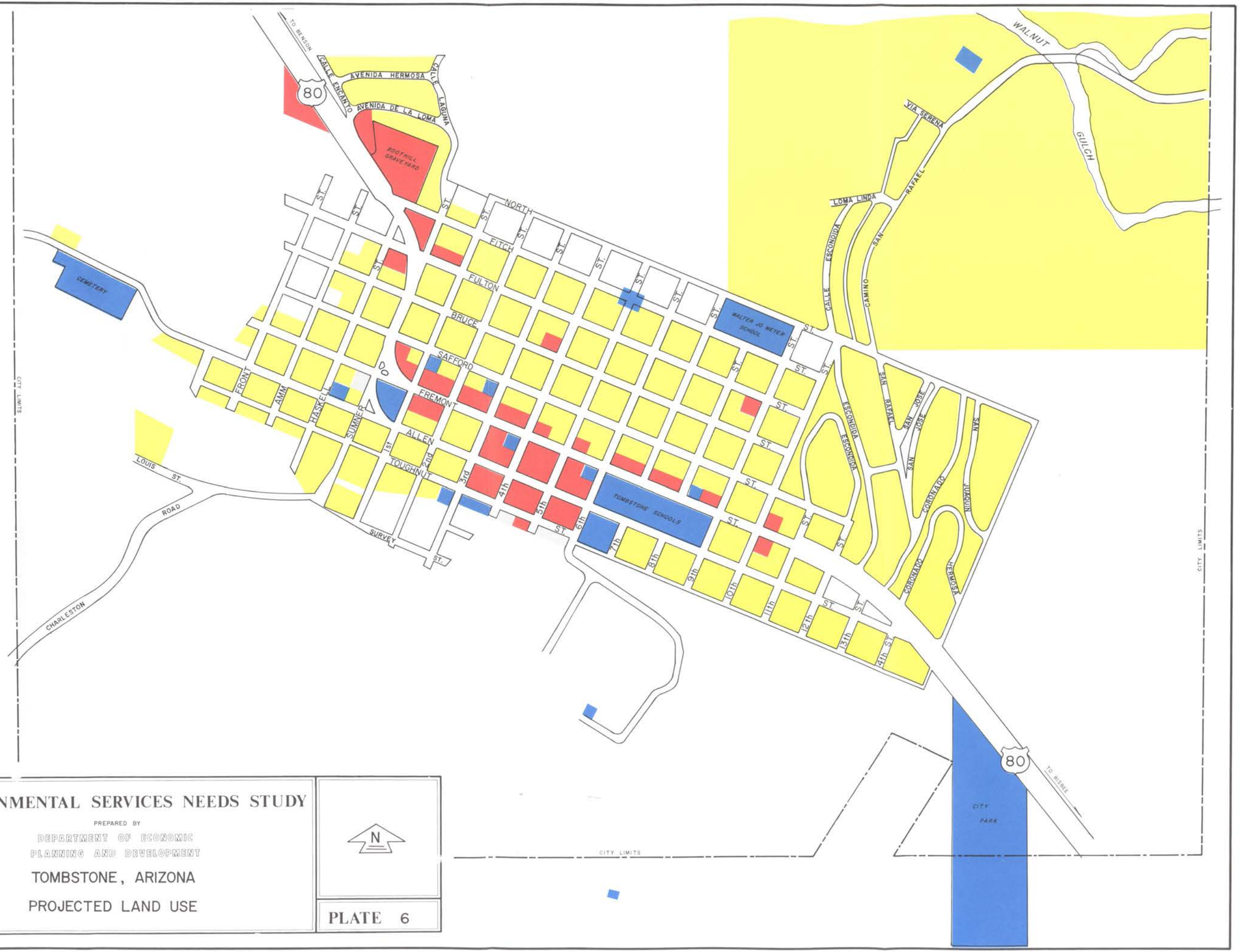
TOMBSTONE, ARIZONA

LAND USE

N

PLATE 5



ENVIRONMENTAL SERVICES NEEDS STUDY

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TOMBSTONE, ARIZONA

PROJECTED LAND USE

PLATE 6

LEGEND
1" LINE
1¼" LINE
1½" LINE
2" LINE
3" LINE
4" LINE
5" LINE
6" LINE
7" LINE
8" LINE
FIRE HYDRANT
VALVE
REDUCER
PLUG
WELL
CITY TANK
1,000,000 GALLON CONCRETE RESERVOIR
2.5 MILES TO SPRINGS
80
N
COCHISE COUNTY
ENVIRONMENTAL SERVICES NEEDS STUDY
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DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT
TOMBSTONE, ARIZONA
WATER SYSTEM
PLATE 7

COMMUNITY OF WILLCOX

HISTORICAL PROFILE

The town was originally called Mahley after James H. Mahley, through whose ranch the railroad passed. In 1880 the name was changed to Willcox in honor of the Commander of the Department of Arizona, a division of the U.S. Army at that time, named General Orlando Willcox. The community was incorporated in 1915 and has for many years been an important Arizona cattle shipping center. Recent widespread use of irrigation has introduced cash crops such as lettuce and cotton and small grains to the economy of Willcox.

PHYSICAL CHARACTERISTICS

The community at an elevation of 4,167 feet is situated in the Willcox basin, a basin of interior drainage, which occupies the northern three-fifths of the Sulphur Spring Valley. The basin is about 48 miles wide at its widest point between the crests of the Little Dragoon and Chiricahua Mountains; it is about 65 miles long from the northernmost point in the Pinabeno Mountains to the south end. Topographically, it is a closed basin that has interior drainage, to Willcox Playa, South of Willcox, at the lowest part of the valley (PLATE 8). Terrain features in and around Willcox are definably flat and level.

Subsurface soils in the area of Willcox consist of moderately consolidated alluvium, poorly consolidated alluvium, and unconsolidated alluvium. All soils are saline or highly alkaline in nature. The sand and gravel layers interlayered with small-sized clay and silt particles of the unconsolidated alluvium, constitute the principal aquifer in the area and yield large quantities of water to wells. Wells east of Willcox Playa and south of Willcox have the highest yields. This is possibly related to the confining nature of the consolidated Playa soil deposits, which causes local artesian conditions.

A natural depression existed in the Willcox Basin, the lowest part of which was situated in the Willcox Playa. As irrigation activities increased in the area, two large cone depressions have resulted from groundwater withdrawal for irrigation. One cone encompasses Willcox and extends several miles northward and the other includes the farmland east of the Playa and extends northward to a point five miles east of Willcox.

Water tables have continually dropped in the region. Through 1966 water levels have dropped more than 100 feet and, in some cases, up to

300 feet in the more heavily developed areas. Water declines in the Willcox area have been in excess of 90 feet. Groundwater resources for the basin have been estimated at three million acre-feet which appear sufficient to meet the domestic water needs of this part of Cochise County.

SOCIO-ECONOMIC PROFILE

The economy of Willcox is based upon retail and wholesale trade and services. It serves the local farms and ranches and also the tourist traffic on Interstate 10. The community is planning to relocate some of its tourist services nearer to Interstate 10 to overcome the disadvantage it received when a bypass around Willcox was completed in 1970. The impact of the bypass on the economy of Willcox is seen in gasoline tax revenues. Revenues totaled $28,974 in Fiscal Year 1968-1969. These revenues declined in Fiscal Year 1969-1970 to $24,919. This indicates a loss in automobile traffic through the town. In addition to relocating services, a third exit off the freeway into the town is also planned. These factors along with some promotional events such as Rex Allen Days should enable the community to retain its tourist trade despite the bypass.

Agriculture has always been important in the area surrounding Willcox. Most of the farming and ranching activity is located in what is known as the Stewart area, northwest of Willcox and in the Kansas Settlement area, south of Willcox. Citrus fruits and vegetables have been tried, but the variation in climate makes growing difficult. Lettuce production, which at one point had reached 6,000 acres, has fallen off. Shipment of lettuce from Willcox has dropped from 2,243,000 cartons in 1961 to 973,000 in 1968. 6/ During the peak of the agricultural season, the farms use as many as 500 migrant workers in their fields. At present a restraint exists on this source of labor as there is limited adequate housing for migrants, however, a grant to improve housing is presently being sought. Due to the agricultural activity surrounding Willcox several grain and farm equipment wholesale companies have located in the town. The employment in these companies makes Willcox the largest center of wholesale employment in the county.

Manufacturing is a developing sector in the Willcox economy. While employment is still small at present, a plastics factory has recently opened which expects to employ 100 workers by the fall. If successful, this could attract other industries into the area.

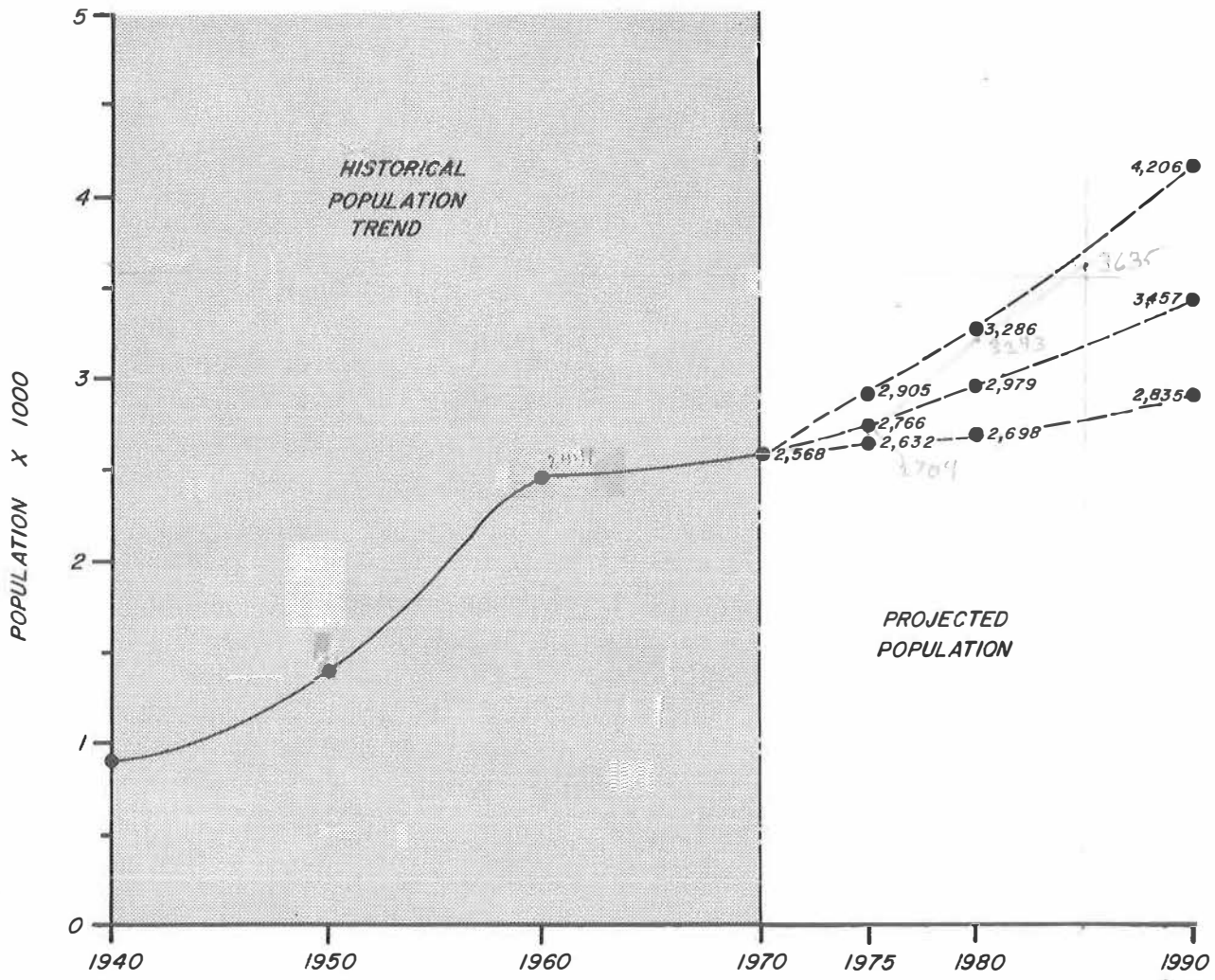


FIGURE III-2, POPULATION OF WILLCOX AND PROJECTIONS TO 1990

Other important sources of employment in Willcox are the public utilities, two of which have their district offices in the town, and government, particularly in the school system.

Based upon this economic outlook, the population of Willcox is projected to at least maintain the .5 percent per annum rate of growth it has had over the past ten years. A more probable median rate of growth projection gives a population of 3,457 by 1990. A high rate of growth would give a population of 4,206 by 1990 (FIGURE III-2). The underlying assumption of all these projections is that Willcox will continue to grow despite the setbacks it received when the Interstate 10 bypass was constructed.

LAND USE

Present Land Use Patterns

The City of Willcox encompasses a land area of 1,640 acres. Seven-hundred acres, or 42.7 percent of this area has been developed for urban purposes, and 940 acres are vacant (PLATE 9). Developed land is usually defined as land which is being utilized for some form of urban use, i.e., residences, commercial buildings, in contradistinction to land which is either used for agricultural purposes or land which is unused, but does not include open areas or parks specifically set aside for these purposes.

Residential land uses currently utilize 161 acres of the developed land area (TABLE III-6). This is below the average for communities of comparable size, which normally average between 40 and 45 percent of the developed land area. A significant factor in Willcox's residential uses is that of the 800 dwelling units, 146 are dilapidated and unsafe for human habitation, or are significantly deteriorated. This may be due to the low per capita income and the lack of building codes when the town was developing. In addition to the shortage of standard permanent housing, the town has a migrant farm laborer housing problem. The housing currently utilized by the laborers is small and lacks both plumbing and electricity. Most of these workers either live in tent camps on the eastern edge of the town or along the highways leading into the town.

Willcox serves as the trade center for a region of approximately 8,500 and an overnight stopping point for tourists traveling Interstate 10. These are the reasons that the commercial district is almost twice the size of comparable towns.

Willcox's commercial uses are divided into two types. The first is the highway-oriented type, i.e., motels, restaurants, service stations. These are located adjacent to State Route 86 which, until recently, served as the major highway through the area. The second type of commercial use is locally oriented, i.e., convenience stores, markets, etc. These uses have located next to the highway uses along Mahley and Grant Streets. Unfortunately, many of these establishments are housed in old and deteriorating buildings.

TABLE III-6

WILLCOX LAND USE ACREAGE - 1971

Land Use Category	Acres	Percent of Developed Area
Residential	161.0	23.0
Commercial	40.0	5.7
Industrial	89.0	12.7
Public and Quasi-Public	108.0	15.3
Streets and R/W	302.0	43.3
TOTAL DEVELOPED AREA	700.0	
VACANT LAND	940.0	
TOTAL LAND AREA	1,640.0	

Source: Comprehensive Plan; City of Willcox, 1971, I. Dale Despain and Associates.

Industrial uses in Willcox are associated with the agricultural activities in the area. The uses are composed of farm machinery and equipment sales and service and agricultural produce shipping facilities.

Projected Land Use Patterns

Willcox has experienced steady growth over the past decade in response to the increased activity in agriculture and tourism. Four new motels have been built since 1960 along with several other commercial and public buildings. Approximately 200 new housing units were constructed west of Curtis Road in this same time period.

The city realizes its need for an additional 75 units of housing to replace those units which are either deteriorated or delapidated. This number does not include new housing for the migrant laborers.

The city is using the neighborhood concept in planning for future development (PLATE 10). The development plan places the new residential development west of Curtis Road in the northwest and southwest neighborhood areas. The plan also recommends that the vacant lots

already platted should be developed with individual buildings and the unplatted land west of present development should be utilized for large-scale developments, i.e., mobile home parks, planned unit developments, and migrant labor housing projects.

The retail center will probably stay between Curtis Avenue and the Southern Pacific Railroad tracks. This area will serve the 8,500 residents of the local trade area. The comprehensive plan does recommend that the buildings and store fronts be changed to depict the styles found in Willcox during the early days. In this respect a new building is currently under construction which will house a Cochise County visitors bureau and a Museum of the Southwest.

The Fort Grant Road Interchange is a big attraction to highway-oriented businesses. New businesses will probably locate in this area, but it seems unlikely that a large number of highway-oriented businesses will move out of the downtown area. It seems that these businesses will initiate a highway campaign to attract tourists into the central business district.

The comprehensive plan recommends that industrial uses locate in the area adjacent to the railroad tracks and to the east of them. The area along Mahley Street presently has warehouses and shipping points located along it east of the Southern Pacific Railroad tracks. This area will probably expand as an industrial area and should be improved to provide for these uses. The plan also recommends that the area bordered by Bisbee Avenue, Airport Road and Interstate 10 should be retained for public and quasi-public uses. The area adjacent to the Fort Grant Road Interchange is excluded for commercial uses (PLATE 10).

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

Domestic water for Willcox was obtained from several shallow wells with high fluoride content. In early 1971, a new supply was put into operation through financial assistance offered by the U.S. Department of Housing and Urban Development (HUD). The new well system is located approximately seven miles north of the city in the peripheral zone of the Willcox Playa. This well and the new sixteen-inch transmission line are noted on PLATE 11.

Water Supply. The new well system has a rated delivery capacity of approximately 2,200 gallons per minute. Estimated daily peak demands

on the well system are in the range of 300-350 gallons per minute. The wells used prior to installation of the new supply produced water of high fluoride content. The new supply is, however, of exceptional water quality (TABLE III-7).

TABLE III-7

WATER QUALITY DATA FOR WILLCOX WATER SUPPLY - 1971

Parameter	Concentration (mg/liter)
Total Dissolved Solids (TDS)	190.0
Total Hardness	92.0
Calcium	31.0
Magnesium	3.0
Sodium	25.0
Alkalinity (Methyl Orange)	108.0
Chlorides	15.0
Fluorides	0.8
Nitrates	2.0
Sulphates	20.0

Source: Arizona State Department of Health, Water Supply Div.

Water Distribution System. The distribution network includes a one-million gallon storage tank and a 5,000 gallon booster tank and pump assembly (PLATE 11). The network has recently been expanded by addition of the new transmission line from the new wells. Approximately one-third of the water mains consist of small lines which are two inches in diameter.

Water Usage. Water consumption in Willcox averaged approximately 290,000 gallons per day during the summer month of June 1970. TABLE III-8 presents water use data for the forty-seven month period of record starting in July 1967 and ending in May 1970. These data are reportedly for approximately 975 service connections on the distribution network within the community.

TABLE III-8

WATER USE DATA FOR WILLCOX
July 1, 1967 - May 31, 1971
(x1000)

Month	Total Monthly Gallonage 1967	1968	1969	1970	1971
January		2,780	2,685	3,386	3,990
February		2,612	2,668	2,754	3,724
March		2,771	4,250	3,814	6,789
April		4,663	6,800	5,756	6,750
May		6,413	6,300	6,832	7,115
June		8,432	7,300	8,650	
July	4,022	6,442	6,028	5,790	
August	5,021	4,084	4,754	4,185	
September	3,721	4,054	4,976	5,130	
October	4,330	4,999	4,703	4,418	
November	3,619	3,140	3,206	3,330	
December	2,310	3,303	3,421	3,630	

Source: City of Willcox.

Water Service Rates. All water service connections to the distribution network are metered. Consumers are charged in accordance with the following plus a monthly service charge based on meter size:

Residential dwellings, single family use -	$.40 per thousand gallons for the first five-thousand gallons used per month; $.30 per thousand gallons for each additional one-thousand gallons used per month.
Commercial and Multiple -	$.40 per thousand gallons for the first ten-thousand gallons used per month; $.30 per thousand gallons for each additional one-thousand gallons used per month.
Users outside of city limits -	Charged twice the rates established for water used within the city limits.

The rate schedule was revised in 1969 and was set to yield sufficient revenue to (1) amortize indebtedness of the existing system; (2) meet the cost of operating and maintaining the system; and (3) provide additional revenue with which to amortize part of the cost of acquiring the new source of water. Consideration was also given to the need for additional funds to pay for critically needed water mains.

Future Needs

Water supply needs for the community are adequate to meet the demands presented in TABLE III-9. The well delivery capacity coupled with available water storage capacity are sufficient to meet requirements for a number six (6) fire rating established by the National Bureau of Fire Underwriters.

The transmission line is sufficient to deliver approximately 2,000 gallons per minute into the distribution network.

This flow plus flow added by storage are adequate to satisfy a fire demand in excess of seven and one-half hours at a sustained demand of 2,250 gallons per minute.

TABLE III-9

PROJECTED AVERAGE DAILY AND YEARLY DOMESTIC WATER DEMANDS FOR WILLCOX IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet per Year
Summer	354,400		433,800		639,300		
HIGH		221		269		396	
Winter	139,400		190,600		328,000		
Summer	337,500		393,200		525,500		
MEDIAN		210		243		325	
Winter	133,000		172,800		269,600		
Summer	321,100		356,100		430,900		
LOW		200		221		267	
Winter	126,300		156,500		221,100		

Source: Staff estimates.

Water supply problems are not evident for the system, however, delivery capacity of the distribution system can cause major problems, particularly in the areas where distribution line sizes are two inches or less in diameter. These sections should be increased to at least four-inch lines.

SEWERAGE AND WASTEWATER TREATMENT

Existing Facilities

Soil characteristics in the Willcox area have been noted as highly alkaline in nature. This class of soil is typified by tightly cemented subsurface soil formations which are not compatible with the use of septic tank - leach field systems of sewage disposal. Prior to 1960, the area was constantly plagued by failing septic tanks systems and public health problems. As a result of these problems, the community undertook the development of a sewage collection and disposal system (PLATE 12).

The collection system has undergone limited expansion since the 1960's and at present serves nearly all dwellings in the community. The only exception is the area located on the west side of the freeway. The network consists of approximately 2.5 miles of ten-inch and approximately 18 miles of six and eight-inch sewer lines. Due to the topography of the community, three sewage lift stations are utilized in the system. Presently, there are approximately 970 service connections in the collection network.

Sewage treatment is provided basically by two wastewater stabilization lagoons with surface areas of 5.1 and 7.0 acres. An outmoded and inoperable primary clarifier and digester are located at the treatment site. These facilities have been bypassed.

The lagoons are loaded in parallel with little effluent leaving the facility in the summer months as the result of evaporation and seepage. During the winter periods sewage flows decrease, but effluent is discharged to a dry wash due to a decrease in the rates of evaporation. Effluent discharged to the dry wash flows southward into the Willcox Playa and is lost primarily by seepage.

Sewage flows are estimated near 225,000 gallons per day in the summer months and 200,000 gallons per day during the winter months. These flow rates indicate a lagoon surface loading of about 36 pounds of Biochemical Oxygen Demand (BOD) per acre.

Future Needs.

Several main collector lines of six-inch diameter are located in the collection system. It is reported that these mains have a very low slope which results in poor flow characteristics. Because of the mains' size, blockages can occur. A recently completed engineering study for the system recommends the replacement of the smaller lines with larger diameter pipe. The installation of these larger lines should be accomplished within the next five years.

Projected sewage flows expected in future years are presented in TABLE III-10.

TABLE III-10

PROJECTED AVERAGE DAILY AND YEARLY SEWAGE FLOWS FOR WILLCOX IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet per Year
Summer	230,360		281,970		415,600		
HIGH		155		188		277	
Winter	105,000		143,000		246,000		
Summer	219,400		255,600		341,600		
MEDIAN		147		170		228	
Winter	100,000		129,600		202,000		
Summer	208,700		231,500		280,000		
LOW		140		155		187	
Winter	95,000		117,000		166,000		

Source: Staff estimates.

The high projection level for sewage flows in 1990 indicates a possible organic surface loading on the lagoons of approximately 58 pounds of BOD per acre. The Arizona State Department of Health recommends a maximum surface loading of 50 pounds of BOD per acre. If Willcox grows according to the high rate of projection, a need for expanded waste treatment facilities would be needed by 1985.

As the Willcox area is based on an agricultural economy, the consideration of using treated effluent as a water resource for irrigation

could be advantageous to the community. Wastewaters produced in the community are of low salt content and as a consequence would make an ideal water for irrigation of forage crops.

SOLID WASTE DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

Community services include biweekly residential and once daily commercial garbage pickup. Trash is picked up once weekly. Collected wastes are disposed of in the city dump located about one mile east of the city limits (PLATE 3).

Burning of accumulated waste materials at the dumpsite has been eliminated as much as possible with the cut and cover technique used for disposal. Operational and maintenance costs for the facility are absorbed by the city.

Future Needs

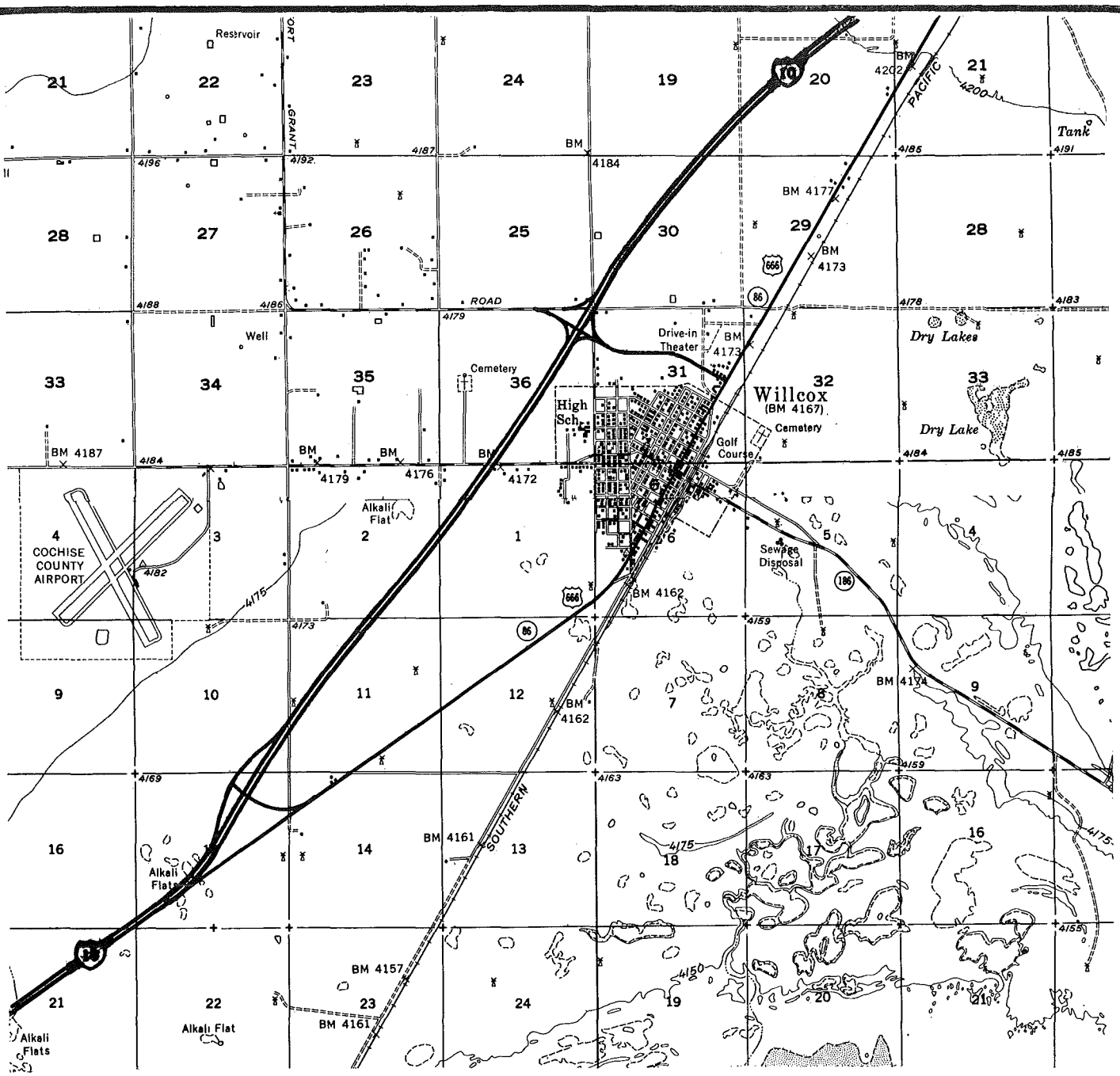
The present site is adequate for present needs although additional land should be acquired to allow for future demands. Estimated yearly solid waste production levels for the community are found in TABLE III-11.

TABLE III-11

PROJECTED SOLID WASTES PRODUCTION LEVELS FOR WILLCOX IN 1975, 1980 AND 1990
(Tons Per Year)

	Production Levels		
Year	Low	Median	High
1975	2,440	2,565	2,693
1980	2,836	3,130	3,454
1990	3,684	4,492	5,465

Source: Staff calculations.



SOURCE: U.S. Dept. of the Interior, Geological Survey, 1958

SCALE—MILES

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

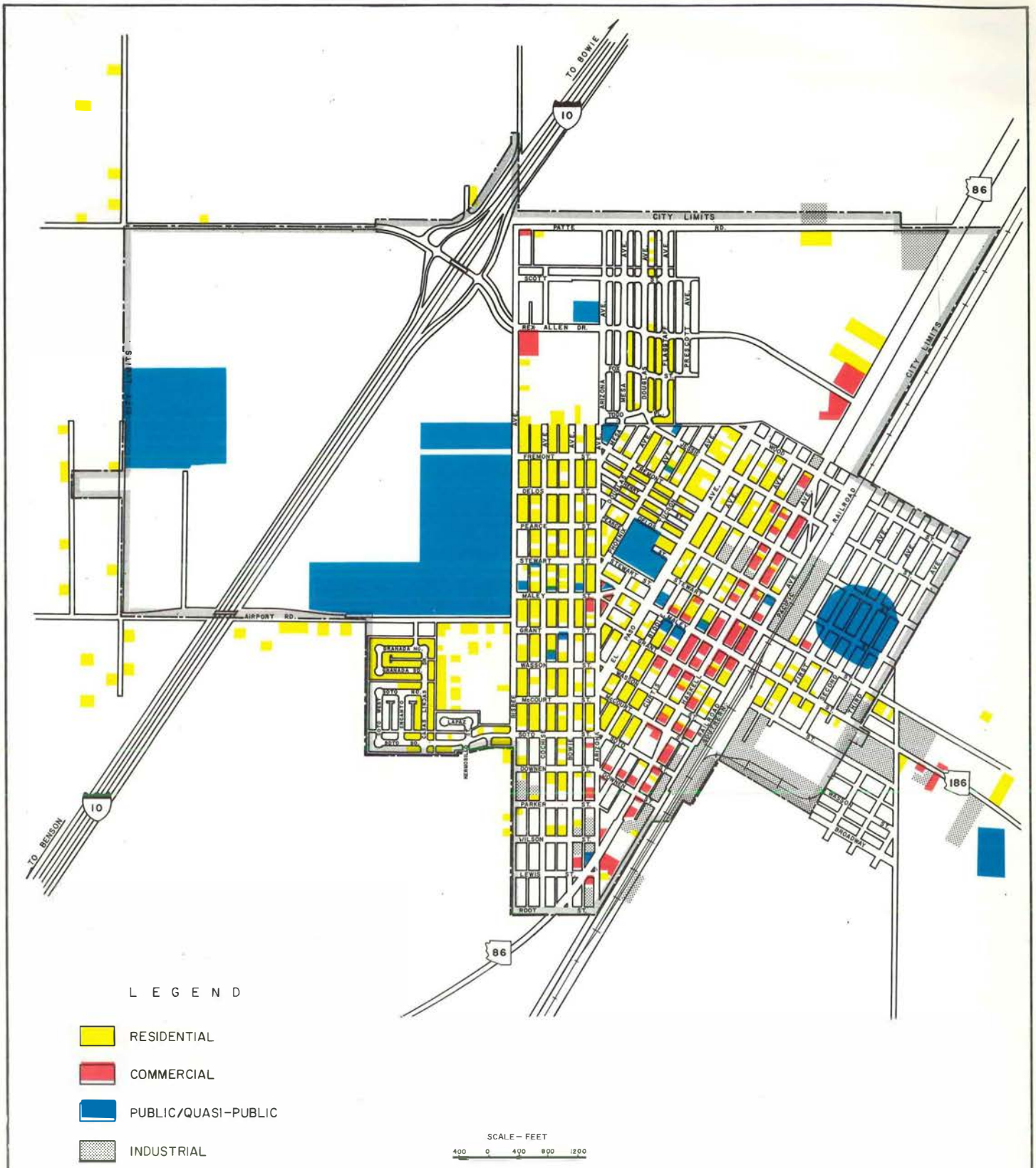
PREPARED BY

DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

WILLCOX, ARIZONA TOPOGRAPHIC FEATURES

N

PLATE 8



L E G E N D

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL

SCALE – FEET

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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WILLCOX, ARIZONA

LAND USE

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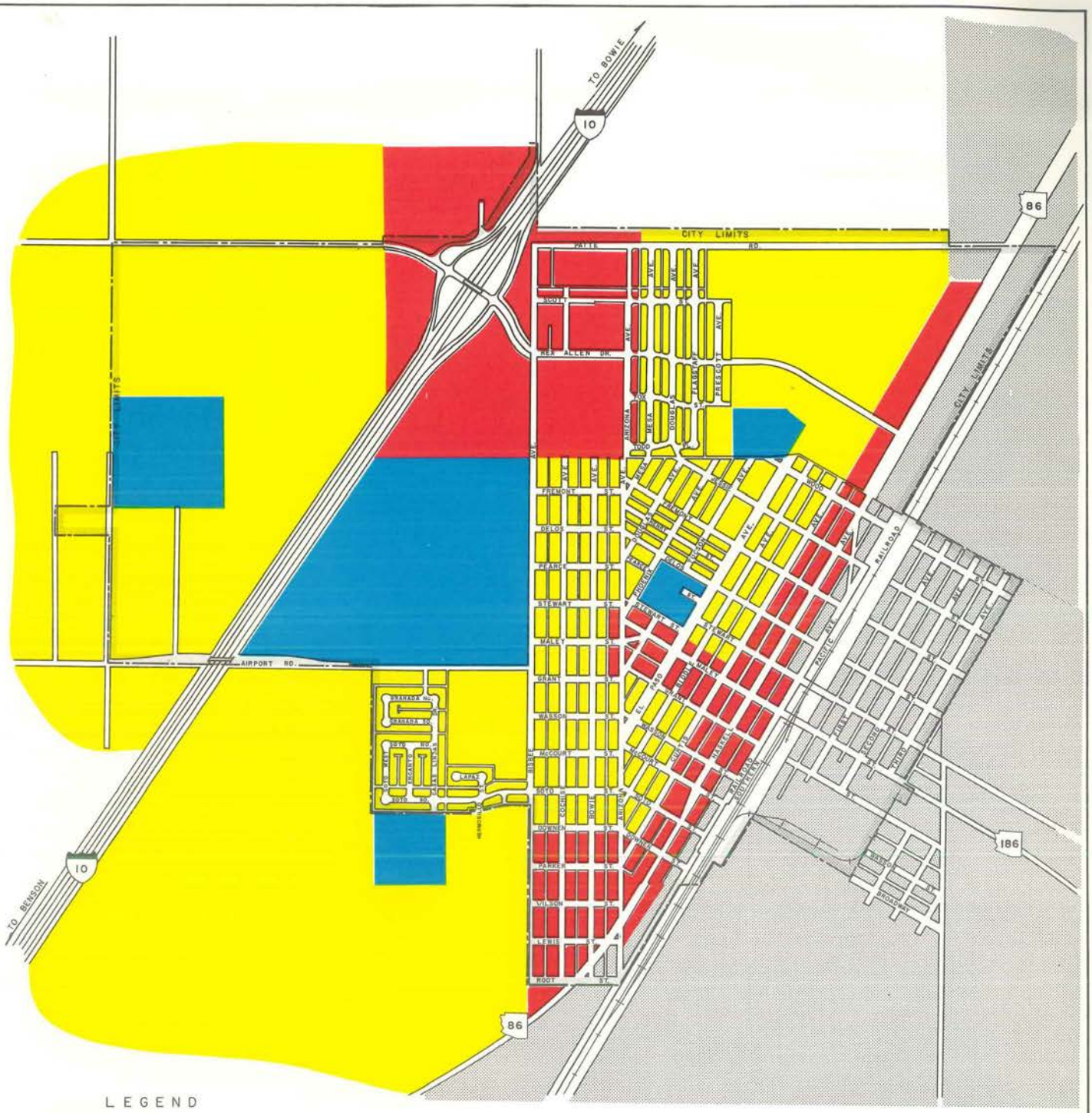
PLATE 9



LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL

SCALE—FEET

400 0 400 800 1200

SOURCE: 701 Comprehensive Plan by I. Dale Despain & Associates

COCHISE COUNTY

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WILLCOX, ARIZONA

PROJECTED LAND USE

N

PLATE 10

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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WILLCOX, ARIZONA WATER SYSTEM

PLATE II

LEGEND

10" LINE
8" LINE
6" LINE
LIFT STATION
TREATMENT POND

SCALE – FEET
400 0 400 800 1200

COCHISE COUNTY

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WILLCOX, ARIZONA SEWER SYSTEM

N

PLATE 12

COMMUNITY OF BENSON

HISTORICAL BACKGROUND

Benson is a small community located in western Cochise County near the San Pedro River. It received its name from Judge William Benson, who spent many years and was well known in the mining regions of the west. The town was founded in 1880 when the Southern Pacific Railroad came through Southern Arizona. Benson became a rail shipping point for Tombstone to the south and was incorporated in 1926.

PHYSICAL CHARACTERISTICS

The community is located on a plain (elevation 3,685 feet above sea level), within the San Pedro River Basin watershed. To the southwest of the area are the Whetstone Mountains with elevations rising in excess of 7,000 feet. Eastward are the Dragoon Mountains where elevations again exceed 7,000 feet. From these mountains extensive alluvial deposits have been generated which are evidenced in the valley where Benson is situated. The valley is roughly three miles in width with the edge marked by steep irregular escarpments. The Benson area is generally flat to rolling in topographic character (PLATE 13). Drainage channels traverse the area generally perpendicular to the San Pedro River. The intermittent washes usually are parallel to each other and mostly shallow in depth.

Surface soils, as noted before, are alluvial in nature, consisting of water-worn gravel and finer soil particles placed over lake sediments. Alluvial deposits in the area are mostly shallow in depth in proximity to the San Pedro River, however, their depth increases moving toward the mountains. Contained within the alluvial deposits are soil pockets with high clay content which shrink or swell depending on moisture content. These deposits are not compatible with septic tank sewage disposal facilities due to slow rates of percolation. Natural vegetation commonly associated with these soils consist of mesquite, salt bush (along the San Pedro River) and creosote bush on the valley floor.

SOCIO-ECONOMIC PROFILE

Within the town of Benson, retail trade and services are the main sources of employment. Its location at the intersection of Interstate 10 and U.S. Highway 80 makes it an opportune stopping place for travelers to and from other parts of the state. As a result there are many gas

stations, restaurants and motels. In addition, the residents of St. David and Pomerene use Benson as a shopping center.

El Paso Natural Gas has a turbine station located on the outskirts of town. It employs about fifty people and is one of the largest single employers in the area. The largest employer is the Apache Powder Company, located eight miles south of Benson at Curtiss. It has about 265 workers and produces products such as blasting powder, ammonium nitrate, sulfuric acid and anhydrous ammonia. Aside from this there is no significant manufacturing activity in Benson. State and local government employs a large number of people in the community. Most of these workers are affiliated with the school system.

The biggest development potential for Benson appears to lie in the manufacturing area. Retail trade and services are already well developed. A freeway bypass is presently under construction similar to the one at Willcox. While the long-run effect of this on Benson's economy is uncertain, initially it will probably have a dampening effect on new retail trade and services. Whether or not the population will expand in the next two decades will depend in part on the communities ability to adjust to the construction of the bypass and its ability to attract manufacturers into the area.

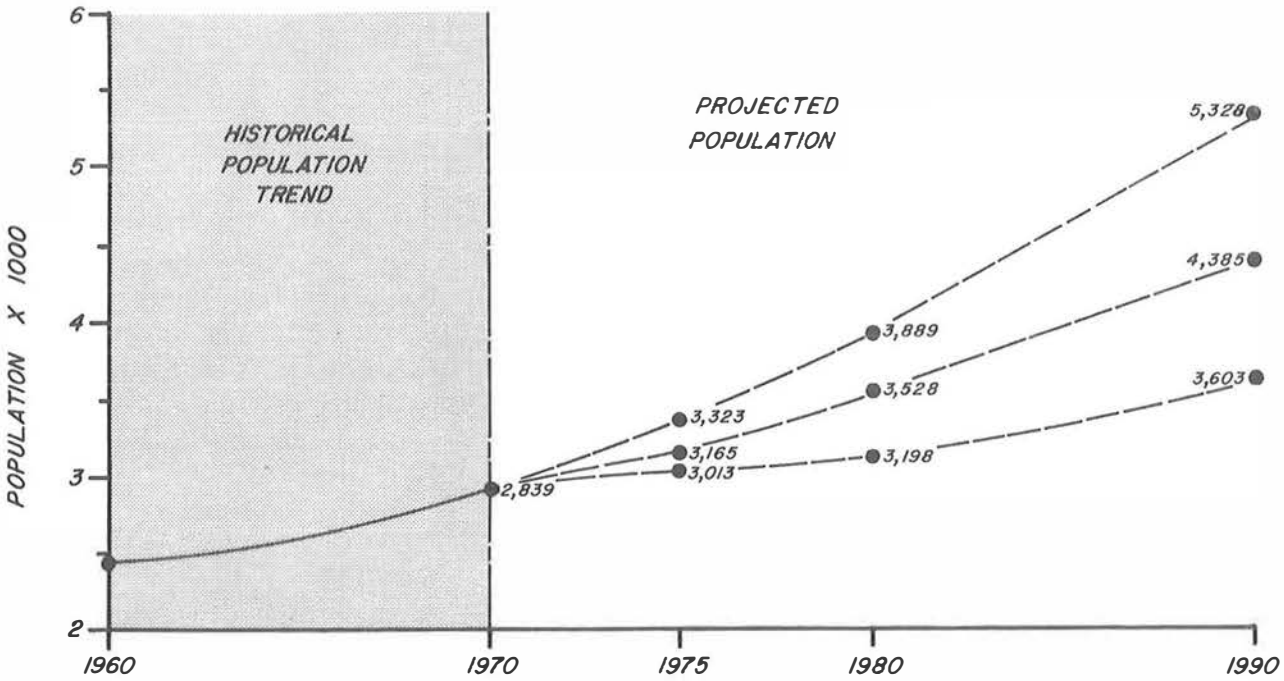


FIGURE III-3, POPULATION OF BENSON AND PROJECTIONS TO 1990

The population projections are based on these considerations. It is assumed that Benson will adjust and the population will expand. FIGURE III-3 shows low, median and high projections through 1990. If Benson continues to grow at the same rate of growth that it averaged in 1960 through 1970, then a population of 4,385 is projected for 1990. This is the median and most probable rate of growth. A low projection of 3,603 by 1990 and a high projection of 5,328 complete the range of population projections.

LAND USE

Present Land Use Patterns

Initial development in Benson occurred along Fourth Street, between Patagonia and San Pedro Streets. The town was originally dependent upon the railroad, but as the railroad declined the town became more dependent upon U.S. 80. The direction of growth was east and west from the original townsite, with the commercial uses locating along the highway.

Commercial land uses account for 8.25 percent of the developed land in 1970 (TABLE III-12). This land use classification includes all retail sales and service establishments, motels and hotels. As shown on PLATE 14, the highest concentration of commercial uses is still along U.S. 80, between Land Avenue and Gila Street with a second parallel district along Fifth Street between Patagonia and San Pedro Streets. Small concentrations of commercial uses occur in scattered patterns both east and west of the original commercial district.

Residential land uses account for 42.86 percent of the developed land area, making it the largest category (TABLE III-12). The residential uses in Benson are characterized by their large variations in structure, size and condition of the units. The units are predominately single family units.

TABLE III-12

BENSON LAND USE ACREAGE - 1970

Classification	Land Use (acres)	Percent Of Total
Residential	205.2	42.86
Commercial	39.5	8.25
Industrial	44.1	9.21
Public and Quasi-Public	190.0	39.68
TOTAL	478.8	100.0

Source: General Development Plan for Benson and the Dept. of Economic Planning and Development.

The housing study conducted by Ferguson and Associates in 1970 revealed that 15 percent or 150 units were deteriorating and that six percent or 59 units were completely delapidated. Most of these substandard units are located around Fifth Street and Caterina and are within the original town area.

Industrial land uses utilize more acreage than do the commercial uses. This is a deceiving fact in that most of the land classified as industrial is used by the El Paso Natural Gas Company for a pumping facility north of the commerce district. Most of the land is used for either storage or has been left vacant as a safety zone. Small amounts of industrially classified land are found throughout the city but most of these are either small light industrial shops, i.e., garages, welding shops, etc., or open equipment storage yards.

The second largest land use classification is the public and quasi-public uses. This category identifies various land uses of a general public welfare nature, i.e., schools and playgrounds. The town of Benson has several large park areas and schools which account for most of this category and gives the town a comparably larger public and quasi-public land area than similar sized communities.

Projected Land Use Patterns

The town has adopted the neighborhood concept of planning for their future development. Normally, this concept uses the elementary school and its related recreation facilities as the focal point of the neighborhood. Surrounding the school are the residential areas utilizing various forms and densities of housing. Commercial uses are located so that they are convenient to several of the neighborhood units. The development plan is presented in PLATE 15.

Commercial land uses are expected to continue to concentrate along U.S. 80 and 86. These highways will still serve as the main accesses to the town from the Interstate 10 bypass. Several small clusters of commercial uses have been proposed in the "1990 Development Plan" as part of the neighborhood plans. These shopping centers will probably be convenience stores with the major purchases still being made either in "downtown" Benson or Tucson. The "downtown" area is the commercial area between U.S. 80 and Fifth and between Patagonia and San Pedro Streets. A large expansion of industrial land uses is not foreseeable at this time. As the town grows, more light industry and heavy commercial uses will develop.

The area adjoining the exit from I-10 at Ocotillo Road will be attractive for the location of tourist-oriented commercial establishments and can be expected to develop rapidly after the bypass is opened.

The town has sufficient open space and public land for the present population. The "Development Plan" calls for additional public land to be acquired as the community grows. The area adjacent to the San Pedro River should be considered a prime site for open space and recreational development. This would provide a regional park and would prevent building encroachment upon the flood plain.

The future development pattern of Benson is expected to follow the past trend of being slow yet steady. The economic base of the community is not expected to change significantly, even with the construction of the I-10 bypass. The addition of the Intelligence School to Fort Huachuca and the increasing popularity of Cochise County with the retired will provide the steady population growth providing the stimulus for steady physical growth.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

Water Supply. The existing water supply system for Benson is drawn from the San Pedro Basin through a series of four wells. These wells are all approximately 1,300 feet in depth and have delivery capacities ranging from 250 - 300 gallons per minute. All wells are cased and have pump ratings ranging from 20 to 30 horsepower. Water quality for the supply is presented in TABLE III-13.

TABLE III-13

REPRESENTATIVE WATER QUALITY DATA
FOR BENSON WATER SUPPLY

Chemical Parameter	Parameter Concentration (mg/liter)
Total Dissolved Solids (TDS)	247.0
Total Hardness	114.0
Calcium	31.0
Magnesium	9.0
Sodium	43.0
Alkalinity (Total)	200.0
Chlorides	4.0
Fluorides	1.3
Nitrates	2.0
Sulphates	7.0

Source: Ariz. State Dept. of Health.

Bacteriological quality of the supply has been good although the system does not have facilities for emergency chlorination of the supply. The good bacteriological quality possibly stems from the fact that the wells are exceptionally deep and well-constructed.

Water Distribution System. Water leaving the wells enters the distribution network directly (PLATE 16. The network contains two elevated storage tanks, two booster pumps and one pressure tank. Water storage totals 365,000 gallons which floats on the distribution network.

The distribution network contains approximately 880 service connections which are not classified by type of consumer. Water service rates are based on a monthly service fee of $4.12 which includes the first 7,500 gallons. Gallonage in excess of the first 7,500 to 17,500 is billed at $.20/1,000 gallons and above 17,500 at $.15/1,000 gallons. These fees are independent of meter sizes.

Water Usage. The community keeps no record of cumulative water usage for the distribution system. Wells are, at present, unmetered as to output and there is apparently no concern on the part of city officials for keeping such information available. Revenues from the water collection are noted in TABLE III-14.

TABLE III-14

ANNUAL WATER REVENUES FOR BENSON
1965-1970

Year	Revenue	Estimated Population	Estimated Revenue/Capita
1965	$29,911	2,659	$11.24
1966	30,914	2,692	11.48
1967	33,424	2,726	12.26
1968	36,300	2,760	13.15
1969	36,796	2,793	13.17
1970	40,747	2,839	14.35

Source: City of Benson

Cumulative records of daily, monthly and yearly water demands are essential in determination of delivery efficiencies and comparison of revenues and expenses as a function of water delivered. Data of this nature is invaluable for the planning of future needs. Using the estimated per capita revenue data in TABLE III-14 along with the past water service

fees, estimated per capita and yearly water use figures were calculated as indicated in TABLE III-15

TABLE III-15

ESTIMATED WATER USE DATA FOR BENSON, 1965-1970

Year	Per Capita Yearly Use (gal./cap)	Average Daily Use (gal./day)	Per Capita Daily Use
1965	58,300	424,700	160
1966	59,900	441,800	164
1967	65,100	486,200	178
1968	71,030	537,100	195
1969	71,160	544,800	195
1970	72,360	562,800	198

Source: Staff calculations.

It is estimated that the well system is capable of delivering a minimum of 1,440,000 gallons of water per day. For the 1970 population of 2,839 this would amount to 507 gallons per capita per day.

Future Needs

The need for expansion and/or modification of the water supply system will be minimal in future years. The present system of wells appears adequate to meet the high projection level of demands noted in TABLE III-16.

Additions and modifications to the distribution system will, however, be in order. The extending looping of water mains will be necessary in the area of development noted in PLATE 15. Additional water storage facilities will also be required, particularly if the high rate of population growth is followed. An adequate storage capacity within a distribution system is by present-day standards about three to four times the average daily demand.

Community leaders should consider planning for at least one new well within the next ten years and the development of additional storage capacity in the next five years.

TABLE III-16

PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR BENSON IN 1975, 1980 AND 1990

Projection Level	1975 Gallons/day	1980 Gallons/day	1990 Gallons/day	Acre-feet per Year
Summer	864,000	1,062,000	1,587,700	
HIGH	774	949	1,420	
Winter	518,400	637,800	953,700	
Summer	822,900	963,400	1,306,700	
MEDIAN	737	861	1,169	
Winter	494,000	578,800	784,900	
Summer	783,400	873,000	1,074,000	
LOW	702	781	960	
Winter	470,000	524,500	645,000	

Source: Staff Calculations.

SEWERAGE AND WASTEWATER TREATMENT

The original sewage collection and disposal system serving Benson was constructed in 1948. Additional collection lines and outfall extensions were constructed on a sporadic basis over the years as dictated by urban growth. The sewage treatment capabilities were expanded in 1964 with the construction of a new lagoon facility.

Existing Facilities

The collection network (PLATE 17 is, for the most part, gravity fed. However, two lift stations are utilized for transfer of sewage to the stabilization ponds which have a total estimated surface area of about 8.5 acres. Seasonal problems have occurred in the stabilization ponds as evidenced by the evolution of noxious odors.

Total sewage flow, for the present, into the stabilization ponds has been estimated to range from 320,000 to 456,000 gallons per day for winter and summer, respectively. Effluents from the treatment facilities are used entirely for irrigation purposes. The sewer system is financially maintained through a monthly sewer service fee (TABLE III-17).

TABLE III-17

ANNUAL SEWER SERVICE REVENUES
FOR BENSON, 1965-1970

Year	Annual Revenue	Revenue Per Capita/Yr.*
1965	$ 9,611	$3.61
1966	9,984	3.71
1967	9,997	3.67
1968	10,628	3.85
1969	12,570	4.50
1970	13,020	4.58

Source: City of Benson; and Staff Calculations.

Future Needs

The stabilization ponds are presently undersized for the population served by the system. Using Arizona State Department of Health criteria, the community should be served by stabilization ponds with a combined surface area of 9.7 acres. The odor problems presently occurring in the ponds indicate possible organic overloading. This condition by itself justifies planning for additional sewage treatment facilities in the near future. TABLE III-18 presents projected sewage flows which may be found in the area for the years 1975, 1980 and 1990.

As the areas undergo development, extensions and additions will be necessitated in the collection network as indicated on PLATE 15. The 1990 projections of sewage flow will require approximately 18, 15, or 12 surface acres of ponds for high, median and low levels of population projection noted.

TABLE III-18

PROJECTED AVERAGE DAILY AND YEARLY
SEWAGE FLOWS FOR BENSON IN 1975, 1980 AND 1990

Projection Level	1975 Gallons/day		1980 Gallons/day		1990 Gallons/day		
Summer	562,000		690,000		1,032,000		
HIGH		532		654		977	Acre-feet per Year
Winter	389,000		478,000		715,000		
Summer	535,000		626,210		850,000		
MEDIAN		507		593		805	
Winter	371,000		434,000		589,000		
Summer	509,000		567,000		698,000		
LOW		482		538		661	
Winter	353,000		394,000		484,000		

Source: Staff Calculations.

SOLID WASTE DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

The community presently provides trash and garbage pickup and disposal on a biweekly schedule. Collected wastes are disposed of at the community dumpsite located approximately one mile north of the city limits adjacent to the sewage stabilization pond. Accumulated materials at the dumpsite are controlled by open burning.

The city maintains the dumpsite facility and service equipment through a collection fee. Revenues for the last six years are noted in TABLE III-19.

TABLE III-19

GARBAGE COLLECTION REVENUES FOR BENSON, 1965-1970

Year	Annual Revenue	Annual Revenue Per Capita
1965	$ 9,659	$3.63
1966	10,080	3.74
1967	10,590	3.88
1968	12,124	4.34
1969	12,460	4.46
1970	13,159	4.64

Source: City of Benson

Future Needs

The present method of waste disposal is outmoded in comparison to the standards established nation-wide. Consideration should be given to the conversion of the existing facility to an efficiently operated sanitary landfill.

The community should also consider the relocation of the present site in approximately ten years. As urbanization takes place north of Interstate 10, as indicated in PLATE 15, the present dumpsite area would be better suited for park purposes.

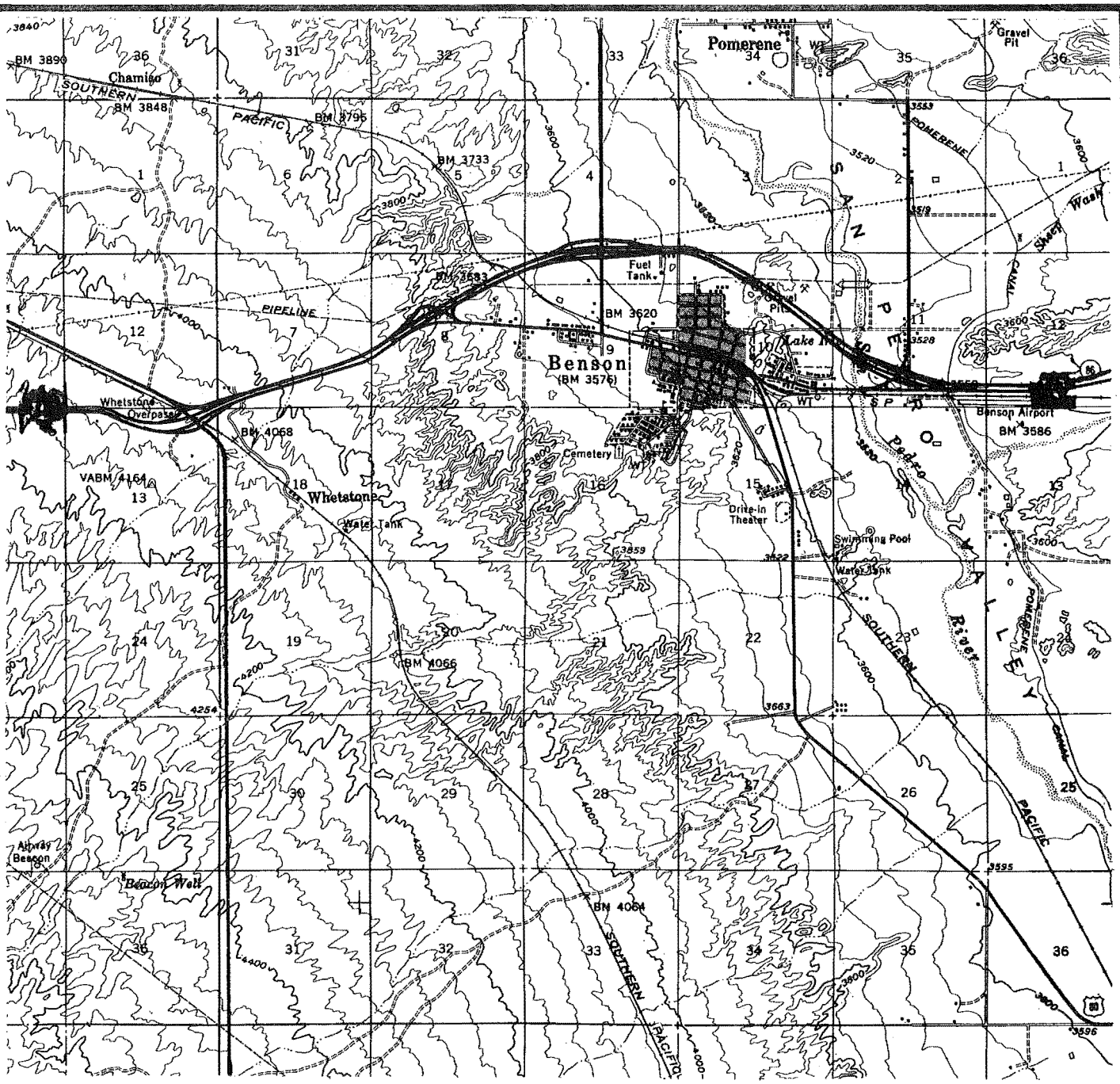
Future solid wastes production levels for the area are noted in TABLE III-20.

TABLE III-20

PROJECTED SOLID WASTES PRODUCTION LEVELS FOR BENSON IN 1975, 1980 AND 1990
(Tons Per Year)

	Production Levels		
Year	Low	Median	High
1975	2,793	2,934	3,080
1980	3,362	3,700	4,088
1990	4,682	5,698	6,923

Source: Staff Calculations.



SOURCE: U.S. Dept. of the Interior, Geological Survey, 1958.

SCALE—MILES

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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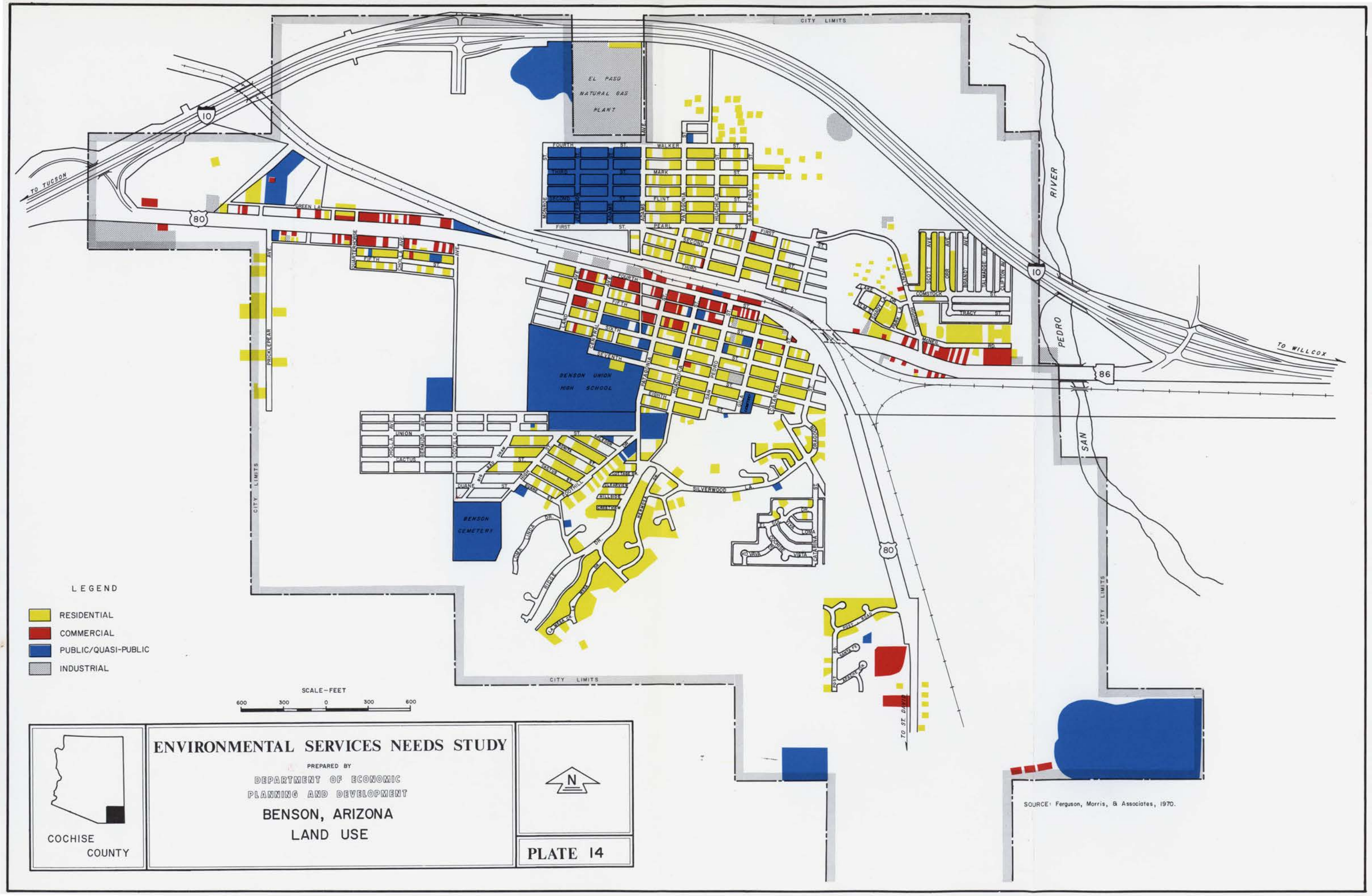
BENSON, ARIZONA

TOPOGRAPHIC FEATURES

N

PLATE 13


CITY LIMITS
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PRICKLEPEAR AVE.
WATERHOUSE
FOURTH ST.
WALKER
THIRD ST.
MARK
SECOND ST.
FLINT
FIRST ST.
PEARL
MONROE
ADAMS
PALOMINA
HUACHUCA
SAN PEDRO
FIRST
SECOND
THIRD
FOURTH
FIFTH
SIXTH
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LAND
CENTRAL
BENSON UNION HIGH SCHOOL
NORTH
GILA
LA TARANTA
UNION
CACTUS
DUANE ST.
BENSON CEMETERY
SILVERWOOD LA.
LOMA LINDA DR.
SILVER
VISTA DR.
COMSTOCK
TRACY ST.
MCNEIL RD.
RIVER
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BENSON, ARIZONA
LAND USE
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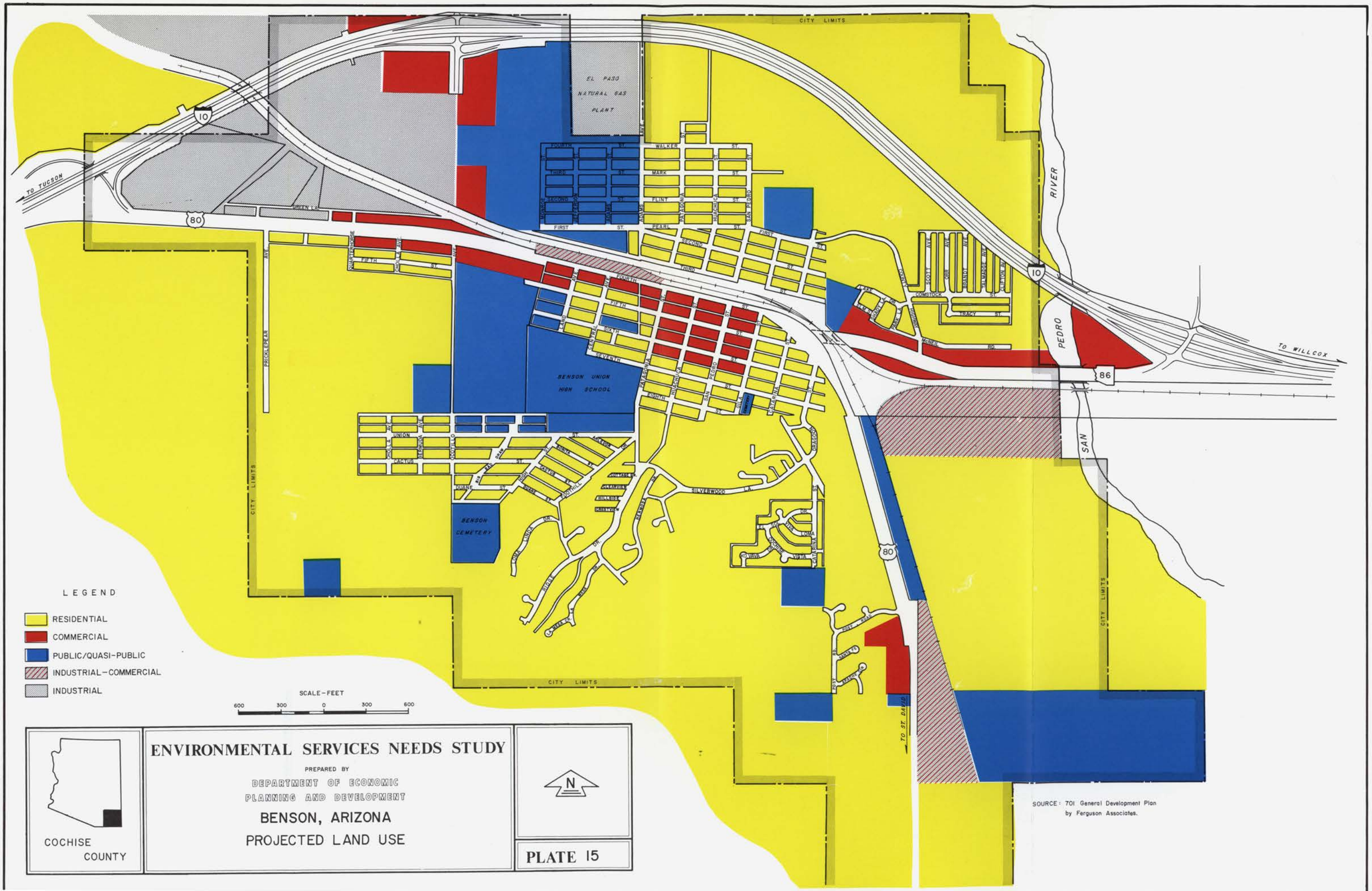
PLATE 14
SOURCE: Ferguson, Morris, & Associates, 1970.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MARK ST.
FLINT ST.
PEARL ST.
PALADONA
HUACHUCA
SAN PEDRO
MONROE
JEFFERSON
ADAMS
ANNIE
CENTRAL AVE.
LAKE AVE.
ALAMO AVE.
ORCHARD AVE.
CHICHILA AVE.
UNION AVE.
BERMUDA AVE.
CACTUS
OCOTILLO
DUANE ST.
SILVERWOOD LA.
BENSON UNION HIGH SCHOOL
BENSON CEMETERY
RIVER
SAN PEDRO
TO WILLCOX
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TRACY ST.
MCNEIL RD.
TO ST. DAVID
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INDUSTRIAL-COMMERCIAL
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BENSON, ARIZONA
PROJECTED LAND USE
N
PLATE 15
SOURCE: 701 General Development Plan by Ferguson Associates.

COCHISE COUNTY

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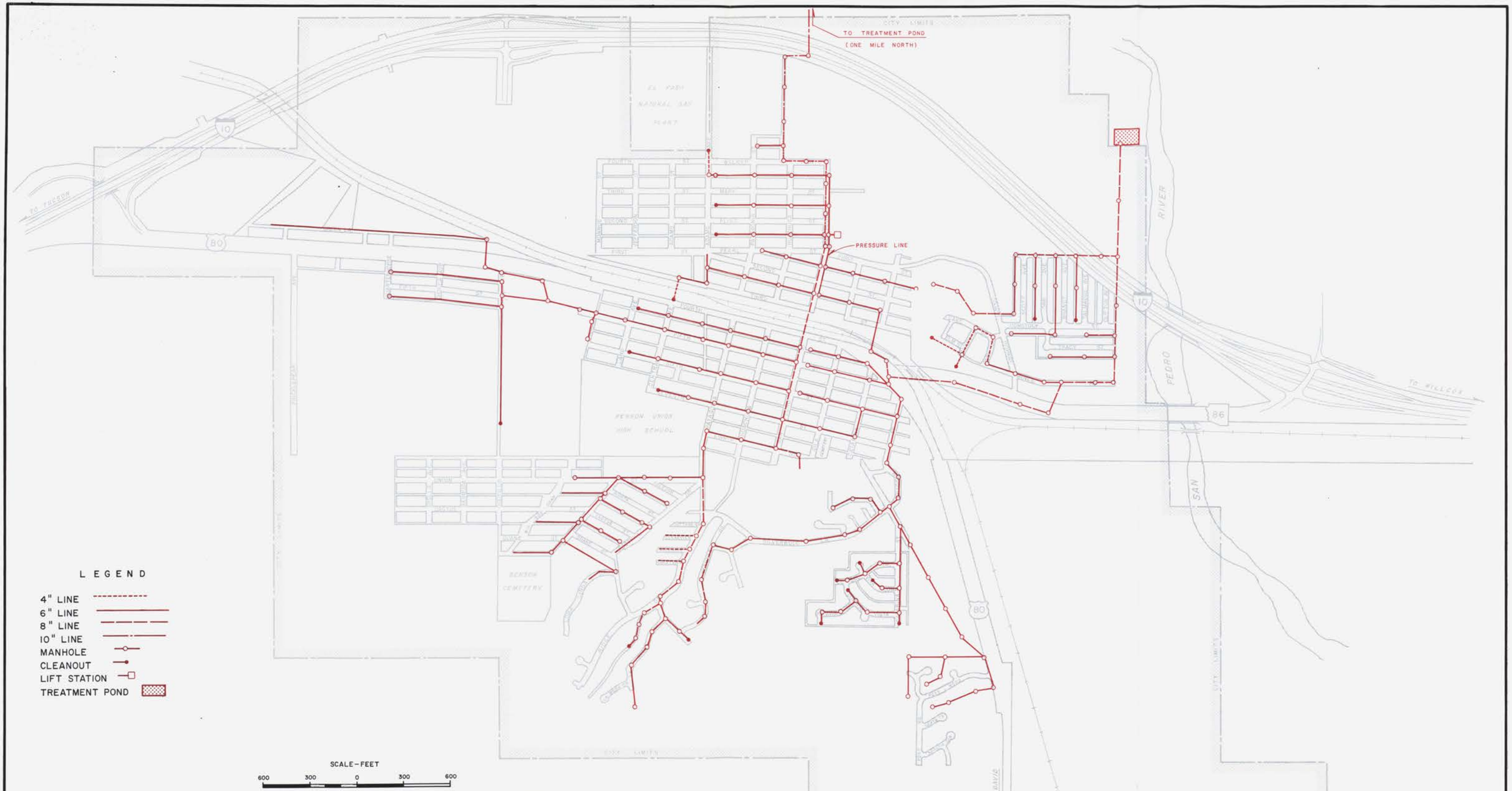
BENSON, ARIZONA

WATER SYSTEM

PLATE 16



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BENSON, ARIZONA

SEWER SYSTEM

PLATE 17

COMMUNITIES OF

SIERRA VISTA AND HUACHUCA CITY

HISTORICAL PROFILES

SIERRA VISTA

Before 1875, cattle ranches were scattered throughout the Santa Cruz, Sonoita and San Pedro Valleys. By 1877, marauding bands of renegade Apaches and Mexican bandidos had become so dangerous that the Sixth Cavalry was dispatched from Camp Grant to locate a center of operations from which the Army could protect the settlers. Hence, in the same year that Ed Schieffelin discovered silver at Tombstone, Camp Huachuca was established in the mouth of Central Canyon at the foot of the Huachuca Mountains.

In 1878, Camp Huachuca was designated a permanent Army post and four years later was renamed Fort Huachuca. Until the Chiricahua Apache insurrection was quelled in 1886, Huachuca troops were constantly engaged in skirmishes of the Southwest's last Indian war.

Conditions in Mexico worsened during the later years of the long Diaz regime and uprisings in Sonora necessitated patrol of the International Border by Huachuca troops. A succession of contests for possession of border towns and customs houses extended intermittently from 1911 to 1915.

In 1911, motivated by its attractive physical surroundings, proximity to the Border, good water supply, and excellent health experience, Fort Huachuca was designated a regimental station. During both World Wars it served as a training center, quartering some 22,000 soldiers and 800 civilians during World War II. In 1947, it was closed as an active post, reactivated for two years during the Korean War, and then closed again.

As the U. S. Cavalry provided a progressively more settled environment, miners, ranchers, farmers and merchants settled near the Fort at the site later to become the City of Sierra Vista. Since 1915, the community has been known successively as Buena, Overton, Garden Canyon, Fry, and finally, Sierra Vista.

In 1954, Fort Huachuca was selected as the permanent site of the Army's Electronic Proving Grounds and a period of intensive construction and development began which continues at the present time. The rush to

Fort Huachuca created an uncoordinated, disorderly and unplanned camptown type of growth, some of which is still evident. The need for supplementary housing and supporting services triggered an explosion of activity in the several unincorporated settlements adjoining the Fort. Sierra Vista's dominance developed rapidly and, in 1956, it was incorporated as a City.

HUACHUCA CITY

The community was incorporated on December 8, 1958. The city limits as established on that date were enlarged with the annexation of Huachuca Vista Annex subdivision on March 10, 1960.

Primary development came about through subdivision land promotions and home construction. Prior to incorporation, this area served as a satellite bedroom community for people working at Fort Huachuca.

PHYSICAL CHARACTERISTICS

SIERRA VISTA

The incorporated area of Sierra Vista is situated on the northeastern slope of the Huachuca Mountains, where elevations generally exceed 7000 feet above sea level. The topography of the townsite is rolling in character with elevations averaging about 4600 feet (PLATE 18). Intermittent stream beds and washes run northeasterly through the area.

Soils are basically alluvial in nature placed over extensive sedimentary deposits of gravel, sand and silt, which are mostly unconsolidated.

Climate for the region is close to ideal for year-round living comfort. Rainfall occurs on an average of only five days during the months of March, April and May and average daily temperatures in April range from a low of 41° to a high of 68° F. Average winter temperatures range from a daily minimum of 33° to a maximum of 61°F.

Annual rainfall averages about 17 inches and is largely divided between winter and summer months, about one-third occurring during December, January and February and the remainder during July and August. Summer rainstorms are brief and very pronounced. Snowfall is scant, reaching a possible maximum of three inches in the month of February.

Vegetation for the region is predominately desert grass (mesquite), which gradually changes to Chapparal and Oak woodlands with the increase in altitude towards the Huachuca Mountains.

HUACHUCA CITY

Topography, soils, climate and vegetation features of the community are practically identical with those of Sierra Vista with the exception of a lower elevation and the proximity of the Babocomari River (PLATE 19.

SOCIO-ECONOMIC PROFILE

For the purposes of population projection, these two communities are treated as one broad economic area within which increased population will distribute itself. The Sierra Vista-Huachuca City area is economically dependent upon Fort Huachuca, which was recently annexed by Sierra Vista. Industry in the area is comprised of convenience food stores, motels, service stations and restaurants to serve the military and civilian personnel employed at the base. The majority of these establishments are in Sierra Vista which has the larger population. Many of the contractors with the base have offices in Sierra Vista. The area is a potential site for industries to locate who do business with the Fort, though at present there is no manufacturing activity in the community. This may be related to earlier uncertainty on the part of the local population as to the permanency of the Fort's operation. Now, however, it is generally accepted that the Fort will be a permanent installation.

Construction work forms a significant part of the area's economy. The Fort has contracted for varied facilities to be built in the past few years. Its demand for housing will increase by approximately 1,.300 units in the next year due to the moving of the Army Intelligence School to the Fort in October 1971. About 200 housing units will be built in the Fort, while the majority of the other units will be in the area immediately outside the Fort.

Besides being a boon to the construction industry, the moving of the Army Intelligence School will increase demand for services in the Sierra Vista-Huachuca City area and thus support increased employment in these establishments.

The expected increase in population from the moving of the Army Intelligence School is reflected in the population projections of Sierra Vista and Huachuca City. FIGURE III-4 shows the growth of these two cities combined. This figure shows the population of Sierra Vista and Huachuca City as 4,451 in 1960. In addition, the 1960 population of the Fort of 10,500 is illustrated. With the annexation of Fort Huachuca in 1971, the population at the Fort became a part of Sierra Vista. This explains the huge jump in the solid line portion of the graph. The increase between 1971 and 1972 is the estimated increase from the addition of the Army Intelligence School. Growth after this point reflects the summation of the individual population projections of Sierra Vista and Huachuca through 1990. A median rate of growth of 5.7 percent per year was used for Sierra Vista, while a median rate of 1.0 percent per year was used for Huachuca City. Low and high rates were also projected. Use of these rates resulted in a median population projection of 29,287 for Sierra Vista and 2,114 for Huachuca City. These individual projections are shown in FIGURE III-4.

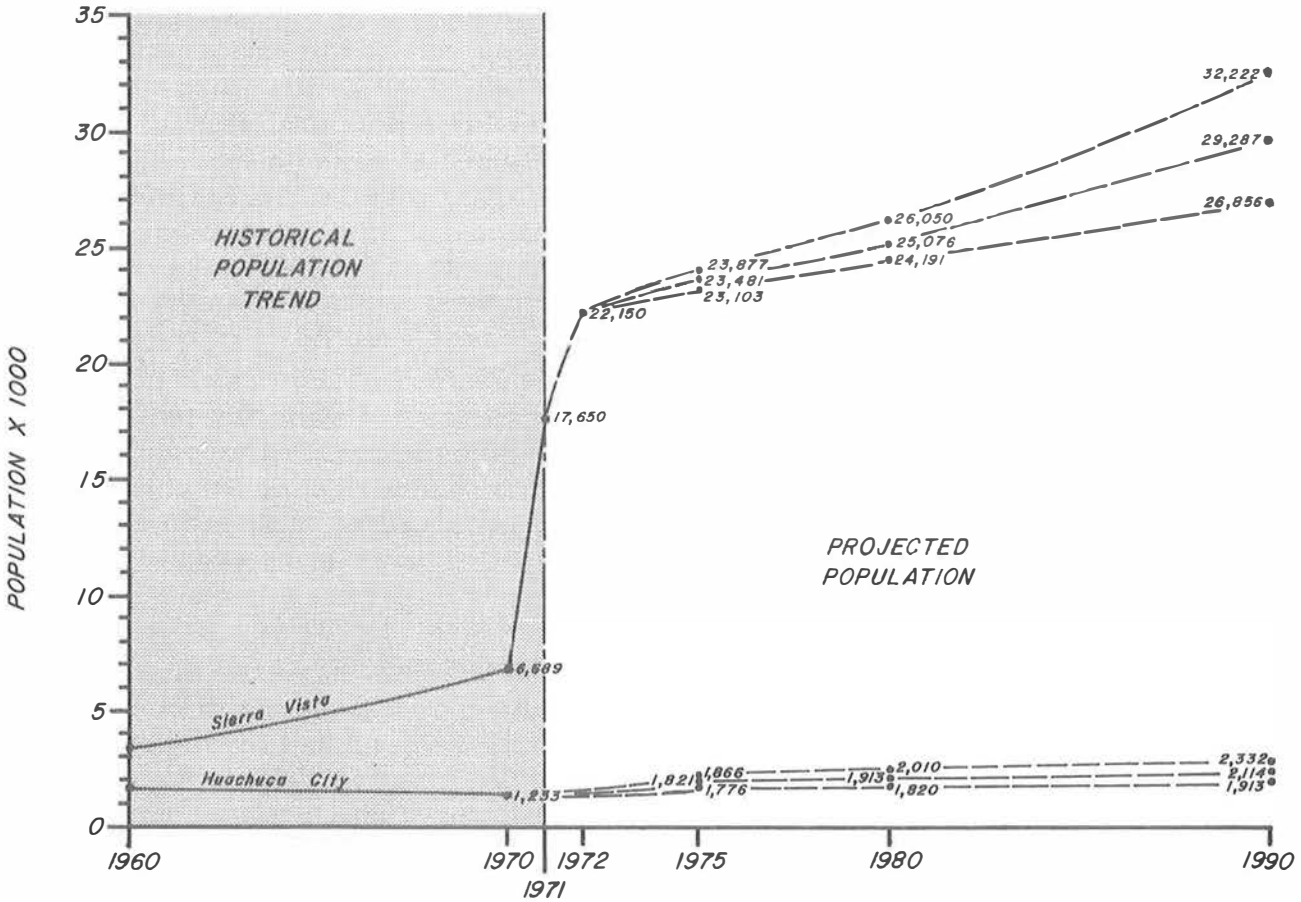


FIGURE III-4, POPULATION OF SIERRA VISTA AND HUACHUCA CITY AND PROJECTIONS TO 1990

LAND USE

SIERRA VISTA - Present Land Use Patterns

The existing pattern of Sierra Vista is the product of rapid growth, wholesale land speculation and the lack of development controls. The lack of land development policies have left the community with scattered residential areas, intermittent strip commercial development, and large open areas of vacant land (PLATE 20). The community has developed along Arizona Highway 92, with the highest concentration of urban land development located immediately east of the main gate to Fort Huachuca.

Residential areas are scattered throughout the community and have a wide variety of structure types and quality of development. Most of the single-family residential areas are homogeneous.

Mobile homes make up 35.6 percent of the total housing supply (TABLE III-21). Many of these mobile home units, especially in the unincorporated area of Fry, have been parked on individual lots among conventional housing units. This practice of mixing mobile homes with conventional housing units has resulted in instability and depreciation of the area. 7/

TABLE III-21

HOUSING UNITS IN THE SIERRA VISTA PLANNING AREA

	Family	Mobile Home	Multi-Family	Total Units
Sierra Vista	1,576	467	220	2,263
Fry	64	427	4	495
Outside of City Limits	24	151	--	175
TOTAL	1,664	1,045	224	2,933

Source: 1970 Housing and Population Report, Department of Economic Planning and Development.

Within the city limits, there are several mobile home parks. The majority of these parks were not designed as mobile home parks and do not offer sufficient area per unit, off-street parking, recreational facilities nor paved streets. These parks do not provide competition in the open housing market, but due to the influx of military and related civilian personnel locating in Sierra Vista and the absence of adequate numbers of conventional housing, mobile homes are serving as a convenient form of quick housing.

Multi-family residential development is substantially behind the market demand, making up only 7.6 percent of the total housing supply. The multi-family development has concentrated in the area north of the railroad right-of-way and west of North Avenue.

Commercial development is concentrated in two areas. The first commercial district is in the form of strip development along Arizona Highway 90. The commercial uses are a mixture of retail stores, service establishments, offices, motels, used car lots and mobile home sales lots.

The area between Wilcox Street and Highway 90 and between Fab Avenue and Seventh Street is being developed into a new commercial district. Several retail chain stores have recently located here and are forming the nucleus for a new central commercial district. There is sufficient area for parking and the entrances are located on collector streets instead of the city's major thoroughfare.

Industrial land uses in Sierra Vista are of the non-manufacturing types, and might be classified as "heavy commercial", i.e., construction material yards welding and machinery repair shops, warehouses and truck terminals. These uses are scattered throughout the northern area and along the railroad right-of-way west of Carmichael Avenue. For the most part, these industrial uses have developed independent of topography and adjacent land uses.

Public and quasi-public uses include the schools, parks, governmental buildings, churches and public services uses. The elementary schools have been located in concentrated areas of residential development. The junior and senior high schools are located on land purchased from the state at the intersection of Highways 90 and 92. Each school is on a forty-acre parcel which should be adequate for future expansion.

The city has a community park and swimming pool immediately east of the junior high school. The city park land was recently purchased from the state while the rodeo field and shooting range north of the high school are on state leased land.

SIERRA VISTA - Projected Land Use Patterns

The population of Sierra Vista is projected to grow during the next twenty years. Population growth will stimulate land development activities in order to provide the necessary housing and needed services. Sierra Vista has traditionally been behind their population with land development activities particularly with regard to public services.

Residential land uses will make up the largest amount of new land development in Sierra Vista during the next twenty years. The predominance of the residential uses is expected to be comprised of single family dwelling units situated on lots with a minimum size of 6,000 square feet.

New urban development activities are expected to concentrate in two areas. The first area is adjacent to the existing development noted on PLATE 21 where growth is projected to occur in northerly, southerly, and easterly directions. The land ownership pattern is the controlling factor in shaping this pattern of growth. The second area of projected land development is south of Sierra Vista along Arizona Route 92. This area is in the initial feasibility and planning stages at the present time.

The community is in need of multi-family housing units. There are a large number of military personnel seeking housing for periods of two years or less. But the community does not have different apartment units to meet the existing demand. This situation should generate additional moderately priced multi-family housing in future years.

Mobile homes will be an important segment of the Sierra Vista housing market. The use of the mobile home as a permanent form of housing will probably continue to increase during the immediate future. The placement of these units and the development of mobile home parks will in large part determine the character of much of the community for many years to come.

The city has zoned most of the land on both sides of Arizona 90 commercial, which will encourage small specialized businesses to continue to locate along this strip. These commercial uses will probably continue to be mixed with the new development taking place on vacant sites away from conflicting uses and unsightly establishments. The strip can be expected to continue to move eastward skipping those tracts which are unsightly or too costly.

New industrial development in Sierra Vista will probably be of the non-manufacturing type. It is expected to continue to be located on scattered sites throughout the northern and central parts of the community and in areas away from existing residential development.

The land uses in the older areas of the city and the Fry area are expected to become increasingly mixed. This means that heavy commercial uses and various forms of housing, i.e., multi-family, single-family and mobile homes, will take over the older buildings and vacant lots in these areas. In many instances conflicting uses may locate adjacent to each other causing possible depreciation of these areas in terms of their value, for both residential and commercial uses.

The new area of land development south of the city limits is in the initial planning stage. Development is expected to consist mostly of residential uses, with some convenience types of commercial establishments centrally located to support the residential uses. The actual development of this area is not expected to be significant for three to five years, with single family units and mobile homes predominating during the initial stages of development.

HUACHUCA CITY - Present Land Use Patterns

The town is located across from the north gate of Fort Huachuca astride State Route 92. The community has developed at the north and south extremes of the city limits with development at the center being inhibited by terrain features and land ownership patterns (PLATE 22). This separate development has created many service and access problems. for the community.

Residential uses constitute over one-third of the developed land area. The residential development on the north side of the community is almost fully completed. The development is composed of various forms of housing units interrupted periodically by nonconforming industrial uses.

Much of the residential development on the southern area of the community is newer than that on the northern area with many of the newer units being financed with the assistance of the Farmers Home Administration.

There are sixty-two units of multi-family housing located primarily in four developments, with several duplex units scattered throughout the residential areas. These multi-family developments are generally located in the southern area of the town.

A new subdivision is under construction in the center section of the town along Skyline Road. This area has been left undeveloped prior to this time due to the terrain and the land ownership of the area. The streets have been graded and the new housing units are under construction.

The second largest land use is public and quasi-public. These areas are used primarily for the general welfare of the community and include city hall, churches and schools. There is a large amount of land in this category, but actual development utilizes only a small fraction of the area. Only 1.5 acres of the 15-acre town hall site are developed, with most of it being held as open space.

The school is conveniently located in the center of the town on a 40-acre site. The site is relatively large for the present school, but most of the land is used as a community park and playground.

Commercial uses are mostly composed of highway-oriented businesses. This is normal for a small town located on a highway, although local shopping facilities are notably lacking because of the proximity to Sierra Vista and the Fort Huachuca shopping facilities. Most of the commercial uses are located along Huachuca Boulevard. There are vacant lots, junk yards, abandoned buildings and open storage yards between these commercial establishments.

The industrial uses indicated on PLATE 22 are either open storage yards, salvage yards or heavy repair facilities, some of which are located in the residential areas.

HUACHUCA CITY - Projected Land Use Patterns

Huachuca City's future development is limited by the Fort Huachuca Military Reservation on the east and south; by the Babocomari Land Grant and river on the north and, to a minor extent, by the topography west of Huachuca Boulevard. The latter restriction is not impregnable in that residential uses could be located there if the lots were of sufficient size and carefully located.

The town has adopted the neighborhood concept in their planning activities. The town's present land use pattern already meets the criteria for this concept of planning and development. The school and city hall are centrally located and, with the addition of accessible north-south streets, this central area could be the focal point of community activity (PLATE 23).

The predominate housing unit is the single family dwelling. This will probably remain the primary form of housing, although for a short period the use of mobile homes will increase as a form of temporary housing until additional multi-family units can be completed.

TABLE III-22 indicates a substantially large increase in the amount of land projected to be utilized for single family residential development. This is due to the fact that the available remaining land is less favorable for development than that which has already been developed, and will require more acreage per housing unit than present residential development.

TABLE III-22

COMPARISON OF EXISTING LAND USE TO PROPOSED LAND USE FOR HUACHUCA CITY PLANNING AREA

	1968		Proposed	
Land Use Category	Acres (Gross)	Percent of Total	Acres (Gross)	Percent of Total
Single Family Residential	45.5	2.42	313.6	16.7
Multi-Family Residential	3.0	.02	6.9	0.4
Mobile Homes	31.0	1.65	27.9	1.5
Open Space Undeveloped Land	1,658.9	88.27	1,128.7	60.1
School	40.0	2.13	51.2	2.7
Recreation & Community Facilities	2.9	.21	15.2	0.8
Community Commercial			8.7	0.5
Highway Commercial	7.6	.45	5.0	0.3
Highway Commercial (Lt. Industrial)	--	--	28.5	1.5
Industrial	4.9	.26	9.4	0.5
Industrial Park	0.0	--	145.1	7.7
Streets	84.5	4.59	138.1	7.3
TOTAL	1,878.3	100.00	1,878.3	100.0

Source: Huachuca City Community Development Plan and the Department of Economic Planning and Development.

Huachuca City has 127.4 acres of land which has been classified as public or quasi-public, which is a significant amount when compared to communities of equal size. This is usually considered an asset to a growing community provided the land is in the desired location and can be used for the desired purposes.

The Huachuca City planning area, as defined by the "Huachuca City Comprehensive Plan," has 84.5 acres dedicated for public rights-of-way, representing approximately 4.6 percent of the total land area. There are 63.2 acres of right-of-way within the city limits, which accounts for 35.6 percent of the city's developed land. This is compared to the national average for small towns of 25 percent of the land used for streets. The excessive amount of land used for streets can be accounted for by the town developing at both ends and having little development between and adjacent to the right-of-way of Arizona 90. The ratio of area utilized for streets to the total amount of developed land will decrease as the center portion of the town becomes developed.

The city proposes to develop the school site into a combination school and community playground. This will make it convenient for the residents of the south side, but a second park is needed in the northern area. The city proposes to develop this park on Mohave Street (PLATE 23).

Commercial land uses have been proposed for two areas. The first area should encourage the expansion of commercial uses between Cochise and State Route 92. These should be more community-oriented types of businesses. The second concentration of commercial uses is planned along Highway 92 on the south side of town. These are to be highway-oriented uses, i.e., motels, restaurants, service stations. Major retail purchases are still expected to be made in either Sierra Vista or in Fort Huachuca.

At the present time there are no industrial plants located in the community. The town has set aside in their community development plan seven acres of land for industrial purposes. This land is not totally committed to industrial use, in that it can be used for residential purposes if it is determined that the land would be better utilized for that cause.

SIERRA VISTA - Existing Facilities

The urban area of Sierra Vista is served by three separate water systems operated by three private water companies. The distribution networks for these systems are shown in PLATE 24.

The largest segment of the urban area is served by Southwest Water Company. The franchised service area involves six sections of land which includes the unincorporated townsite of Fry, the subdivisions of Garden Canyon, Garden Canyon Nos. 2 and 3, Garden Canyon Heights, Garden Canyon Terrace, Montana Homes, El Coronado Heights, Verde Meadows and Whispering Hills. It is estimated that approximately 70 percent of the franchised area is developed. The present distribution network for these subdivisions is capable of serving an estimated 2,000 customers.

Yearly water usage for the system and the number of customers are noted in TABLE III-23. The rapid increase in the number of customers between 1961 and 1963 came about through the consolidation of smaller systems serving individual subdivisions into one major system.

TABLE III-23

YEARLY WATER USAGE AND NUMBER OF CUSTOMERS
FOR SOUTHWEST WATER COMPANY
SIERRA VISTA, ARIZONA

Year	Customers Residential	Customers Commercial	Yearly Water Demand (gallons)
1961	711	58	123,409,700
1962	711	58	--
1963	1,113	136	248,298,500
1964	1,155	156	230,107,300
1965	1,169	161	243,913,738
1966	1,196	163	243,950,140
1967	1,230	163	293,851,200
1968	1,239	163	258,805,300
1969	1,281	175	297,419,400
1970	1,308	225	256,650,000

Source: Arizona Corporation Commission

The supply end of the water system is comprised of a series of six wells ranging in depths from 550 to 700 feet. Total delivery capacity is estimated at 5,010 gallons per minute (7,214,400 gallons per day). Water quality for the system is presented in TABLE III-24

TABLE III-24

REPRESENTATIVE WATER QUALITY DATA FOR
SOUTHWEST WATER COMPANY
SIERRA VISTA, ARIZONA

Chemical Parameter	Concentration milligrams/liter
Total Dissolved Solids	515.0
Total Hardness	110.0
Calcium	19.0
Magnesium	42.0
Alkalinity	188.0
Chlorides	32.0
Fluoride	0.43
Nitrates	32.0
Sulphates	158.0

Source: Arizona State Department of Health.

The distribution network is comprised of 117,208 feet of pipe, 31,005 feet of which is four-inch or over in line size. Although they are not all noted in PLATE 24, the system contains a series of 15 storage tanks with a total capacity of 1,228,000 gallons.

Cochise Enterprises, Inc. - Water Division, owns and operates the water system in Bella Vista Subdivision and other small land developments contained in a franchised area comprising three sections of land. This system is relatively small having approximately 288 customers at the end of 1970 (TABLE III-25).

TABLE III-25

YEARLY WATER USAGE AND NUMBER OF CUSTOMERS FOR COCHISE ENTERPRISES INC., SIERRA VISTA, ARIZONA

Year	Residential	Commercial	Yearly Water Demand (gallons)
1961	49	11	15,103,790
1962	52	11	16,349,424
1963	69	15	19,881,100
1964	78	15	19,200,000
1965	109	15	25,165,310
1966	137	16	25,768,310
1967	146	18	37,600,000
1968	192	20	45,253,000
1969	264	24	60,000,000
1970	280	24	70,000,000

Source: Arizona Corporation Commission.

The distribution network is supplied by a series of three wells. Well depths are: #1-640 ft.; #2-650 ft. and #3-600 ft. Well #1 has a 40 hp submersible pump, while #2 and#3 have 40 hp turbine pumps. Rated delivery capacity is estimated at 750 gallons per minute for all three wells. Water quality data is presented in TABLE III-26.

TABLE III-26

REPRESENTATIVE WATER QUALITY DATA FOR COCHISE ENTERPRISES WATER SYSTEM - SIERRA VISTA, ARIZONA

Chemical Parameter	Concentration milligram/liter
Total Dissolved Solids (TDS)	200.0
Total Hardness	152.0
Calcium	42.0
Magnesium	11.0
Sodium	14.0
Alkalinity (M. O.)	166.0
Chlorides	3.0
Fluoride	0.14
Nitrates	1.0
Sulphates	7.0

Source: Arizona State Department of Health (Tucson).

The distribution network is comprised of 54,024 feet of pipeline of which about 1,000 feet is plastic pipe. Transmission lines amount to 38,024 feet while distribution mains account for 15,000 feet of pipe. The transmission lines contain 8,766 feet of pipe with line sizes of four inches or more. All distribution lines are under four inches in diameter. Included in the distribution network are four storage tanks with a total capacity of 420,000 gallons.

The Arizona Water Company owns and operates the smallest water system in Sierra Vista. The franchised area includes the subdivisions of Village Meadows, Village Meadows No. 2, Village Meadows Estates, Sulger Estates and East Foothills. The commercial area adjacent and south of State Highway 90, the Buena Elementary School and a park and recreation area are also included within the franchise limits.

Water supply for the system is derived from a series of four wells with a total delivery capacity of approximately 700 gpm (1,008,000 gallons per day). TABLE III-27 outlines pertinent well data.

TABLE III-27

WELL DATA - ARIZONA WATER COMPANY
SIERRA VISTA, ARIZONA

	Well Designation			
	#1	#2	#3(Sulger E.)	#4 (Sulger W.)
Depth (ft.)	504	605	310	228
Diameter (in.)	12	16	8	6
Drawdown (ft.)	30	--	--	31
Pump Setting (ft.)	460	500	--	--
Static Water Level (ft.)*	351	375	171	169
Pump Type	Turb	Turb	Subm.	Subm.
Rated Horsepower	50	60	--	3
Rated Delivery Capacity (gpm)	260	370	--	20

*Below Surface.

Source: Arizona Water Company.

All wells are cased to the depths noted in TABLE III-27 and produce water of good quality as noted in TABLE III-28.

TABLE III-28

REPRESENTATIVE WATER QUALITY DATA
ARIZONA WATER COMPANY WATER SUPPLY
SIERRA VISTA, ARIZONA

Chemical Parameter	Concentration milligrams/liter
Total Dissolved Solids (TDS)	190.0
Total Hardness	144.0
Calcium	41.0
Magnesium	10.0
Sodium	10.0
Alkalinity	158.0
Iron	0.3
Chlorides	4.0
Fluoride	0.1
Nitrates	1.0
Sulphates	8.0

Source: Arizona State Department of Health.

The wells pump directly into the distribution network through pressure tanks. The delivery network contains an estimated 52,800 feet of distribution and transmission pipeline, four pressure tanks and one major storage reservoir (steel) with a capacity of 250,000 gallons. Additional water storage is gained in pressure tanks which bring the total storage capacity to 260,000 gallons. The large storage reservoir floats on the distribution network.

Water service connections and average water consumption per customer for the system are noted in TABLE III-29.

TABLE III-29

YEARLY WATER USAGE AND NUMBER OF CUSTOMERS
FOR ARIZONA WATER COMPANY
SIERRA VISTA, ARIZONA

	Customers		Average Yearly Water Use (gallons per year)	
Year	Residential	Commercial	Residential	Commercial
1961	111	5	164,050	194,820
1962	138	7	195,070	231,030
1963	142	7	205,030	344,680
1964	174	6	163,770	468,410
1965	173	12	184,990	439,780
1966	178	13	172,310	318,870
1967	278	17	156,510	460,030
1968	327	20	164,650	787,850
1969	341	19	159,670	719,330
1970	404	21	156,070	690,730

Source: Arizona Water Company.

Suggest As daily
271-5005

The customer data noted in TABLE III-29 are for the month of December for each year indicated. The sharp increase in service connections between 1966 and 1967 resulted from the Strategic Communications Command relocation at Fort Huachuca in that year.

Average per capita water consumption in the 1961-1970 period for Cochise Enterprises, Southwest Water and Arizona Water Companies were found to be 173, 145 and 138 gallons per day, respectively. The demands placed on the Arizona Water Company have been relatively constant over the last ten year period with respect to residential consumption on a per capita basis. However, for commercial uses the demands have more than tripled over the same period of time on an individual user basis. In 1961 individual commercial users utilized an average of 534 gallons of water per day. In 1970, this figure increased to 1,892 gallons per day. The dynamic increase in commercial water use rates is possibly indicative of high use rates, generated by the presence of Fort Huachuca, at laundromats, coin-operated laundries, restaurants, etc. Water service rates for the respective water companies serving Sierra Vista are noted in TABLE III-30.

TABLE III-30

WATER SERVICE RATES FOR
SIERRA VISTA, ARIZONA*

Water Company	Basic Service Fee per minimum gallonage	Cost Above minimum gallonage
Southwest:		
Fry District	$3.86/5,000	$.35/1,000 gal.
Sierra Vista District	$3.94/4,000	$.35/1,000 gal.
Kings Manor District	$6.30/4,000	$.35/1,000 gal.
Whispering Hills District	$6.30/4,000	$.35/1,000 gal.
Arizona:	$5.60/2,000	$.75/1,000 gal.
Cochise Enterprises:	$5.75/4,000	$.70/1,000 gal. (to 10,000 gal.)
		$.50/1,000 gal. (over 10,000 gal.)

*Fees indicated do not include tax.

Source: Arizona Corporation Commission.

The rates for the smaller water systems are understandably higher than those of the larger water system. This situation arises due to higher unit operational and maintenance costs associated with the smaller systems. Reviewing the three systems collectively, it is noted that at the end of 1970 there were a total of 1,992 residential and 269 commercial service connections. Total delivery capabilities for the combined systems is approximately 6,460 gallons per minute or 9,310,000 gallons per day. The Southwest Water Company provided 65 percent of the residential and 83 percent of the commercial service in the community.

SIERRA VISTA - Future Needs

The three individual water systems found in Sierra Vista will undergo very marked expansion during the next five-year period of time. This expansion will be the direct result of expansion of the military training activities and capabilities at Fort Huachuca.

To meet the mandates under which the individual water companies are franchised, each will be required to provide the necessary service, through expansion, to new development. As pointed out in the land use discussion, residential and commercial development will essentially saturate the existing vacant areas noted in PLATE 21.

It is difficult to judge or even recommend the planning goals which private water companies should strive for in future years. Each of the companies discussed appears to have the capability and resources to provide whatever needs arise in the areas of Sierra Vista which they serve.

Future water supply needs for the community on an overall basis are presented in TABLE III-31.

TABLE III-31

PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR SIERRA VISTA IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day	1980 Gallons/day	1990 Gallons/day	Acre-feet per Year
Summer	4,226,000	4,872,000	6,670,000	
HIGH	3,368	3,908	5,339	
Winter	2,125,000	2,580,000	3,834,000	
Summer	4,156,000	4,689,000	6,062,000	
MEDIAN	3,312	3,762	4,853	
Winter	2,090,000	2,483,000	3,485,000	
Summer	4,089,000	4,524,000	5,559,000	
LOW	3,256	3,629	4,450	
Winter	2,056,000	2,395,000	3,196,000	

Source: Staff estimates.

The community has, prior to this study, considered purchase of the water systems serving the area. This position is concurred with and further recommended, as municipal ownership of a water system provides the citizens with certain benefits which make municipal ownership very desirable. The water demands, in the quantities noted in TABLE III-31,

indicate that it is feasible for the municipality to purchase the private water service franchises.

The acquisition of privately owned utilities is more complicated and expensive for the city now, than had it installed a system over the years on its own. However, certain advantages to be gained by the city will make the acquisition of the water systems feasible. The citizenry will be benefited by a larger, fully integrated water system which can bolster the communities fire protection position. In addition, community ownership will provide revenues which may be used as a means to diminish the demands for community operating funds that must be obtained from other sources. One of the most important assets of combined water systems, based on economies of scale, would be the realization of reduction in water service rates.

HUACHUCA CITY - Existing Facilities

The water system serving Huachuca City was acquired from the Artic Water Company in 1968 through a $175,000 bond issue (PLATE 25). Since this purchase, minor expansion and modifications have been carried out by the municipality. A new well was recently installed augmenting the supply end of the system. Presently there are four wells located in the community with one well held in a standby status for emergency purposes. Well data is presented in TABLE III-32. Each well pumps directly into the distribution network through pressure tanks.

TABLE III-32

WELL DATA FOR HUACHUCA CITY WATER SYSTEM

	Well Designation			
	#1	#2	#3	#4
Depth (ft.)	311	316	297	402
Static Water Level (ft.)	197		52	200
Diameter (in.)	12	12	8	12
Type Pump	Subm.	Subm.	Subm.	Turb.
Horsepower	50	50	30	
Capacity (gpm)	326	500		418

Source: Arizona State Dept. of Health, Water Supply Division.

Operating wells in the system are capable of delivering approximately 1,300 gallons per minute (1,870,000 gallons per day). Water quality data for the wells is presented in TABLE III-33.

TABLE III-33

REPRESENTATIVE WATER QUALITY DATA
HUACHUCA CITY WATER SYSTEM

Chemical Parameter	Concentration milligrams/liter
Total Dissolved Solids (TDS)	190.0
Total Hardness	176.0
Calcium	41.0
Magnesium	18.0
Sodium	9.0
Alkalinity (M.O.)	162.0
Chloride	6.0
Fluorides	0.3
Nitrate	8.0
Sulphates	7.0

Source: Arizona State Department of Health
Water Supply Division

TABLE III-34

WATER USAGE IN HUACHUCA CITY
July 1970 - May 1971

	Year	Average Gallons Pumped Daily	Average Daily Per Capita Use
July	1970	193,000	156
August	1970	135,000	109
September	1970	171,000	139
October	1970	142,500	116
November	1970	110,000	89
December	1970	121,000	98
January	1971	129,000	105
February	1971	133,000	108
March	1971	219,000	178
April	1971	225,000	182
May	1971	229,500	186

Source: Huachuca City and Staff Calculations.

The water distribution netowrk serves 405 customers with average total demands reaching approximately 230,000 gallons per day during summer months (TABLE III-34). The distribution network does not contain facilities for emergency chlorination as all operating wells are in excess of 300 feet in depth. A major deficiency of the system is the lack of water storage facilities.

HUACHUCA CITY - Future Needs

An immediate need for the community water system is the development of sufficient water storage capacity for adequate fire protection. A water system by today's standards should have a reserve in storage of three to four times the average daily demands. By 1975 water demands presented in TABLE III-35 indicate a storage need of approximately 1,100,000 gallons.

The present well supply facilities appear adequate to meet the future needs projected for the community.

TABLE III-35

PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR HUACHUCA CITY IN 1975, 1980 AND 1990

Projected Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer	367,600		416,000		529,400		
HIGH		295		333		423	
Winter	183,000		217,000		298,500		
Summer	359,000		396,000		480,000		
MEDIAN		287		317		383	
Winter	178,500		206,600		271,000		
Summer	350,000		376,700		434,300		
LOW		280		302		347	
Winter	174,000		196,600		245,000		

Source: Staff estimates.

SEWERAGE AND WASTEWATER TREATMENT

SIERRA VISTA - Existing Facilities

The community has to date completed the construction of seven sewage collection improvement districts. In 1958, Sewer District No. 1 was organized and the first sewage disposal plant constructed at North Avenue at Cyr Street. Original plant capacity for the district was anticipated to serve all homes in the area. However, construction of homes in surrounding areas overloaded the treatment facility by 1967. The original treatment plant was a modified trickling filter system.

Development of additional improvement districts since 1958 resulted in several small lagoon facilities serving unrelated areas of the community. In 1968 a program was initiated for tying together these small systems into one combined system. This program has been successful with the community now having all collection systems tied together with a single sewage treatment facility located east of the Whispering Hills Subdivision (PLATE 26).

Sewage treatment is carried out by stabilization lagoons made up of cells of approximately six acres surface area loaded in series. Effluent is discharged to an intermittent wash which drains in a northeasterly direction to the San Pedro River. State Health Department records in 1969 indicated the eighteen acres of lagoon provided a relatively high degree of sewage treatment for estimated flows of 300,000 gallons per day.

Sewer system planning and financing is complicated by the fact that existing residential developments are widely scattered. This type of situation makes it very difficult financially to install trunk sewers necessary to provide municipal sewer service to all. As a consequence, individual septic tank systems are used as a means of sanitary waste disposal. Septic tank density has become exceedingly high in some areas of the community, causing saturated soil conditions. Such problems can result in contamination of local ground water supplies and the endangering of public welfare.

SIERRA VISTA - Future Needs

The city has recently entered into a contract with a consulting engineer for the detailed analysis of the existing sewerage and sewage treatment systems, and the preliminary design of needed facilities.

Such a study is definitely needed for the community due to the rapid increase in population through the pending annexation of land to the city along with the population influx generated by increased military activity at Fort Huachuca. Engineering and design of improvements at this time is paramount to the providing of an adequate, dependable and efficient municipal sewage disposal system.

Future sewage flows expected to originate in the community are presented in TABLE III-36. By 1990, 3,460 acre-feet of waste water (high projection) could conceivably be generated which would need a higher degree of treatment prior to disposal or reuse.

TABLE III-36

PROJECTED AVERAGE DAILY AND YEARLY SEWAGE FLOWS FOR SIERRA VISTA IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day	Acre-feet per year	YEAR 1980 Gallons/day	Acre-feet per year	YEAR 1990 Gallons/day	Acre-feet per year
HIGH Summer	2,756,000	2,192	3,178,000	2,537	4,350,000	3,463
HIGH Winter	1,600,000		1,928,000		2,868,000	
MEDIAN Summer	2,700,000	2,156	3,059,000	2,442	3,954,000	3,148
MEDIAN Winter	1,573,000		1,856,000		2,607,000	
LOW Summer	2,657,000	2,121	2,951,000	2,356	3,626,000	2,886
LOW Winter	1,548,000		1,790,000		2,390,000	

Source: Staff Calculations.

HUACHUCA CITY - Existing Facilities

Sewage collection and disposal facilities for the community were constructed in 1968 (PLATE 27). The collection system provides service to all presently occupied property within the city limits. Trunk lines and outfalls are 10 and 12-inch respectively. In total there are 12,450 lineal feet of 12-inch outfall line which terminates at the stabilization lagoon treatment facility.

The wastewater treatment facility is constructed on a 33-acre site obtained from the Federal Government approximately one mile east of the community. The lagoon has approximately two acres of surface area and is reportedly designed for a population of 1,800. Effluent from the facility is disposed of in Babocomari Wash. There are no provisions for flow measurement at the facility and, as a consequence, only estimates of actual sewage flows can be made. Estimated summer and winter sewages flows are 140,000 and 85,000 gallons per day respectively. These flow data would give a very high daily organic surface loading rate on the existing lagoon.

HUACHUCA CITY - Future Needs

Using standard design criteria for sewage stabilization ponds adopted by the Arizona State Department of Health, the community wastewater treatment facility should have a minimum surface area of four acres. Presently the existing lagoons have an estimated surface loadings of 210 to 233 pounds of five-day Biochemical Oxygen Demand per day. Organic loadings of this magnitude on a surface area of two acres will eventually result in odor problems and very low levels of treatment efficiency. Expected future flows will produce operational problems at the present treatment facility (TABLE III-37).

TABLE III-37

PROJECTED AVERAGE DAILY AND YEARLY SEWAGE FLOW FOR HUACHUCA CITY IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet per Year
Summer	239,000		271,400		345,100		
HIGH		192		216		274	
Winter	138,000		162,800		251,900		
Summer	233,000		258,300		312,900		
MEDIAN		188		206		248	
Winter	134,750		155,000		228,300		
Summer	227,000		245,700		283,100		
LOW		183		196		225	
Winter	131,400		147,400		207,000		

Source: Staff Calculations.

Expected population growth in the area will generate overloaded conditions on the existing lagoon facility. It would, therefore, be advantageous for the community to formulate plans for increasing sewage treatment capabilities within the next five-year period. Plans for increasing lagoon sizes could contain a schedule for providing existing undeveloped areas in the community with sewage collection services.

SOLID WASTES DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

Solid wastes collection services are available in Huachuca City and Sierra Vista on bi-weekly schedules. Collection and disposal services in Huachuca City are owned and operated by the municipality. A franchised contractor provides service in Sierra Vista.

Collected solid wastes materials for both areas are disposed of in a sanitary landfill situated in a ravine located north of the school in Huachuca City. The landfill is maintained and operated through an agreement with Huachuca City and a private contractor. Solid waste materials originating at Fort Huachuca also are disposed of at the Huachuca City site in addition to wastes collected by county road crews.

Future Needs

The existing sanitary landfill is reaching capacity due to high-intensity loading schedules. It has been estimated that the facility can operate for nine more months, at which time a new site will be needed. Huachuca City has been attempting to acquire forty acres of federal land for a new sanitary landfill north of the present site. These efforts have been complicated due to leased grazing rights which will not expire until November of 1972.

Future solid wastes production levels for the region are presented in TABLE III-38.

The tonnages noted in TABLE III-38 are assumed to contain solid wastes generated within the boundaries of Fort Huachuca which are transported to the sanitary landfill.

The securing of land for a regional landfill site is necessary for the continuation of adequate and efficient disposal of solid wastes in the

area. It may be advantageous for all legal entities concerned to work together in obtaining a new landfill site for the region.

TABLE III-38

PROJECTED SOLID WASTES PRODUCTION LEVELS
FOR HUACHUCA CITY AND SIERRA VISTA IN
1975, 1980 AND 1990
(Tons Per Year)

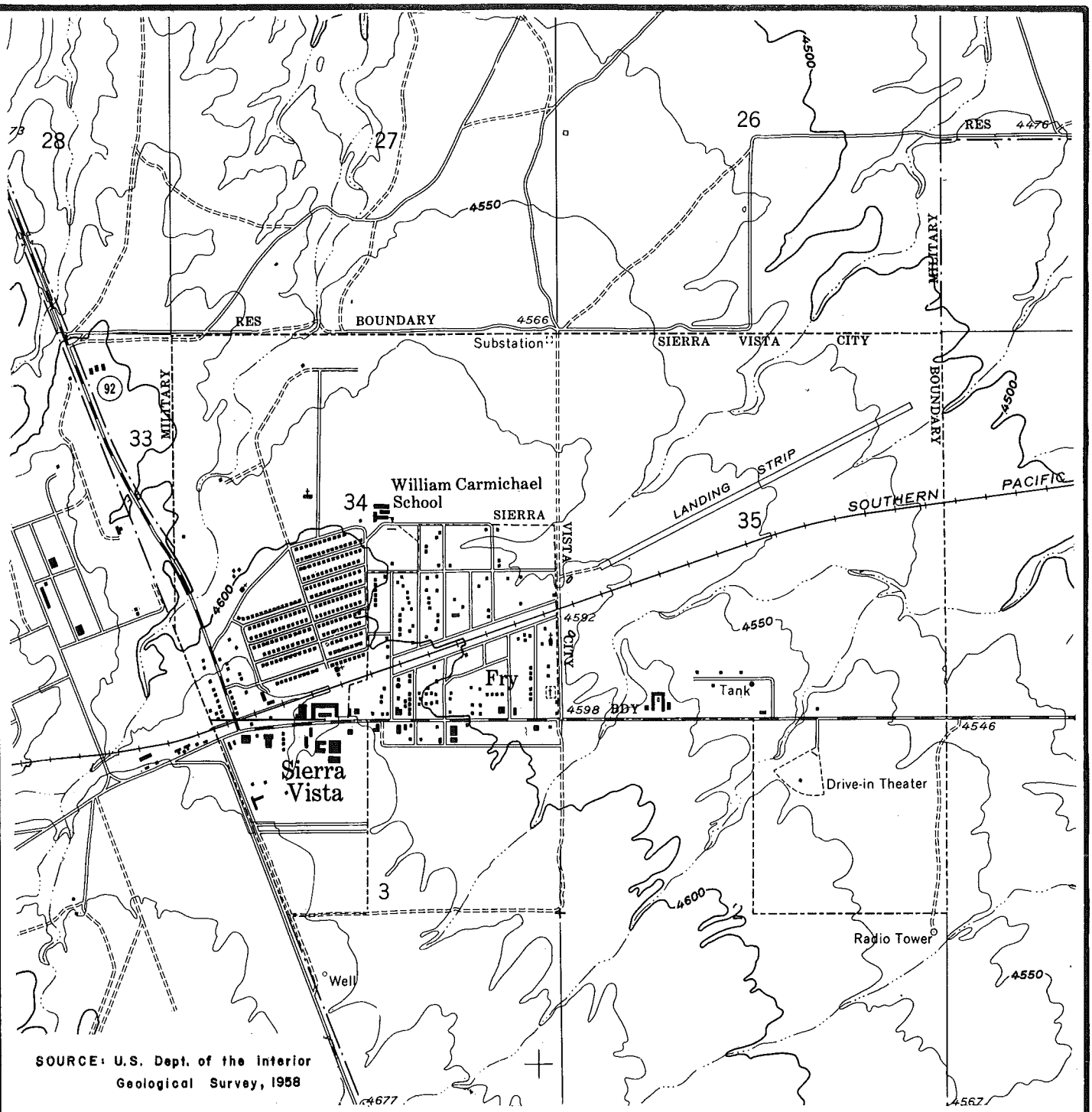
HUACHUCA CITY

	Production Levels		
Year	Low	Median	High
1975	1,646	1,688	1,730
1980	1,913	2,040	2,112
1990	2,486	2,747	3,030

SIERRA VISTA

	Production Levels		
Year	Low	Median	High
1975	21,417	21,766	22,134
1980	25,430	26,360	27,384
1990	34,897	38,055	41,869

Source: Staff Calculations.



SOURCE: U.S. Dept. of the Interior
Geological Survey, 1958

SCALE—FEET

0 1000 2000 3000 4000 5000 6000

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

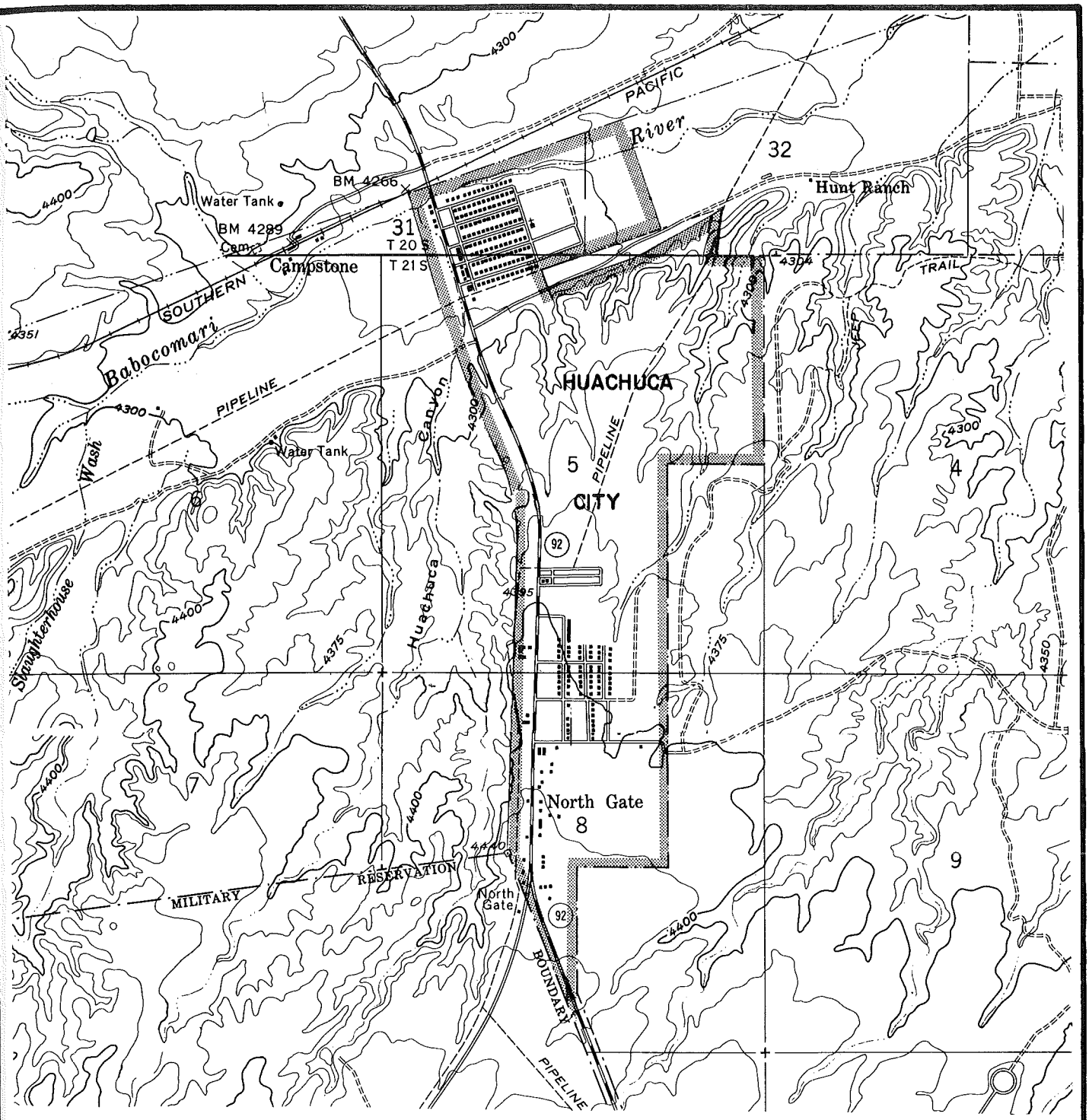
PREPARED BY

DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

SIERRA VISTA, ARIZONA
TOPOGRAPHIC FEATURES

N

PLATE 18



SOURCE: U. S. Dept. of the Interior
Geological Survey, 1958

SCALE — FEET

1000 0 1000 2000 3000 4000 5000

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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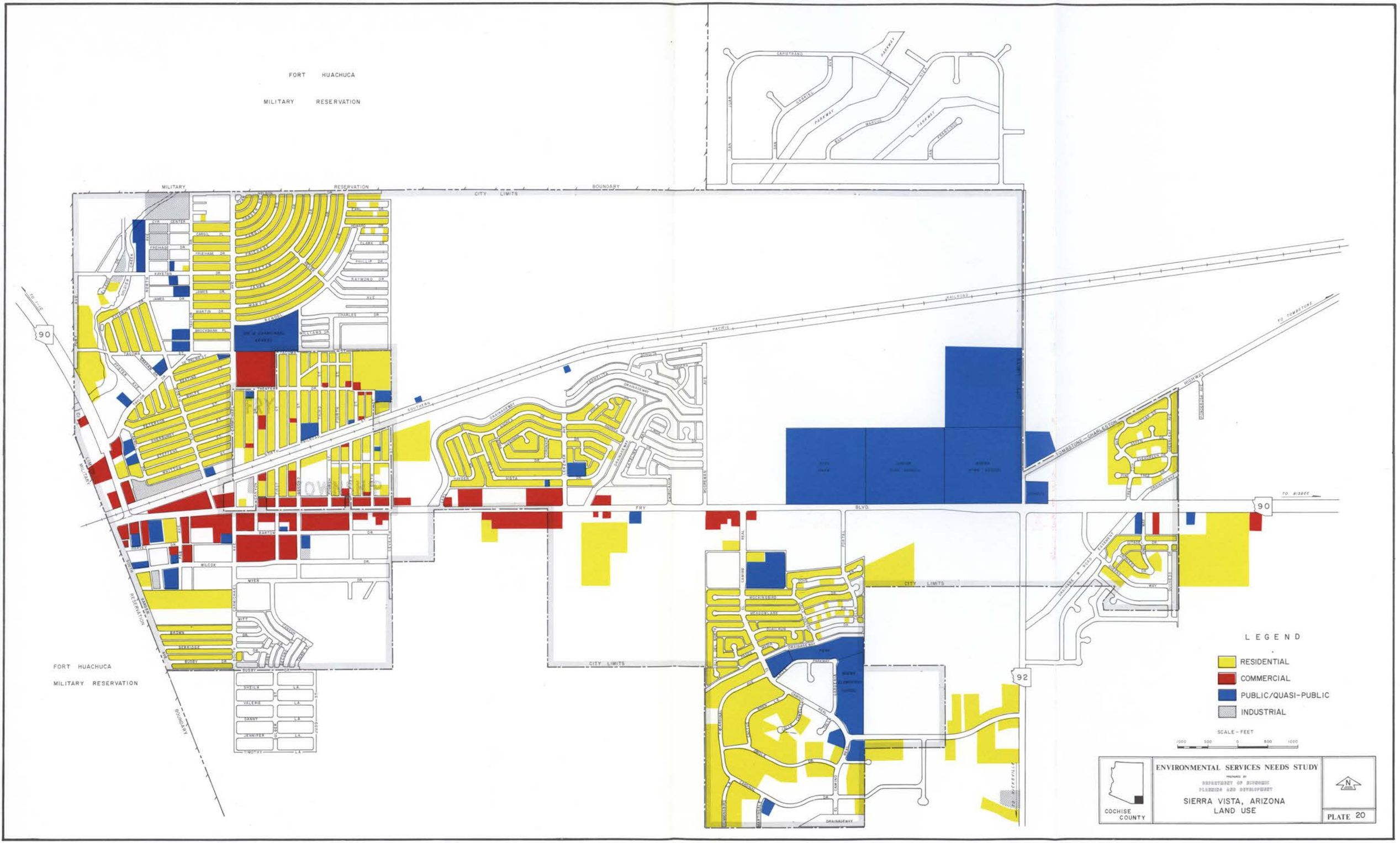
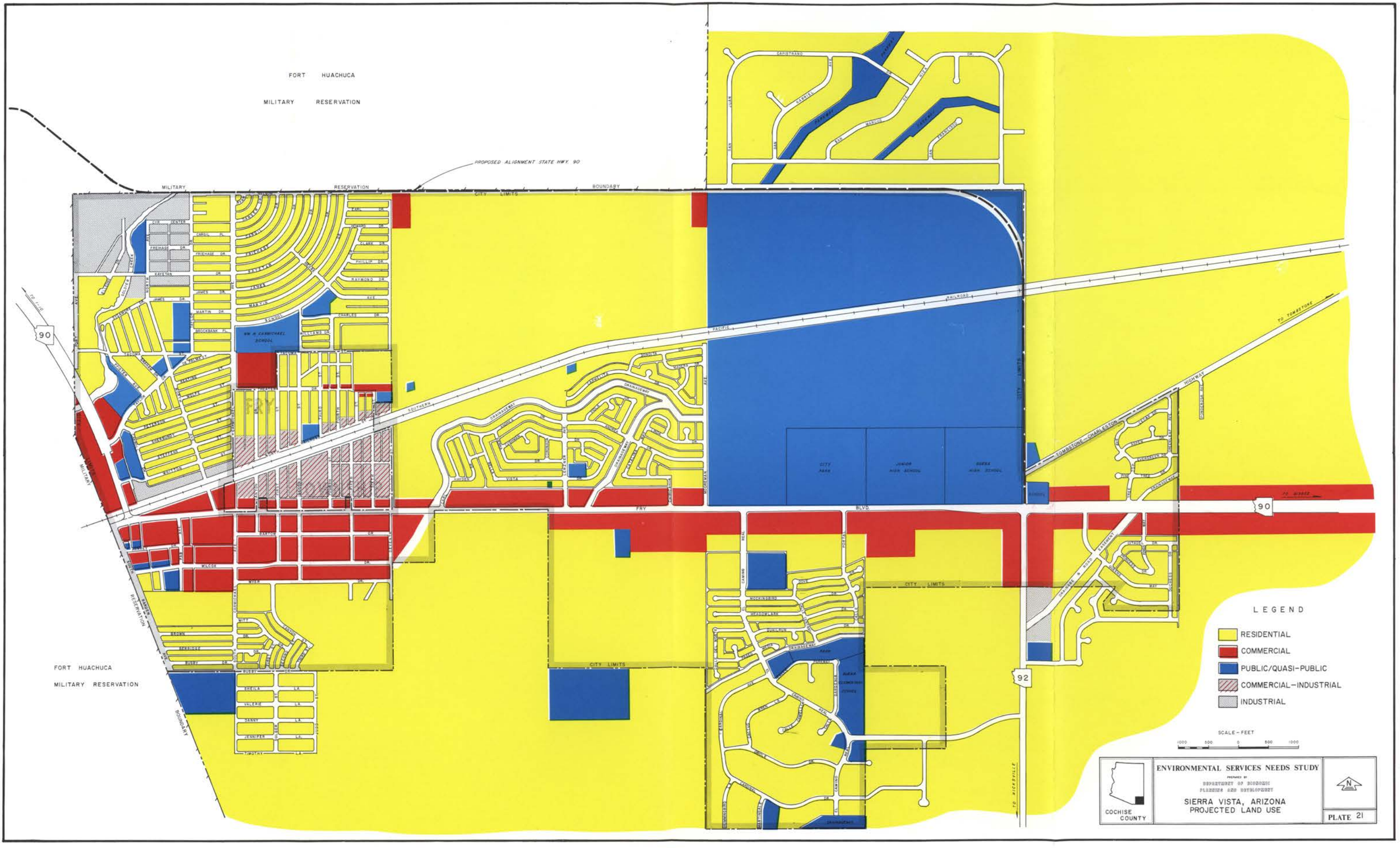
DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

HUACHUCA CITY, ARIZONA TOPOGRAPHIC FEATURES

N

PLATE 19


FORT HUACHUCA
MILITARY RESERVATION
MILITARY RESERVATION BOUNDARY
CITY LIMITS
FRY BLVD.
SOUTHERN PACIFIC RAILROAD
SIERRA VISTA
90
92
TO TOMBSTONE
TO BISBEE
LEGEND
RESIDENTIAL
COMMERCIAL
PUBLIC/QUASI-PUBLIC
INDUSTRIAL
SCALE - FEET
COCHISE COUNTY
ENVIRONMENTAL SERVICES NEEDS STUDY
SIERRA VISTA, ARIZONA
LAND USE
PLATE 20


FORT HUACHUCA
MILITARY RESERVATION
PROPOSED ALIGNMENT STATE HWY. 90
MILITARY RESERVATION BOUNDARY
CITY LIMITS
FRY BLVD.
SOUTHERN PACIFIC RAILROAD
TO TOMBSTONE
TOMBSTONE-CHARLESTON HIGHWAY
TO BISBEE
TO RICKSVILLE
90
92
WM. H. CARMICHAEL SCHOOL
CITY PARK
JUNIOR HIGH SCHOOL
SIERRA HIGH SCHOOL
LEGEND
RESIDENTIAL
COMMERCIAL
PUBLIC/QUASI-PUBLIC
COMMERCIAL-INDUSTRIAL
INDUSTRIAL
SCALE - FEET
1000 500 0 500 1000
COCHISE COUNTY
ENVIRONMENTAL SERVICES NEEDS STUDY
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DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT
SIERRA VISTA, ARIZONA
PROJECTED LAND USE
N
PLATE 21

FORT HUACHUCA

MILITARY RESERVATION

MILITARY RESERVATION BOUNDARY

CITY LIMITS

BABOCOMARI

SAN IGNACIO DE BABOCOMARI LAND GRANT BOUNDARY

MARICOPA AVE.
YUMA
NAVAJO
APACHE
PIMA
YAVAPAI AVE.
MOHAVE AVE.
GILA AVE.
PINAL ST.
COCHISE ST.
SANTA CRUZ ST.

HUACHUCA BLVD.

FAIRBANK AVE.
ELGIN AVE.
DRAGOON AVE.
THIRD ST.
SECOND ST.
FIRST ST.
GRANT ST.
CLARK ST.
PERSHING ST.
PATTON ST.

MILITARY RESERVATION BOUNDARY

TO SIERRA VISTA 92

TO I-10 92

RIVER

FT. HUACHUCA MILITARY RESERVATION

SCALE - FEET

1000 500 0 1000

LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL
- VACANT

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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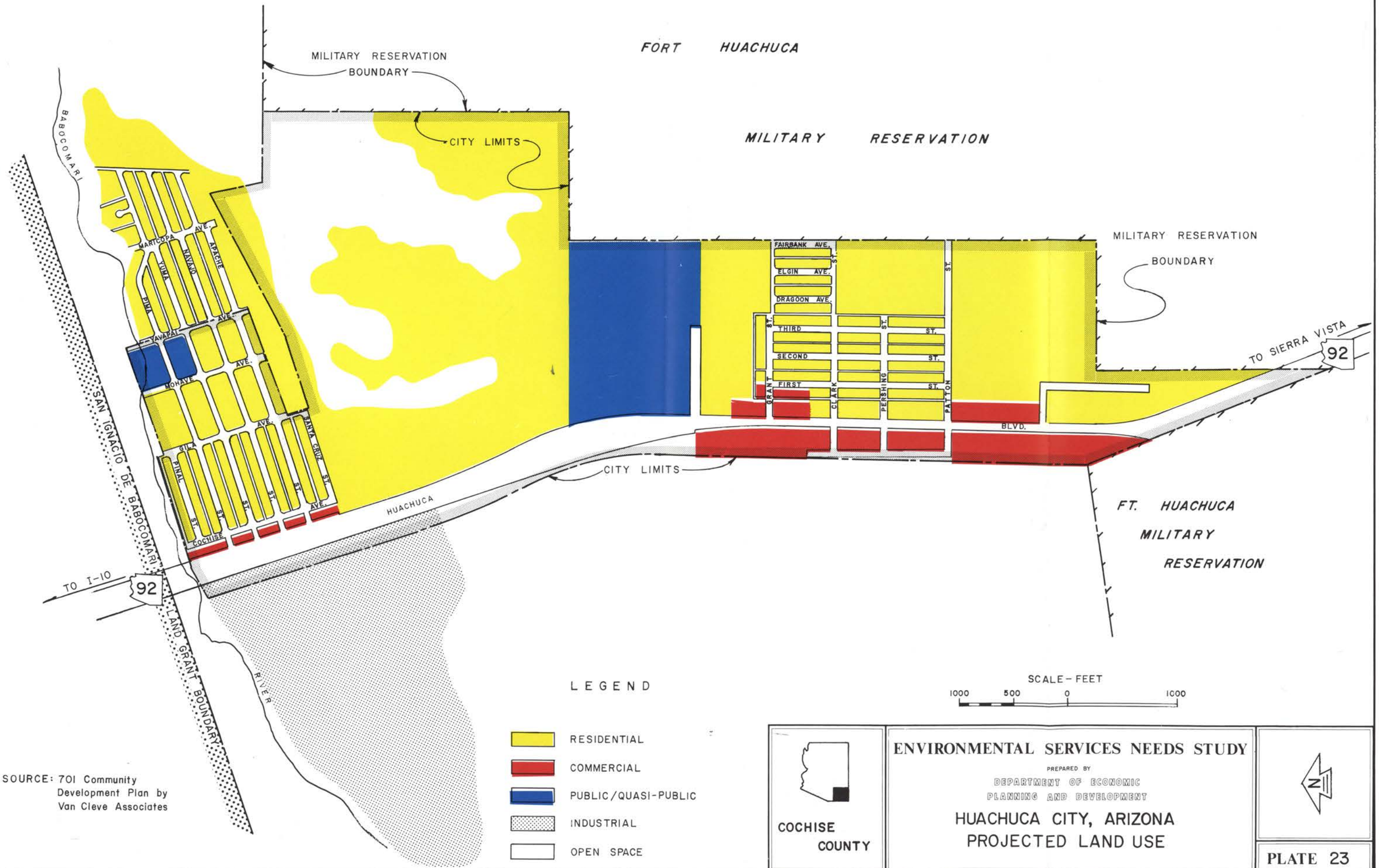
HUACHUCA CITY, ARIZONA

LAND USE

N

PLATE 22



SOURCE: 701 Community Development Plan by Van Cleve Associates

ENVIRONMENTAL SERVICES NEEDS STUDY

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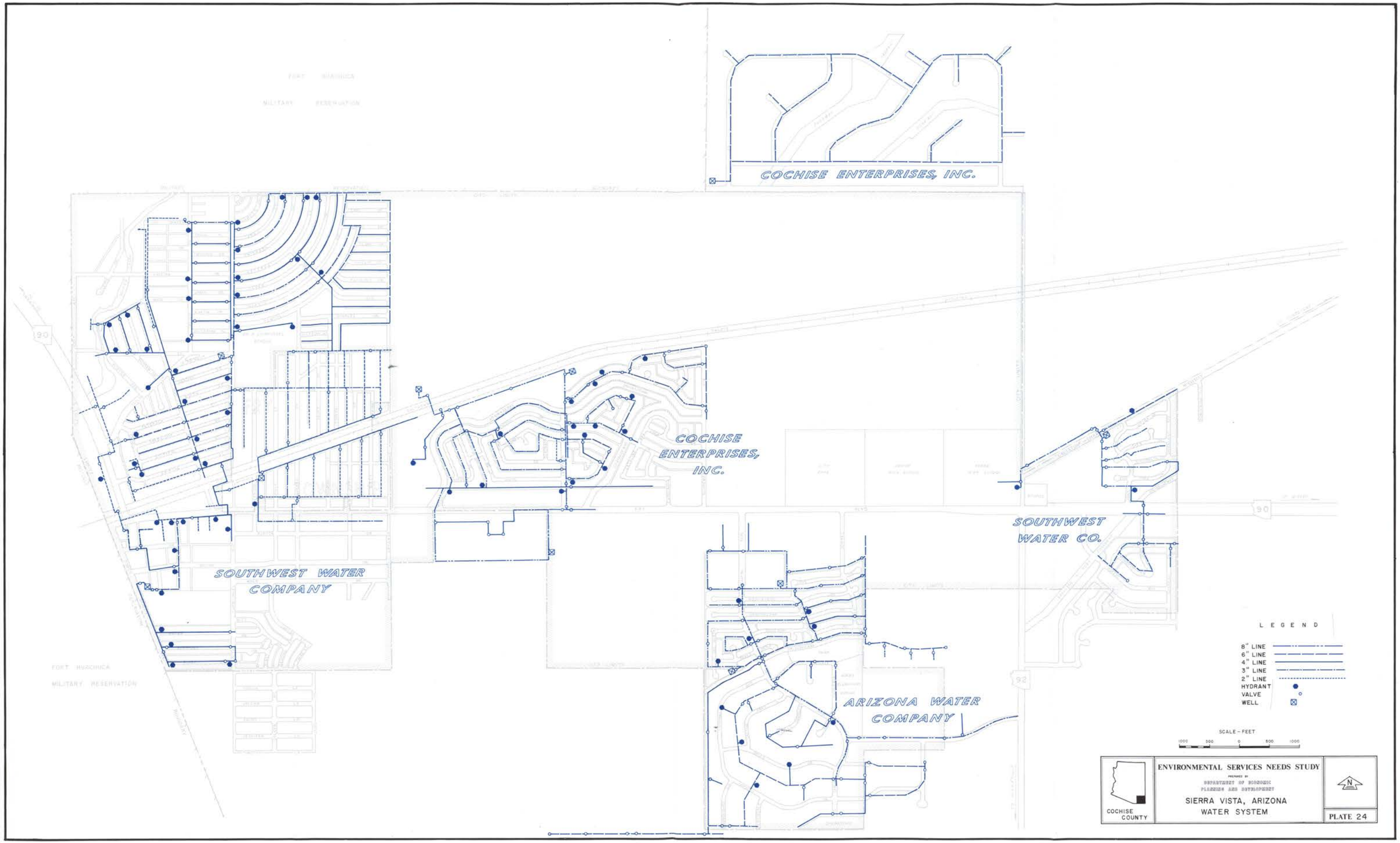
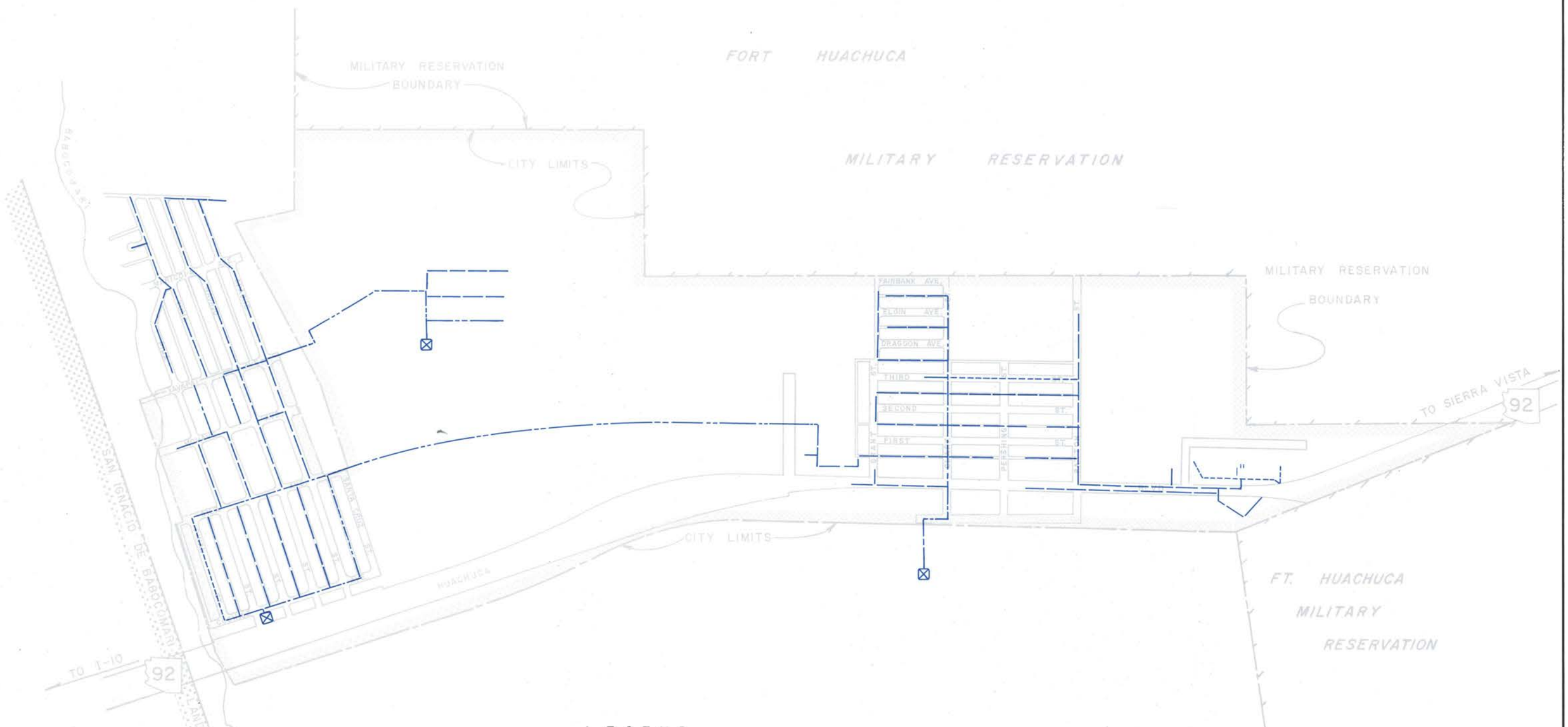
HUACHUCA CITY, ARIZONA
PROJECTED LAND USE

PLATE 23


COCHISE ENTERPRISES, INC.
COCHISE ENTERPRISES, INC.
SOUTHWEST WATER COMPANY
SOUTHWEST WATER CO.
ARIZONA WATER COMPANY
FORT HUACHUCA
MILITARY RESERVATION
90
92
LEGEND
8" LINE
6" LINE
4" LINE
3" LINE
2" LINE
HYDRANT
VALVE
WELL
SCALE - FEET
1000 500 0 500 1000
COCHISE COUNTY
ENVIRONMENTAL SERVICES NEEDS STUDY
PREPARED BY
DEPARTMENT OF ECONOMIC
PLANNING AND DEVELOPMENT
SIERRA VISTA, ARIZONA
WATER SYSTEM
N
PLATE 24



LEGEND

8" LINE
6" LINE
4" LINE
3" LINE
(EXCEPT WHERE NOTED)
WELL

SCALE - FEET
1000 500 0 1000

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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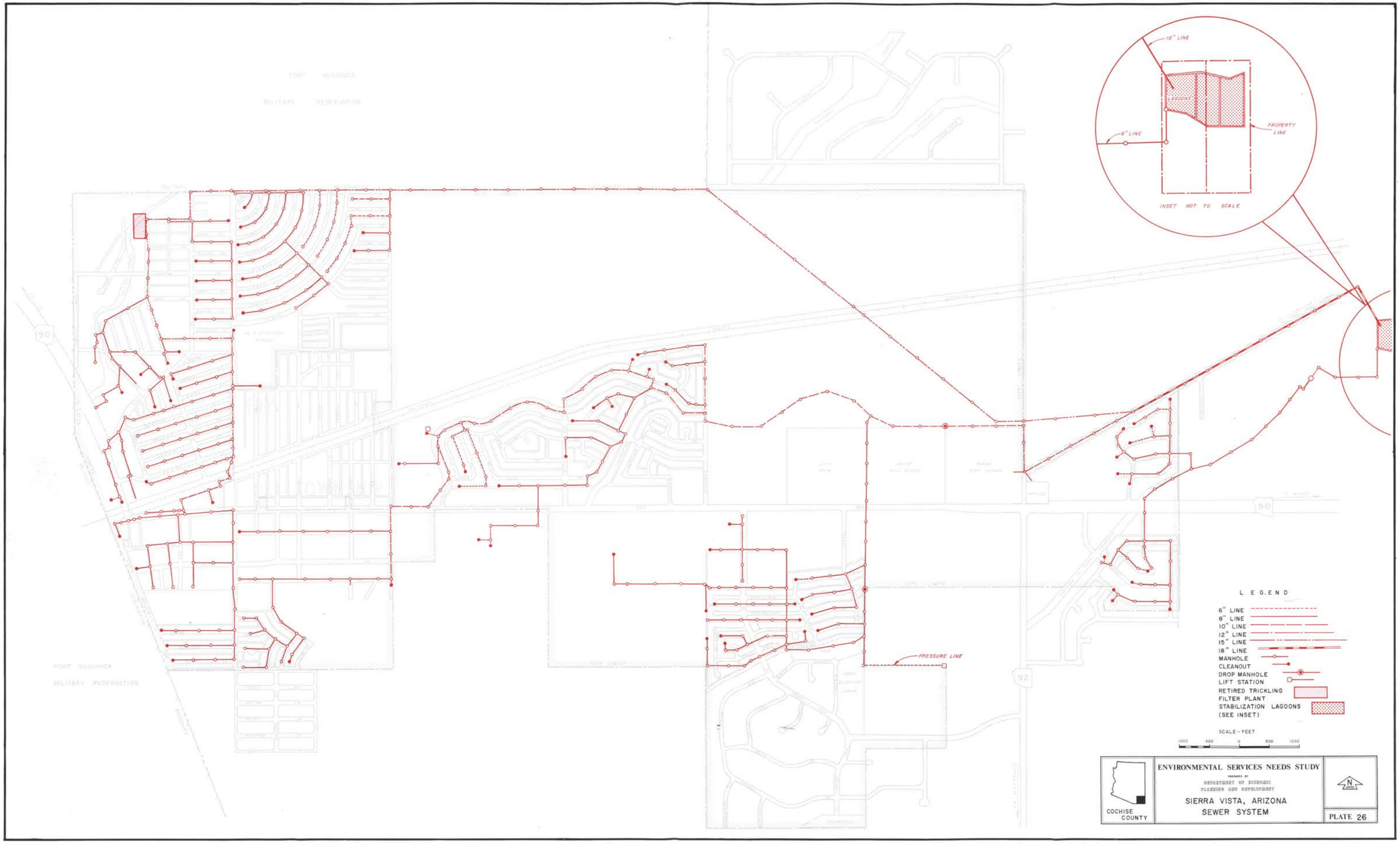
HUACHUCA CITY, ARIZONA WATER SYSTEM

PLATE 25


18" LINE
LAGOONS
8" LINE
PROPERTY LINE
INSET NOT TO SCALE
PRESSURE LINE
90
92
LEGEND
6" LINE
8" LINE
10" LINE
12" LINE
15" LINE
18" LINE
MANHOLE
CLEANOUT
DROP MANHOLE
LIFT STATION
RETIRED TRICKLING FILTER PLANT
STABILIZATION LAGOONS (SEE INSET)
SCALE - FEET
1000 500 0 500 1000
COCHISE COUNTY
ENVIRONMENTAL SERVICES NEEDS STUDY
PREPARED BY
DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT
SIERRA VISTA, ARIZONA
SEWER SYSTEM
N
PLATE 26

L E G E N D

12" LINE
10" LINE
8" LINE
6" LINE

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

HUACHUCA CITY, ARIZONA SEWER SYSTEM

PLATE 27

COMMUNITY OF NACO

HISTORICAL BACKGROUND*

The first Americans to settle in the Naco area were Mr. and Mrs. John Towner in 1898. Active development of the community of Naco started about 1900 when John Joseph Newell emigrated to the area from Ireland and began homesteading several sections of land adjacent to the international boundary between Mexico and the United States. In January of 1906, Mr. Newell and his associates formed the Naco Real Estate and Improvement Company and developed a townsite map for the community. The name Naco reportedly may have been derived from the joining of the last two letters of Arizona and Mexico. Naco is also the name of a type of limestone deposit that is prevalent in the region.

The community became active after 1900 as a port-of-entry for copper ores mined at Cananea, Sonora, Mexico, forty-miles south of the border. Prior to construction of the railroad through Naco to Cananea, in 1907, there were as many as 500 horse teams quartered in the area for wagon trains which transported copper ore to Bisbee.

Turmoil was created in the area from 1906 to 1929 by intermittent rebellions and revolutions occurring in Mexico. From 1929 to the present, Naco has experienced a very peaceful existence, with the exception of some smuggling during the days of prohibition. The major activities of the community are now related to the import of cattle and copper ores and export of machinery and equipment.

PHYSICAL CHARACTERISTICS

The developed area of Naco is located approximately eight miles southwest of Bisbee, Arizona within the San Pedro River Watershed. The community lies at an elevation of 4,615 feet above sea level in slightly rolling to level topography (PLATE 28). Soils are alluvial in nature with extensive depths. Surface soils are further characterized by the presence of caliche and tightly cemented limestone deposits. The subsurface geologic formations are sedimentary, being comprised mostly

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*The historical data and information were supplied by Mr. Fred Valenzuela and Mr. Tom Newell of Naco.

of limestone and sandstone. Naco is uniquely situated over a subterranean basin which contains large quantities of groundwater. The water supplies for Naco and the City of Bisbee are drawn from this basin.

Climate for the area is marked by heavy summer rains and mild year-round temperatures. Approximately 45 percent of its annual precipitation occurs in July and August when extensive currents of moist air move into southern Arizona from the Gulf of Mexico. Vegetation in the area is predominantly desert grasses and shrubs.

SOCIO-ECONOMIC PROFILE

The economy of Naco is based primarily upon retail trade. There is one main street in the town where all the businesses are located. These consist primarily of grocery stores and service stations. Although Naco has a sister city located on the other side of the border, it is not a major tourist attraction. Naco shares in the cattle shipping business which occurs in the fall of each year. At that time 20,000 to 25,000 cattle a day are moved into the United States from Mexico through the border sites in Arizona. Naco has one processing yard.

In addition to retail trade, other employment opportunities in the town include government work in the school or at the border. Other inhabitants commute to Bisbee and Sierra Vista.

The future for Naco is good. Bisbee's country club is located near the community and its presence will probably lead to new good quality residential construction in the area. In addition, a section of road connecting Naco to the road from Douglas to Cananea will soon be paved. This will result in increased traffic through the town.

Taking these factors into consideration, the population of the area is projected to increase slightly. At a maximum, population is forecasted to reach 1,600 by 1990. The present population is estimated to be about 800, excluding Bisbee Junction. Low, median and high projections for 1975, 1980 and 1990 are given in FIGURE III-5.

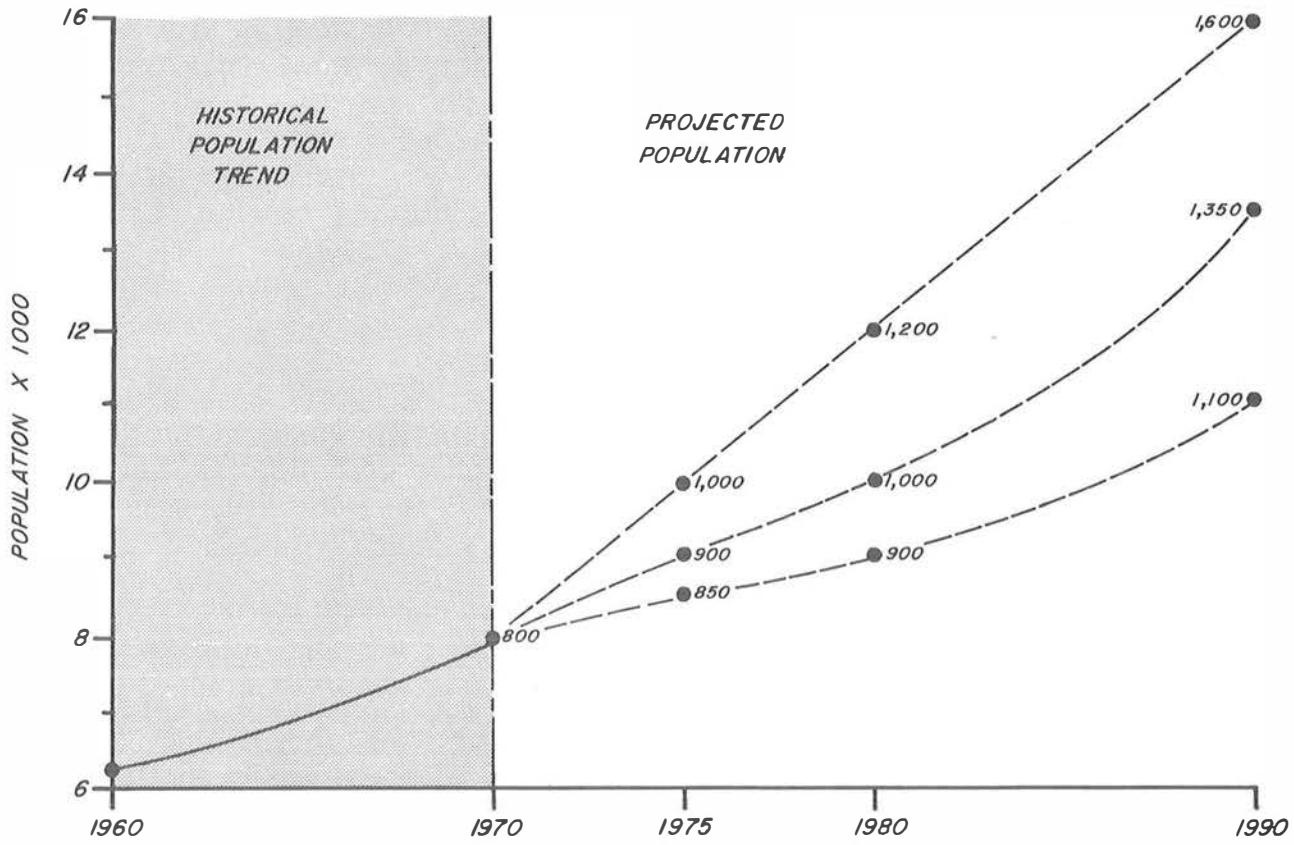


FIGURE III-5, POPULATION OF NACO AND PROJECTIONS TO 1990

LAND USE

Present Land Use Patterns

Naco is primarily a residential area serving as a bedroom community for Bisbee and nearby Fort Huachuca. Residential development is concentrated within a three-block area along D Street. There are 136 dwelling units in Naco with most of the units being the single-family type (PLATE 29).

All the commercial uses are concentrated in Blocks 9 and 10 of the Town Plat. These commercial uses are small retail service establishments serving the people of the local community.

The Bureau of Immigration and Naturalization and the U.S. Customs Office maintain a customs house adjacent to the Internation Boundary.

The largest land use in Naco is the Bisbee Country Club located in the northern edge of the community. The club serves residents from Bisbee as well as Naco.

Projected Land Use Patterns

New residential development for Bisbee has been occurring in San Jose, five miles north of Naco. The direction of residential development is south but has been relatively slow due to the uncertain economic conditions facing the Bisbee area.

The residents of Naco expect to receive new residential growth due to their being a bedroom-type of community for Bisbee and Fort Huachuca. New subdividing activity has occurred recently north of the Bisbee Country Club (PLATE 30). These subdivisions are expected to be fully completed within the next 10 to 15 years.

Additional residential development is likely to remain on an individual lot basis. Most of the homes were constructed by their owners and it is not likely that this procedure will change in the near future.

The main road serving the community is scheduled for realignment within the next few years. This will encourage new residential development to move eastward.

The paving of the road from Naco, Mexico to the Cananea Highway will make it easier to move livestock and produce from Mexico. This will effectively increase the volume of traffic utilizing Naco as a port-of-entry although the community has not been declared a free port.

The community has been relatively slow in growing, but the growth has been steady. There are no reasons to assume that land use patterns will not continue to change during the study period.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

Domestic water for Naco is supplied by the investor-owned and operated Naco Water Company. The supply end of the water system

consists of a series of five relatively shallow wells. All wells are drilled to varying depths into the natural subsurface groundwater basin on which Naco is situated. Well data for the supply are noted in TABLE III-39.

TABLE III-39

WELL DATA - NACO WATER COMPANY
NACO, ARIZONA

	#1	#2	#3	#4	#5
Depth (ft.)	208	200	170	600	175
Static Water Level (ft.)	113	121	80	365	--
Capacity (gpm)	175	175	125	250	100

Source: Arizona Corporation Commission.

All wells are cased and produce water of exceptional quality with the exclusion of Well #4 which is used primarily for industrial purposes (TABLE III-40). This well exceeds the recommended U.S. Public Health Service limit for sulphate concentration of 250 milligrams per liter.

TABLE III-40

WATER QUALITY DATA FOR WELLS SERVING
NACO, ARIZONA - NACO WATER CO.
(Parameter concentration in milligrams per liter)

Chemical Parameter	#1	#2	#3	#4
Total Dissolved Solids (TDS)	180.0	185.0	225.0	600.0
Total Hardness	140.0	148.0	172.0	490.0
Calcium	46.0	47.0	55.0	136.0
Magnesium	6.0	7.0	8.0	36.0
Sodium	17.0	21.0	24.0	49.0
Alkalinity (M.O.)	148.0	152.0	152.0	144.0
Chloride	8.0	13.0	28.0	124.0
Fluorides	0.4	0.42	0.37	0.31
Nitrates	9.0	9.0	10.0	12.0
Sulphates	8.0	8.0	11.0	265.0

Source: Arizona State Department of Health (Tucson).

All wells pump directly into the distribution system through related pressure tanks. Seven storage tanks with a total capacity of 220,000 gallons and one in-line chlorinator are contained in the distribution network. Transmission lines consist of 1,000 feet of pipe over four inches in diameter, and 29,390 feet of distribution mains. The distribution system contains a total of 20,020 feet of pipe under four inches in deameter (PLATE 31).

Present water usages and the number of consumers served by the system have increased respectively, approximately 65 and 47 percent over the 1961 figures seen in TABLE III-41.

TABLE III-41

WATER USAGE AND NUMBER OF CONSUMERS FOR NACO WATER SYSTEM, NACO WATER COMPANY

	Water Consumer Classes			
Year	Residential	Commercial	Industrial	Water Sold (Gallons/Year)
1961	113	6	1	8,280,000
1962	113	6	1	7,300,000
1963	123	6	1	8,200,000
1964	--	--	--	--
1965	152	8	2	10,297,000
1966	158	7	2	13,536,000
1967	169	6	2	12,813,000
1968	172	6	2	13,526,800
1969	172	6	3	13,131,800
1970	177	6	3	14,640,000

Source: Arizona Corporation Commission

The information presented in TABLE III-41 indicates an estimated per capita water consumption of 72 gallons per day. Water service rates for the system are based on a basic fee of $3.50 per month, plus $.68/1000 gallons.

Future Needs

Population growth for Naco has been projected to occur at a moderate rate. Moderate ordered growth will result in the increase of urban density within the townsite. This will generate a demand for expansion of the water distribution network. Water supply facilities are adequate at the present to meet the 1990 projected needs (TABLE III-42).

TABLE III-42

PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR NACO IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Acre
Summer	112,000		146,400		227,200		
HIGH		89		121		197	
Winter	64,000		88,800		150,400		
Summer	100,800		122,000		191,700		
MEDIAN		81		101		166	
Winter	57,600		74,000		126,900		
Summer	95,200		109,800		156,200		
LOW		76		91		135	
Winter	54,400		66,600		103,400		

Source: Staff Estimates.

SEWERAGE AND WASTEWATER TREATMENT

Existing Facilities

Naco is without collection and centralized sewage disposal facilities. Sanitary disposal of sewage wastes is handled on an individual basis by use of septic tank systems.

Surface soil conditions in the community are not ideally suited for septic tank systems. The presence of caliche and tightly cemented soils has generally resulted in their systems having short operational lifetimes. Septic tank problems have been occurring at an increasing rate in the area and have prompted the recent formation of the Naco Sanitary District.

Officials for the District are actively attempting to secure funds for the design of a sewerage collection system and disposal facility.

Future Needs

The development of adequate facilities for wastewater treatment in the community should be continued. The anticipated rates of growth for the community indicate that it would be highly advantageous, in terms of cost effectiveness, for the community to initiate construction of the needed collection network and treatment facilities.

Projected average sewage flows in the community are presented in TABLE III-43.

TABLE III-43

PROJECTED AVERAGE DAILY AND YEARLY SEWAGE FLOWS FOR NACO, ARIZONA IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/Day		YEAR 1980 Gallons/Day		YEAR 1990 Gallons/Day		Acre-feet Per Year
Summer	73,000		94,800		147,200		
HIGH		63		90		147	
Winter	48,000		66,000		113,600		
Summer	67,700		79,000		124,200		
MEDIAN		56		75		124	
Winter	43,200		55,000		95,850		
Summer	62,000		71,100		101,000		
LOW		53		68		101	
Winter	40,800		49,500		78,100		

Source: Staff Calculations.

SOLID WASTES DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

Garbage collection and disposal are an individual responsibility for the citizens of Naco. Wastes are either buried or burned on the site or transported to the dump indicated on PLATE 3.

Future Needs

Naco has the potential for developing into a thriving community. At some time within the next twenty years, conditions will no doubt be right for the community to incorporate. Prior to incorporation an overall development plan for implementing the necessary environmental services needed in the community should be undertaken. Such a plan would set forth the needs and liabilities for which the community, in an incorporated status, would be responsible.

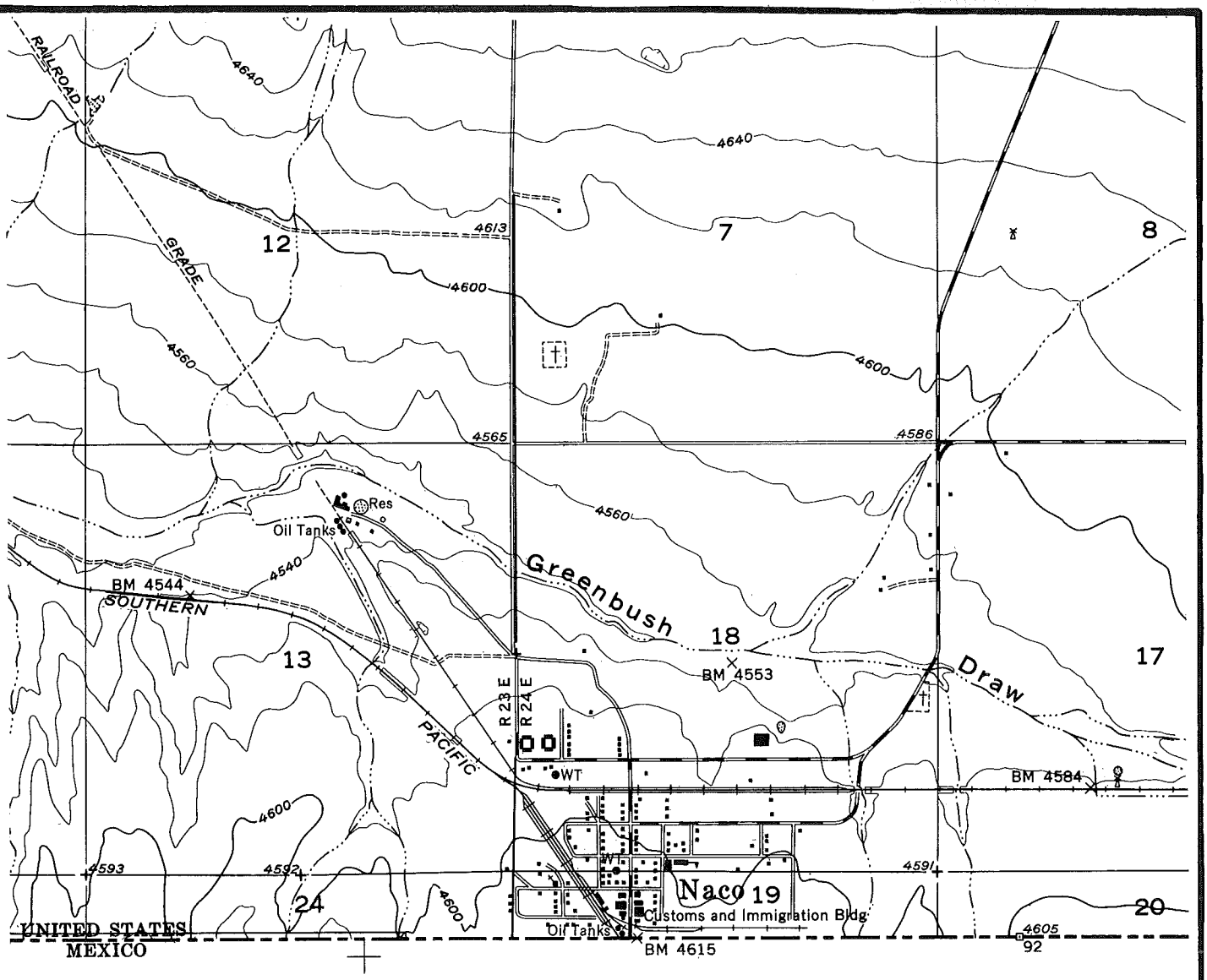
Solid wastes disposal problems will grow with increasing population. Projected solid wastes production levels for the community are noted in TABLE III-44.

TABLE III-44

PROJECTED YEARLY SOLID WASTES PRODUCTION
FOR NACO IN 1975, 1980 AND 1990
(Tons Per Year)

	Production Levels		
Year	Low	Median	High
1975	788	834	927
1980	946	1,051	1,261
1990	1,429	1,754	2,079

Source: Staff Calculations.



SOURCE: U.S. Dept. of the Interior, Geological Survey, 1958.

SCALE—FEET

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

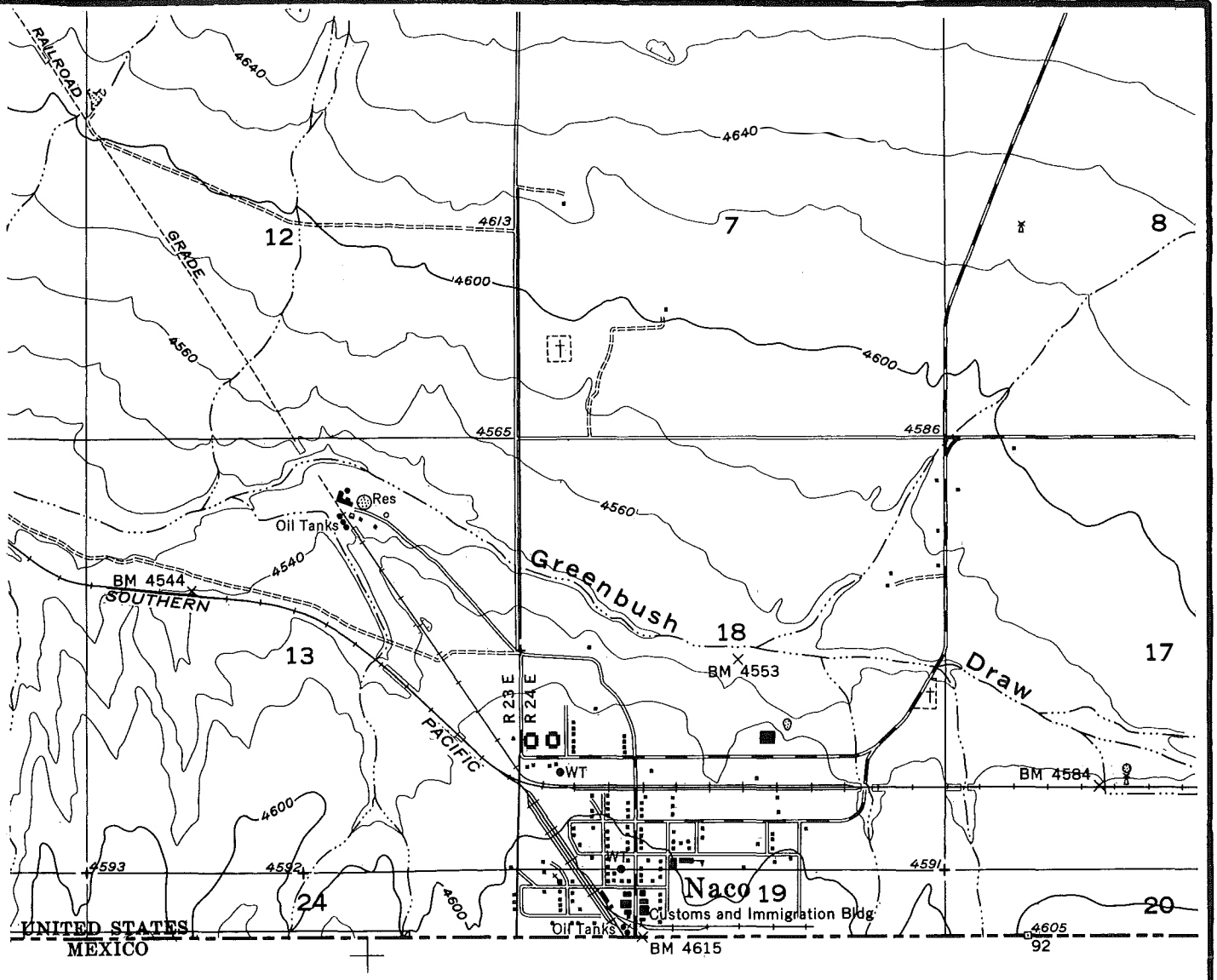
PREPARED BY

DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT

NACO, ARIZONA
TOPOGRAPHIC FEATURES

N

PLATE 28



SOURCE: U.S. Dept. of the Interior, Geological Survey, 1958.

SCALE—FEET

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NACO, ARIZONA
TOPOGRAPHIC FEATURES

N

PLATE 28

GREENBUSH

DRAW

TO BISBEE

BISBEE COUNTRY CLUB

8TH ST.

7TH ST.

6TH ST.

4TH ST.

3RD ST.

2ND ST.

A B C D E F G H I K L M N

SOUTHERN PACIFIC

NACO ELEMENTARY SCHOOL

ABANDONED RAILROAD RIGHT-OF-WAY

RAILROAD

UNITED STATES

MEXICO

SCALE — FEET

400 200 0 200 400

LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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NACO, ARIZONA

LAND USE

N

PLATE 29

GREENBUSH

DRAW

TO BISBEE

BISBEE COUNTRY CLUB

8TH ST.

7TH ST.

6TH ST.

4TH ST.

3RD ST.

2ND ST.

A B C D E F G H I K L M N

SOUTHERN PACIFIC

NACO ELEMENTARY SCHOOL

ABANDONED RAILROAD RIGHT-OF-WAY

RAILROAD

UNITED STATES

MEXICO

SCALE — FEET

400 200 0 200 400

LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI-PUBLIC
- INDUSTRIAL

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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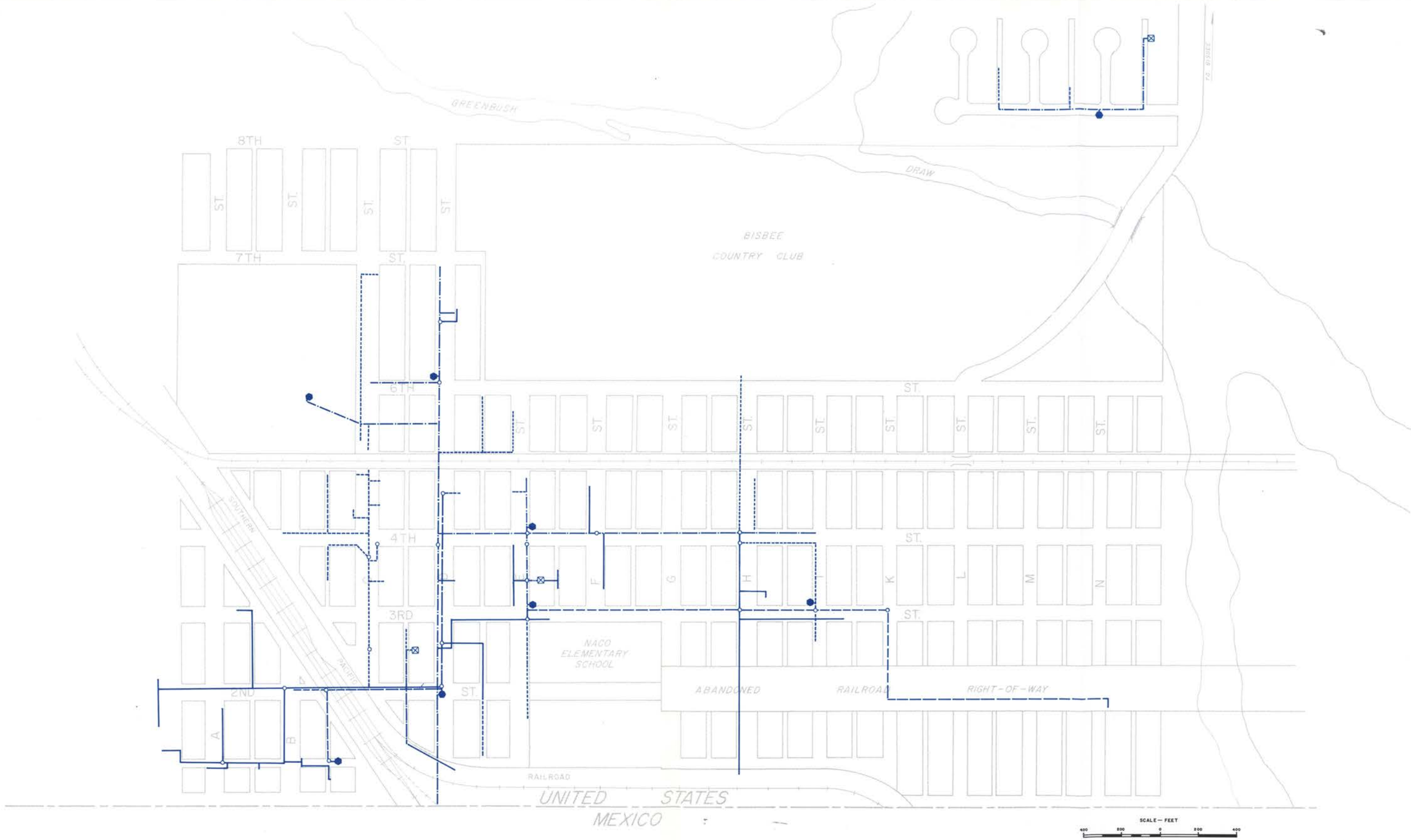
NACO, ARIZONA

PROJECTED LAND USE

N

PLATE 30



L E G E N D

6" LINE
4" LINE
3" LINE
2" LINE
1 ½" LINE
FIRE HYDRANT
VALVE
WELL

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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NACO, ARIZONA

WATER SYSTEM

N

PLATE 31

OTHER RURAL AREAS IN COCHISE COUNTY

This section discusses small areas of rural development not holding an incorporated status, located throughout the county with populations below 500. Rural developments of this nature usually have small "private" or "co-op" operated water supply systems and, in all cases, are without centralized sewage collection and disposal, or solid waste collection and disposal services. In some areas, water supply service systems are fragmented due to the scattered development of subdivisions by private enterprises.

COMMUNITY OF BOWIE

HISTORICAL BACKGROUND

Bowie was established on land which was donated by Captain James H. Levis for use by the Cochise Mining and Milling Company in 1880. The company built their offices and a mill on the land and a town slowly grew up around these original buildings. A post office was established in the early 1880's and was called Leviston in honor of Captain Levis. Prior to the establishment of the Leviston Post Office, mail was brought fourteen miles each day from Fort Bowie. In 1908, the name of the town was changed to Bowie.

PHYSICAL CHARACTERISTICS

The community is situated in generally flat to slightly rolling topography approximately 10 miles northeast of the Dos Cabezas Mountains at an elevation of 3,750 feet above sea level (PLATE 32). It lies on the west side of the San Simon Valley about five miles from normally dry San Simon Creek. Surface water drainage for the area moves to the north and northwest reaching the westward flowing Gila River, 35 miles north of Bowie.

Geology of the area consists of extensive deposits of alluvial soils with generally good percolation rates. The prevailing vegetation types in the area vary from creosote bush and mesquite grass to chaparral and oak woodland in the foothills of the surrounding mountains. Bowie has a dry climate with moderate amounts of precipitation falling only in July and August. During these two months, moist, tropical air from the Gulf of Mexico frequently flows down the San Simon Valley and overrides the nearby mountains. During the rest of the year, rainy days are few and far between. However, they tend to occur most frequently in the winter months when storms from the north move down through Arizona. Average yearly rainfall is 10 inches. Daily minimum and maximum mean daily temperatures are 48 and 81 degrees, respectively.

SOCIO-ECONOMIC PROFILE

Bowie is a small unincorporated farming town located off Interstate 10 whose main sources of employment are in retail trade and education. The town serves the needs of the surrounding ranches to a limited extent. Actually most purchases are made in Willcox, which is only a half-hour drive from Bowie. The proximity of Willcox has a negative influence on the amount of tourist traffic along Interstate 10 which Bowie receives.

The potential for development in Bowie is limited. Old Fort Bowie, located outside the town has been designated a national historic site and will be renovated in the future. While this will increase the tourist traffic passing through Bowie, the nearness of Willcox will again probably limit this development.

Since Bowie is an unincorporated town, there are few data available on its population. The 1970 U.S. Census shows that the population of the Bowie division has declined by 160 people in the past ten years from 1,433 in 1960 to 1,273 in 1970. The population in the 1960 census for Bowie was 717. This has decreased to a population of 489 in the 1970 census of the population. Based on this figure and the trend of the division, the population projection for Bowie suggests it will probably maintain its present population level. It is possible that eventually the overall growth of the county may affect Bowie, however, within the next twenty years a stable population seems most likely. This is illustrated in FIGURE III-6, along with the high and low projection. The low projection is that Bowie will decline in population and have a population of 465 in 1975, 442 in 1980 and 400 in 1990. The high projection, which allows for a slight gain in population, results in a population of 513 by 1975, 539 by 1980 and 595 by 1990.

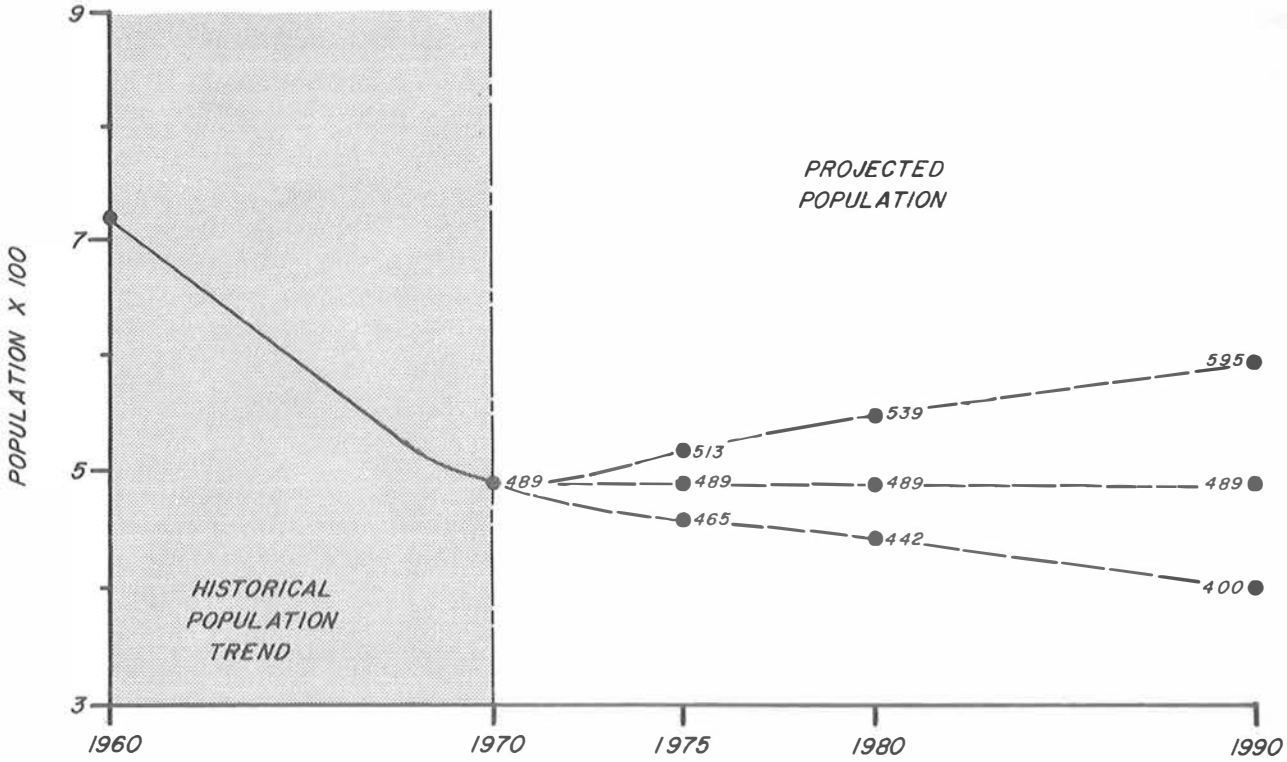


FIGURE III-6, POPULATION OF BOWIE AND PROJECTIONS TO 1990

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

Domestic water service for the community is supplied by the Bowie Water Company. This utility is a nonprofit co-op maintained by an elected board of officials.

The supply consists of two wells which are sunk to a depth of 500 feet and two 10,000 gallon water storage tanks. Total delivery capacity for the two wells is 600 gallons per minute. Both Well #1 and #2 are cased with static water levels of 300 and 316 feet and power ratings of 40 and 50 horsepower, respectively. Water quality data for the wells are found in TABLE III-45.

Transmission and distribution mains are made up of approximately 4,800 feet of pipe four inches or more in diameter and 38,220 feet of pipeline of less than four inch diameter. The distribution system

has had a fairly constant number of service connections over the ten-year period from 1961 to 1970. In 1961, there were 215 connections, while in 1970 there were 208. The number of connections peaked in 1967 with 230 active customers. Water rates are $5.15 per month for a minimum usage of 10,000 gallons per month. Above the minimum gallonage, water is sold for $.25/1,000 gallons.

TABLE III-45

WATER QUALITY DATA FOR WELLS SERVING
BOWIE, ARIZONA - BOWIE WATER COMPANY

	Parameter Concentration (Milligrams per Liter)	
Chemical Parameter	Well #1	Well #2
Total Dissolved Solids (TDS)	200.0	210.0
Total Hardness	61.0	58.0
Calcium	20.0	20.0
Magnesium	2.0	2.0
Sodium	48.0	50.0
Alkalinity (M.O.)	94.0	94.0
Chlorides	24.0	24.0
Fluorides	0.12	0.11
Nitrates	4.0	4.0
Sulphates	34.0	34.0

Source: Arizona State Dept. of Health, Water Supply Division.

Future Needs

A detailed engineering analysis of community water supply and distribution needs should be undertaken. Existing needs include the development of additional water storage capacity in the distribution network.

SEWERAGE AND WASTEWATER TREATMENT

Existing Facilities

The developed area of Bowie is without a centralized sewage collection and disposal system. All sewage wastes generated in the community are treated by individual septic tank leach pit or bed type

disposal systems. Soils in the area are generally alluvial in character and, with the exception of deposits of caliche, are suitable for this form of sewage disposal system. In addition, densities for septic tanks in the area are low, being 1.76 units per acre.

Minor problems have occurred with these systems which are primarily related to the age of the facility, rather than the incompatibility of septic tanks systems found in the area. A properly operated and maintained septic tank system can be expected to operate satisfactorily for ten years or more prior to some form of failure within the system.

Future Needs

Although the centralized collection and disposal of sewage wastes is a definite asset for a community, Bowie at this time has only a minor need for such a system. If the high projection of growth for the community should be followed, it would be advantageous for the community to formulate a plan of development for sewage collection and disposal facilities.

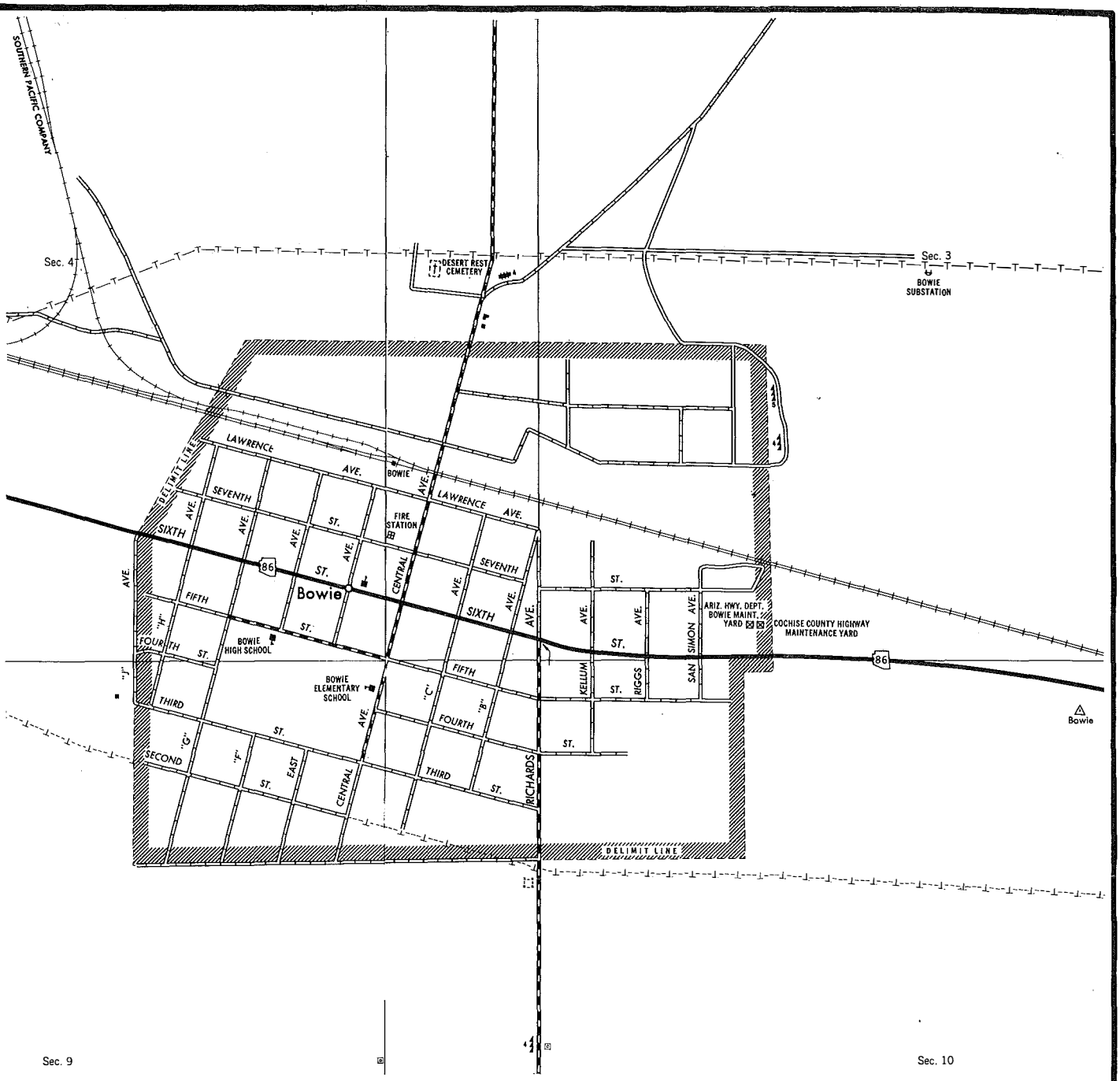
SOLID WASTES DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

Community services do not include garbage collection and disposal. Responsibility for solid wastes disposal falls on individual property owners through on-site burning or by transport to open dumps (PLATE 3). Burning is practiced at the dumpsite as a means to control the volume of accumulated wastes.

Future Needs

An efficient solid wastes collection service would benefit the community. Community leaders should consider some form of collection service for the area and the development of a properly operated sanitary landfill at the present site.



SOURCE: 1966 General Highway Map,
Arizona State Highway Dept.

SCALE—FEET

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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BOWIE, ARIZONA
GENERAL FEATURES

N

PLATE 32

COMMUNITIES OF ELFRIDA, DRAGOON, MCNEAL, NICKSVILLE AND SAN SIMON

The above community developments are small rural areas with estimated populations that range from 50 to 400 (PLATES 33, 34, 35, and 36). These areas are the smallest levels of rural development in Cochise County which are provided with a public water supply. They are discussed as to their environmental services needs, for they may be the starting points from which larger rural communities will develop in future years.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Existing Facilities

Domestic water supply services are provided by private water companies. These companies are outlined briefly by community in TABLES III-46 through III-50.

TABLE III-46

ELFRIDA DOMESTIC WATER USERS ASSOCIATION
WATER SUPPLY SYSTEM DATA FOR
ELFRIDA, ARIZONA

Year	Residential	Commercial	Public	Yearly Water Usage (gal.)
1970	111	13	2	13,129,320
1969	108	13	2	13,027,642
1968	106	13	2	14,067,000
1967	98	14	2	12,893,810
1966	96	14	-	13,080,770
1965	92	14	-	12,770,640
1964	92	14	-	--

Source: Arizona Corporation Commission

The Elfrida system is supplied by one well about 300 feet in depth. The distribution network contains two storage reservoirs with a total capacity of 85,000 gallons.

TABLE III-47

DRAGOON WATER COMPANY WATER SUPPLY SYSTEM DATA FOR DRAGOON, ARIZONA

Year	Residential	Commercial	Industrial	Yearly Water Usage (gal.)
1970	26	-	-	1,566,420
1969	34	7	-	3,966,705
1968	28	1	3	2,824,600
1967	24	-	1	2,496,200
1966	21	-	-	3,345,116
1965	24	-	-	2,761,590
1964	25	-	-	2,040,000

Source: Arizona Corporation Commission.

The Dragoon facilities consist of two wells with depths of 860 and 900 feet. The wells have a rated delivery capacity of 90 gallons per minute to the distribution network. Water is supplied through approximately 3,800 feet of distribution mains and one storage tank.

TABLE III-48

EICKS WATER SYSTEM - WATER SUPPLY SYSTEM DATA FOR MCNEAL, ARIZONA

	Customers			Yearly Water Usage (Gallons)	
Year	Residential	Commercial	Industrial	Pumped	Sold
1970	9	2	1	3,451,920	2,551,920
1969	7	2	1	2,636,690	1,263,690
1968	5	2	1	5,460,809	4,321,538
1967	5	2	1	6,924,549	5,784,960
1966	5	2	-	1,915,596	1,910,540
1965	5	2	-	1,916,533	1,901,530

Source: Arizona Corporation Commission.

The Eicks water system is supplied by a series of three wells with depths of 180, 225 and 400 feet. The wells pump directly into the distribution system which contains two storage tanks of 15,000 gallons capacity each.

TABLE III-49

NICKSVILLE WATER COMPANY WATER SUPPLY SYSTEM DATA FOR NICKSVILLE, ARIZONA

Year	Residential Customers	Yearly Water Usage (gallons)
1969	31	1,800,000
1968	29	1,439,672
1967	19	--

Source: Arizona Corporation Commission.

The Nicksville water supply facilities consist of three wells and one spring. The wells have depths of 185, 265 and 408 feet. Most of the water supplied to the system, however, originates from the spring source. The distribution network contains three storage tanks; one tank of 14,000 gallons capacity and two of 13,000 gallons each.

TABLE III-50

SAN SIMON WATER SUPPLY COMPANY WATER SUPPLY SYSTEM DATA FOR SAN SIMON, ARIZONA

Year	Customers Residential	Customers Commercial	Yearly Water Usage (gallons)
1970	75	-	5,000,000
1969	80	-	-
1968	80	-	-
1967	79	-	-
1966	76	1	-
1965	79	1	4,800,000
1964	75	1	-
1963	73	4	-
1962	47	13	-

Source: Arizona Corporation Commission.

The San Simon Supply is comprised of two wells with depths of 700 and 1,200 feet. These wells feed directly into the distribution network which has two storage tanks with a total capacity of 60,000 gallons.

Future Needs

All the systems are relatively small in terms of number of customers and extensiveness of the distribution networks. Water supply for the systems appear adequate to meet future needs, with the exception of the facilities serving San Simon. Property owners in this area are currently attempting to purchase the water company and operate it as a co-op. It is hoped that more efficient service will result for the community through acquisition of the system.

It is difficult to assess which of these systems will feel the greatest demand for expansion or modification in the next twenty-year period. Population growth projections for the county as a whole would seem to indicate the possibility of growth in all the rural areas presented, as well as those areas which have not been mentioned.

SEWERAGE AND WASTEWATER TREATMENT

Existing Facilities

The remaining rural areas of Cochise County depend on the septic tank system of sanitary disposal of sewerage wastes. The use of septic tanks for small areas is probably the most economical means of waste disposal. Except in areas where soils are incompatible with septic tank systems, this form of disposal is justified. Densities of less than one septic tank per acre are not uncommon.

Future Needs

Septic tank sewage disposal facilities will continue to be the predominant means of sewage disposal for rural areas. As these areas develop and septic tank densities approach five (5) per acre, if soil conditions permit, planning should be instituted for development of centralized waste water collection and disposal facilities.

SOLID WASTES DISPOSAL PRACTICES AND TECHNIQUES

Existing Facilities

All areas of development discussed are without services for collection and disposal of solid waste materials. Individual responsibility

prevails for disposal of collected wastes at area dumpsites or by burning (PLATE 3). Open dumps are periodically maintained by County Highway Department personnel and equipment. However, burning of accumulated materials is a common practice by those who utilize the dumpsites. Sanitary landfills are non-existent in the county, except in the more populated areas.

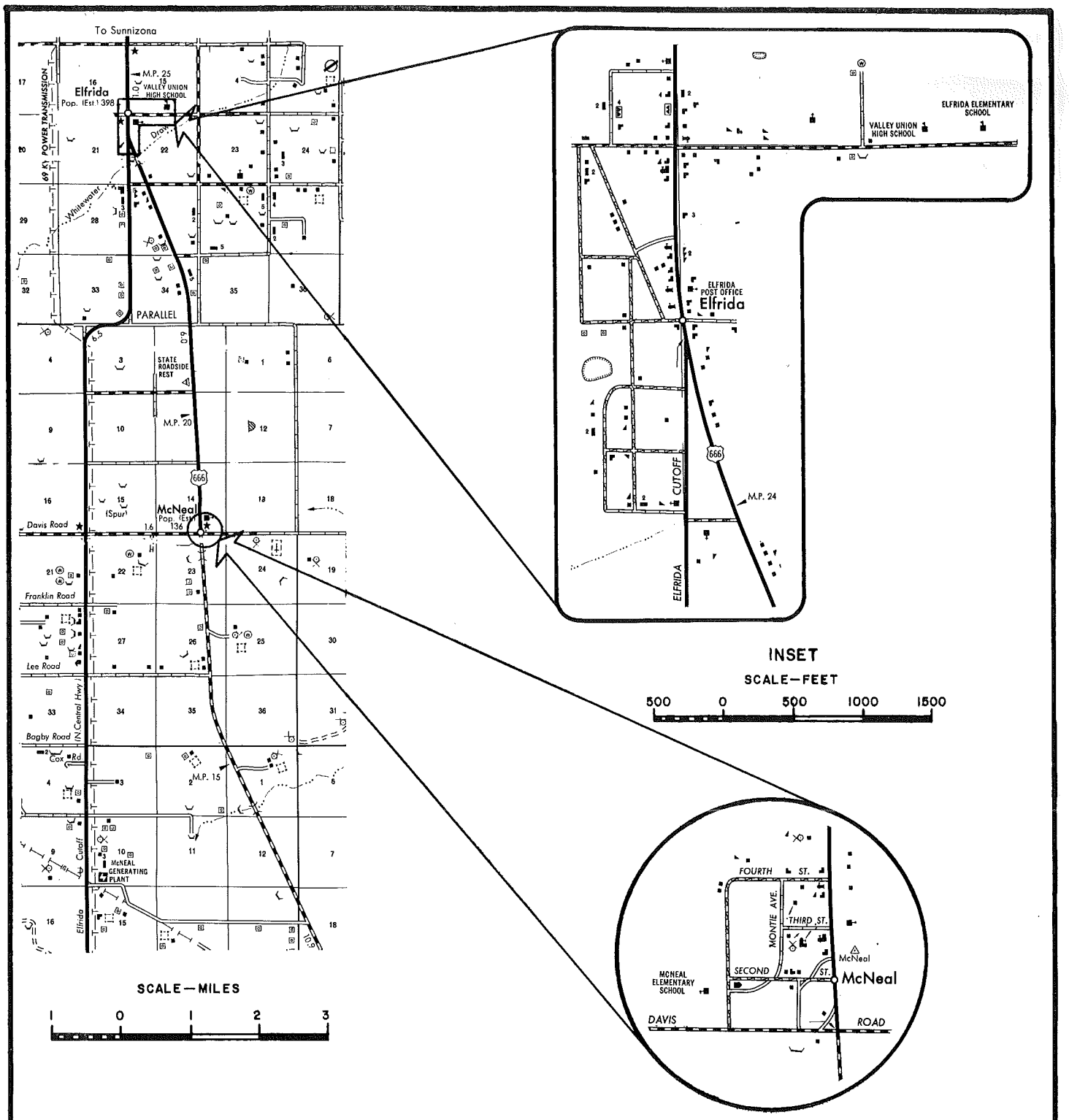
Future Needs

As the rural areas grow, the need to dispose of solid wastes materials in an efficient and safe manner will become apparent. The county should carry out a detailed study of waste production levels in all areas of development which could be used to support the formulation of a detailed study on the location of regional sanitary landfills. Such facilities would serve all areas of present and future development.

RECREATION AREA NEEDS

There is little need for any immediate or near-future changes in water supply systems, or sewage and solid waste disposal facilities for the recreation areas of Cochise County. Recreation and camping accommodations as well as the lodge and adjoining cabins at Parker Canyon are served by a spring-fed distribution system and well. Facilities at Rucker Canyon consist of a well and small distribution system for the 14 camping units. Both campgrounds are served by vault privys and the lodge at Parker Canyon is served by septic tanks. No problems have arisen with these facilities. The remoteness of some of the recreation sites presents a problem in collecting and disposing of solid waste.

Solid waste production figures for recreational activity have been estimated at 1.25 pounds of associated materials per visitor day. 8/ Recreational use of Forest Service lands in Cochise County have been estimated for 1970 at 274,400 visitor days. This would indicate that in 1970 approximately 343,000 pounds of solid wastes were generated as a result of recreational activity. The forest service provides daily pickup of solid wastes during the summer months at campgrounds where use is heavy. These schedules are lengthened during the off-seasons of activity.



SOURCE: 1966 General Highway Map, Arizona State Highway Dept.

COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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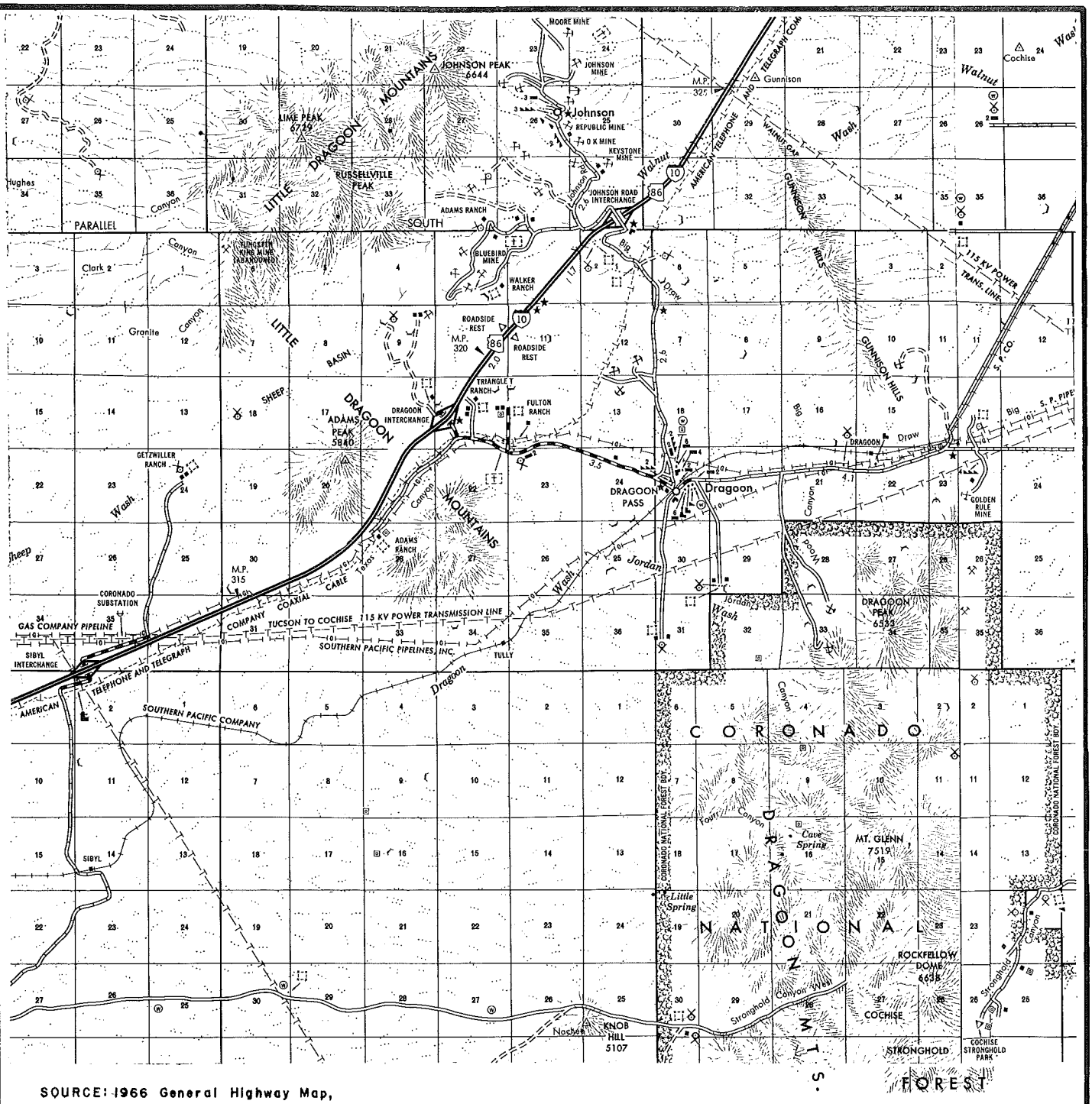
ELFRIDA & McNEAL, ARIZONA GENERAL FEATURES

N

PLATE 33



SOURCE: 1966 General Highway Map, Arizona State Highway Dept.

SCALE—MILES

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COCHISE COUNTY

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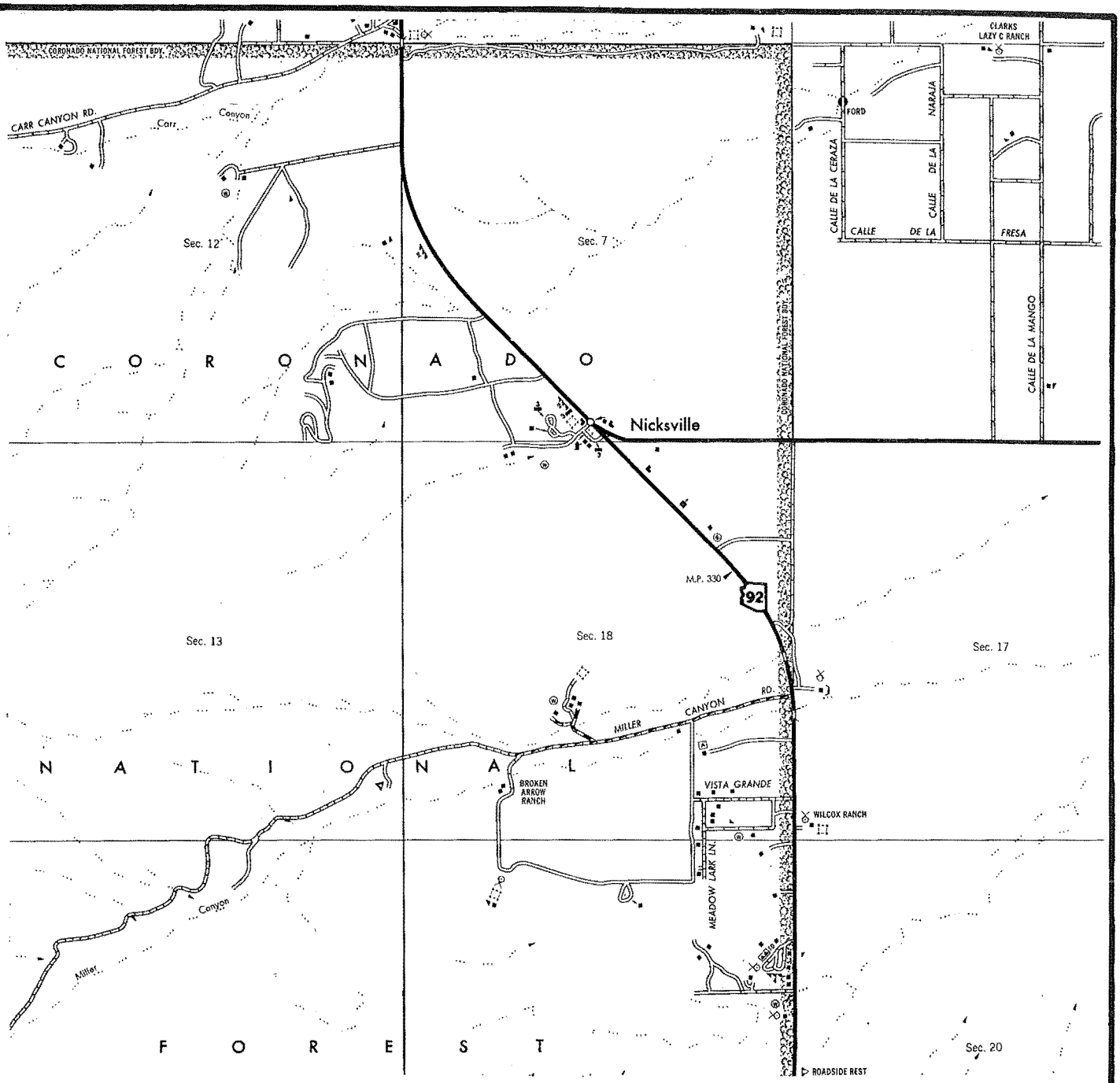
DRAGOON, ARIZONA GENERAL FEATURES

N

PLATE 34



SOURCE: 1966 General Highway Map,
Arizona State Highway Dept.

SCALE – FEET

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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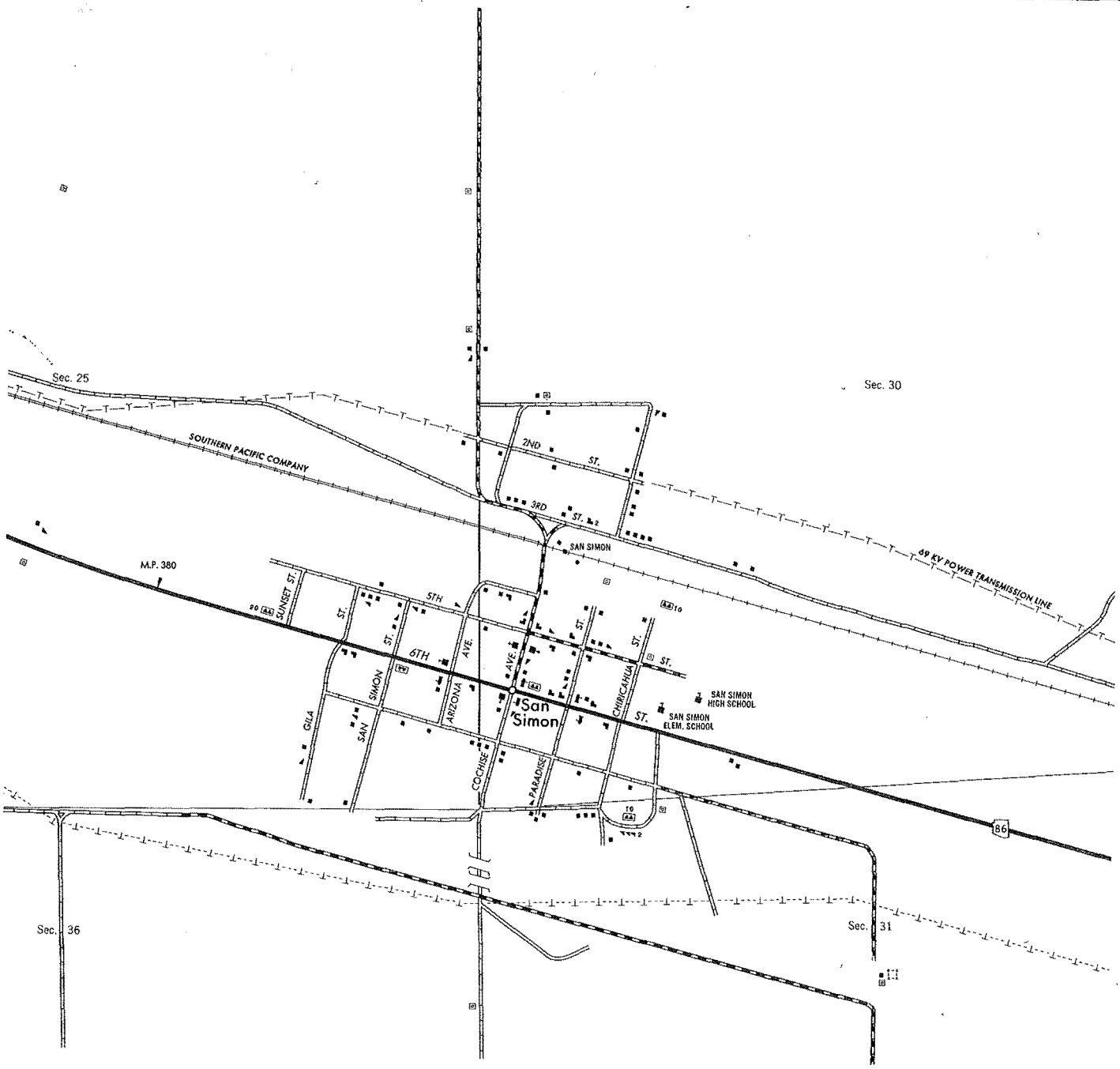
NICKSVILLE, ARIZONA
GENERAL FEATURES

N

PLATE 35



SOURCE: 1966 General Highway Map, Arizona State Highway Dept.

SCALE—FEET

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COCHISE COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

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SAN SIMON, ARIZONA
GENERAL FEATURES

N

PLATE 36

REFERENCES SECTION I

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SECTION II

CHAPTER I. ENVIRONMENTAL SERVICES ESTIMATED COSTS

It is the responsibility of municipal officials faced with the need for environmental services to know how much required installations should cost. Actual project costs do not become available until plans and specifications have been completed and approved, bids for construction work, materials and equipment received, and contracts let. Yet there is need for preliminary concepts of what the eventual cost will be long before these finalization steps have been taken. In short, there is need for valid "measuring sticks" or guidelines which will supply preliminary cost estimates for projects.

There is no substitute for actual cost information, but costs estimates play an important role in the preliminary stages of environmental services planning, despite the fact that decisions often must be based on needs within a community or the availability of funds. While the size of a project may be firmly established by the population to be served or regulatory requirements, knowledge of what the project may cost will be of great value:

- Cost estimates may dictate whether a project should be phased out in stages rather than a full-scale works on a one-time basis.

- Cost estimates may ascertain the future period for which capacity will be provided or for which actual construction will be scheduled on a long-range plan.

- Cost estimates can help municipal and county officials develop planning for rational financing on a long-range basis.

- Cost estimates can serve as a guide in judging the validity of competitive bids when contracts are to be let.

- Cost estimates can help guide bond issue referenda and assure investors in such bonds of the stability of the offerings.

These examples of the serviceability of construction cost estimates point up the responsibility in establishing guidelines. They demonstrate the need for using cost statistics of known validity in offering cost estimating guidelines and for clear interpretation of such data in terms of their limitations as well as their proven values. They also serve as warnings that estimates are no more than estimates; that the estimates must be used by persons versed in their application; that estimates are no substitute for actual cost experiences by public officials; and that estimates cannot and do not reflect total project costs.

The cost data found in the succeeding sections do not cover certain important items in the overall cost of the actual completion of a constructed project. Non-covered items include administrative, engineering, financing and other services, and land costs. These factors should be kept in mind during review of the following costs data.

SEWERAGE AND SEWAGE TREATMENT PROJECTS

The difference between sewerage and sewage treatment plant projects is best illustrated by a comparison of the percentage breakdown of their four major components of construction -- material, labor contractor's plant, and overhead and profit -- as shown in TABLE I-1.

TABLE I-1

MAJOR COMPONENTS OF CONSTRUCTION FOR SEWAGE TREATMENT PLANTS AND SEWERS
(1970)

	Percent of Total Cost			
Item	Material	Labor	Contractors Plant	Overhead and Profit
Sewage Treatment Plants	54.49	25.33	6.45	13.73
Sewers	35.52	18.48	31.30	14.70

Source: U.S. Department of Interior, Federal Water Pollution Control Administration.

The costs of sewer lines installed in trenches (TABLE I-2) includes (a) excavation, (b) cost of pipe, (c) placing and joining of the pipe, and (d) backfilling of the trench. Sheeting and shoring, gravel

TABLE I-2

ESTIMATED AVERAGE UNIT COSTS FOR CONSTRUCTION OF SEWAGE COLLECTION LINES - 1970
(For Illustrative Purposes)

Vitrified Clay Pipe		Asbestos Cement Pipe	
Diameter, inches	Cost/foot	Diameter, inches	Cost/foot
8	$ 3.65-$ 4.55	8	$3.66-$ 4.58
10	$ 6.00-$ 7.50	10	$4.93-$ 6.16
12	$ 8.00-$10.02	12	$6.28-$ 7.85
15	$12.05-$15.10	15	$9.27-$11.60

Source: Project Staff Estimates

foundation cradle or incasement of pipe and surface restoration are excluded. The ranges of costs depicted are based on construction cost indexes for July, 1970. It should be understood that the range of prices indicated here are influenced further by the size of the project and the inplace soil characteristics. Definite economics of scale result with larger sewer projects.

Consideration should also be given to the type of pipe to be used in a project. Factors such as life expectancy, durability, unit weight, strength and ease of assembly, and inclusion of service connections all influence final cost figures in sewerage projects.

Costs for waste water treatment facilities are primarily based on the degree of treatment which may be required by regulatory agencies. As the degree of treatment moves from primary to secondary to tertiary, the costs increase correspondingly (FIGURE I-1). 1/

Generalized costs for basic waste water treatment processes are presented in TABLE I-3. The costs for waste water treatment facilities are also influenced by economies of scale. The possibilities of areas joining together in regionally organized waste treatment projects can be advantageous for communities in proximity to each other. Economies of scale through consolidation of waste sources and the resulting cost advantages are exemplified in FIGURE I-2. 2/

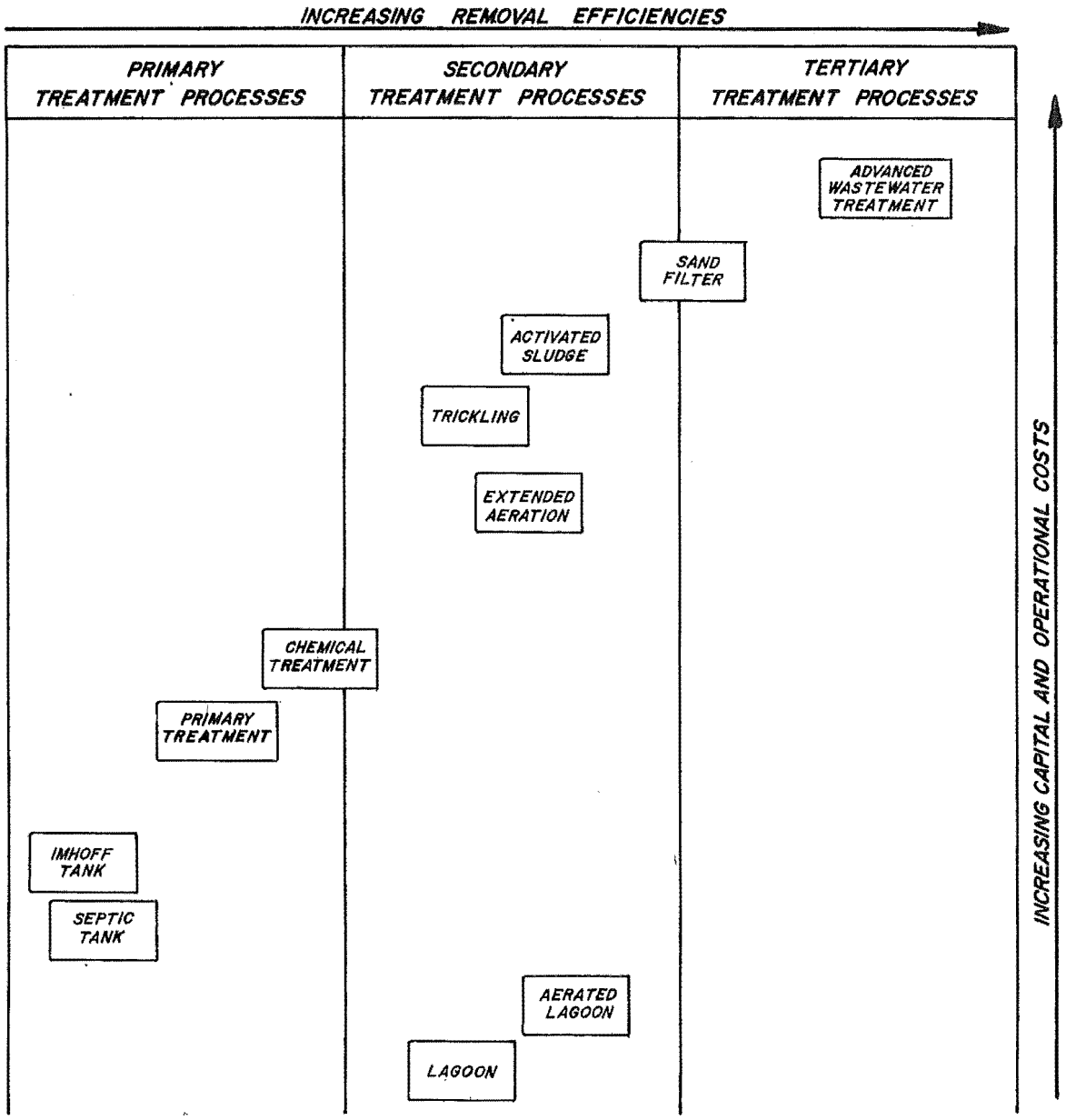
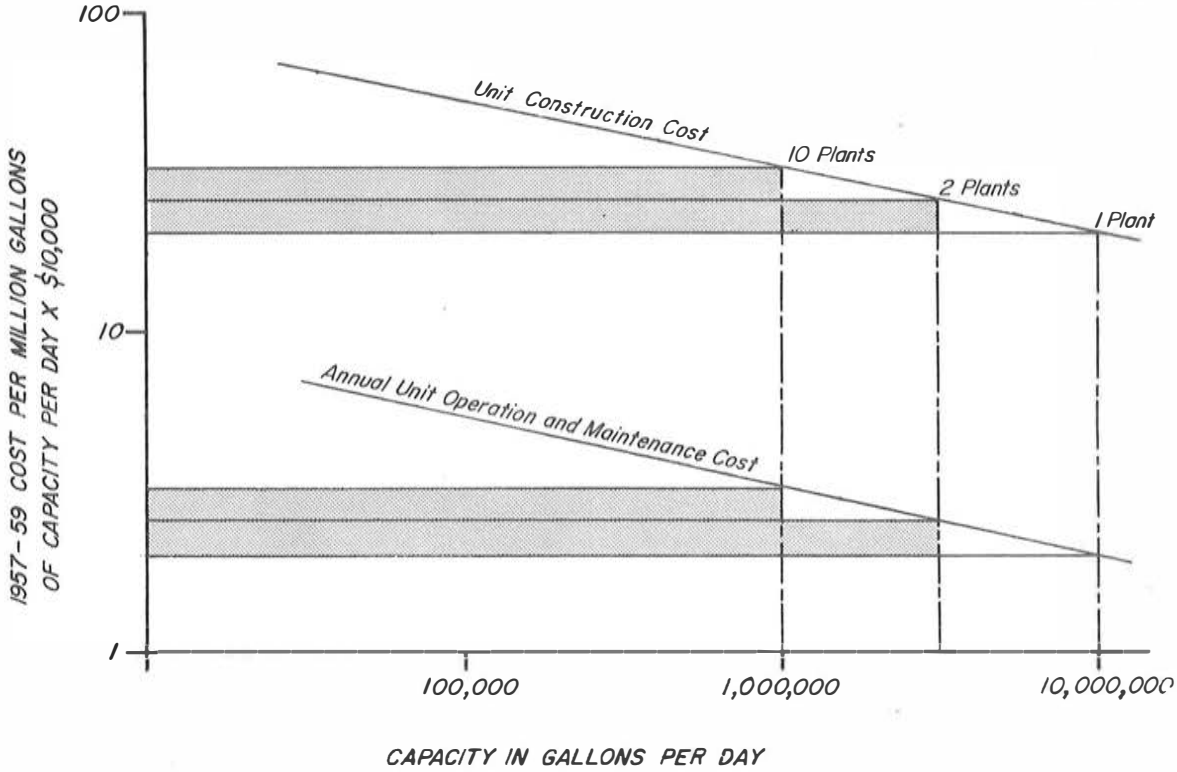


FIGURE I-1. GENERALIZED RANKING OF UNIT COST AND REMOVAL EFFICIENCIES OF CONVENTIONAL WASTE TREATMENT PROCESSES



	Construction Cost	Interest Charges	25 Years Operation	Lifetime Costs
10 plants	$4,200,000	$2,600,000	$7,800,000	$14,600,000
2 plants	$3,200,000	$2,000,000	$6,000,000	$11,300,000
1 plant	$2,500,000	$1,500,000	$4,300,000	$ 8,300,000

FIGURE I -2. APPLICATION OF ECONOMIES OF SCALE THROUGH CONSOLIDATION OF WASTE SOURCES PRODUCING 10 MILLION GALLONS PER DAY OF SEWAGE

TABLE I-3

GENERALIZED COST TO SIZE RELATIONSHIPS OF BASIC WASTE TREATMENT PROCESSES

Process	Million Gallons Per Day Capacity				
	.01	.10	1.0	10.0	100.0
	Construction Cost, $1000's*				
Primary		58.7	308.6	1,247.7	6,559.0
Primary, Separate Sludge Digestion		85.2	305.1	1,092.2	3,084.0
Activated Sludge	11.7	70.8	417.3	2,458.9	14,487.6
Trickling Filter		101.8	288.9	1,374.4	5,045.2
Lagoons	6.2	23.4	88.0	330.3	1,080.0
	Annual Operating & Maintenance Charges, $1000's				
Primary		4.5	19.7		
Primary, Separate Sludge Digestion		5.5	20.6		
Activated Sludge		6.3	31.3	172.3	
Trickling Filter		5.1	18.3	83.3	
Lagoons	0.1	0.6	3.0		

*Source: Modern Sewage Treatment Plants, How Much Do They Cost and Sewage Treatment Plant Cost Index for June 1969.

**Source: R. L. Michels, et al "Operation and Maintenance of Municipal Waste Treatment Plants," Journal of the Water Pollution Control Federation, March 1969. 1962-64 dollars raised to 1968-69 conditions by use of BLS Craftsmen's median earning, 1968 ÷ craftsmen's median earnings, 1963 x table value.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Predicting costs for capital improvements in water systems is difficult, in part because of the variety of equipment and techniques utilized in providing domestic water. Water chemistry and bacteriologic quality of a raw water source also influence total costs related to development of a water supply. Bacteriologic quality of a public water system must adhere to very rigid criteria for the public welfare.

The means by which water quality standards are approached is dependent upon the initial characteristics of the water to be used in a water distribution system. These inherent characteristics establish the basic capital costs for water treatment facilities. For well water meeting

chemical criteria, capital outlay merely involves pumping equipment, pressure tanks and reservoirs, etc., with provisions for protection against bacteriologic contamination in the system. The larger the distribution system the more sophisticated chlorination equipment becomes as well as the construction cost.

Well systems have basic operational costs in power consumption for pumps utilized in the system. FIGURE I-3 gives a generalized presentation of pumping costs versus depth to water on the supply end of a system. 3/

Average cost figures for a hypothetical project involving modification of a water supply and distribution system with a total cost of $122,675 are illustrated in TABLE I-4. The estimates in TABLE I-4 do not include engineering and contingencies or land right-of-way acquisition.

TABLE I-4

COST ESTIMATES FOR A HYPOTHETICAL WATER SUPPLY AND WATER DISTRIBUTION PROJECTION - 1970

Water Supply		
Drill and case well (300' - 10" diameter)		$10,000.00
Water Storage Tank (1,000,000 gallon)		47,000.00
Delivery Line (10" - 4,000')		20,000.00
	Sub-Total	$77,000.00
Water Distribution System		
10" pipe (3,200')		$13,120.00
6" pipe (6,250')		16,875.00
4" pipe (8,200')		11,480.00
Valves		4,200.00
	Sub-Total	$45,675.00
	TOTAL COST	$122,675.00

Source: Project Staff Estimates

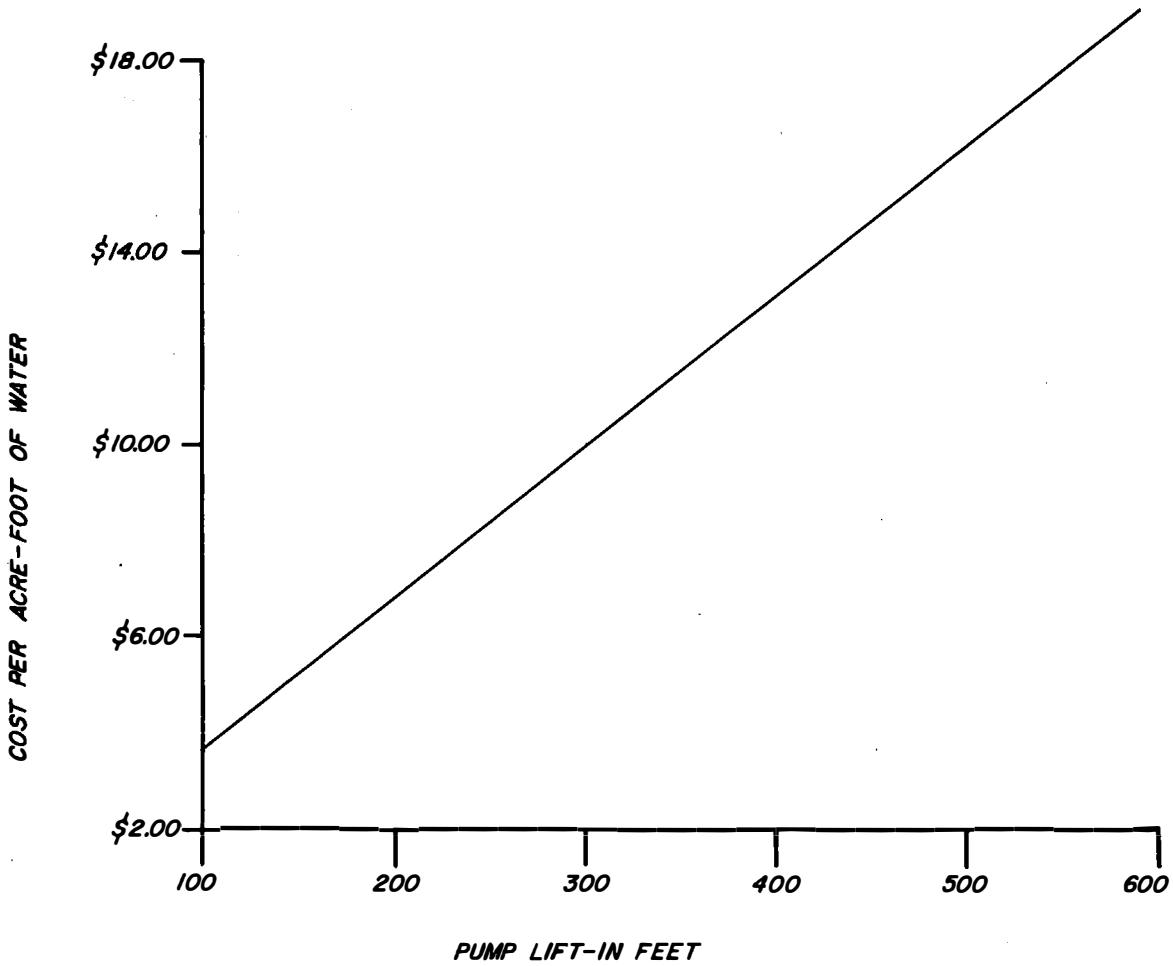


FIGURE I-3, RELATIONSHIP BETWEEN LIFT AND COST PER ACRE-FOOT OF GROUND WATER PUMPED

Another major consideration for costs in water systems development is the amortization of equipment to be used. These costs will be reflected in water service rates, particularly if a community is served by a private utility corporation.

SOLID WASTE MANAGEMENT

One of the most popular means for control of solid wastes is the sanitary landfill. Other forms of processing or disposal are, incineration, composting, grinding to sewers, salvage and reclamation, open burning and pyrolyses. Land filling and salvage operations appear to be the best suited operations for environmental control and service to small communities.

Sanitary landfills have the advantages of being inexpensive and applicable to a wide variety of terrain. Land requirements are the only limiting factor for use of this form of disposal. Sanitary landfills have relatively low outlay and cost of operation and are traditionally accepted by the public. They are adaptable and flexible to accept a wide variety of wastes of varying composition and amount with no pre-treatment required.

The cost of a sanitary landfill consists of the initial investment for land, equipment, and construction features, and the operating costs.

The magnitude of the initial investment depends on the size and sophistication of the landfill. A typical breakdown of the major items that normally constitute the initial investment is as follows:

1. LAND
2. PLANNING AND DESIGNING
   a. Consultant
   b. Solid Wastes Survey
   c. Site investigation
   d. Design, plans, specifications
3. SITE DEVELOPMENT
   a. Land development -- clearing, landscaping, drainage features, etc.
   b. Access roads
   c. Utilities -- water, electricity, telephone
   d. Fencing, signs
4. FACILITIES
   a. Administration
   b. Equipment maintenance
   c. Sanitation
   d. Weight scales
5. EQUIPMENT -- TRACTOR, SCRAPER, ETC.

Generally, the major portion of the initial investment is for the purchase of the land and equipment. Often a sizable part of the initial investment for land and equipment can be recovered through the development or use of the land and the salvage value of the equipment.

If funds are not available for the proposed investment, consideration should given to leasing land or equipment, or both, to spread the cost over the life of operation.

The operating cost of a sanitary landfill depends on the cost of labor and equipment, the method of operation, and the efficiency of the operation. The principal items in operating cost are:

1. PERSONNEL
2. EQUIPMENT
   a. Operating expenses -- gas, oil, etc.
   b. Maintenance and repair
   c. Rental, depreciation, or amortization
3. COVER MATERIAL -- MATERIAL AND HAUL COSTS
4. ADMINISTRATION AND OVERHEAD
5. MISCELLANEOUS TOOLS, UTILITIES, INSURANCE, MAINTENANCE TO ROADS, FENCES, FACILITIES, DRAINAGE FEATURES, ETC.

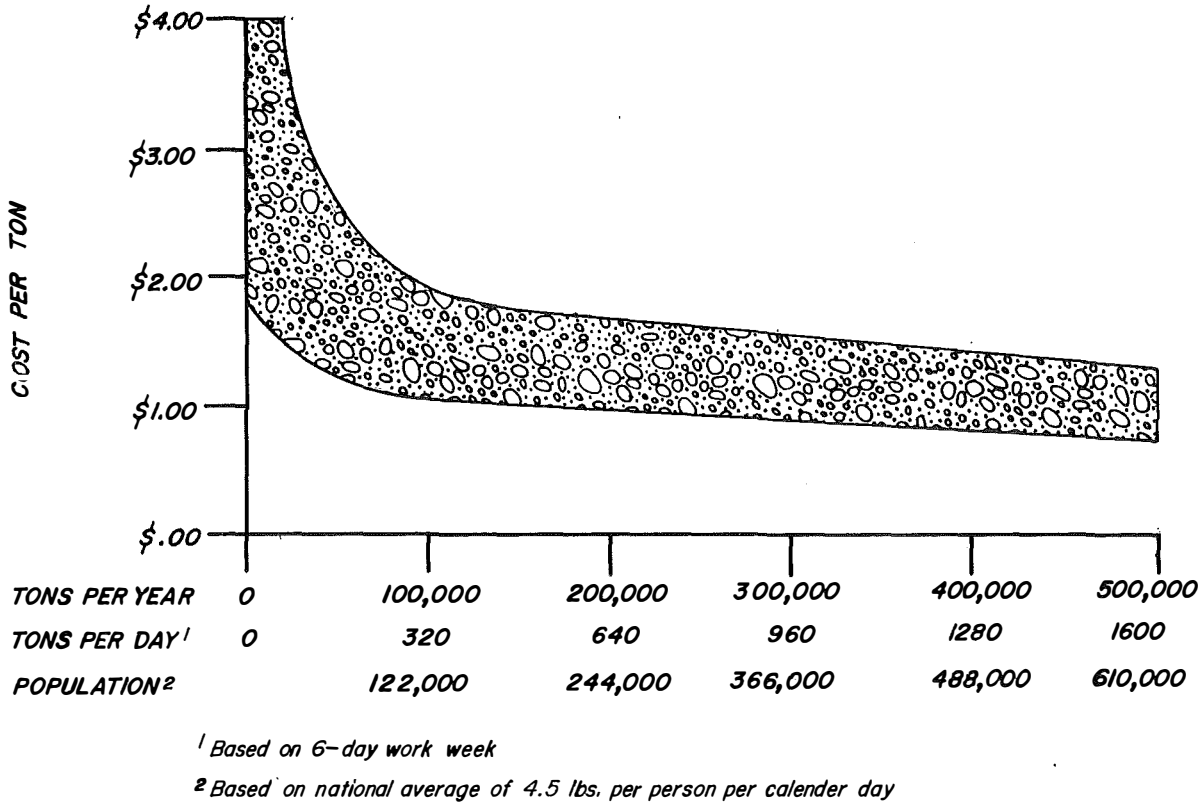
Wages ordinarily make up about 40 to 50 percent of the total operating cost. Equipment equals 30 to 40 percent; cover material, administration, overhead, and miscellaneous amount to about 20 percent.

Operating costs per ton versus the amount of solid wastes handled in tons and the population equivalent may be charted (FIGURE I-4). Operating costs for a small operation handling less than 50,000 tons per year varies from $1.25 to approximately $5.00 per ton. This wide range is primarily due to the low efficiency of the smaller operations which are usually operated on a part-time basis.

Full-time personnel, full-time use of equipment, specialized equipment, better management, and other factors that lead to high efficiency are possible at large sanitary landfill operations. The increased efficiency results in lower unit cost of disposal. The unit cost of a large landfill handling more than 50,000 tons per year will generally fall between $0.75 to $2.00 per ton.

To compare the true cost of sanitary landfilling with that of incineration or composting, it is essential that the costs and returns of the initial investments and the hauling costs be considered along with the total disposal costs including the disposal of incinerator residue and noncompostable materials. The hauling costs of a collection system that uses the sanitary landfill disposal method may be higher than the hauling costs of a system using incineration or composting, since sanitary landfills are generally located farther from the waste-generating area than are incinerators or compost plants. A sanitary

landfill, however, may increase the value of a plot of unusable land by converting the site to a playground, golf course, park. . . ., thereby obtaining a major investment cost advantage over incineration and composting.



[1] Based on 6-day work week

[2] Based on national average of 4.5 lbs. per person per calender day

FIGURE I-4, SANITARY LANDFILL OPERATING COSTS

CHAPTER II. FINANCING ENVIRONMENTAL SERVICES

INTRODUCTION

The intent of this chapter is to acquaint the local community with the different means available for financing environmental services systems. The descriptions are meant only as references and not as a substitute for either the opinions of city and county attorneys or the advice of qualified federal program specialists or bond council.

Local communities have found it necessary to construct, improve and expand their water and sewer systems, sewage treatment facilities, and solid waste disposal facilities. However, due to the growing complexities of municipal and county finance, careful examination must be made of the various sources of funding to insure that each dollar is spent wisely.

BONDING

Cities and towns often find it necessary to incur a large debt to finance capital improvements, i.e., water and sewage facilities. The state has authorized incorporated cities and towns to issue various kinds of bonds to finance this debt. There are three types of bonds which can be used for financing capital improvements for environmental systems: they are general obligation bonds, revenue bonds and special improvement bonds.

General Obligation Bonds

The most common method of bonding for general municipal purposes is the general obligation bond. These bonds are retired from revenues generated from property taxes, which are part of the municipalities general revenue sources. These bonds are often referred to as "full faith and credit" bonds because they are guaranteed by the taxing authority of the issuing governmental unit.

Because these bonds are backed by the taxing powers of the issuing governmental body and they use general municipal revenues for retirement, the local government is limited to the amount of debt incurred

and the interest rate paid. The Arizona Revised Statutes (ARS) allow a maximum interest rate of nine percent per annum. The ARS state that the amount of debt incurred with general obligation bonds cannot exceed four percent of the total assessed valuation of the taxable property. 5/

This type of bonding is generally not encouraged for water and waste disposal projects. The debt limit as defined by the Arizona Revised Statutes is often very low for small communities. This type of bonding is usually reserved for other types of capital expenditures which cannot be financed by other forms of bonding or federal assistance.

Communities may find that mixing general obligation bonds with revenue bonds can be advantageous in marketing the bonds and acquiring federal backing. This is a decision which is dependent upon the bond market, current interest rate and the community's financial planning.

Revenue Bonds

Revenue bonds are used to finance revenue generating facilities. This form of bond is secured by the revenues of the facilities for which they were issued. If these revenues are not sufficient to repay the bonds, the related governmental unit is not obligated to provide tax revenues for repayment. Because these bonds are not secured by the taxing power of the government, they usually bear a higher interest rate than general obligation bonds.

A lower interest rate may be achieved through the assistance of federal insurance and support. The Federal Government (in the case of rural areas, the Farmers Home Administration) will buy issues which cannot be sold at a reasonable rate of interest. The issuing communities must meet specific conditions to qualify for such support, one of which is that the project will reduce the user costs for required services to a level equal to the average of the surrounding communities.

Arizona authorizes the issuance of revenue bonds for specific purposes, including electric, water, gas, transportation, waste disposal systems, and airport and off-street parking facilities. Revenue bonds do not have to meet the debt limitation required by ARS for general obligation bonds. They do have to meet the following statutory requirements; they must be approved by a majority of the voters in a referendum; they must mature within thirty years of the date of issue; they may not bear an interest rate over nine percent and may not be sold for less than par. 6/

Special Improvement Bonds

Special improvement bonds are issued to finance capital improvements on projects such as streets and sewers. The bonds are secured by assessments levied against the properties which are receiving benefits by the improvements. 6/

SPECIAL DISTRICTS

Special Improvement Districts

There are two types of special districts which may be formed to finance environmental improvements. The first is the Special Improvement District. This type of improvement district is formed by the County Board of Supervisors for a defined geographic area and for specific functions. The creation of a special improvement district is easy and straightforward, however, each district has its own set of required procedures for initiation. 7/ To determine what functions each special district may perform and the required procedures for delineation, a review of the appropriate statutes and legal precedent should be carried out.

Special Assessment Improvement District

The second type of special district is the special assessment district. This is the common method of financing required capital improvements, especially for small areas. 7/ The basic premise of this type of district is that the individual properties receiving the primary benefits of the improvement should pay for the improvement. An improvement district may be formed by the city or town council by its own initiative or by petition of the local property owners.

FEDERAL GRANTS AND LOAN PROGRAMS

The Federal Government is increasingly being asked to assist local governments in financing public facilities. There are five federal departments which make moneys available for water systems and waste disposal facilities.

Rural communities with a population up to 5,500 are eligible to receive federal assistance from the Farmers Home Administration (FHA) of the Department of Agriculture. FHA provides assistance in the form

of loans, grants and technical assistance to rural communities, nonprofit organizations, new towns and, under special conditions, responsible land developers. Eligibility and grant approval is on an individual project basis within the guidelines established by the administrating agency.(See TABLE II-1.)

Both FHA and the Department of Housing and Urban Development (HUD) provide federal assistance to communities between 2,500 and 5,500 population.

Communities in excess of 5,500 population must apply to HUD for federal community services assistance. Also included under HUD's jurisdiction are councils of government, counties, special districts, states and non-profit organizations serving urban communities.

To encourage the expansion and development of a designated areas' economy, the Economic Development Administration (EDA) of the Department of Commerce also provides grants and loans for water and waste disposal facilities. To qualify, a state, county or community must be designated an economic redevelopment district or area. In certain cases these EDA grants can be used to supplement other federal grant-in-aid programs which may be received by the applicant.

The Department of Health, Education and Welfare provides grants for the development of solid waste disposal projects which demonstrate new techniques of disposal or recycling. At the present time Arizona does not have a state agency designated to administer this program nor a statewide solid waste disposal plan. This means that all inquiries for this must be directed to the Public Health Service in San Francisco, and must be of such scope as to serve an area large enough to be considered a district.

The Federal Water Pollution Control Administration administers grants for the construction of sewage treatment facilities and outfalls which are needed to prevent inadequately treated sewage from being discharged into public waterways. TABLE II-1 provides an outline of the federal programs available to assist rural communities in providing the basic water and waste disposal facilities required by their residents.

TABLE II-1

MAJOR FEDERAL AID PROGRAMS UTILIZED FOR PROVIDING ENVIRONMENTAL SERVICES*

Program Title	Authorizing Legislation	Administering Agency	Program Description
Rural Water and Waste Disposal Assistance	Consolidated Farmers Home Administration	Farmers Home Administration, U.S. Dept. of Agriculture Andrew J. Mayberry Rm. 6026, Federal Bldg., 230 N. 1st Ave. Phoenix, Ariz. 85025	Loans, grants & technical assistance are made available to towns under 5,500 population or profit and non-profit organizations for the engineering, construction, repair or expansion of domestic water, sewage treatment and solid waste disposal facilities.
Public Works Planning Advances	Section 701 Housing Act	Community Resources Development Admin. Dept. of Housing & Urban Develop. 2500 Wilshire Blvd., Los Angeles, Calif., 90056	Interest-free advances are to states, municipalities & other public bodies to aid in financing the engineering and architectural design work which is preliminary to the construction of a public works project.
Advance Acquisition of Land	Section 704 Housing and Urban Development Act	Community Resources Development Administration, Dept. of Housing & Urban Development, 2500 Wilshire Blvd., Los Angeles, Calif., 90056	Grants for interest charges on funds borrowed to provide for the propitious acquisition of land needed up to 5 years in advance of public works projects.

TABLE II-1
(Continued)

Program Title	Authorizing Legislation	Administering Agency	Program Description
Public Works & Econ. Dev. Facilities	Public Law 89-136 Title II	Economic Devel. Administration, Dept. of Commerce, Paul Luke, 522 N. Central, Phoenix, Arizona 85025	Grants up to 50 % of project costs & loans up to 100% of land acquisition and improvements for public works and service facilities to encourage industrial or economic expansion. Only projects designated "redevelopment areas" eligible.
Basic Water & Sewer Facilities Grants	Section 702 Housing & Urban Development	Community Resources Develop. Administration Dept. of Housing & Urban Development 2500 Wilshire Blvd. Los Angeles, Calif. 90056	Direct grants up to 50% of the cost of land & construction are made to assist communities in the construction of basic water & sewer facilities, excluding sewage treatment, necessary to improvement of health and living standards.
Public Facility Loans	Title II Housing Amendments of 1955	Community Resources Development, Administration, Dept. of Housing & Urban Development 2500 Wilshire Blvd. Los Angeles, California 90056	Long term, low interest loans are made to finance local public works projects where credit is not otherwise available on reasonable terms.

TABLE II-1
(Continued)

Program Title	Authorizing Legislation	Administering Agency	Program Description
Grants for Waste Treatment Works Construction	Section 8, FWPC Act 33 U.S.C. 466 et seq	Environmental Protection Agency, Dept. of Interior, c/o Arizona State Dept. of Health, Water Pollution Control Division, Joe Obr, Director, 4019 N. 33d Ave., Phoenix, Arizona	Grants are made to states & municipalities to assist in the construction of waste treatment works, including outfall & Interceptor sewers, which are needed to prevent discharge of inadequately treated sewage.
Solid Waste Disposal	Solid Waste Disposal Act	Bureau of Solid Waste Management, Dept. of Health, Education and Welfare, 760 Market St. San Francisco, California 94102	State and local agencies may receive grant support for demonstrations relating to the application of new or improved methods of solid waste collection, storage, processing and ultimate disposal.

*Compiled by Project Staff. For further information contact State of Arizona Department of Economic Planning and Development, 3003 North Central, Suite 1704, Phoenix, Arizona 85012. Phone: (602) 271-5005.

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2. Shah, K. L. and G. W. Reed. "Technique for Estimating Construction Costs of Waste Treatment Plants," Water Pollution Control Federation Journal, May 1970.

2. Nelson, A.G. and Busch, C.D., Cost of Pumping Irrigation Water in Central Arizona, University of Arizona, Technical Bulletin 182, April 1967.

4. U. S. Department of Health, Education and Welfare, Public Health Service Environmental Health Bureau of Solid Waste Management, Sanitary Landfill Facts, Publication 1792, Second Edition, 1970.

5. Constitution of Arizona, Article IX, Sec. 8 and ARS 35-451 through 475.

6. Arizona Revised Statutes 9-521 through 9-540.

7. Arizona Revised Statutes 9-692 and 9-731.

SECTION III

CHAPTER I. POPULATION PROJECTIONS METHODOLOGY

In this study, population projections are presented for the county and all well-defined communities with less than 5,500 residents. In general, county projections are easier to make, and wider choice of method is available than for communities. A lengthy time series is available for Arizona county populations and these data are sufficient to lend themselves to several different approaches for population projections. Community data, however, are quite often difficult to find, and this limitation constrains the choice of projected population methods that can be utilized. For these reasons, different methodological approaches are used for the county and the community level.

COUNTY POPULATION PROJECTIONS

This projection basically utilized a ratio of the county population to the state total. The method is explained below, and Graham County is used as an example.

TABLE I-1

GRAHAM COUNTY POPULATION PROJECTION

Year	Arizona Population	Graham County Population	County as a % of State	Annual Average Rate of Growth
1950	749,857	12,985	1.73	
1960	1,306,161	14,045	1.08	-4.6
1970	1,777,482	16,578	0.93	-1.48
1975	2,081,500	18,525	0.89	-0.98
1980	2,381,500	21,195	0.89	-0.48
1990	3,108,500	27,355	0.88	-0.15

TABLE I-1 shows the data used to project Graham County's population. The first row shows the population of the state and below that is the population of Graham County. The third row shows Graham County's population as a percent of the state's and the fourth row shows at what rate that ratio has declined over time. For instance in 1950

Graham County had 1.73 percent of the state's population and by 1960 it had only 1.08 percent. Over the ten-year period, Graham County's share of the total state population declined at an average annual rate of -4.6 percent per year. Likewise, the rate of decline of the county's share of state population between 1960 and 1970 was -1.48 percent per year. That is, the ratio of the county's population to the state still declined, but not as fast as it did from 1950 to 1960. The ratio of the county's population to the state's declined at an annual average rate of 4.6 percent per year between 1950 and 1960 and at an annual average rate of 1.48 percent per year between 1960 and 1970. The projected annual average rate of growth of the ratio between 1970 and 1975 is -0.98 percent per year and this seems to be in line with the past trend. If the ratio between 1970 and 1975 does decline at this annual rate (-0.98 percent per year) then in 1975 Graham County will contain 0.89 percent of the state's population as seen in row three, column four. That percent is then applied to the projected state population for 1975 to get a county projection for that year of 18,525. (The state population projection has previously been made by the U. S. Bureau of Census.) The same method is then used to project the county's population for 1980 and 1990. One final refinement is then made. After each county's population was projected in the above manner, the projections were forced (proportionally increased or decreased) to sum to the projected total for the state.

COMMUNITY POPULATION PROJECTIONS

Small Arizona communities for which good population time series are available seem to be the exception rather than the rule. Payson, for instance, is one of the communities under study in Gila County and a Payson population projection is required. However, no census population data have ever appeared for that particular community, thus eliminating the use of the ratio method in projecting Payson's population. Other communities, for which good historical data are available, have demonstrated wide population swings in past years and there often appear to be no close relationships between the community population and the county. Once again, the ratio method is inappropriate.

The method that has been chosen for community population projections is based upon annual average growth rates. Where a good community time series is available, the annual average rate of growth over the previous twenty years is calculated. If there are no apparent factors that are expected to cause the community to deviate from that rate, then the population is simply extrapolated into the future using the historical rate. If dynamic factors are apparent that can cause a

significant deviation from past trends, then the seasoned judgment of the researcher is required to anticipate the magnitude and direction of these changes. There is no "formula" available to accomplish this, and oftentimes local knowledge, plans and judgment are the most important factors in the projection. Judgment is usually preferable to a strict adherence to a rigid methodology.

Judgment also plays an important role in projecting population for a community such as Payson. Where no officially documented current population data are available, estimates by local sources (banks, utilities, post offices, etc.) are used as a base. If no past trends are available to indicate future growth, then judgment is again called for and potential growth rate that seems appropriate for the community must be selected and extrapolated to the future. Again this rate is based upon knowledge of local resources and plans for exploitation.

Rates of growth based upon the above method are designated the medium projection and are thought to be the most probable. But, since a high degree of error is possible, a projection range is desirable. By reviewing the historical growth of a cross section of small Arizona towns, it appears that the growth rate for a short period (ten years, for instance) may deviate by as much as two percentage points from the long-term growth rate. Thus, a community may have increased in population at an annual rate of growth of four percent per year over a thirty-year period. But in one particular decade of that period it may have increased as little as two percent per year or as much as six percent. This range of plus or minus two percent could, then, be taken as the high and low projections for the community and the probability should be quite high that the actual future population will fall somewhere in that range. The problem is that by ranging the high and low projections by plus or minus two percent from the medium rate, the resultant projections are so wide as to be practically meaningless. An alternative range was therefore chosen.

The majority of the small communities in the state have not exhibited deviations significantly greater than plus or minus one percentage point in terms of the annual average rate of growth. The exceptions are those that annexed large numbers of persons in a particular decade and those that either gained or lost population due to dramatic changes in employment opportunities. But, it is felt that these types of dramatic population changes cannot be accurately incorporated into a twenty year projection. Therefore, the range of plus or minus one percent is utilized herein.

CHAPTER II. EMPLOYMENT PROJECTIONS METHODOLOGY

In this study, employment projections have been prepared for the county on an industry by industry basis for 1990. The projection of total employment in Cochise County is related to the 1990 median population and labor force projections. The labor force is projected as a percentage of the population. In this case, the labor force participation rate is increased from 33.3 percent of the population in 1970 to 35 percent in 1990 in accordance with established trends.

The percent of the population which might be unemployed was applied to the projected civilian work force to obtain an estimate of unemployment. A 3.0 percent unemployment rate was used which assumes full employment in the economy. This results in a projection of 31,438 total employment in Cochise County in 1990.

The distribution of the employment among the broad industry groups is based primarily on the 1967 labor earnings distributions. However, knowledge of local plans and conditions and the judgment of the analyst have been used to modify statistical trends. The average annual numerical increase is projected as a more reasonable estimate of future employment in the industry. In the case of trade and services, the absolute increase obtained through this numerical average approach is modified to provide what is believed to be a reasonable estimate in the judgment of the researcher as related to changes occurring in the economic structure.

The finance, insurance, real estate, transportation, communication and public utilities industries reflect a reasonably stabile employment to population ratio; therefore, this ratio is projected forward with some confidence.

In the remaining sectors, mining, contract construction, government and agriculture dynamic factors are apparent from the industry analysis which are certain to cause significant deviation from 1967-1970 employment trends. Therefore, independent estimates were made. Mining, for instance, was adjusted to reflect the closing of the Bisbee mines and partial reopening under more automated conditions. Contract construction was increased significantly to reflect the fact that Central Arizona Project construction will still be taking place in

1990. Civilian government employment was increased in relative importance compared to 1970 to compensate for the present cut-back in civilian employment in the Armed Forces. Agricultural employment was decreased absolutely to reflect developments projected to take effect in the sector by 1990.

CHAPTER III. PROJECTION METHODOLOGIES FOR WATER SUPPLY DEMANDS AND SEWAGE PRODUCTION LEVELS

GENERAL DISCUSSION

Good management and design of water-supply and wastewater-removal systems demand a knowledge of the volumes and flows involved and their relation to population and time. An idea of water demands is obtained by review of past and current rates of water use stated in terms such as gallons per day per capita or gallons per day and month, etc. The per capita and related figures generalize the experience and are, therefore, useful in comparing the use records of different communities and in estimating future needs of individual communities and areas (county).

The quantities of water delivered in North American Communities tend towards values shown in TABLE III-1, but with wide variations, because of differences in (1) climate, (2) standards of living, (3) extent of sewerage, (4) type of commercial and industrial activity, (5) cost of water, (6) chemical quality of water, (7) distribution system pressures, (8) completeness of meter age and (9) irrigation practices.

TABLE III-1

NORMAL WATER CONSUMPTION

	Quantity, gpcd*	
Class of Consumption	Normal Range	Average
Domestic	15 - 70	50
Commercial & Industrial	10 -100	65
Public	5 - 20	10
Water Unaccounted For	10 - 40	25
TOTAL	40 -230	150

*Gallons per capita per day.

Source: Fair, G.M.; D. A. Okun, Water and Wastewater Engineering, Volume 1, Water Supply and Wastewater Removal, 1966, John Wiley and Sons.

The "normal range" of variations noted in TABLE III-1 are complicated, with respect to projecting future needs, in that water use practices of people over time have been increasing.1, 2/

Concomitant to water use will be the production of sewage wastes. These wastes are disposed of by some form of individual facility or, if available, in a sewage collection system. The qualities of wastewaters produced are related to the factors stated above with the exception of irrigation practices. Sewage flows are usually 60 to 70 percent of domestic water use rates and sometimes greater where sewage collection systems are relatively new and moderate climates prevail.3, 4 /

SPECIFIC PROCEDURES

Future water demands for small rural communities were based on review and analysis of current and past water use data obtained through public works directors or private water utilities. Data obtained for long periods of time were considered as most reliable while, in some cases, where limited amounts of data were available, generalizations had to be made. Water use for a years time and the variations for the time of year were tabulated. From this information, each month of the year was quantified as a percentage of the maximum month of water use which in all cases occurred during the summer. From these monthly percentages an average was obtained for the year's average monthly use which for most areas surveyed, was in the range of 60 to 80 percent of the maximum month.

From the maximum and minimum month consumption data, which corresponds basically to the summer and winter periods of the year respectively, per capita water consumption rates were calculated. These figures were calculated for each year in which past data were available. Those communities with long series of data, i.e., 10 years, indicated an increasing trend in per capita water use. In some cases where a definable industrial sector of economic activity was present, the increasing trends for domestic water use were, in a sense, overshadowed by the industrial water use rates. For example, the community of Fredonia has an industrial classed water user which demands 1,600,000 gallons of water per month while residential classed users demand an average of 18,500 gallons per month.

Considering the increasing trends exhibited by the rural communities under study and information derived from a limited literature review, an assumption of increasing per capita water use amounting to an average of two (2) gallons per capita per year was used in this report.

Although there are definite possibilities of variation in this figure, depending on the local situations, it was felt that for rural areas with populations less than 5,000, two (2) gallons per capita per year is indicative of these areas.

Determination of present per capita water use rates and the expansion of these rates to the years 1975, 1980 and 1990; and then multiplied by the population projections for the area results in projected water needs.

Determination of county needs for the years 1975, 1980 and 1990 were obtained by averaging the per capita summer and winter demands for all areas of development in the county. In Coconino County for example, water use rates for the community of Flagstaff were included in the determination of present average county per capita water uses. These figures were again expanded by use of the two (2) gallons per capita per year and multiplied by the residual population figures determined by subtracting from the projected total population figures for the county, the population of selected communities outlined individually. A summation was then carried out to arrive at a total county demand estimate for water needs. These figures were developed in terms of total yearly water needs in acre-feet.

Sewage production rates levels were assumed proportionate to the domestic water use rates. Sewage flows during winter within an individual community were estimated as being 70 to 75 percent of the water used. Summer sewage flows were estimated at 60 - 65 percent of the water used in the community. 4/ The lower percentage during summer months is indicative of more fresh water used for irrigation and cooling purposes which would correspondingly decrease the contribution to sewage flows by residents of an area.

CHAPTER IV. PROJECTION METHODOLOGY FOR SOLID WASTES PRODUCTION LEVELS

GENERAL DISCUSSION

The measurement of rates of solid wastes production for rural areas in Arizona have never been attempted. Some studies have been prepared for the major metropolitan areas of Arizona on solid waste disposal problems and rates of production. Smaller urban areas and rural communities in Arizona have not been a part of any form of study related to defining disposal problems and techniques or actual rates of waste production.

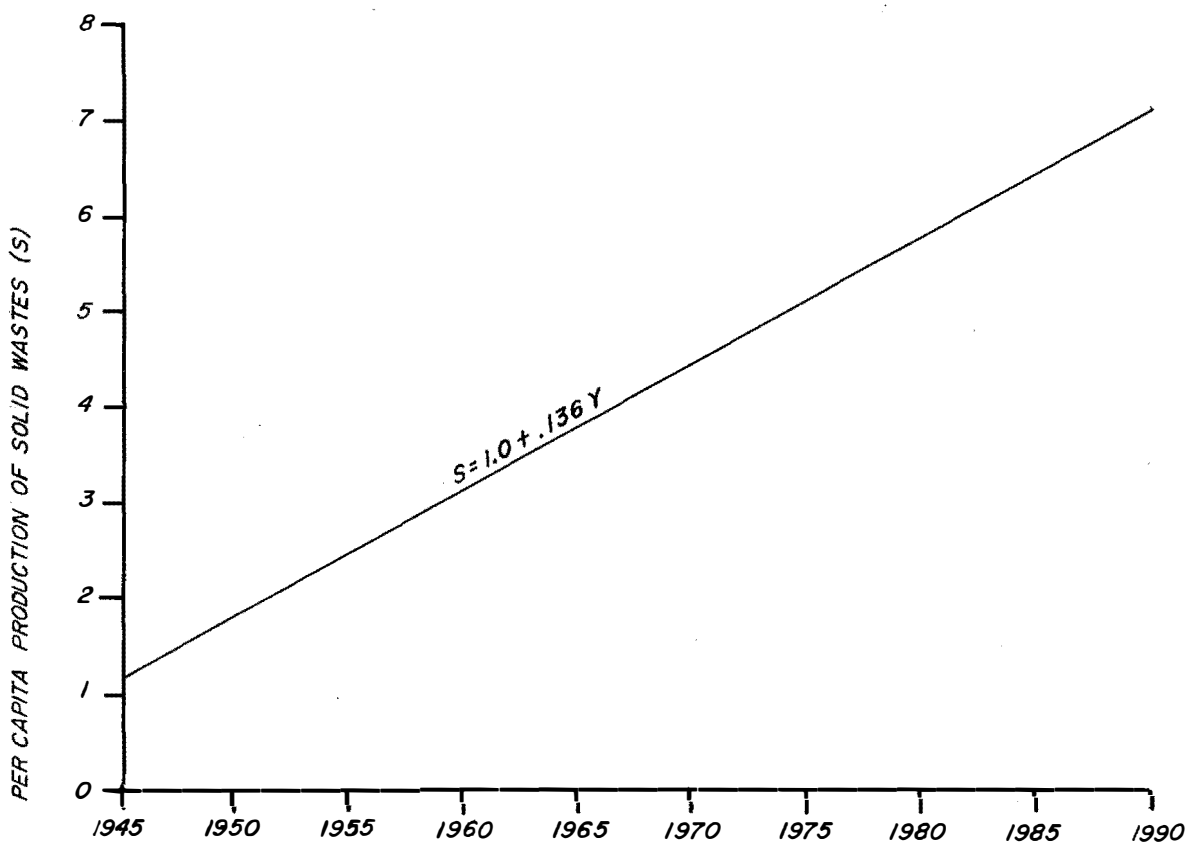
Generally solid wastes are defined as those materials that are solid or semi-solid consisting of refuse, garbage and rubbish. Solid wastes and by-products related to their breakdown constitute one of the forms of environmental pollution that is growing at an alarming rate! It is estimated that per capita quantities of garbage produced in the 1970's will increase 50 percent and that by the 1980's production are estimated to double. 5,6/

SPECIFIC PROCEDURES

As no valid indicators of solid waste production levels were available with which to quantify levels of production, a literature review was undertaken to develop per capita solid waste production figures. Articles and publications were reviewed which made some reference to rural areas or small communities. Waste production levels on a per capita basis were used to develop an equation which would give an idea of the future solid waste production levels and the anticipated increasing trends.

FIGURE IV-1 depicts the increase of per capita solid wastes production levels according to the equation indicated which was obtained from regression analysis of data for the 23-year period from 1946 to 1968.

Production levels in tons per year outlined for individual communities and county totals were obtained by multiplying population figures by the per capita production levels obtained from FIGURE IV-1 for the respective projection years.



S = Solid wastes production, lbs. per capita per day

Y = (A - 1945)

A = Year for which "S" is to be determined from 1946 thru 1990

FIGURE IV-1, PER CAPITA SOLID WASTES PRODUCTION LEVELS FROM 1946 TO 1968 AND PROJECTIONS TO 1990
(Source: Reference 5 through 21)

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