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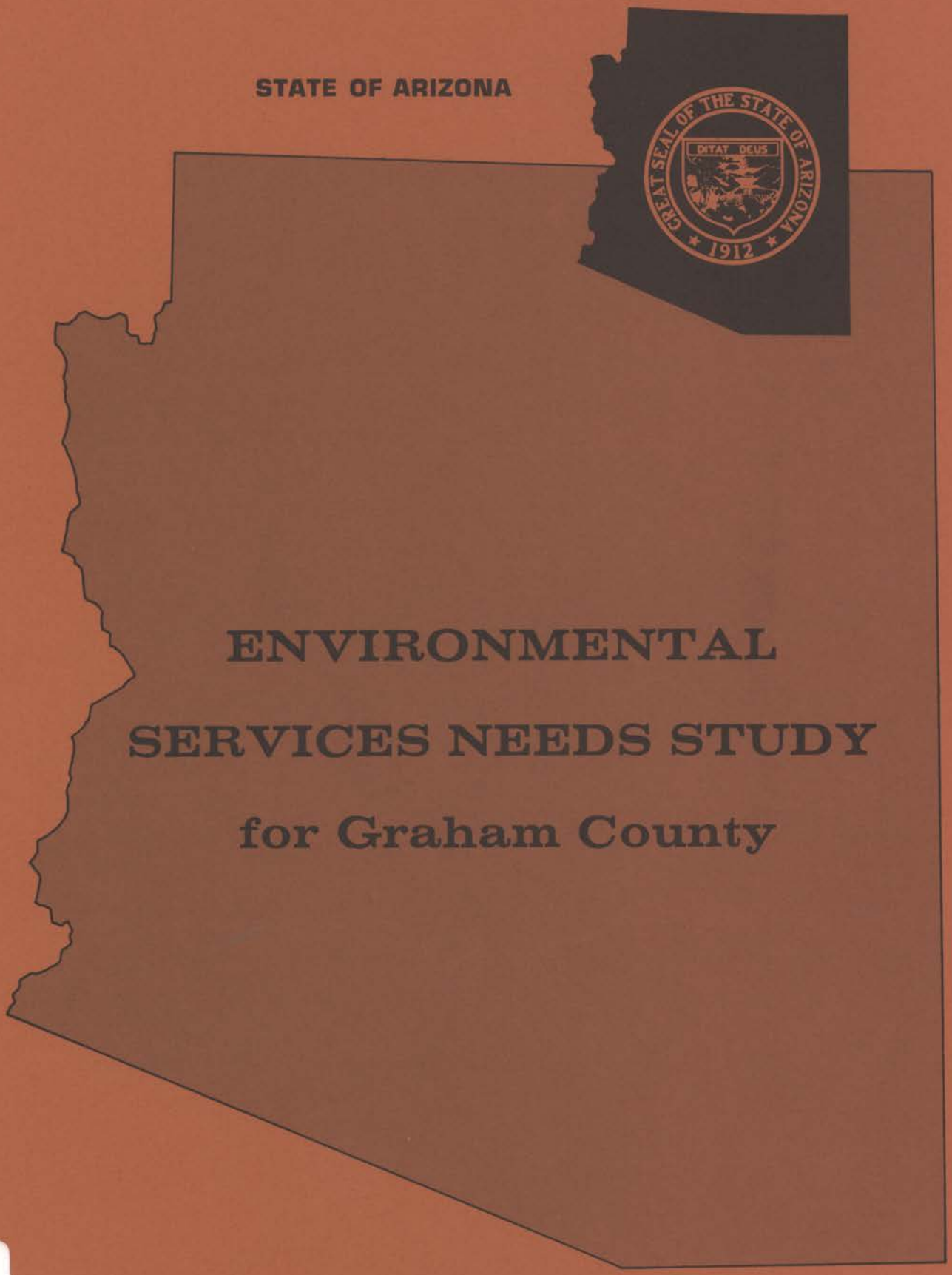

ENVIRONMENTAL SERVICES NEEDS STUDY for Graham County

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Ec-7

Planning Division • Office of Economic Planning and Development

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STATE OF ARIZONA

GRAHAM COUNTY

ENVIRONMENTAL SERVICES NEEDS STUDY

1970-1990

Prepared by

PLANNING DIVISION

OFFICE OF ECONOMIC
PLANNING AND DEVELOPMENT

April 1975

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of Agriculture, Farmers Home
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FOREWORD

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 was organized on a county basis with FHA regulations providing the framework for selections of study areas within the counties. 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 services in rural areas of Graham County. In addition, the completion of the study meets the following related objectives:

> The delineation of probable areas of community growth and their concomitant need for "environmental service systems" (see definition).
>
> An appraisal of existing land use patterns and environmental services problems which may result from various types of future use.
>
> The collection and interpretation of data projecting the future needs for environmental services on a county-wide and individual community basis.

Definitions

For the purposes of this report, the following definitions shall apply.

> "ENVIRONMENT" - The aggregate of physical, social, and cultural conditions that influence the life of an individual or community.
>
> "SERVICES" - (1) Contributions to the welfare of others; (2) Facilities supplying some public demand.
>
> "COMMUNITY" - (1) A unified body of individuals; (2) People with common interests living in a particular area.
>
> "WATER SUPPLY SYSTEM" - Wells, surface water collection reservoirs, storage reservoirs and tanks, water treatment equipment, distribution pipelines, water meters and all other appurtenances which serve to supply the public within a community or built-up area with a source of water suitable for drinking.
>
> "SEWERAGE" - Pipelines and/or appurtenances which serve the public within a community or built-up area with a means of disposing sewage wastes from the properties on which they may reside. This term refers to the means by which sewage wastes are transported to some point removed from the community, or built-up area, for treatment.

"SEWAGE TREATMENT SYSTEMS" - Devices or equipment used for the expressed purpose of removing the organic and pathogenic constituents of sewage, and capable of producing an effluent safe for discharge to a water body, stream or disposal by seepage through soil to subterranean water tables.

"SOLID WASTES DISPOSAL METHODS" - Devices and/or means serving, or utilized by, the citizens of a community, or built-up area, for removal of disposal of garbage, trash, grass and brush clippings from places of residence.

"ENVIRONMENTAL SERVICES" - "Water Supply Systems," "Sewerage," "Sewage Treatment Systems" and "Solid Wastes Disposal Methods" utilized by the citizens of a community, or built-up area to serve public welfare and enhancement, enjoyment or maintenance of the environment in which they reside.

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SECTION 1

CHAPTER I. INTRODUCTION AND SUMMARY

The preparation of this report on Environmental Services Needs in Graham County was financed in part by a grant from the U.S. Department of Agriculture, Farmers Home Administration. The intent of the report is to establish a basis from which planning for future environmental service needs for rural communities can be undertaken. The report has been organized to present a perspective of county needs as a summary of individual needs within the rural communities of the county. Farmers Home Administration regulations were used to establish a framework for selection of study areas in which the basic requirement is a semblance of community organization and/or a population not exceeding 5,500 when the study was undertaken.

The general well-being of citizens and character of a community can be assessed to a certain degree by the adequacy and availability of community services and facilities, i.e. schools, parks hospitals, and environmental services. In larger, well established communities, the provision of such services is not too difficult a task, since programs and established procedures are available to meet the occurring needs. However, smaller rural communities often have difficulty in the timely development of facilities and services to meet needs generated by community growth. This is not primarily a function of government, within a rural community but the lack of planning guidelines which allow for coordinated development of needed facilities.

There are federal and state grant and loan programs available to rural communities for financing needed facilities. The primary prerequisite for these programs is a planning study.

This report is concerned with the identification and evaluation of three of the basic services generally found in a community. The systems are water supply, sewage collection and disposal facilities, and solid waste management facilities as defined in an environmental context as follows:

> "ENVIRONMENT" - The aggregate of physical, social, and cultural conditions that influence the life of an individual or community.
>
> "SERVICES" - (1) Contributions to the welfare of others; (2) Facilities supplying some public demand or need.
>
> "COMMUNITY" - (1) A unified body of individuals; (2) People with common interests living in a particular area.
>
> "WATER SUPPLY SYSTEM" - Wells, surface water collection reservoirs, storage reservoirs and tanks, water treatment equipment, distribution pipelines, water meters and all other appurtenances which serve to supply the public within a community or built-up area with a source of water suitable for drinking.
>
> "SEWERAGE" - Pipelines and/or appurtenances which serve the public within a community or built-up area with a means of disposing sewage wastes from the properties on which they may reside. This term refers to the means by which sewage wastes are transported to some point removed from the community, or built-up area, for treatment.

"SEWAGE TREATMENT SYSTEMS" - Devices or equipment used for the expressed purpose of removing the organic and pathogenic constituents of sewage, and capable of producing an effluent safe for discharge to a water body, stream or disposal by seepage through soil to subterranean water tables.

"SOLID WASTES MANAGEMENT SYSTEMS" - Devices and/or means serving, or utilized by, the citizens of a community, or built-up area, for removal of disposal of garbage, trash, grass and brush clippings from places of residence.

"ENVIRONMENTAL SERVICES" - The aggregate of "Water Supply Systems," "Sewerage," "Sewage Treatment Systems" and "Solid Wastes Management Systems," utilized and relied upon, by the citizens of a community, or built-up area to serve public welfare and maintenance of community integrity ("Environment").

Conclusions related to existing needs outlined in this report are based upon field surveys and information provided by community, county and state representatives. Future needs are based upon methodologies discussed in Section III of this report and qualitative judgements as to life expectancies of existing facilities, and modifications or expansion requirements indicated by respective rates of growth.

The vast majority of population and development within Graham County is in the Safford Valley.

TABLE I-1

EXISTING AND FUTURE* WATER SUPPLY AND DISTRIBUTION NEEDS IN RURAL AREAS OF GRAHAM COUNTY

Community or Developed Area	Existing Needs**					Future Needs 1980					Future Needs 1990				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Safford	●					●					●			●	●
Thatcher	●					●					●			●	●
Ft. Thomas			●			●			●	●	●				
Pima				●		●				●	●				

**Needs classifications:

1. Replacement and/or modifications (expansion) within distribution system.
2. Water storage or additional storage facilities.
3. Detailed engineering evaluation of system and preparation of distribution network schematics.
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.

Existing and future water supply and distribution needs for communities surveyed in the Safford Valley are outlined in TABLE I-1. The needs expressed are categorized in terms of varied system modifications and/or expansions, water supply augmentation or additional engineering evaluation of the existing facilities or needed systems.

TABLE I-1 illustrates the need for water supply augmentation in two areas due to increasing land development activities.

Future water supply demands for the rural areas noted in TABLE I-1 are presented in TABLE I-2.

TABLE I-2

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

DEVELOPED AREA	PROJECTION YEAR	DOMESTIC WATER DEMANDS PROJECTION LEVELS* LOW	MEDIAN	HIGH
	1975	44	46	50
Ft. Thomas	1980	50	56	62
	1990	67	80	98
	1975	196	206	217
Pima	1980	224	247	273
	1990	290	353	429
	1975	784	800	816
Safford	1980	857	890	928
	1990	1,020	1,100	1,195
	1975	370	390	405
Thatcher	1980	400	445	490
	1990	475	580	695
All Other Areas	1975	1,027	1,042	1,046
of Development**	1980	1,251	1,287	1,327
	1990	1,830	1,948	2,062
	1975	2,421	2,484	2,534
COUNTY TOTAL	1980	2,782	2,925	3,236
	1990	3,682	4,061	4,469

*Water demands are based on low, median and high population projection levels.
**All Other Areas of Development in the Safford Valley and Graham County.

Source: Staff calculations.

The demands noted in TABLE I-2 will be placed on the existing 24 public and semi-public water purveyors in the county (TABLE I-3). Of the 24 systems 95 percent are in a sixteen mile radius of the City of Safford. Also, 17 percent of these systems are investor owned operations. The type of consumers are noted in TABLE I-4.

TABLE I-3

GRAHAM COUNTY PUBLIC AND SEMI-PUBLIC
WATER UTILITIES CLASSIFICATION
July 1974

Class of Owner	Number of Systems
Investor	5
Municipal	4
County	2
Federal	14
TOTAL	25

Source: Arizona State Health Department, Water Supply Division

The general locations of water supply systems are found in PLATE 3. Although a rigid analysis was not undertaken for this report, domestic water sources in future years appear adequate in reference to the estimated demands which could conceivably reach 4500 acre-feet per year by 1990. Present domestic demands are estimated at 2100 acre-feet per year.

TABLE I-4

GRAHAM COUNTY DOMESTIC WATER
SUPPLY CONSUMER CLASSIFICATIONS

Type of Consumer	Number of Systems
Trailer Park	1
Community	4
Motel	2
Subdivision	1
Industrial	1
Camp	2
Recreation	14
TOTAL	25

Source: Arizona State Health Department, Water Supply Division

Existing and future needs for sewage collection and treatment facilities are presented in TABLE I-5. An inventory of wastewater collection and treatment mechanisms is provided in TABLE I-6 and shown on PLATE 3.

TABLE I-5

EXISTING AND FUTURE* SEWERAGE AND WASTEWATER TREATMENT FACILITIES NEEDS IN RURAL AREAS OF GRAHAM COUNTY

Community or Developed Area	Existing Needs**					Future Needs 1980					Future Needs 1990				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Safford			●							●			●		
Thatcher					●			●					●		
Ft. Thomas	●					●							●		●
Pima	●					●							●		●

*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. Construction of collection network and sewage treatment facilities.
3. Expansion and/or additions to sewage collection network.
4. Expansion and/or modification of treatment facilities.
5. Consideration of wastewater reclamation for agricultural or industrial uses should be reviewed.

Source: Staff estimates.

TABLE I-6

WASTEWATER COLLECTION AND TREATMENT FACILITIES INVENTORY FOR GRAHAM COUNTY - 1973

Location	Type Installation	Type Treatment
Bylas	BIA	Evaporative Lagoon
Swift Trail Junction	Bureau of Prisons (Fed.)	Stabilization Lagoon
Fort Grant	State	Aerated Lagoon
Safford	Municipality	Aerated Lagoon
Thatcher	Municipality	Stabilization Lagoon

Oxidation ponds provide the basic form of wastewater treatment found in the county. The septic tank concept of sewage treatment is used extensively in the remaining rural areas.

Wastewater production levels within the county are presently estimated at 1500 acre-feet per year. The major portion of this production is generated in the Safford-Thatcher area (41 percent). Projected future levels of sewage production that may be generated by the year 1990 are noted in TABLE I-7.

TABLE I-7

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

DEVELOPED AREA	PROJECTION YEAR	SEWAGE PRODUCTION PROJECTION LEVELS* LOW	MEDIAN	HIGH
	1975	28	30	32
Ft. Thomas	1980	32	35	39
	1990	44	53	65
	1975	128	134	141
Pima	1980	149	164	181
	1990	189	230	280
	1975	470	480	490
Safford	1980	528	548	571
	1990	656	707	768
	1975	240	250	265
Thatcher	1980	270	295	325
	1990	310	380	460
All Other Areas	1975	636	645	648
of Development**	1980	793	815	841
	1990	1,260	1,340	1,418
	1975	1,502	1,539	1,576
COUNTY TOTAL	1980	1,772	1,857	1,957
	1990	2,459	2,710	2,991

*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 in the Safford Valley and Graham County.

Source: Project Staff Estimates.

Problems related to the adequate disposal of refuse, garbage and other forms of solid waste materials become more evident within an area as population densities increase. At present solid waste disposal problems in rural areas of Graham County are minimal. This is primarily because of an efficient management program of the Graham County Health Department. A few isolated dumpsites exist however, the sanitary landfill concept of disposal is used as a form of solid wastes disposal. An inventory of sites for Graham County is noted on PLATE 3.

The existing county landfill handles an estimated 15,000 tons per year (1974) of waste materials. Future annual production levels for solid wastes are noted in TABLE I-8.

TABLE I-8

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

DEVELOPED AREA OF COMMUNITY	PROJECTION YEAR	SOLID WASTES PRODUCTION PROJECTION LEVELS* LOW	MEDIAN	HIGH
	1975	305	320	340
Ft. Thomas	1980	380	420	460
	1990	570	690	840
	1975	1,205	1,265	1,330
Pima	1980	1,500	1,655	1,830
	1990	2,240	2,730	3,320
	1975	5,200	5,290	5,405
Safford	1980	6,190	6,430	6,700
	1990	8,460	9,120	9,900
	1975	2,270	2,690	3,675
Thatcher	1980	2,380	2,975	4,780
	1990	2,500	3,280	5,380
	1975	6,750	6,850	6,875
All Other Areas	1980	8,965	9,225	9,510
of Development**	1990	15,070	16,035	16,970
	1975	15,730	16,415	17,625
COUNTY TOTAL	1980	19,415	20,705	23,280
	1990	28,840	31,855	36,410

*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 in the Safford Valley and Graham County.

Source: Staff calculations.

The Gila River groundwater reserves in the Safford Valley area are estimated at 200,000 acre-feet with little apparent drop in the groundwater table over the years. In relation to the projected demands, it appears that an adequate domestic water supply is available to the valley water purveyors. However, the water supply systems will face a continuing series of events related to system modification, expansion and/or new equipment needs.

Preventive maintenance carried out on periodic or continuous schedules for existing system components can prolong expected equipment usefulness. A point in time is inevitably reached where components breakdown or complete failure occurs. In some instances, costs are minimal but in others they can be extensive; i.e. new well pump and motor or new water storage reservoir. Recognition of such eventual needs, on the part of domestic water purveyors, can be effectively utilized to plan for future needs within their respective jurisdictions.

The projected water supply demands for Graham County also reflect increased production of sewage waste waters.

The smaller rural areas of the Safford Valley have marginal needs for centralized sewage collection and disposal facilities. As these areas develop there will be more need for such systems. However, the events leading up to the formation of sewer improvement districts and eventual construction of facilities can be offset by a comprehensive program of maintenance for existing septic tank systems and adherence to detailed rigid design criteria for new septic tank facilities. The soil characteristics of the Safford Valley are predominantly alluvial and indicates septic tank leach field systems should have long lifetimes.

If projected population levels coupled with poor land use planning result in dwelling unit densities of five or more per acre, sewage collection systems will be in order. When such needs are apparent, review of situations in the entire valley should be undertaken with the intent of establishing a long range plan for resolving regional sewage collection and treatment needs. The rising costs of construction suggests that approaching the development of such systems on a regional scale could provide for the cost effective delivery of future needed services.

The regional approach is further supported by the relationships of the agricultural economy of the area and the use of reclaimed wastewaters as an irrigation supply. The effluent from the Thatcher facility is used in such a manner. Consideration of a regional wastewater management program which includes reclamation and reuse would benefit the Safford Valley in the near future. The establishment of such a program will be initiated by the Arizona State Department of Health this year for purposes of determining the future wastewater treatment capabilities of the valley.

This situation has resulted primarily from a comprehensive program of solid waste management by the Graham County Department of Health. There are dumpsites located at Ft. Thomas, Eden, Thatcher and Ft. Grant, and sanitary landfills located at Central, Safford, San Jose and Artesia. A dumpsite at Pima was recently closed. The location of these sites are noted on Plate 1.

The communities of Pima, Safford and Thatcher have submitted detailed solid waste management plans pursuant to ARS 36-132.01 which indicates effective planning for future facilities has been implemented. By 1990, an estimated 480,000 tons of solid waste will be generated in the Safford Valley (TABLE I-8). Such a quantity will require approximately 400 acre-feet of sanitary landfill volume for adequate disposal. Therefore, site planning (location and size) at this time will resolve a serious disposal situation in the future and correspondingly be cost effective.

Approaches utilized in planning sanitary landfill sites involve mainly site selection, land use, accessibility and environmental acceptability. From the planning stage a design activity results which is well defined up to the time the landfill site is turned over to the operator. At some sites, the planning ceased at this point, and at others, the planning and design diminished. The discontinuity of planning and design results in a scarcity of instructions to aid the operator in optimizing earth movement around the site itself. Improper earth movement can result in a loss of refuse capacity in addition to increased operational costs.

For effective solid waste management an attempt must be made to minimize the total costs associated with a landfill site. It is therefore necessary to extend the planning stage of a solid waste management program and design activities that follow to include day-to-day operations.

CHAPTER II. COUNTY PROFILE

This chapter presents a profile of the physical characteristics, social and economic conditions, and land use and ownership patterns of Graham 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 and economic growth for the county as a whole are also presented. Population growth estimates are utilized in the projection of environmental services needs of the county, and of the individual communities outlined in CHAPTER III.

HISTORICAL PROFILE

The county was formed in 1881 from parts of Pima and Apache Counties. Approximately one-third of the county is Indian Reservation. It is thought that the county was named for the area's highest mountain peak, Mt. Graham. During the 1870's farming settlements began near the present sites of Safford, Thatcher and Pima. The Gila Valley proved to be one of the best farming areas in Arizona and agricultural activities have played a primary role in the life of the county since that time.

Safford has been the county seat at various times throughout the history of the county. It was last made the county seat in 1915 and has remained there to the present.

PHYSICAL CHARACTERISTICS

Physiography and Geology

Graham County contains portions of two major physiographic provinces; the Basin and Range Lowlands (southern two-thirds of county) and the Central Highlands (northern one-third of county). Elevations range from approximately 2,800 feet in the Gila River Valley to 10,720 feet Mr. Graham. In general, the ranges rise 5,000 feet or more above the adjacent valleys.

The county is composed of alluvial plain and valley areas and moderately rugged mountainous terrain. Alluvial valleys are filled with silt, sand and gravel to depths of 2,000 feet in some areas. These primarily unconsolidated deposits are from the Quaternary and Upper to middle Tertiary period. Mountains and rock outcroppings in the north along the eastern border and in the southwest portions of the county consist primarily of volcanic rock of basaltic composition from the Cenezoic era. Older Precambrian rocks of schist, gneiss and fine-to-course grained igneous intrusive rock extend from the northwestern border through the Pinaleno Mountains to the southern county border. Intrusive igneous rocks of the Tertiary and Upper Cretacious geologic periods exist near Aravaipa and the Santa Teresa Mountains.

Soils in the northern portions of the county are developed soils from basaltic parent material. Central and southern areas are covered with alternating strips of shallow soils on granite, schist and basalt parent rock in the steep upland areas and developed soils from acid igneous alluvium in the hilly reaches of the thermic region.

Climate

In general, Graham County experiences cool winters and warm to hot summer temperatures. Winter temperatures normally vary from the low thirties at night to the upper fifties during the day. The average January temperature is 44° F. Summer temperatures usually vary from the mid-sixties to the upper nineties during the day. The average July temperature is approximately 85° F. with generally low humidity. The county averages 200 frost-free days per year.

Graham County generally receives most of its rainfall from summer thunderstorms. Some winter precipitation and occasional strong winds result from storms originating over the Pacific Ocean. Average annual precipitation for the area is ten inches. However, precipitation varies as does temperature, with the topography of the county. For example, Safford experiences approximately nine inches of rainfall each year, while Fort Grant near the Pinaleno Mountains receives over 12 inches of precipitation each year. Snowfall for the county as a whole is generally less than four inches per year.

Natural Vegetation

Vegetational cover in Graham County consists of a variety of types ranging from Ponderosa Pine and other forest trees to creosote bush, salt brush and other plants capable of surviving hot desert climates.

Forested areas containing chaparral, oak woodland and yellow pine exist at elevations above 4,000 feet (FIGURE II-1). Vegetation of this type is most dense in northern portions of the county and in the Galuiro and Pinaleno Mountain ranges. Graham County has 396,333 acres of National Forest lands and an additional 2,001 acres of forests held under state or private ownership. Grasslands containing mesquite and other desert grasses are found throughout the county at elevations between 3,000 and 6,000 feet. Desert conditions prevail along the Gila River and in the southern portions of the county where elevations drop below 3,000 feet. Sagebrush, yucca, burrsage mesquite, creosote bush and Indian wheat are some of the predominant species in this area.

NATURAL RESOURCES

Mineral Resources

Mining activity in Graham County is not extensive at the present time. However, the area is being explored for possible future activities and preliminary reports indicate an extremely high copper potential. Copper mining is now in progress in the Aravaipa Valley, near Klondike and in the eastern portion of Graham County north of Safford.

Lode gold is found in base-metal sulfide replacement deposits and in gold-quartz vein deposits in western Graham County. Smaller deposits are found near Safford. Lead deposits are also found in these two locations.

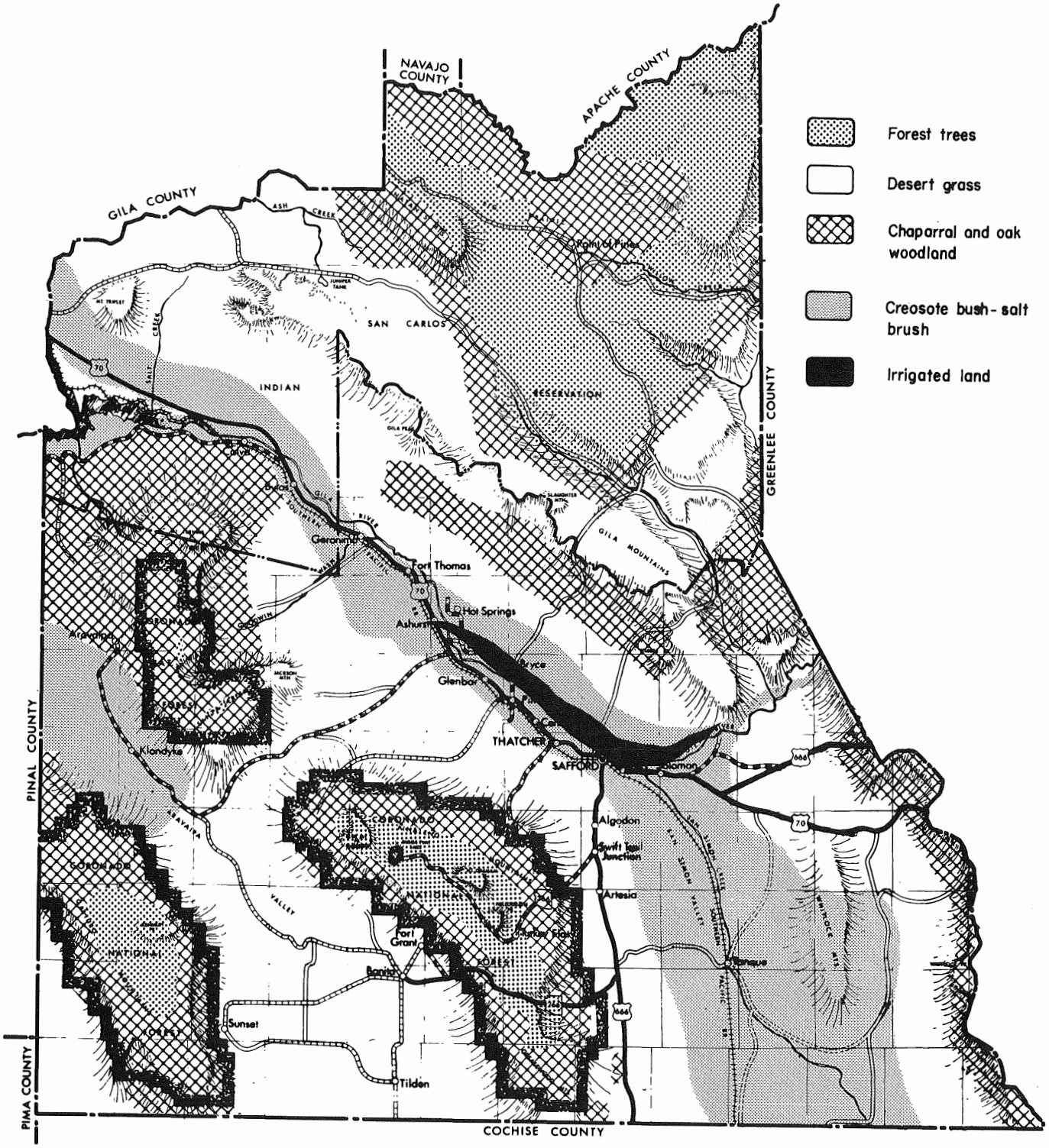


FIGURE II-1. VEGETATION OF GRAHAM COUNTY.

Molybdenum, silver, zinc and beryllium deposits and minor occurrences of antimony and stibium are located primarily in a belt running east - west across the central portion of the county. Cobalt and nickel deposits are found near the Hot Springs - Ashurst area, south of Fort Thomas.

Major occurrences of diatomite exist on the San Carlos Indian Reservation, at Solomon and Whitlock Hills (FIGURE II-2)

Vein type uranium occurrences are found in Southern Graham County and pumice occurs along the eastern border. Sand and gravel operations are in progress in Safford.

Water Resources

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 occurence and availability of water. The brief descriptions of these factors presented in the preceding sections should, therefore, be kept in mind while considering the water resources of Graham County.

Surface Water. For the purpose of water resource studies, Arizona has been divided into several hydrologic study areas based on its interstate river basin and drainage systems. Graham County contains portions of four of Arizona's major drainage systems: (1) Upper Gila River area (80%); (2) Sulphur Springs Valley area (9%); (3) San Pedro River area (10%); and (4) Salt River area (1%). (FIGURE II-3).

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."3/ Storage is water which has been artificially impounded in surface or underground reservoirs, or water which is naturally detained in a drainage basin.

Climatic conditions vary throughout the county influencing to a great extent the amount of runoff made available from precipitation in the area. Although the area receives an estimated 2,220,000 acre-feet of precipitation each year, evapo-transpiration processes reduce the amount of available water by more than 90%. Average annual runoff for most of the area is less than 1.0 inch. However, annual runoff figures are as high as eight inches for higher elevations in the Pinaleno Mountains. Unit runoff figures measuring flow in the main stem of the Gila River (within Graham County) range from 16 to 48 acre feet per square mile. For tributary streams, the range in unit runoff is much greater. A summary of the county's surface water records and streamflow data is provided in Table II-1. All surface water supplies have been appropriated, however, and no real surplus water exists.

Principal storage reservoirs and lakes in Graham County are listed in Table II-2. For the purpose of this report, those areas which retain measurable amounts of surface water only after heavy rains are omitted from the table, since meaningful data regarding capacities of drainage areas for these facilities would have been exceedingly difficult, if not impossible, to generate. Graham County varies between 60 and 64 inches, depending on the location of the water body within the County.

SOURCE: Arizona Bureau of Mines
Bulletin 180

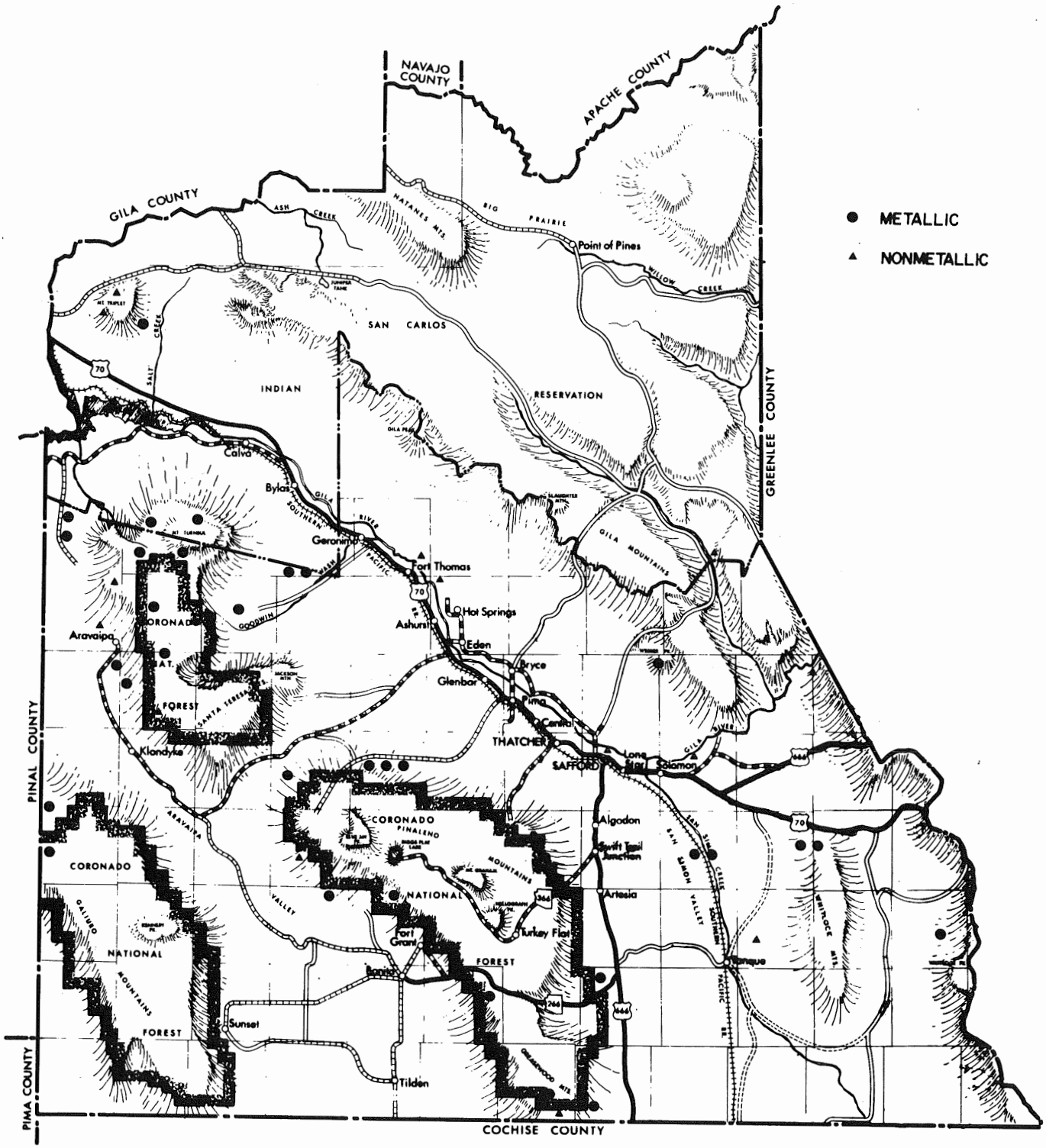


FIGURE II-2. MINERAL OCCURRENCES IN GRAHAM COUNTY.

SOURCE: Arizona Bureau of Mines

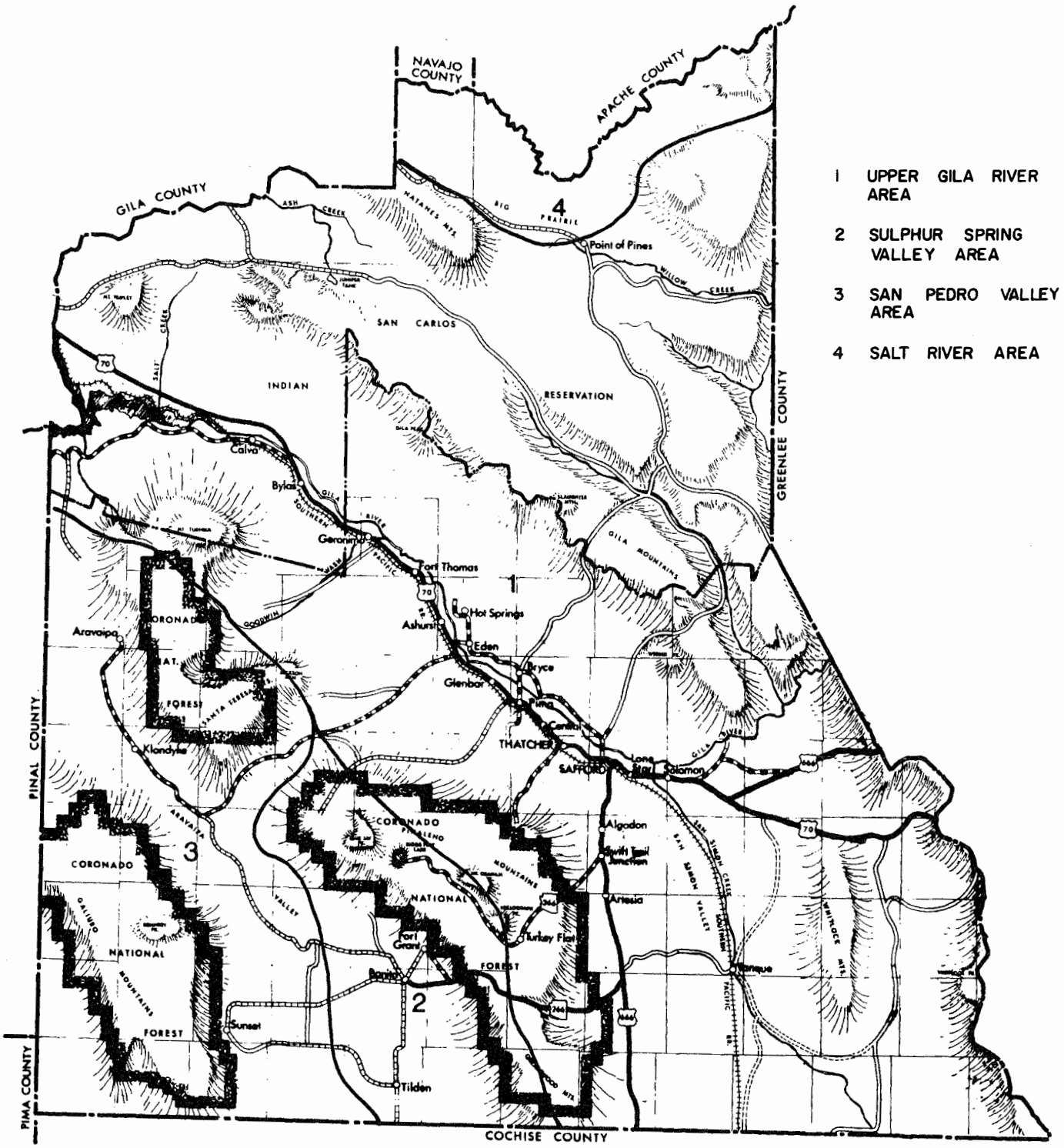


FIGURE II-3. DRAINAGE BASINS - GRAHAM COUNTY.

TABLE II-1

SURFACE WATER RECORDS - STREAMFLOW DATA
GRAHAM COUNTY

Gaging Station and Number*		Drainage Area (sq. mi.)	Elevation of Gage ft. above mean sea level)	STREAMFLOW Average Acre-Ft.	Average cfs**	Max. (cfs)	Min. (cfs)	Unit Runoff (ac-ft/ sq. mi.)	Period of Record (yrs)
4450	Willow Creek Diversion near Morenci	--	5,985	6,320	8.73	26.2	0	--	1945-66
4455	Willow Creek near Point of Pines	102	--	8,330	11.5	3,710	0	82	1944-66
4480	Gila River below Bonita Creek near Solomon	7,856	--	230,900	319	24,000	27	29	1932-40
4485	Gila River at Head of Safford Valley near Solomon	7,896	3,065	320,000	442	100,000	11	40	1914-66
4510	Gila River near Solomon	7,950	--	383,700	530	100,000	25	48	1914-32 1940-50
4570	San Simon River near Solomon	2,192	2,960	10,140	14	27,500	0	4.6	1935-66
4585	Gila River at Safford	10,459	--	205,600	284	33,000	0	20	1940-46 1956-65
4602	Fry Creek at Thatcher	24.	2,955	323	.446	132	0	--	1963-68
4665	Gila River at Calva	11,470	2,514	182,400	252	39,000	0	16	1929-66
4685	San Carlos River near Peridot	1,027	2,580	34,460	47.6	40,600	0	34	1929-66

* gaging station numbers are those used by USGS in surface water records
** cfs = cubic feet per second

Source: Bulletin 180, Arizona Bureau of Mines, Tucson, Arizona, 1969; "Water Resources Data - Part 1, U. S. Department of the Interior, 1969.

TABLE II-2

SELECTED STORAGE RESERVOIRS AND LAKES IN GRAHAM COUNTY

Reservoir or Lake	River Basin	Drainage (sq. mi.)	Type of Structure	*Use	Capacity (acre-ft.)	Surface Area (acres)
Dry Lake	Gila	6.6	Earthfill	R, K	628	150
Graveyard Wash Ret. Dam	Upper Gila	19.3	Earthfill	F	1,270	155
Green Mountain	Gila	0.3	Earthfill	R, K	136	17
H-X Det. Dam	Upper Gila	147.0	Earthfill	F	1,640	172
J. David Lee Dam	Upper Gila	25.5	Earthfill	F	1,900	205
Beef Corral	Gila	5.0	Earthfill	R, K	144	19
Bonita	Gila	20.0	Earthfill	R, K	590	46
Cactus	Upper Gila	0.1	Earthfill	I	55	6
Parks Lake Det. Dam	Upper Gila	132.0	Earthfill	I, M, S	8,000	1,095
Riggs Flat Lake	Upper Gila	1.0	Earthfill	W, R	123	13
Roger Reservoir	Upper Gila	0.0	Earthfill	I	412	35
San Simon Det. Dam	Gila	1,310.0	Earthfill	F	2,900	590
Stockton Det. Dam	Upper Gila	153.3	Earthfill	F	4,700	560
Boni Lake	Gila	2.0	Earthfill	R, K	120	15

*Use F - Flood Control
I - Irrigation
K - Stock Watering
M - Municipal
R - Recreation
S - Silt Control

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

Groundwater. Groundwater is a transitory phase of the hydrologic cycle wherein water percolates downward over long periods of time through weakly consolidated and unconsolidated rock, and is stored below the land surface. Most of the groundwater in Graham County is found in alluvial deposits consisting of sand, gravel, silt and clay. The consolidated sedimentary rocks in the northern portion of the county contain very little space for groundwater storage, however, small amounts of stored water can be found in the fractures of these rocks. This water is discharged by springs in a few areas. In Graham County, the principal areas of groundwater storage are (1) the Safford Basin, (2) the San Simon Basin, (3) Aravaipa Valley, and (4) the Willcox Basin.

The Safford Basin is a typical Basin-and-Range sediment-filled trough trending northwest between uplifted mountain ranges. Over 80% of the basin lies in Graham County - the remainder is found in Gila County. The alluvium underlying the floodplain of the Gila River and its tributaries ranges from 40 to 100 feet thick. This alluvium is at present the principal developed aquifer and is in most cases, capable of yielding from 50 to 2500 gallons per minute (gpm) of water to wells.4/ Groundwater from Safford Basin is used to supplement Gila River surface water used to irrigate specific amounts of county acreage. Groundwater has been pumped for agricultural and irrigation purposes since 1935, and it is estimated that approximately 2.3 million acre-feet of water have been withdrawn from the basin since that time.6/ The depth to water along the flood plain of the Gila River in the Safford Basin varies from approximately 10 to 60 feet. Depth to water in most other areas of the basin rarely exceeds 200 feet.7/ According to the U.S. Geological Survey, approximately 200,000 acre-feet of groundwater is available from storage in the Safford Basin.

That portion of the San Simon Basin located in Graham County also has extensively developed groundwater resources. Well yields are generally the same as those of the Safford Basin. Pumping activities in the region have been relatively continuous since 1915. The large quantity of groundwater withdrawn since that time has caused a substantial decline in the water table. A few areas report declines of more than one foot per year. Just south of Graham County is Cochise County which contains the main portion of the San Simon Basin. Declines in much of this area have been almost three feet per year.

All of the Aravaipa Valley drainage area and a small portion of the Willcox Basin are located in Graham County. These groundwater storage areas have not as yet been extensively developed. Wells in the Aravaipa Valley are generally less than 150 feet deep and are not equipped to produce large quantities of water. Groundwater is used primarily for domestic and stock purposes, as well as for irrigation of small pastures and orchards. It is assumed that the amount of withdrawal does not exceed the amount of natural recharge, although the amount of groundwater pumped annually is not known.6/

Groundwater withdrawal in that portion of the Willcox Basin located in Graham County has not yet caused large declines in the water table. Large scale pumping has been going on in the region since 1940. Until 1963 the average water level decline was .43 foot per year. However recent expanding development has doubled that amount. Total groundwater withdrawal from the underground reservoirs in Graham County is estimated to range between 2.5 and 3.0 million acre-feet.[8]

Groundwater reservoirs in the county receive water from five major sources: (1) underflow of the Gila River; (2) underflow from tributary washes; (3) direct recharge from the penetration of rainfall; (4) infiltration from irrigation water; and (5) leakage from the older alluvium. Current data with respect to the amount of recharge to groundwater reservoir from these five sources are unavailable at this time.

Water Quality. U.S. Geological Survey water quality investigations indicate that the dissolved-solids content for most of the water throughout Graham County ranges from 286 ppm (parts per million) to about 2,544 ppm. Some of the deeper wells produce water that is over 5,000 ppm. Dissolved solids in the county consist primarily of sodium, calcium, bicarbonate and chloride.[9] In general, waters in Graham County are considered suitable for irrigation, except in those areas where the salinity of the water can be harmful

to crops which are not very tolerant to high salts. High levels of dissolved mineral salts in surface and ground waters is a potential major water quality problem in the Safford Basin.

All water sources developed for domestic uses must 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-3.

TABLE II-3

WATER QUALITY STANDARDS
FOR DOMESTIC WATER SUPPLIES

Chemical Parameter	Limiting Concentration milligrams/liter
Arsenic	0.01
Chloride	250.0
Copper	1.0
Cyanide	0.01
Fluoride	0.6-1.7*
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: USPHS 1962 Drinking Water Standards.

Recent water quality data obtained from wells throughout Graham County are listed in Table II-4.

TABLE II-4

WATER QUALITY DATA FROM SELECTED WELLS
IN GRAHAM COUNTY, ARIZONA

Location Q-TS-RE-SEC	Depth (ft)	Static Level (ft)	Date	Chemical Constituant (mg/liter) CA	MG	NA	CL	SO4	F
D-04-21-18	70	30	9-9-66	60	14	207	244	140	2.0
D-06-24-25	48	6	6-20-67	47	10	51	56	56	.6
D-06-25-07	100	67	9-9-66	159	60	368	695	260	1.2
D-06-25-19B	65	35	4-12-67	79	30	310	360	180	2.5
D-07-26-07CC	150	40	7-8-66	266	71	470	850	350	1.0
D-07-27-07	700	20	9-9-66	7	2	368	256	270	9.0
D-07-27-17DD	1,130	180	7-8-66	2	2	95	20	90	2.5
D-08-25-08CDB	300	75	10-5-66	75	38	188	228	290	5.0
D-08-26-04ACA	320	100	4-3-67	15	6	48	40	24	.6
D-11-22-09D	500	100	6-20-67	33	8	53	36	26	.8

SOURCE: "Quality of Arizona's Domestic, Agricultural and Industrial Waters," Agricultural Experiment Station, Report 256, University of Arizona, February 1970.

POPULATION AND ECONOMY OF GRAHAM COUNTY

In order to make projections of future water requirements and to plan for sewage and solid waste management, it is essential to have growth and locational information about the population and industry in the 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. The most significant features affecting growth and development in Graham County are the growth of Safford as a retail trade center for the surrounding rural areas and the expansion of mining operations in both Graham and Greenlee County.

Population Growth and Projections

Graham County, with a 1970 population of 16,327, is the third smallest county in Arizona in terms of population. It has a land area of 4,640 square miles which means a population density of 3.6 persons per square mile compared to the state average of 15.4 persons per square mile. Only 10 percent of the land in the county is privately owned. In addition to large amounts of federal and state-owned land, the San Carlos Indian Reservation occupies 33.5 percent of the total land area. Most of the private land is located in either Gila River Valley, the Sulphur Springs Valley or the Aravaipa Valley. Sixty percent of the population lives in four towns located along U.S. 70 in the Gila River Valley; Pima, Safford, Thatcher and Bylas. The largest city is Safford, with a population of 5,333. The second largest is Thatcher with a population of 2,320.

FIGURE II-4 shows the county's past population and projections to 1990. The population has been increasing yearly since 1930. According to the median population projection, 18,500 residents are projected by 1975; 21,200 by 1980; and 27,400 residents by 1990. This median projection is considered the most probable. Low and high projections are also shown in FIGURE II-4. All of the projections are based upon the long-term relationship between the county and state population and assume that Graham County's share of the state population will continue to decline in the future as it has in the past.

The support for this population growth will come from several segments of the economy. Safford's growth as a retail trade center will be one source of outside income to support population growth. Increased mining activity both in the county and in Greenlee County will be an additional source. Also, the growing popularity of the county as a retirement site will support growth.

Most of this increased population will probably settle in the Safford-Thatcher area of the county. Some of the land south of Safford has already been subdivided. The biggest restraint upon development of this land will be water scarcity. Settlement of other areas of the county will be extremely restricted due to the land ownership patterns.

Employment, Industry Analysis and Labor Earnings

Graham County has a civilian work force which averaged 4,675 persons during 1970. Annual average employment was estimated to be 4,425. This results in a 5.3 percent unemployment rate, slightly higher than the state rate of 4.5 percent.

Graham County's labor force and employment by broad industry groups for 1967-1970 with a projection for 1990 is shown in TABLE II-5. Government is the largest sector

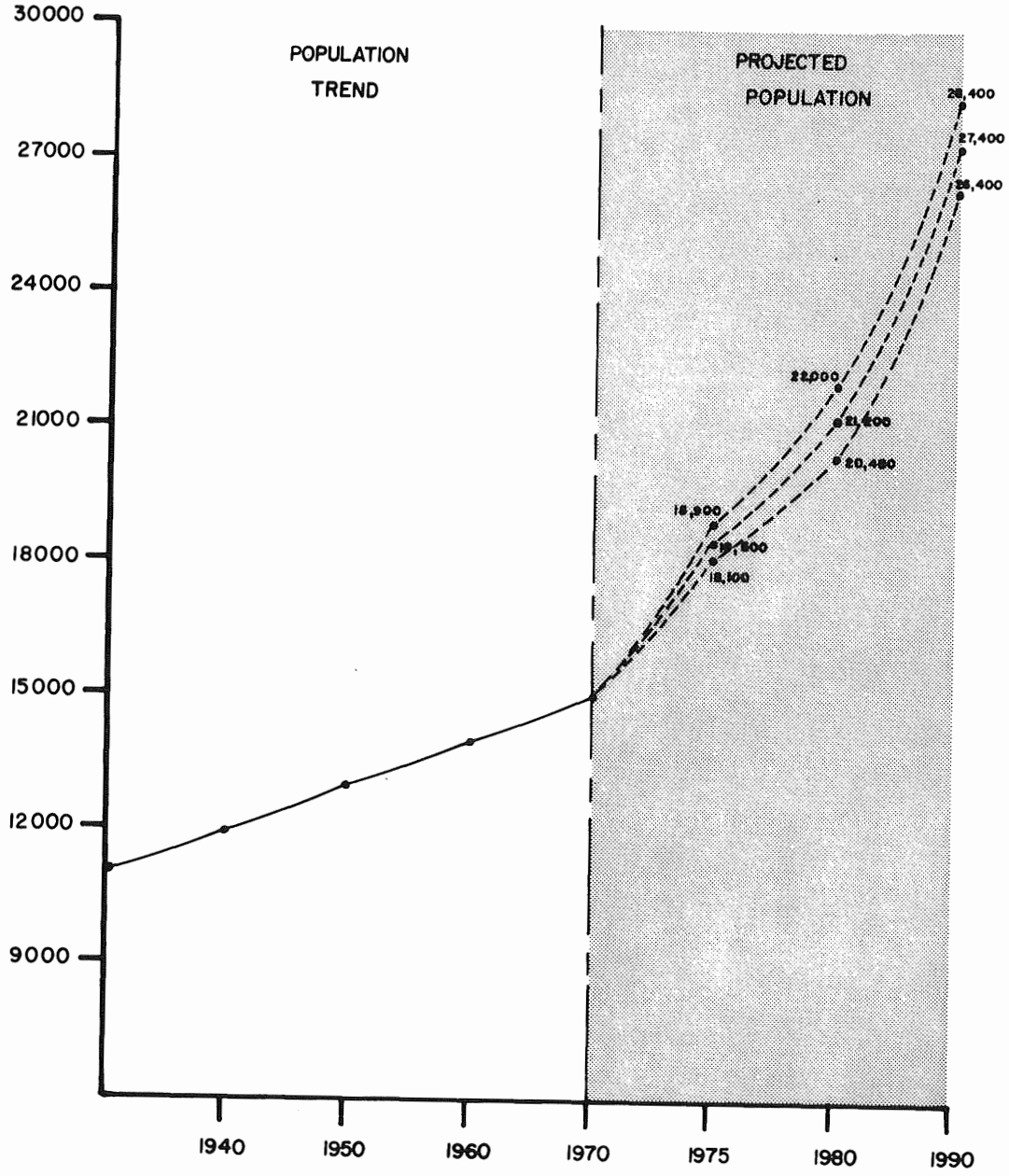


FIGURE II-4. POPULATION OF GRAHAM COUNTY WITH PROJECTIONS TO 1990.

employing 27 percent of those working in the county. The second largest sector is agriculture which employs on the average 900 persons per year, or 20 percent of total employment in 1970. In terms of 1969 labor earnings data, agriculture preceded government. Table II-6 presents the related labor earnings data. The employment projection for 1990 shows an absolute increase in all sectors. Mining, contract construction, and services are all projected to increase in relative importance while agriculture is expected to decline in importance.

TABLE II-5

GRAHAM COUNTY - LABOR EARNINGS DATA

	1950	1962	1965	1966	1967	1968	1969
Total Earnings	15,123	18,550	26,418	26,154	26,705	30,765	32,035
Farm Earnings	8,413	4,956	9,851	8,543	8,205	10,929	9,974
Non-Farm Earnings	6,710	13,594	16,567	17,611	18,500	19,836	22,061
Government Earnings	1,875	5,205	6,481	7,058	7,987	8,935	9,871
Total Federal	338	1,755	1,534	1,603	1,869	2,136	2,206
Federal Civilian	278	1,586	1,389	1,432	1,649	1,913	1,976
Military	60	169	145	171	220	223	230
State and Local	1,537	3,450	4,947	5,455	6,118	6,799	7,665
Private Non-Farm Earnings	4,835	8,389	10,086	10,553	10,513	10,901	12,190
Manufacturing	306	688	1,143	1,299	1,097	971	959
Mining	6	17	97	239	99	712	877
Contract Construction	382	618	645	559	573	238	570
Trans., Comm., and Public Utilities	474	574	704	742	697	694	782
Wholesale and Retail Trade	2,173	3,326	3,718	3,830	4,040	4,085	4,427
Finance, Insurance and Real Estate	118	365	604	618	577	600	613
Services	1,200	2,466	2,827	2,914	3,087	3,336	3,697
Other	176	335	348	352	313	263	265

Source: Office of Business Economics

TABLE II-6

GRAHAM COUNTY EMPLOYMENT 1967-1970

	1967	1968	1969	1970	1990
Civilian Work Force	4,200	4,075	4,250	4,675	8,395
Unemployment	300	225	175	250	335
Percent Unemployment	7.1	5.5	4.1	5.3	4.0
Total Employment	3,900	3,850	4,075	4,425	8,060
(a) Nonagricultural Wage and Salary	2,450	2,575	2,775	3,125	6,605
Manufacturing	225	150	150	175	365
Nonmanufacturing	2,225	2,425	2,625	2,950	6,165
Mining & Quarrying	25	25	75	75*	400
Contract Construction	75	100	75	75	200
Trans., Comm., and Public Utilities	100	100	100	100	200
Trade	700	675	700	775	1,420
Finance, Insurance & Real Estate	75	75	75	*	160
Service	475	450	525	600	1,475
Government	975	1,000	1,075	1,200	2,310
(b) All Other Nonagricultural Employment	350	375	400	400	630
(c) Agriculture	900	900	900	900	900

AGRICULTURE. Agriculture has played a leading role in the economic life of Graham County. In 1970, 900 persons were employed in agriculture, 20 percent of total employment. Both crop raising and livestock are important to the county, accounting for 31.3 percent of labor earnings in 1969. Cattle are raised throughout the county. In addition, there is a large feedlot operation in Pima. Graham County is also the leading supplier of swine in Arizona.

Crops raised include barley, sorghums, cotton and alfalfa. In 1969, 57,125 acres were devoted to these crops. The largest crop was sorghum with 22,000 acres being devoted to it; second was cotton with 17,400 acres. Most of the sorghums are raised in the Bonita area while most of the cotton is grown in the Safford area. It is expected that in the future, grains and sorghum will increase in relative importance among crops and that there will be a general tendency towards fewer but larger operations. Total acreage is not expected to increase greatly over the next 20 years.

MINING. While mining has played a very small part in Graham County's history in the past, it is expected to grow in importance in the next 20 years. There is only one major copper mine in operation at present; however, two or three companies are presently undergoing testing operations and it is expected that at least one of these mines will be in operation within three or four years. If this happens, mining employment in the county will expand. Other employment in the county will also expand as additional support services will be necessary for the new workers. Based on the expectation of the opening of these mines, mining employment by 1990 is projected to increase to around 400.

CONTRACT CONSTRUCTION. In 1970, there was an average of 75 people employed in contract construction in Graham County. Construction activity should increase over the next 20 years. Employment is projected to reach 200 by 1990. Many of these workers will be involved in residential construction as there is a lack of adequate housing in Graham County at present. Other workers will be employed in such projects as a new hospital and increased educational facilities. A large shopping center is also planned in the Safford area.

MANUFACTURING. Manufacturing is not very well developed in Graham County. Food processing firms account for the largest amount of manufacturing employment. Other industries include a recently opened back pack manufacturing firm, printing companies and a sawmill. While manufacturing employment declined between 1967-1968, due partly to the closing of a garment manufacturer, it has since picked up and is projected to reach 315 persons by 1990. Labor earnings data also reflects the closing of the plant. Most new manufacturing activity can be expected to locate in the Safford-Thatcher area. Any industrial development on the San Carlos Indian Reservation will probably be in their industrial park which is located in Gila County.

WHOLESALE AND RETAIL TRADE. Retail trade is one of the growing areas in Graham County. By 1970, 775 persons were employed in retail and wholesale trade in the county. This represented an increase of 75 persons over 1969. This figure should increase considerably over the next 20 years. The demand for new retail trade establishments will come from retirees moving into the county, miners residing in Graham County working at the Greenlee or Graham mines, and rural residents in the other portions of Graham County, the northern part of Cochise County and western area of New Mexico. These people are increaingly using Safford as a shopping center. A new shopping center is planned between Safford and Thatcher.

Wholesale trade employment is relatively small, being only 10 percent of trades employment. It should grow somewhat over the next two decades, but not as rapidly as retail trade employment. By 1990, employment in both retail and wholesale trade is projected to increase to 1,420 persons.

FINANCE, INSURANCE AND REAL ESTATE. Employment in this sector has averaged less than two percent of total employment in Graham County in the past four years. These services are concentrated in the Thatcher-Safford area where most of the population lives.

Although labor earnings in this sector have increased at a rate of nine percent per year since 1950, they were only 1.9 percent of total labor earnings in the county during 1969. Both earnings and employment should continue to grow in the coming decades as facilities expand to meet the needs of the larger population. As shown in TABLE II-5, employment is projected to increase approximately 160 by 1990, an increase of approximately 85 persons from 1970 employment in this sector.

SERVICES. Employment in this sector has averaged about 12 percent of total employment in the past three years. Labor earnings in the service industries were almost 12 percent of total labor earnings in 1969. Most workers are employed in motels and rooming houses or in medical services. Some growth is expected in the sector over the next 20 years. A new hospital is planned. The nursing home in Safford has plans for expansion. Personal services can also be expected to increase to meet the demands of retirees and new working families. This increased demand for personal services and health services is reflected in the projected 1990 employment figure of 1,475 for the service industry in Graham County.

TRANSPORTATION, COMMUNICATIONS AND PUBLIC UTILITIES. This has not been a dominant sector in the economy of Graham County. Labor earnings total earnings in the county during 1969. From 1967 through 1970, employment in the industry group remained fairly constant. Approximately 50 percent of all workers in the industry are employed by the public utilities with another 25 percent employed by motor freight firms. Employment is projected to increase by 100 persons by 1990 to meet the growing needs of the increased population in the area.

GOVERNMENT. Government has been the largest sector in Graham County in terms of employment. A total of 1,200 persons were employed in 1970. Most of these worked for state and local government. The County's six elementary schools, four high schools and two junior highs account for a large part of this employment. Other state and local employment includes work in the government administrative offices, in the state prison, and the state industrial school at Fort Grant. Eastern Arizona College also employs a number of people at the county level. Most federal employment is in the local post offices. Other employment is at the federal prison and with the park service.

As facilities expand at all levels of government, particularly in the area of education, employment should increase. By 1990 it is estimated that government employment will reach 2,310.

LAND OWNERSHIP AND LAND USE

Land Ownership

Land ownership is an essential component of any land use study in that it is a major determinant of where various types of land uses occur. The more intensive types of land uses, i.e., residential, commercial and industrial land developments, occur almost exclusively on privately owned land. Lands administered by federal and state agencies are managed under the multiple use concept as defined by the Bureau of Land Management and the U.S. Forest Service.

Graham County has a total land area of 2,950,000 acres. The ownership of 90.3 percent of this land area is divided among various federal and state governmental agencies as indicated on TABLE II-7.

TABLE II-7

LAND OWNERSHIP FOR GRAHAM COUNTY - 1971

Classification	Acres	% of Total Area
FEDERAL	2,111,598	71.4
Indian Reservation	989,000	33.5
Bureau of Land Management	719,265	24.3
U.S. Forest	396,333	13.4
Other Federal	7,000	0.2
STATE OF ARIZONA	551,433	18.6
PRIVATE	292,489	9.9
TOTAL	2,955,520	100.0

SOURCES: Bureau of Land Management, U.S. Forest Service, State Land Department and Department of Property Valuation.

The San Carlos Apache Indian Reservation encompasses the northern third of Graham County, occupying 989,000 acres within the county (Plate 1). This land is predominantly used for livestock grazing, timbering and outdoor recreation. There are several small villages on the reservation; most of which are along the Gila River and San Carlos River valleys. These two river valleys are also the predominant areas of agricultural activity on the reservation.

The San Carlos Lake is a popular recreation site in central Arizona and has been developed by the San Carlos Apache Indian Tribe with assistance from the Bureau of Indian Affairs and the Economic Development Administration. The land use on the reservation is discussed in more detail in the Indian Reservation Report published by this Department.

The Bureau of Land Management administers 719,265 acres in Graham County. BLM is required to classify all their lands as either being for sale or for retention under the Classification and Multiple Use Act of 1964. The majority of the public domain lands in Graham County were classified for multiple use management which includes grazing, mining, watershed protection, recreation and wildlife protection. All uses of these public lands are designed to assure the maximum benefit to the public with the least disruption of the natural resources of the land.

The Coronado National Forest has the primary jurisdiction over the National Forest lands in Graham County. The forest lands are located in three separate holdings which total 396,333 acres (Plate 1). These blocks of land are managed and classified by management plans which determine the uses that may be made of the lands in accordance with the Multiple Use - Sustained Yield Act of 1960. In Graham County the forest lands are used primarily for grazing, watershed and wildlife protection. There are several small areas, principally in the Graham Mountains, which are used for recreational purposes.

The State of Arizona owns 551,433 acres in Graham County. The State Land Department is responsible for the administration of state-trust lands. The majority of these lands were obtained in lieu of school sections granted the state by the Enabling Act of 1910, but not transferred to the state because they occurred within National Forest, National Park and reclamation withdrawal lands.

The lands are classified for either their resource value or are sold at public auction. The lands which are retained are usually leased. Table II-8 indicates the amounts of state owned land in Graham County by types of lease.

TABLE II-8

STATE LANDS IN GRAHAM COUNTY BY TYPE OF LEASE - 1970

Type of Lease	Acres
Agricultural	1,216.92
Commercial	3,205.93
Grazing	531,918.57
Rights-of-Way	1,208.67
U.S. Contracts	123.54
TOTAL	537,673.63*

*Does not add to total in Table II-7 because not all of the State owned lands are being leased, but rather, retained for State sponsored uses.

SOURCE: State Land Department Annual Report 1970.

Privately owned land only accounts for 9.9 percent of the total land area of the county. The private lands are concentrated along the Gila River Valley and in the Sulphur Springs Valley as shown on Plate 1. Both of these areas are used primarily for agricultural and ranching purposes. Most of the urban land development has occurred in the Upper Gila River Valley adjacent to U.S. Highway 70.

Existing Land Use

Land use in Graham County is characterized by livestock grazing and agricultural activity. The privately owned lands are concentrated in the Sulphur Springs and Gila River Valleys which are the primary agricultural and grazing areas within the county.

U.S. 70 is the only major highway which traverses the county and provides the backbone for most of the urban development. Urban land uses are defined as those land uses which have been developed primarily for residential, commercial and industrial purposes in contradistinction to land which is either predominantly used for agricultural purposes or land which is undeveloped. Urban land uses in Graham County account for 0.18 percent of the total land area (Table II-9).

TABLE II-9

EXISTING LAND USE FOR GRAHAM COUNTY - 1971

Classification			% of Total Area
Urban Land Uses		5,418.56	.18
Residential	1,586.71		
Commercial	322.52		
Industrial	219.83		
Public and Quasi-public	3,289.50		
Mining		17,601.76	.59
Agricultural		88,250.13	2.99
Grazing and Range Lands		2,497,145.00	84.64
Desert and Mountain Lands		347,104.55	11.58
TOTAL		2,955,520.00	99.9

SOURCE: State Department of Property Valuation.

The communities of Thatcher, Pima and Safford are the primary urban centers (Plate 2). All three communities are service centers for the local agricultural activity and for the highway traffic using U.S. 70. There are several smaller, unincorporated communities within the Gila River Valley which are also local service centers, these include Geronimo, Eden and Fort Thomas.

The agricultural activity in the Gila River Valley occurs along the lowlands adjacent to the river. This activity is supported by the water from both underground and surface sources. This area is intensively farmed with the principal crops being cotton, sorghum grains, alfalfa and corn. Most of these are relatively high water users yet low in economic value.

The second agricultural region encompasses the southwestern part of the county (Plate 2). This area is the north end of the Sulphur Springs Valley which extends from central Cochise County into south-central Graham County. The agricultural activity in this area of Graham County is less intensive than either the Gila River Valley or the Cochise portion of the Sulphur Springs Valley due to the limited amount of water. The principal crops are the same as those for the Gila Valley which are high water users yet are of low economic value.

Livestock grazing uses the largest amount of land in the county. Much of this activity occurs on public lands which accounts for 90.3 percent of the land area within the county. This activity is the most extensive along the lower river valleys, being limited by terrain and vegetation in the higher, mountainous areas.

There has been a significant amount of mineral exploration in the Gila, Whitlock and Pinaleno Mountains, north and south of the Gila River Valley. Up until the present time, mining operations have been small, being restricted by the low copper content of the ore. As the price of copper increases, large scale commercial mining operations may become profitable in this area. Current mining activities on both public and private lands account for only 0.59 percent of the total land area.

Generalized Future Land Use

New urban land development is expected to remain in the existing communities. Safford and Thatcher are expected to receive most of the new urban growth with the possibility of these two communities ultimately growing together to form a single urban complex (Plate 2). The towns of Pima and Solomon are relatively small, but they have been experiencing some land development activity, mostly agricultural. The unincorporated communities of Bylas and Fort Thomas are isolated clusters of residential and small commercial land uses serving the local agricultural activity. Both of these communities are not expected to experience any significant new urban land development activity within the next twenty years.

The area shown on Plate 3 as suburban development is actually an isolated area encompassing the Safford airport which has a potential for industrial park development. The activity in this area, although physically separated from the Safford urban area, is closely related to it and should be considered as a satellite of the Safford urban area.

The Gila River and Sulphur Springs Valleys are expected to continue to be intensely farmed although agricultural activities will ultimately be limited to the availability of water. The Gila River Valley obtains its water from the Gila River and this is supplemented by pumping from the underground aquifiers. This pumping also slows the salt depositing process produced by irrigating with the river water.

Agricultural activity in the Gila River Valley is not anticipated to expand onto large amounts of new land, but rather, operations on existing lands will be intensified. There will probably be a decrease in the number of acres farmed as urban land uses compete for the land adjacent to the existing urban development. The activity in the Sulphur Springs Valley area will be restricted by their water limitation and to the types of land which can be put into production. The principle crops are expected to remain alfalfa, sorghum and cotton.

Mining activities have primarily been exploratory, encompassing the mountainous areas north and south of Safford. Deposits of low grade copper have been found, but at this time they are not economical to process. There is optimism being expressed by various county officials that these deposits will become profitable to mine within the near future. If full-scale mining operations were to be initiated it would require large amounts of land due to the low grade of the ore and the large amount of waste which would be produced and require disposal. If mining operations were initiated, new processing facilities relatively close to the mines would be required along with additional housing and commercial development.

Presently much of this mineral bearing land is on the public domain land which has been leased for exploration purposes. When this land is put into production it will most likely be patented and transferred to private ownership thereby increasing the tax assessment base of the county.

Livestock grazing is the largest user of land in Graham County and probably will remain so during the next twenty years. The actual number of animals being grazed is not anticipated to increase significantly and may even be reduced due to the incorporation of "dry lot feeding" into the production of livestock.

Recreation in Graham County appears to have a large potential although it has not been exploited to any degree. The Coronado National Forest had developed only approximately five acres for recreational purposes on its land with five acres for recreational purposes on its land with Graham County. The county accounts for only 1.1 percent of the outdoor recreational experiences in the National Forests which are located in Arizona (Table II-10.)

TABLE II-10

RECREATION PARTICIPATION IN ARIZONA - 1970

County	Visitor-Days* Use (Thousand)	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.

Sightseeing and general camping are the most popular activities according to the U.S. Forest Service (Table II-11). Neither of these activities requires developed sites, and only some form of access to scenic areas.

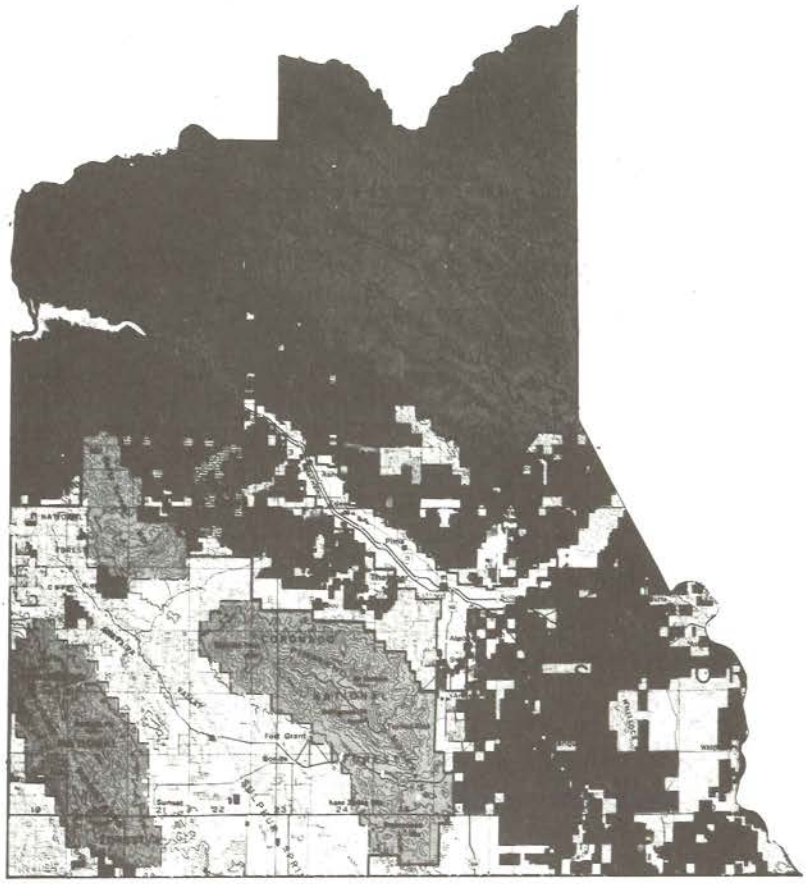
The potential for recreation, especially in the Mt. Graham area south of Safford and Thatcher is substantial. The improvement of the road system in this area would attract additional campers, picnickers, hunters, fisherman and other recreational enthusiasts especially from the Tucson and Phoenix metropolitan areas.

TABLE II-11

OUTDOOR RECREATION PARTICIPATION
CORONADO NATIONAL FOREST
GRAHAM COUNTY - 1970

Activity	Visitor Days (thousands)	Percent of Total
Sightseeing	17.1	22.5
Hiking	2.9	3.8
Bicycling	.1	.1
Horseback Riding	1.7	2.2
Boating	.4	.5
Fishing	5.3	7.0
Camping	21.6	28.6
Picnicking	7.8	10.3
Recreation Residence	8.2	10.8
Snow Play	1.7	2.2
Hunting	6.3	8.3
Other Activities	2.2	2.7
TOTAL	75.3	100.0

Source: U. S. Forest Service - RIM Center.



LEGEND

- State Office
- Land Office
- District Office
- District Boundary
- Extension of BLM District Area of Administrative Responsibility (Limited and Overlapping)
- Bureau of Land Management
- Indian Reservations
- National Forest
- National Parks, Monuments, and Recreation Areas, State County, and City Parks containing 1,500 acres or more
- Wildlife Refuge
- Military Reservations and Military Withdrawals
- Private
- Indian Ceded Lands
- Reclamation Withdrawn Lands
- State Trust Lands

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LAND OWNERSHIP

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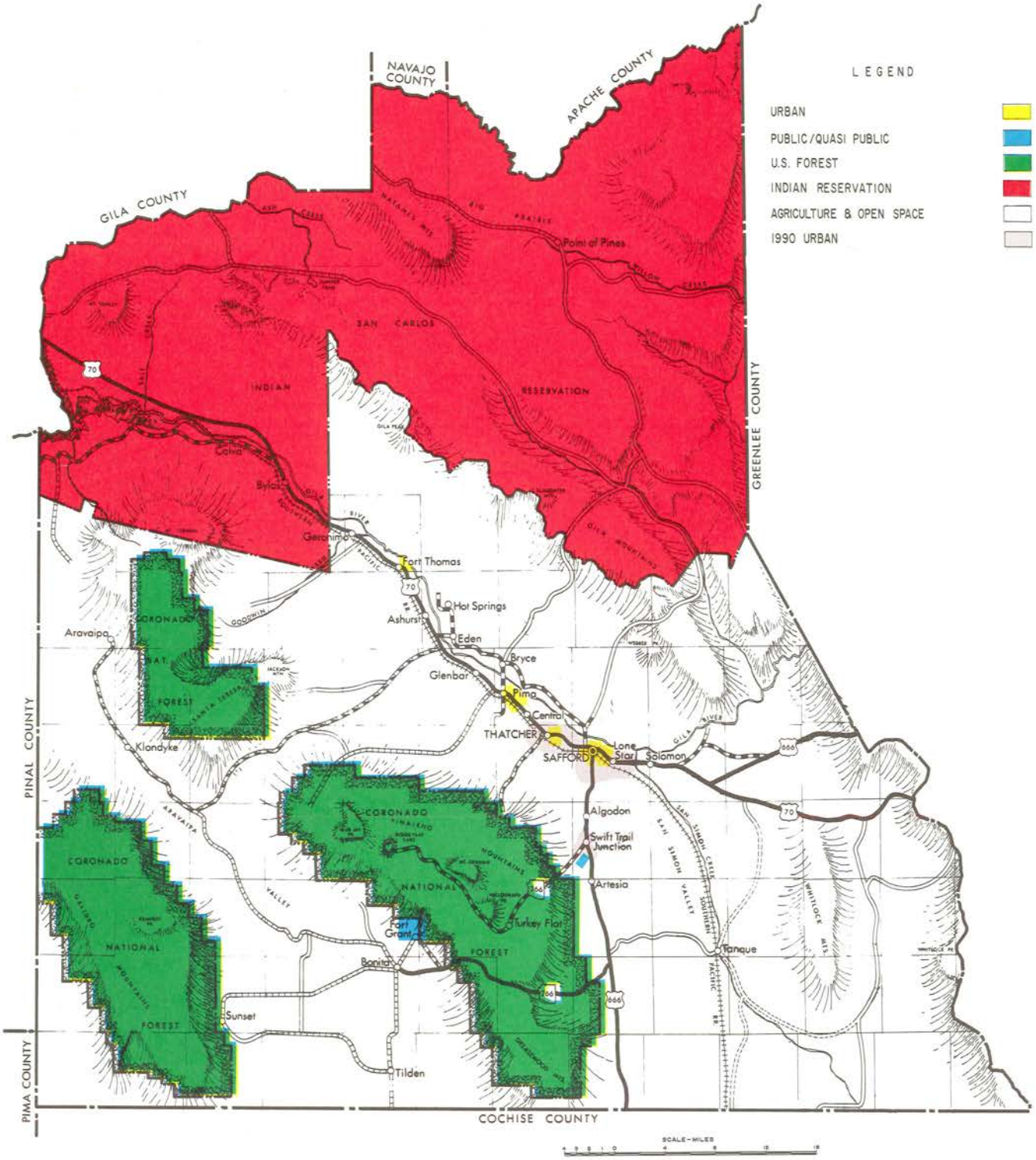
PLATE 1



U.S. Highway
State Highway
City, Town, Settlement
Railroad
River, Creek
Lake
Mountain
Indian Reservation Boundary
National Forest Boundary

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GRAHAM COUNTY, ARIZONA
LAND USE

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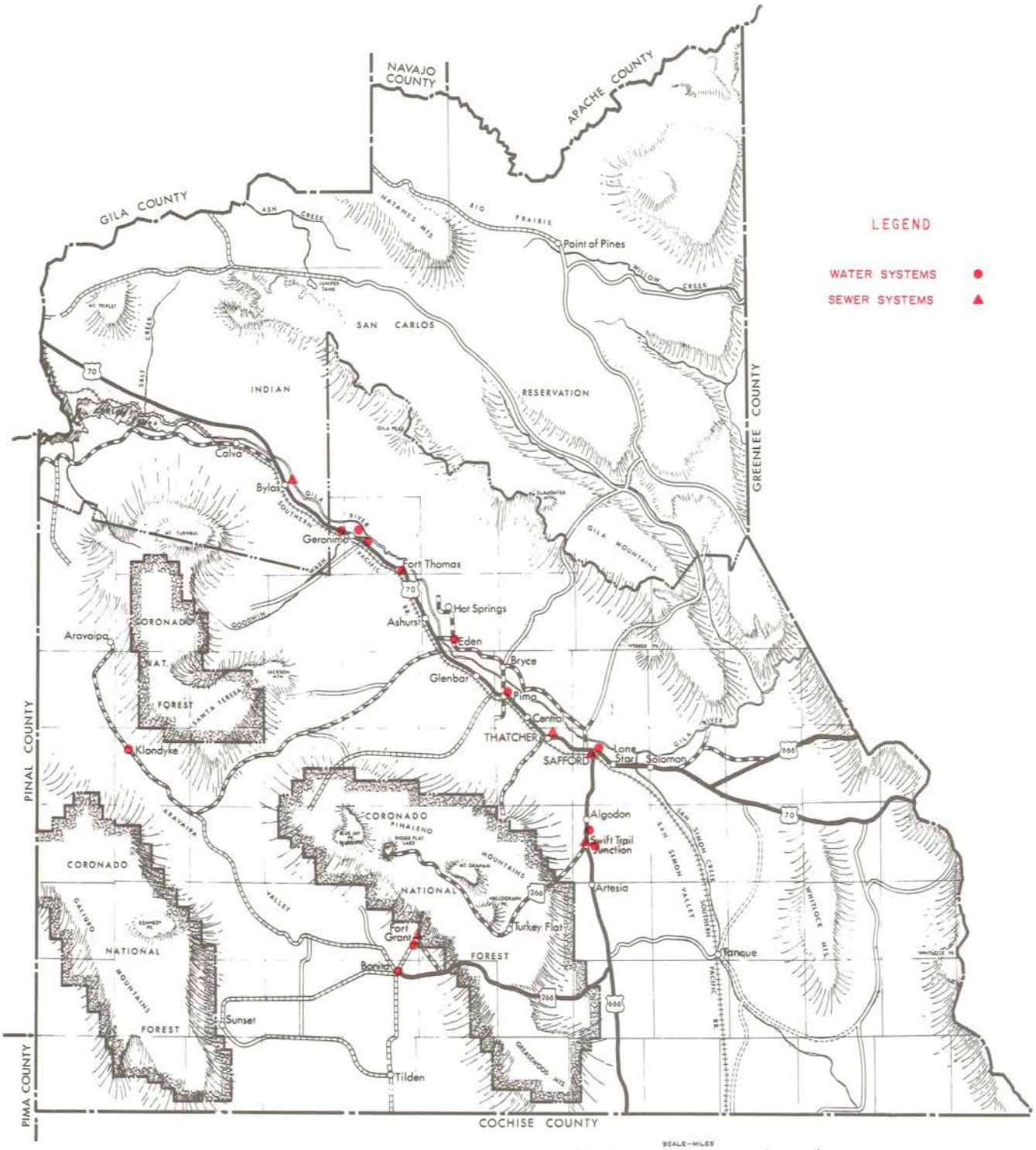
PLATE 2



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GRAHAM COUNTY, ARIZONA

INVENTORY OF FACILITIES

PLATE 3

CHAPTER III. SAFFORD VALLEY-REGIONAL PROFILE

Approximately 91 percent of the total population of Graham County resides in the Safford Valley Region. The area is comprised of 208,500 acres of land situated along the Gila and San Simon Rivers. The valley has 21 communities; Geronimo, Emery, Fort Thomas, Eden, Glenbar, Bryce, Pima, Central, Thatcher, Safford, Graham, Cactus Flat, Swift Trail Junction, Artesia, Hollywood, Lone Star, Solomon, Gripe, San Jose, Buena Vista and Sanchez. The largest of these communities are Safford, Thatcher, Pima and Fort Thomas. These communities are within easy travel distance to the central part of the valley which is situated in the Thatcher-Safford area. The valley shares a common economic base of agriculture which is tied to the water resources of the Gila River and physical nature of soils.

The multitude of communities in general proximity to each other suggests that planning for future environmental services should be carried out on a regional basis. The initiation of the planning process is accomplished in the following pages through presentation of historical background, physical features, population characteristics, economic base conditions and man-made systems which include, land use, water supply facilities, sewage treatment and solid waste management practices. From the above information projections are developed which can be used in planning for environmental services systems to meet demands and needs in future years.

HISTORICAL PROFILE

History in the Safford Region dates back 15,000 years. The first known inhabitants were a Mogollon people who endured many hardships. The Mogollon tribes lived in highly fortified walled-up caves, fearing not only human enemies but the unpredictable floods of the Gila River which washed away their tiny fields. The Mogollon people excelled at hunting but that ability did not enable them to defend themselves against the more warlike tribes who eventually drove them away.

The area's written history originated in 1546 A.D. from the notes of Francisco de Coronado's historian. Coronado, in search of gold, found only adobe pueblos and lodges of painted buffalo skins.

About 1700 A.D. the Apaches laid claim to the Upper Gila. Their strength and tenacity effectively prevented white settlement until after the Civil War. U.S. territorial rights came to the area in the mid-1850's with the Treaty of Hidalgo and the Gadsden Purchase. At this time, trappers and prospectors had begun to invade the area and mining was soon flourishing.

With mining, agricultural markets opened up and the economy in general began to develop. More settlers arrived and railroads crossed the area with spur lines branching out to mines and to the new and growing communities.

The first American settlement on thy present Safford site was in 1874 when a group of ranchers and farmers settled in the Gila Valley after their ranches and farms in Gila Bend had been washed out. A post office opened the same year and the town was named in honor of Governor Safford who was visiting the Valley that year. In 1883, Safford became the County Seat of Graham County.

Present day Thatcher had its beginnings when John Moody bought the Conley Ranch in 1881. In 1882, four more Mormon families joined him. The present site of Thatcher was initially purchased in 1885 to be a future townsite. The name of the town resulted from a Christmas visit in 1882 of Mormon apostle Moses Thatcher. A post office was established in 1888 and the community incorporated in 1899.

Pima was originally named Smithville in honor of Jesse Smith, a Mormon leader. In February of 1879, several Mormons searched for a settlement site where it would be feasible to construct a canal. In March, Joseph Rogers and party settled. More settlers arrived in April and a village was laid out with 16 blocks of four lots each. The settlers experienced the usual troubles of malaria and lawlessness but they held out and were able to permanently secure their community. In 1880, with the establishment of a post office, the town's name was changed to Pima.

Camp Thomas was established in the Gila River Valley to replace Camp Goodwin in the summer of 1876. Approximately nine months later the name of the camp was officially changed to Fort Thomas. Until the mid 1880's, the post consisted of a group of poorly constructed shacks and barracks which housed the soldiers and commanding officer. These dwellings were constructed by the soldiers themselves at no expense to the federal government, however, in 1884, funds became available and new buildings were constructed.

In 1886 Geronimo surrendered and the fort slowly lost importance and by 1892 was abandoned. In the meantime, however, a community had grown up around the fort and had adopted the name Fort Thomas. A post office was established there in 1877.

As early as 1873, the first settlers began supplying small quantities of charcoal, hay, and grain to nearby mines. With increased settlement and with the expansion of the canal systems for irrigation, a self-sufficing type of agriculture was established, with alfalfa, corn, small grains, fruits, and vegetables, as the main crops, supplemented by livestock. Increased mining activities and the building of railroads created markets for surplus products and livestock. The nearby markets have continued to absorb much of these products. The outlying range has been an inducement to the raising of livestock, and feeding and fattening of livestock has provided much of the cash income, more recently augmented by special crops, mainly cotton.

Although crop production figures are available only for Graham County as a whole, they express the trend in agriculture of the area, since this valley is the main agricultural district of the county. The 1890 Federal census gives the main crops as hay, corn, barley, and wheat, ranking in acreage in the order named. By 1900, the wheat acreage had taken first place, followed in order by alfalfa, barley, and corn. In 1910, alfalfa was the leading crop, followed by barley, wheat, and corn. In 1920 alfalfa still held the leading acreage, with the acreage in wheat next. The acreage devoted to wheat was materially increased over that used in previous years. Barley and corn were next in order, and grain sorghums, which had become an important crop, occupied an acreage equal to corn. Cotton also had been introduced and had become a significant crop. By 1930 the acreage devoted to cotton exceeded that of all other crops and was twice as large as the acreage in alfalfa. The acreage in barley, wheat, corn, and grain sorghums each decreased about one-tenth from that reported in the 1920 census.

Horticultural crops, as apples, pears, peaches, plums, prunes, cherries, apricots, grapes, and strawberries, seem to have attained their peak in 1910 and have since declined. There are now no large orchards, but a few trees are in most of the home gardens. Sweet-potatoes and other vegetables have followed the same general trend.

Among the livestock products, an increase, especially in dairy and poultry products, is noted between 1900 and 1910 and between 1910 and 1920. Dairy products decreased and poultry products increased between 1920 and 1930. Because of the intensive agriculture carried on under irrigation, the average size of farms is small, probably about 40 acres. The range in size is from a few acres in the vicinities of towns and villages to several hundred acres in the outlying districts.

According to the 1935 census, 75.4 percent of the farms were operated by owners, 20.4 percent by tenants, and 4.2 percent by managers. Tenants either pay cash or a crop rental.

PHYSICAL CHARACTERISTICS

Geology, Relief, and Drainage

The valley of the Gila River, known to geologists as the Safford Basin, is a northwest trending, intermontane trough 15 miles wide by 60 miles long. This trough is bounded by the Pinaleno and Santa Teresa Mountains on the southwest and by the Gila Mountains on the northeast. Elevations in the basin range from 2,600 to about 4,000 feet above sea level, but the elevation of Mount Graham in the Pinaleno Mountains is 10,713 feet. Elevations in the Gila Mountains range from 4,000 to 6,000 feet. Topographic features of Ft. Thomas, Pima, Thatcher and Safford areas are illustrated in PLATES 4, 5, 6 and 7.

The Safford Basin has been filled by as much as 3,000 feet of sediment derived almost entirely from the surrounding mountains. The sediment from the Pinaleno and Santa Teresa Mountains is high in quartz and feldspars, as those mountains are principally of granitic gneiss, schist, and granite. The sediment from the Gila Mountains, which formed principally from lava flows and ash beds, is of basaltic, andesitic, and rhyolitic derivation. The Gila Mountains include a few granitic intrusive rocks along their base.

The sediment was carried into the closed basin by sluggish streams. Most of these streams deposited the sediment along their courses and dried up near the central part of the basin, but some probably fed small intermittent lakes that existed in the central part.

The sediment filling the basin can be divided into three units. The lowest is probably 300 to 500 feet thick in the central part of the basin. Where it crops out in a few places at the base of the mountains, this material is course gravel and conglomerate, but south of Thatcher and east of Safford, where it has been observed in deep borings, it is largely a dark-gray clay.

The middle deposit of sediment is as much as 2,000 feet thick. It is fine-grained material and is the major sedimentary fill in the basin.

The uppermost unit of sediment filling the basin consists of thin deposits of gravel.

Depositing of sediment in the basin ended when structural uplift of the area began. This uplift was accompanied by tilting of parts of the basin, and by minor faulting of the beds of basin fill. During this period of uplift, the Gila River formed a course through the central part of the basin, and it began stripping and eroding the basin fill.

As downcutting of the river alternated with periods of stabilization, terraces formed in the basin. Five major terraces were created (FIGURE III-1). General soil associations for the region are noted in FIGURE III-2.

Where washes cut through the terraces, deposits of gravel are exposed. These gravelly deposits were carried to the Gila River by tributary streams during periods when the level of the river was stabilized. The deposits range from 5 to 40 feet in thickness in most places, but near the central part of the basin some of the deposits of gravel in the ancient channels of the Gila River are as much as 150 feet thick. The deposit of gravelly alluvium along the course of the present Gila River is 3 miles wide and as much as 120 feet thick. This gravelly stream alluvium is under the Gila River, and its bordering flood plain is known as the inner valley.

In the inner valley, ground water is more easily obtained in large amounts than it is elsewhere. Likewise, water is more easily obtained in the shallow alluvium deposited by the major tributaries of the Gila River. Some water also has been obtained from the beds of sand and gravel in the basin fill, but normally the wells are 1,000 feet or more deep. Small amounts of ground water have been obtained from the terrace gravel that lies on top of nearly impermeable, fine-grained basin fill.

The Gila River is the only perennial stream in the Safford Area, though it is often dry or nearly dry during the month of June. All other drainageways carry water only after rainstorms or from snowmelt in spring. The river enters the eastern part of the survey area, flows southwest to the vicinity of Solomon, then flows northwest through the rest of the Safford Basin. The elevation where the river enters the area is 3,100 feet, and where it leaves, 2,600 feet. The main tributary of the Gila River is San Simon River, which is near the eastern end of the area. Entering the river from the south are Stockton Wash, Graveyard Wash, Frye Creek, Matthews Wash, and Goodwin Wash. Lone Star, Watson, Peck, and Markham are washes that enter from the north.

The majority of soils in the Safford Area were formed in transported parent material. These soils formed in place from weathered rock. The dominant source of transported parent material is the mountains on either side of the valley along the Gila River. The Pinaleno Mountains on the south side are chiefly granitic, and the Gila Mountains on the north side are mainly rhyolitic. The secondary source of transported parent material is alluvium deposited by the Gila River. This alluvium is mixed and varies in size of particles and in mineral composition. Most of the alluvium has been transported for great distances. The chief area of deposition of the mixed alluvium is the inner valley along the flood plain of the Gila River. In some places the materials from the dominant and secondary sources are mixed, but this mixing has little influence on the formation of soils in the area.

All soils in the survey area, except one type show the influence of lime (alkaline earth carbonates). Although enough lime has been leached downward to form a layer of accumulated lime in these soils, they are generally calcareous throughout.

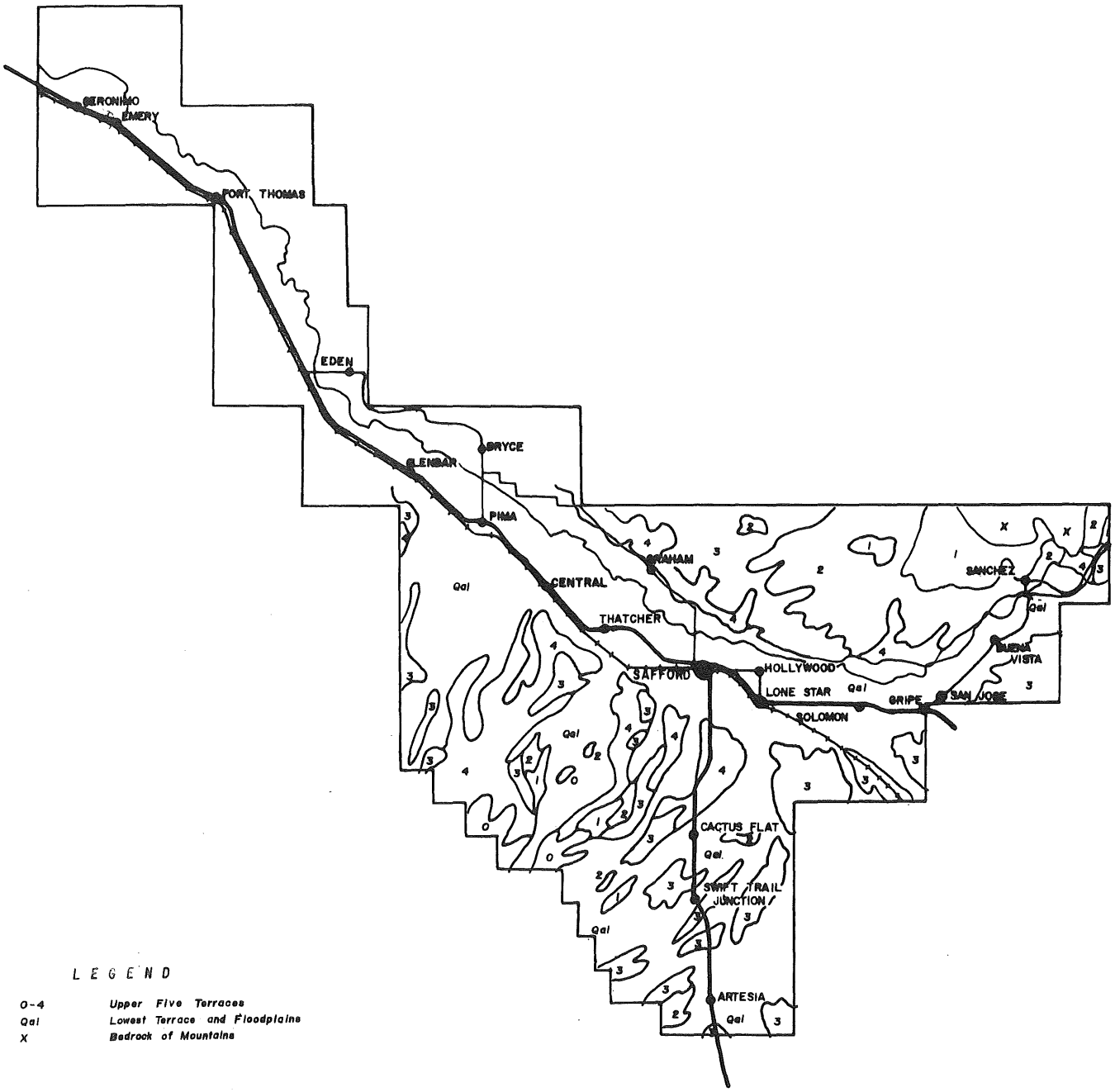


FIGURE III-1. Geologic Terraces of Safford Valley.

1 Grabe-Gila-Anthony association: Deep, nearly level, loamy soils of the inner valley

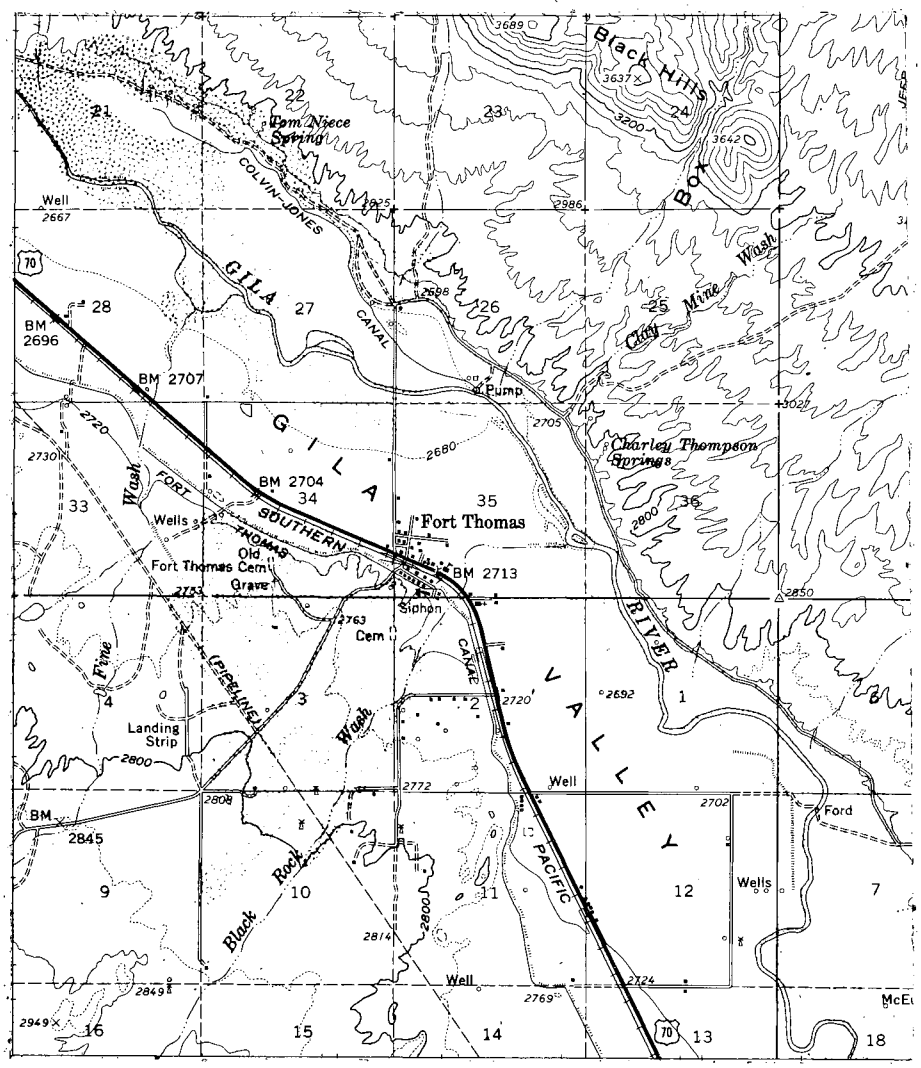
2 Pinaleno-Bitter Spring-Tres Hermanos association: Deep, nearly level to sloping, gravelly soils of the low terraces

3 Continental-Gila-Rough broken land association: Deep, nearly level to gently sloping, gravelly and loamy soils of the low and middle terraces and areas of Rough broken land

4 Continental-Pinaleno-Cave association: Nearly level to steep, gravelly soils of the high terraces that are shallow to deep over accumulated lime

5 Graham association: Shallow, gently sloping to steep, rocky soils of the uplands

FIGURE III-2. Soils of Safford Valley.



SCALE 1:62500

Source: U.S. Department of the Interior
Geological Survey 1960

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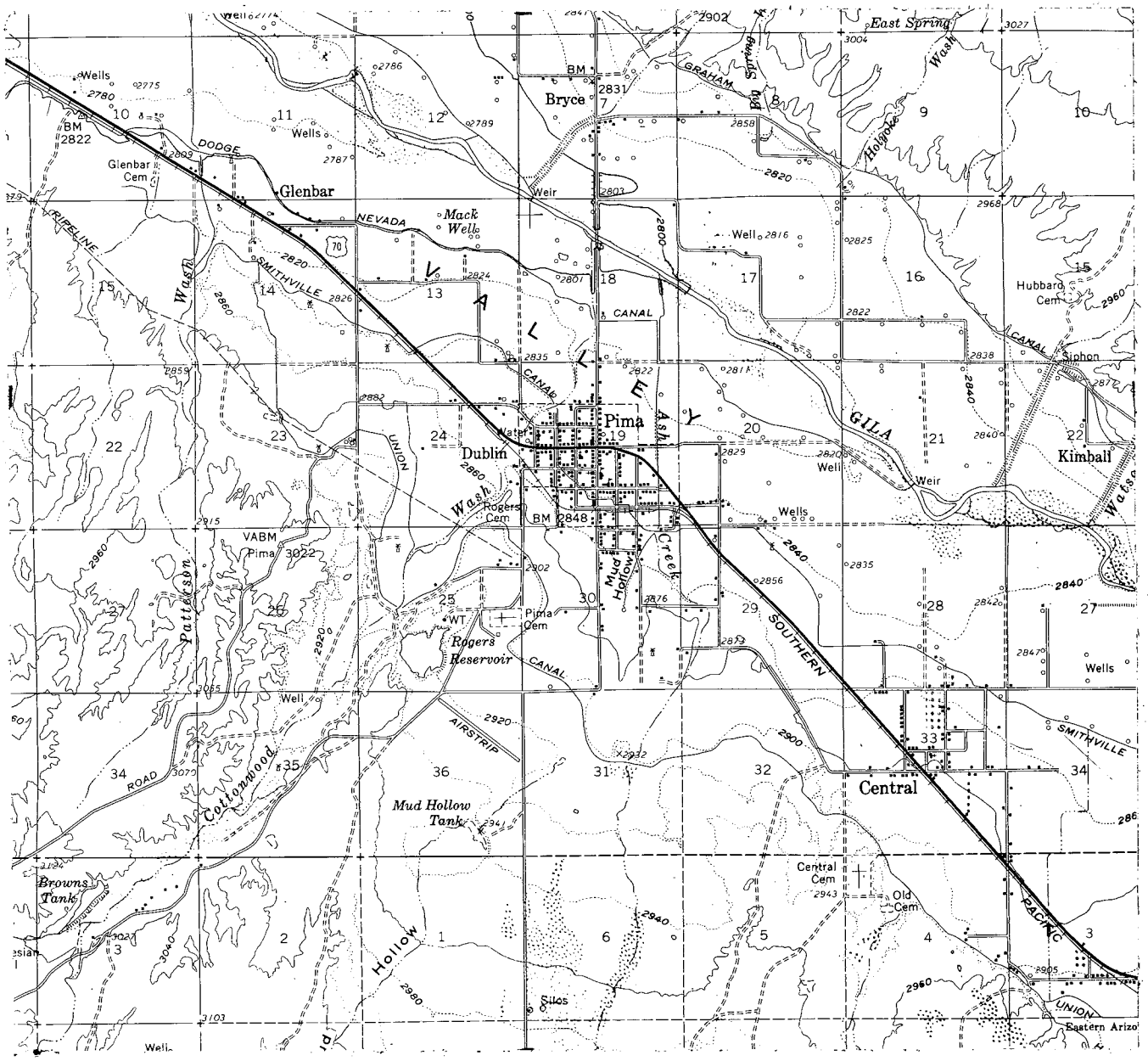
TOPOGRAPHIC FEATURES

PLATE 4



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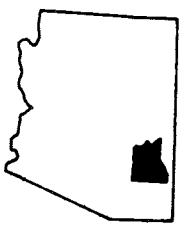
SOURCE: U.S. Department of the Interior
Geological Survey 1969



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TOPOGRAPHIC FEATURES

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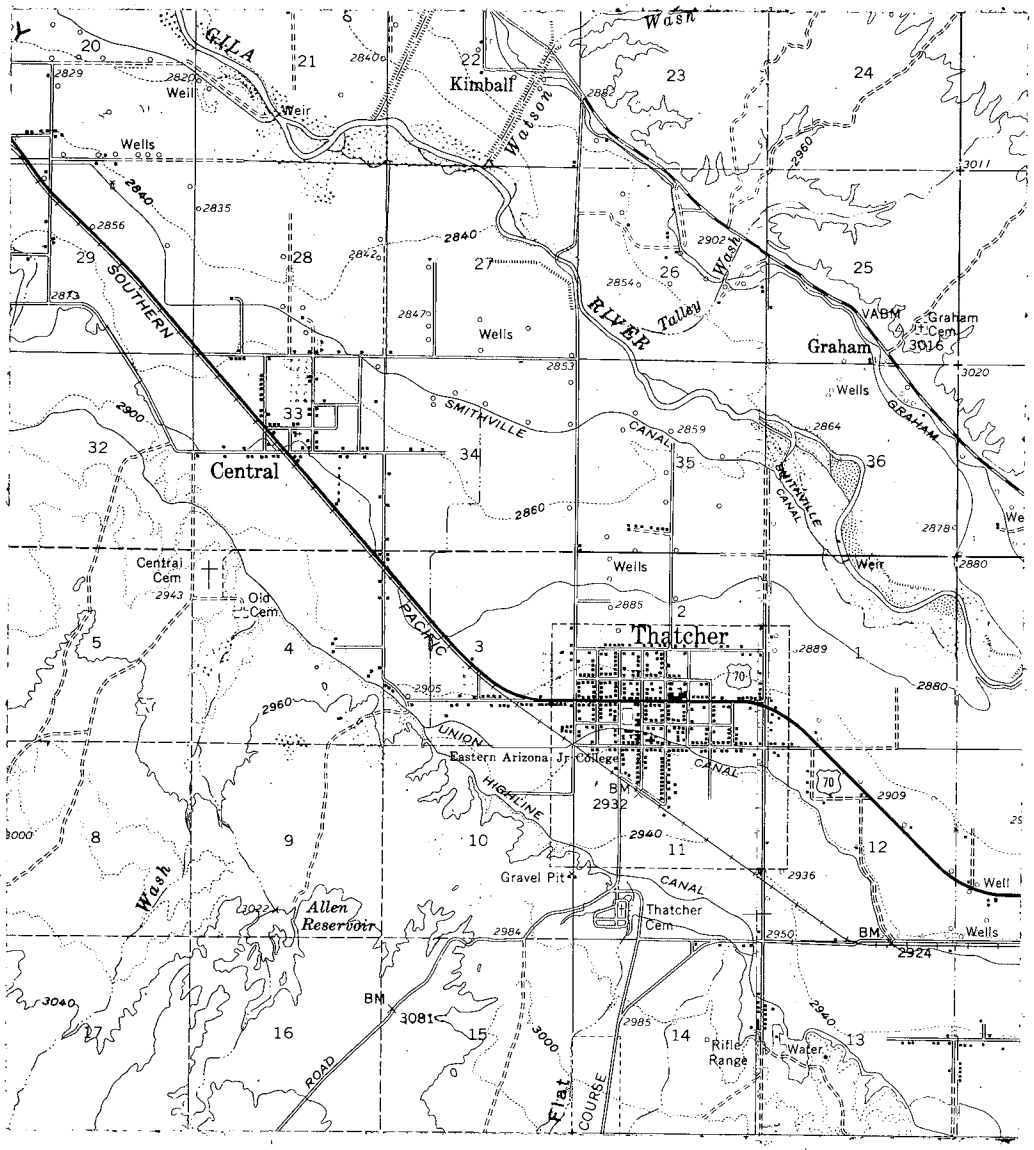
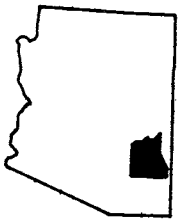
PLATE 5



SCALE 1:62500

SOURCE: U.S. Department of the Interior
Geological Survey 1969



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TOPOGRAPHIC FEATURES

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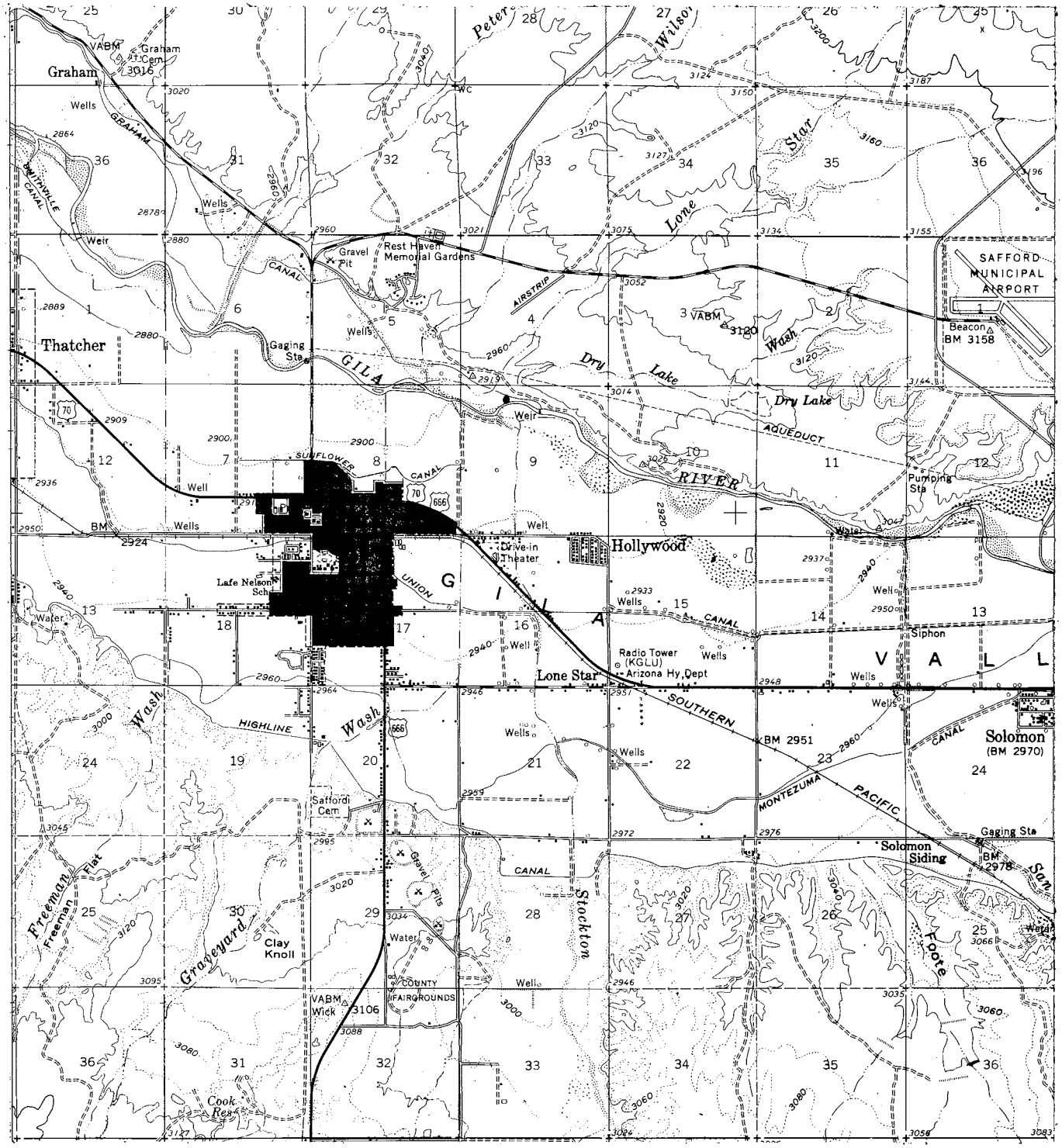
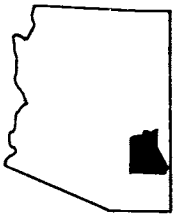
PLATE 6



Source: U. S. Department of the Interior
Geological Survey 1960



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SAFFORD, ARIZONA

TOPOGRAPHIC FEATURES

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PLATE 7

Climate

The part of this survey that extends from Sanchez to Geronimo and southward from Safford to Artesia has warm, desert climate. The rest of the survey area, which is in the Gila Mountains and extends along the foothills of the Pinaleno Mountains, has warm, semidesert climate. The difference between the two kinds of climate in this part of the State is not great. Areas that have semidesert climate have slightly more precipitation and slightly lower temperatures. Most of the Safford Area has warm, desert climate. The temperature and precipitation data in TABLE III-1 are from the weather station at Safford and are representative of a warm, desert climate.

TABLE III-1
SUMMARY OF TEMPERATURE AND PRECIPITATION DATA
FOR THE SAFFORD VALLEY

Month	Temperature				Precipitation [1]		
	Average daily maximum [2]	Average daily minimum [2]	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than [3]—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than [3]—	Average monthly total	One year in 10 will have— Less than—	One year in 10 will have— More than—
	° F.	° F.	° F.	° F.	Inches	Inches	Inches
January	60	28	70	19	0.7	0.1	1.6
February	66	32	77	22	.5	.1	1.2
March	72	37	83	28	.6	(4)	1.2
April	80	43	92	35	.3	(4)	.7
May	89	50	100	43	.1	(4)	.3
June	98	60	106	52	.3	(4)	.8
July	99	68	107	63	1.8	.6	3.2
August	96	66	103	62	1.4	.4	3.4
September	92	59	101	51	1.1	(4)	2.6
October	82	46	93	37	.6	(4)	1.6
November	70	35	80	25	.5	(4)	1.2
December	61	29	72	21	.7	.1	1.5
Year	80	46	[5] 109	[6] 16	8.6	4.8	12.5

[1] For the period 1933-62.
[2] For the period 1899-1957.
[3] For the period 1933-62.
[4] Trace.
[5] Average annual highest maximum.
[6] Average annual lowest minimum.

Summers are warm, and afternoon temperatures of 100°F. or more occur regularly. Temperatures above 110° is not common but occurs on the average of 1 year in every 4. At the higher elevations in the survey area, the temperature is lower than on the valley floor. The maximum temperature at these elevations during summer averages about 5 degrees lower and minimum temperature in winter generally averages 5 to 10 degrees lower.

Precipitation at Safford averages less than 9 inches each year, but more than 2 inches have been recorded in a 24-hour period during heavy summer rainstorms. These storms generally are accompanied by strong winds and hail. During winter, snow is commonly at the summit of the Pinaleno Mountains, but on the average less than 2 inches falls on the valley floor each year. Precipitation at higher elevations is nearly the same as that recorded at Safford, or about 11 or 12 inches annually. Annual snowfall below an elevation of 4,000 feet is usually less than 2 inches.

In general, there are two periods of precipitation annually in the Safford Area. A minor period normally begins in November or December and extends through March. The major period begins in July and extends through most of September. April, May, and June usually are dry, and October and November are fairly dry, until the winter rains begin. On the average, about 20 percent more precipitation occurs during the period from May to October than during the period from November to April. The precipitation in winter comes from the Pacific Ocean, and that in summer, from the Gulf of Mexico. Once or twice during the summer, heavy rains are brought in by winds from a tropical storm on the Pacific Ocean.

Data for humidity are not available for the Safford Area. The amount of moisture in the air generally is low except during rainy periods. Frequent irrigations together with rainstorms increase the relative humidity in summer. The relative humidity for daytime ranges from about 10 percent during dry periods to about 90 percent during periods of heavy precipitation. The average daily humidity for the year is estimated to be about 25 to 30 percent.

Prevailing winds usually blow from the southeast in summer and from the northwest in winter. These winds are moisture laden and provide moisture for the summer and winter periods of precipitation. Fairly mild, steady winds blow for several successive days in spring. The winds sometimes start in March and continue into April or on into May. They carry little moisture, as shown by the small amount of precipitation recorded for these months in TABLE III-1. June has little wind until near the end of the month and generally is warm and dry. Thunderstorms during July and August frequently are accompanied by violent winds, but these storms are of short duration.

The length of the frost-free season can be computed from TABLE III-2. This table is for the period from 1933 to 1962 and gives the probabilities that a stated temperature will occur before or after a specified date. For example, 1 year in 10 a temperature of 32° F would occur as late as April 20, and 5 years in 10 it would occur after March 27. The first freeze in fall occurs before November 8 in about 5 years in 10, or about 50 percent of the time. The average frost-free period is as much as 226 days for 5 years in 10. This length of growing season was obtained by using the dates March 27 and November 8 in the column headed "32° or lower." The number of days actually vary because the dates of the last frost in spring and the first in fall vary, but for 5 years in 10 it will be 226 days. For 1 year in 10, the growing season may be as short as 187 days.

TABLE III-2
PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING AND LAST IN FALL IN THE SAFFORD VALLEY FOR THE PERIOD 1933-1966

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	Feb. 7	Feb. 23	Mar. 11	Apr. 9	Apr. 20
2 years in 10 later than	Jan. 30	Feb. 15	Mar. 2	Mar. 30	Apr. 12
5 years in 10 later than	(2)	Jan. 30	Feb. 13	Mar. 12	Mar. 27
Fall:					
1 year in 10 earlier than	Dec. 18	Nov. 27	Nov. 8	Nov. 2	Oct. 24
2 years in 10 earlier than	Dec. 31	Dec. 7	Nov. 16	Nov. 7	Oct. 29
5 years in 10 earlier than	(2)	Dec. 28	Dec. 3	Nov. 17	Nov. 8

[1] For the period 1933-66.

[2] Computation not feasible.

In general, the length of the frost-free, or growing season, is adequate for all crops that are sensitive to frost. Cotton is the main crop that is sensitive to frost, but tomatoes, okra, and other truck crops are sensitive. Most other crops stop growing vigorously after frost but are not killed. Barley, alfalfa, and most pasture live over the winter, but they do not grow new leaves.

VEGETATION

The generally sparse native desert vegetation consists of shrubs, yucca, cacti, annual grasses and herbs, and a few trees. The thickest cover occurs along the river, where scattered cottonwood and black willow grow in dense thickets of water motie and arrowweed. In a few permanently wet or salty areas saltgrass, seepweed, chamiza, water-tolerant grasses, and tules grow.

The alluvial fans and low stream terraces support a rather complex and varied association of plants, including mesquite, catclaw, creosotebush, hairy squawberry, lotebush, crucifixion thorn, snakeweed, broom baccharis, cacti, bush muhly, tobosa, fluff grass, six-weeks grama, needle grama, silver beardgrass, known locally as feathergrass, three-awn grass, side-oats grama, alfileria, and flowering annuals.

SOIL IRRIGATION AND WATER QUALITY RELATIONSHIPS

The irrigation water for the irrigable acreage of from 35,000 to 40,000 acres is supplied by diversion from Gila River There are no storage reservoirs, therefore only the natural flow of streams is available. After the spring flow from the mountain areas subsides, the water is low, and the water available for certain parts of the area becomes very limited until the summer rains replenish the supply. Priority rights dominate the available supply, and distribution is under control of a water commissioner.

Eleven diversion canals or ditches are found along the river. Very unstable diversion headings are built, and these are frequently torn out by floods. They are easily rebuilt, however, and adjusted to the flow and diversion allowable.

Numerous spillways allow for the flow of excess water to other canals or back to the river, from whence it is redistributed. This feature, together with the return flow from irrigation, provides for very economical use of water, though some farmers in the lower end of the valley complain of the high salt content of the water during low stages of the river sometimes as high as 3,000 mg/liter.

In the valley above Thatcher, very little drainage or alkali trouble has developed since the land has been irrigated, and several areas having a high salt content have been reclaimed. This is because of the favorable relief and good underdrainage. In small areas below Thatcher, however, drainage and accumulation of salts have become problems. This is probably due to the low position and flatness of the land, great variation in character and permeability of the substrata, and deep heavy subsoils, through which water moves slowly.

The largest area of poor drainage and salt accumulation is north of Central. There is an extensive system of drains in this area, and the tendency is for the greater part of the area to show improvement. Small areas remain, however, that have a high water table which comes dangerously near the surface, especially during the irrigation season. Subsurface drainage waters, moving down the slope, reach deep heavy soils, and their movement is checked, thereby causing a rise of the water table. Similar conditions and associations of soils exist elsewhere in the area but to a much smaller extent.

The soils in the region have a wide range in salt concentration, running up to more than 3 percent in a few places that are most favorable for an accumulation of salts. In most places the maximum content is in the subsoils of the heavy soils. The reclaimed areas are producing good yields of crops.

The quantity of water available for irrigation in the valley is usually sufficient for all agricultural purposes. As the crop year progresses from spring to fall, however, the level of water in the Gila River and in most wells goes down, and even the flow from a few artesian wells diminishes. The level of water in the river is restored and ground water recharged in winter and early in spring from rainfall and snowmelt.

The quality of water available for irrigation ranges from poor to good and depends on the kind and amount of salts that are dissolved in the water. Water that is suitable for home use is not necessarily suitable for use in irrigation. Soft water, for example, contains a high percentage of sodium and is harmful when used for irrigation. The majority of available water in the region is not good. Wells as close as a quarter of a mile apart may have water of different quality, depending on location, and adjacent wells may have different quality of water, depending on depth. Water from most artesian, or flowing, wells is poor because the wells are deep. The quality of water in the Gila River varies as the amount of water in the channel varies. As the amount decreases, the quality of the water decreases. (TABLE III-3)

TABLE III-3
WATER QUALITY DATA - GILA RIVER

Location		Bylas		Thatcher		San Jose	
Date		2-19-68	6-25-68	2-19-68	6-25-68	2-20-68	6-25-68
Parameter							
Stream Flow	cfs	2560.0	40.0	--	--	3850.0	93.0
Temp	°C	14.0	29.0	15.0	28.0	10.0	29.0
DO	*mg/l	8.1	12.2	9.3	9.0	9.1	8.0
BOD	mg/l	0.7	4.0	2.0	1.4	0.4	0.5
pH		8.1	8.3	8.1	8.0	8.0	8.3
Conductivity Micromhos		488.0	6800.0	364.0	2000.0	322.0	1200.0
TDS	mg/l	315.0	4221.0	230.0	1180.0	200.0	700.0
Hardness $CaCo_3$	mg/l	130.0	1015.0	116.0	458.0	112.0	233.0
Calcium	mg/l	36.0	268.0	34.0	131.0	31.0	70.0
Magnesium	mg/l	10.0	84.0	8.0	32.0	8.0	14.0
Sodium	mg/l	50.0	950.0	26.0	210.0	23.0	146.0
Chloride	mg/l	49.0	1600.0	24.0	370.0	20.0	235.0
Sulfate	mg/l	50.0	650.0	39.0	260.0	35.0	62.0
Iron	mg/l	25.0	0.24	7.0	0.05K	4.6	0.13
Copper	mg/l	0.05K**	0.01K	0.05K	0.02	0.05	0.01
HCO_3 Ion	mg/l	112.0	260.0	100.0	268.0	100.0	172.0
Fluoride	mg/l	0.8	1.4	0.7	1.4	0.6	1.4
Nitrate	mg/l	1.0	1.0	1.0	2.0	1.0K	1.0
Fecal coliform ***	No/100 ml	--	63	--	1K	--	127

*milligrams per liter
**less than value indicated
***number of organisms per 100 milliliters

Source: Arizona State Department of Health, Bureau of Water Quality Control

SOCIO ECONOMIC PROFILE

As can be concluded from the previous discussion the Safford Valley is primarily agriculturally oriented. Approximately 40 percent of Graham County's total basic employment has been generated by agricultural activities. The major products are beef, dairy goods, poultry and eggs, and cotton and barley. Agriculture is not the largest employing economic sector in the county, but it does contribute more to export employment than any other sector as an estimated three fourths of its agricultural production is sold outside the county. Agricultural production for Graham County is shown in TABLE III-4.

TABLE III-4

GRAHAM COUNTY AGRICULTURAL ACREAGE

	1968	1969	1970	1971
Cotton	16,500	17,400	15,400	
Barley	8,600	9,000	6,800	8,000
Wheat	100	50	1,500	2,000
Sorghum	25,700	22,000	23,500	25,500
Alfalfa	5,500	6,000	N/A	7,000

	1970	1971
Cattle (Total Number)	59,860	55,284

SOURCE: Arizona Crop and Livestock Reporting Service

Safford's central location has made it a trading center for ranch families throughout Graham County, the northern edge of Cochise County, the southern portion of Greenlee County and western New Mexico. Consequently, twenty percent of the area's labor force is engaged in wholesale and retail trade activity. Food stores, auto dealers, building materials, service stations, and eating and drinking places contribute most to employment in wholesale and retail trade sectors.

Although the counties which surround Graham County employ a significant percentage of their labor force in mining, Graham County in 1971 had only 75 workers engaged in mining (1.9 percent of total county employment). Before the undertaking of any large scale mining investment in the area, the size and grade of the ore must be assessed and there will have to be improvements in the efficiency of mining and metallurgy making the mining of low grade ore more profitable. These developments and the price of copper in world markets will tellingly influence the progress of a mining industry in Graham County in the near future.

Currently, a number of coppper firms are involved in major projects in the area. The most significant activity in the Safford Valley is the Phelps-Dodge project located north of Safford. Advanced exploration at this site indicate the development of a sizeable underground mining operation within the near future. .This estimated 250 million ton

reserve of ore will add considerable mining employment to the area. Other firms involved in copper exploration of varying degrees include Inspiration Copper Company, Kennecott Copper Company and American Metals Climax, Inc. Smaller firms are also active in the Safford Valley and surrounding area. Diatomaceous earth is mined south of Safford and shipped via rail to processing facilities at Bowie on the Southern Pacific Railroad's main line.

The Pinaleno and Gila Mountain ranges, which overlook Safford Valley, have contributed substantially to tourism in the area. Tourists, entering Graham County via Highway 70, have brought the area approximately one million dollars of income annually. Most of this expenditure has been at Safford where motel and restaurant facilities are most adequate. The development of roads into the more remote areas of the mountaineous regions will attract hunters and fishermen during the fall and spring, and campers during the summer. Summer homes are also being constructed in certain parts of the ranges. The communities at the base of the mountains are suppliers for visitors and part-time residents. Therefore, the potential in this sector of the economy appears quite encouraging.

Manufacturing accounted for 4.3 percent of total employment in the county in 1972. This somewhat low level of manufacturing stems from the area's remote location and history of isolation. The recent construction of better highways into the Valley will no doubt change this situation. Most of the Valley's manufacturing is by industries using local agriculture for raw materials. These include the cotton gin, a cotton seed oil plant, an ice cream manufacturing plant, a pumice and cinder block manufacturing plant, and several small operations. In 1969, Camp Trails Inc. began manufacturing camping equipment in Safford's Industrial Park. Camp Trails employs 120 workers. A favorable feasibility study on the establishment of a meat packing plant indicates potential in this area.

Government is the largest single contributor to the county's total labor earnings. In 1971, the government sector employed 28.4 percent of the total county employment. Since the county seat is in Safford, a large part of this percentage is located in Safford. Eastern Arizona Community College in Thatcher also contributes significantly to this percentage.

The greatest potential for development in Safford Valley seems to be in the agricultural and recreational sectors. Farm equipment sales and service, agricultural chemicals, processing establishments and farm product assemblers and packers might find opportunities in the Valley.

Development of recreational areas, retired communities and summer home sites could stimulate contract construction activity as well as finance, real estate, transportation and retail sales activities. This gradual development is hoped to expand in the next decade when the copper mining industry in the area matures. Regardless of the pace of development, the Safford Valley residents desire an orderly and systematic evolution of their socio-economic resources.

The communities concentrated within the Safford basin make up the major population center of the County. Approximately 91 percent of the county's population is within thirty mile radius of the Safford Thatcher area. Population projections for major Safford Valley communities are noted in TABLE III-5.

TABLE III-5
POPULATION PROJECTION SUMMARY FOR
SAFFORD VALLEY AND GRAHAM COUNTY
1975, 1980, & 1990

Developed Area	Projection Year	Population Projection Levels Low	Median	High
PIMA	1975	1300	1365	1435
	1980	1430	1575	1740
	1990	1725	2100	2555
THATCHER	1975	2440	2560	2690
	1980	2560	2830	3120
	1990	2830	3450	4190
FT. THOMAS	1975	330	345	365
	1980	360	400	440
	1990	440	530	645
SAFFORD	1975	5605	5710	5830
	1980	5890	6120	6375
	1990	6510	7020	7620
INDIAN RESERVATION	1975	1395	1430	1465
	1980	1430	1500	1580
	1990	1500	1660	1830
ALL OTHER AREAS OF DEVELOPMENT**	1975	7280	7390	7415
	1980	8530	8775	9045
	1990	11595	12340	13060
COUNTY TOTAL	1975	18300	18800	19200
	1980	20200	21200	22300
	1990	24600	27100	29900

**All other areas of development (AOAD) include the local area developments.
Source: Project Staff estimates.

A general breakdown of population characteristics are noted in TABLE III-6

The Safford Valley labor supply is generally quite favorable for most job openings. Most of the labor force participants are longtime valley residents with upwards of 300 men and women available for work during various seasons of the year. TABLE III-7 illustrates employment by sector in the Safford area.

TABLE III-6

SAFFORD VALLEY-POPULATION BY AGE AND SEX

	Safford			Thatcher			Pima		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
6 & Under	363	381	744	165	165	330	100	93	193
7-15	518	508	1,026	206	211	417	119	136	255
16-18	163	189	352	132	95	227	34	32	66
19-21	110	113	223	210	157	367	11	24	35
22-34	337	387	724	170	167	337	85	97	182
35-54	510	604	1,114	186	187	373	111	97	208
55-61	180	207	387	55	50	105	24	42	66
62-64	66	75	141	17	18	35	15	17	32
65-74	164	179	343	35	43	78	55	53	108
75 +	84	185	279	21	30	51	18	21	39
Total	2,505	2,828	5,333	1,197	1,123	2,320	572	612	1,184

TABLE III-7

SAFFORD VALLEY EMPLOYMENT BY SECTOR

	1970 Employment	
	Number	% of Total
Manufacturing	155	8.5
Contract Construction	156	8.5
Transportation, Communications, Public Utilities	82	4.5
Wholesale/Retail Trade	475	25.9
Finance, Insurance, Business Services	125	6.8
Professional Services	283	15.4
Government	118	6.5
Other	439	23.9
TOTAL	1,833	100.0

SOURCE: 1970 CENSUS OF POPULATION, U.S. DEPT. OF COMMERCE

Since the Safford Valley is predominantly an agricultural area, the supply and demand of workers is subject to seasonal fluctuations. In addition to the nearby 350 year-round workers, 600 to 700 are needed in the late spring, summer and fall months. Non-agricultural workers reach peak employment periods just before holiday shopping begins, as retail businesses hire many part-time selling and clerical people. Since many valley workers are reluctant to move during lay-off seasons seasonal laborers often must subsist during the off-season through secondary jobs and long distance commuting. These valley workers would welcome full-time employment.

As a service center for much of Graham and Greenlee counties, the Safford Valley has a well developed and sizeable services sector. In addition to the availability of a broad range of services in Safford, Thatcher, and Pima, headquarters are maintained there by utility firms as well as government agencies serving the area.

TRANSPORTATION. U.S. Route 70 serves the Safford Valley communities of Safford, Thatcher and Pima. This route connects with U.S. 60 near Globe and continues west to Phoenix. U.S. 666 also serves the Safford Valley, providing access to Interstate 10, 34 miles south of Safford and also to the international border with Mexico at Douglas, 112 miles south. Interstate 10 has been completed as far as Lordsburg, New Mexico to the east and with the exception of an eight-mile bypass around Benson and a 45 mile section near Phoenix, as far west as the California border. When finished, Interstate 10 will provide a year-round route to all southern market areas, from Los Angeles to Jacksonville, Florida. A spur line of the Southern Pacific Railroad serves the Safford Valley and connects with the company's main line at Bowie. This line also serves the mining areas of Globe and Miami to the west.

Safford Municipal Airport is located six miles north of the city. This airport has two 4,800 foot lighted and hard surfaced runways. The airport is equipped with a beacon and UNICOM radio, while maintenance and service facilities, including jet fuel, are available. Recent improvement at the site include over five acres of hard-surfaced auto parking.

SERVICE. A total of six motor carriers serve the Safford Valley. Interstate service is provided by Pacific Motor Trucking Company, O.N.C.-Hopper Freight Systems and Western Gillette. Sam Angle Transfer Company and Bigham's Transfer provide service on an intrastate basis.

Both Phoenix and Tucson are reached overnight by motor freight, as are El Paso, Albuquerque and Nogales, Sonora. Other representative delivery times are: Los Angeles, Las Vegas, San Diego - second morning delivery; San Francisco, Reno, Salt Lake City, Denver - third morning delivery; Dallas, Oklahoma City, Cheyenne, Boise, Portland - fourth morning delivery; Seattle, Kansas City - fifth morning delivery.

Southern Pacific Railroad provides the Safford Valley with freight service once a day with the exception of Sundays.

Freight service is provided for carload lots with the shipper having the loading responsibility. There is no less-than-carload service for the Safford Valley, nor is there passenger service at this time. AMTRAK railroad passenger service is available at Tucson, 126 miles southwest, and Lordsburg, New Mexico, 77 miles east.

No regularly scheduled air passenger or air freight service is available in the Safford Valley at this time. However, charter air service is available through Gila Valley Air Service at Safford Municipal Airport. Tucson International Airport, 126 miles southwest of Safford,

provides facilities for domestic and international service. Airlines serving Tucson include Aero Mexico, American Airlines, Cochise Airlines, Continental Airlines, Hughes AirWest, Trans World Airlines and Western Airlines.

Bus service in the Safford Valley is provided by Greyhound, with five westbound and four eastbound buses daily.

ELECTRICITY. Electrical service in the Safford Valley is provided by the City of Safford's municipal system and the Graham County Electric Cooperative. The City of Safford provides electrical service to essentially all residential and commercial/industrial activities within the city limits of that city while the Graham County Cooperative serves the communities of Thatcher, Pima and the unincorporated areas of the valley.

Both systems obtain power from the Bureau of Reclamation although Safford generates most of its power at the city-operated diesel generating plant. This plant has a generating capacity of 6,500 KW which is sufficient to meet the entire needs of the city, without using the extra capacity contracted for with the Bureau. This extra capacity does, however, allow the city sufficient power in cases of power curtailment or emergencies.

NATURAL GAS. Natural Gas service in and around Safford is provided by the municipal system. The City of Safford has a franchise covering that city and a considerable portion of the rural area adjacent. Natural gas is purchased from the El Paso Natural Gas Company at its Tucson main line south of Safford.

The remaining area of the Safford Valley is served by General Utilities with offices in Pima. This firm also purchases gas from El Paso Natural Gas Company.

TELEPHONE. Telephone service to the entire Safford Valley area is provided by Mountain Bell Telephone Company. All Bell System services, except Touchtone and Bellboy, are available.

FINANCE. There are two nationally chartered banks in Safford and one in Pima. Arizona is a state that permits branch banking; hence Valley National Bank has a branch in Safford and in Pima, while the First National Bank of Arizona maintains a branch in Safford. Valley National Bank is the 32nd largest in the nation with total assets of over two billion dollars, while First National Bank is 55th largest in the nation, with total assets of nearly one and one-half billion dollars.

Fidelity Federal Savings & Loan with total assets of nearly 11 million dollars also maintains a branch in Safford.

MOTEL AND MEETING FACILITIES. There are a total of 13 motels in Safford. Thatcher and Pima providing a total of 300 units. Meeting facilities in the area include the frequently used room at the Safford-Graham County Chamber of Commerce, capable of seating fifty persons. The recently completed Cultural Center of Eastern Arizona College at Thatcher has a considerably larger capacity, seating up to 1000.

LAW ENFORCEMENT. The Safford Police Department has eight full time personnel, including the Police Chief. The Department has a total of seven vehicles, all with full emergency and communications equipment.

Thatcher has a two man police department equipped with two vehicles while the Pima Police Department has one officer and one vehicle.

All police officers in the Safford Valley communities are trained through the facilities of the Arizona Department of Public Safety and many are involved with extension courses through Eastern Arizona College.

The Graham County Sheriff's Office headquartered at Safford has 20 deputies assigned to the three community area. The Arizona Highway Patrol also maintains an office east of Safford.

FIRE PROTECTION. The Safford Fire Department is currently staffed by a paid Chief and 25 volunteers. Department equipment consists of three 1,250 GPM pumpers, a 1,000 GPM pumper, and a 750 GPM pumper.

Safford has been rated by the Arizona Fire Rating Bureau as Grades 4 and 9.

Thatcher has a 20 man fire department - all volunteers. Equipment includes a 750 GPM pumper, two 500 GPM pumpers, and a high pressure water truck. Thatcher has a fire rating of Grade 8.

The Pima Fire Department has a staff of 26 volunteers. The Department's equipment includes a 1,000 GPM pumper, a 750 GPM pumper and a 500 GPM pumper. Pima has achieved a fire rating of Grade 9.

A mutual agreement for aid is maintained by the three departments.

LIBRARY. In Safford, there are four library facilities. Safford Public Library holds 20,000 volumes, while the three school libraries combined shelve approximately 25,000 volumes. Eastern Arizona College in Thatcher contains over 21,000 volumes, while Thatcher High School has over 8,000. The Pima High School Library houses 800 books. The Town of Pima maintains a library housing 2,500 volumes.

EDUCATION. Vocational education in the Safford Valley has achieved a high degree of development both at the high school and community college levels. (TABLE III-8)

TABLE III-8

SAFFORD VALLEY EDUCATIONAL FACILITIES

Safford	Number of Schools	Faculty	Enrollment	Per Student Operating Expense
Public Elementary & Jr. High	3	60	1,600	$ 591.00
Public High School	1	38	851	$ 783.00
Thatcher				
Public Elementary & Jr. High	1	28	693	$ 568.10
Public High School	1	14	244	$1011.58
Pima				
Public Elementary & Jr. High	1	18	365	$ 732.00
Public High School	1	7	130	$ 920.00

SOURCE: LOCAL SCHOOL SUPERINTENDENTS

Safford High School has a very comprehensive vocational educational program providing training ranging from Distributive Education in the Marketing and Management fields to a wide variety of trade skills.

Thatcher and Pima High Schools also provide certain trade and craft classes.

Eastern Arizona College in Thatcher offers curricular of two types. A college-parallel (transfer) or occupational program may be pursued. The Associate of Arts or the Associate in Applied Science can be earned in the appropriate program. Additionally, developmental courses in English, Reading, Math and Science are available. Occupational programs include agriculture, business, home economic, technologies, and law enforcement. The present enrollment at Eastern Arizona College is about 1,500, including part-time and extension students.

MEDICAL. The Safford Valley is currently served by a privately operated hospital - The Safford Inn Hospital, Inc. in Safford. This facility has 27 medical/surgical beds and a staff consisting of 12 registered nurses, six LPN's, eleven nurses aides, and two laboratory/x-ray technicians. There are also eight M.D.'s (all general practitioners) affiliated with the hospital, in addition to two surgeons and one urologist who serve on a consultant basis.

The Mt. Graham Hospital, a municipal facility operated by the City of Safford has 31 beds. This facility has recently replaced the Safford Inn Hospital. Long term convalescent care is provided by the Mt. View Nursing Home in Safford which has over 120 beds.

NEWSPAPERS. The Safford Valley is served by two local newspapers. The Eastern Arizona Courier, published weekly in Safford, has a circulation of approximately 7,000. The Graham County Guardian, a weekly also published in Safford, has a circulation of 3,300.

In addition to the local papers, the Phoenix and Tucson morning and evening dailies are available in the Safford Valley.

TELEVISION. The Safford Valley is served by two cable firms, providing area residents with broadcasts from both the Phoenix and Tucson metropolitan areas - a total of eight channels. Cablecom General, Inc. provides service to Safford. The connection fee is $15.00 and monthly service charge is $7.50.

MAN MADE SYSTEMS

LAND USE

The general land ownership and land use characteristics of Graham County have been discussed in Chapter II. Evident from PLATE 2 is the fact that, the Safford Valley represents the major area of development. Furthermore, the communities of Safford, Thatcher and Pima represent the largest populated rural areas within the valley and as such exhibit established land use patterns. As a consequence these communities will be discussed as to their existing and projected land uses which appear to typify the valley as a whole.

EXISTING LAND USES - SAFFORD

The barriers presented by irrigation canals ordinarily have direct influence on the growth of a community. There is no evidence that the relatively narrow canal coursing through Safford has had any lasting effect in retarding growth or the movement of people. Ordinarily, railroad rights-of-way also influence the pattern of a community's growth. Because the branch of the Southern Pacific Railway has such infrequent service, these rails have not been an impediment to the growth pattern, even though they transverse the town from east to west.

U.S. Highway #70 parallels the Southern Pacific tracks to the east of the city and within the corporate limits is located three city blocks north of the railway tracks. With the steadily increasing traffic on Highway #70 this Federal Primary Highway will become more of a barrier to the movement of both pedestrian and local automobile traffic to and from the north part of the city.

In Safford the topography of the land has far greater influence on the past and future patterns of growth than do the man-made barriers. The land falls rapidly from the north of the city line toward the Gila River. This low-lying farm land, with its threat of flooding, has definite disadvantages for residential construction. There has been very little growth north of the highway for a substantial number of years. With the exception of the recent Pecan and Hillcrest Additions practically all of the new residential construction has been to the south and the southwest of the business district. The farm land south of the city limits rises gradually toward the low mesa just beyond the Highline Canal. Because of topography and direction of past growth, the natural movement has continued in this direction. Safford at present is growing at a more rapid rate than it has at any time in the past decade. PLATE 8 shows a relatively high density of development within the city limits, which is probably due to the utilities which the city provides. They are essential to residential growth. The city has less vacant area than most cities of its size, and without previous planning or subdivision zoning regulations presents a remarkably cohesive pattern of land usage.

STREETS. Of the total land area of Safford approximately 27 percent is taken up by streets and alleys and indicates that the city has a high ratio of street area, which is largely due to the 300-foot blocks in the older part of the city north of Eighth Street (TABLE III-9). These block measurements are considerably smaller than those called for by modern city design. As the city grows, some traffic problems will be created by the frequent intersections. If opportunities present themselves in the future, some of the cross streets could be closed. U.S. Highway #70 crosses the city on a four-lane, 100-foot right-of-way. Through traffic transits the populated area easily at present volumes of traffic.

TABLE III-9
EXISTING LAND USE IN SAFFORD

Land Use	Number of Acres	Percent of City Area
Residential		
Single Family	222	33.8%
Multi-family	18	2.7
Commercial	54	8.2
Industrial	15	2.3
Public	27	4.2
Quasi-Public	9	1.4
Streets & Alleys	175	26.6
Canals & Waterways	3	0.4
Railroad R/W	10	1.5
Agriculture	42	6.4
Vacant	82	12.5
Total	657	100.0%

Source: Office of Economic Planning and Development

Note: The 27 acres of public land in Safford are accounted for as follows: Schools - 17 acres (2.6%); Parks - 5 acres (0.8%); Land and Buildings - 5 acres (0.8%).

RESIDENCES. The bulk of the population resides south of the Union Canal in residential subdivisions that were added to the original town site. The homes are newer and of higher standards of construction than those found north of the Union Canal and particularly those north of the highway. Within the city limits approximately 34 percent of the land is used for single family homes. This is a high ratio and indicates that Safford is basically a city of single family residences. For simplicity, two-family homes have been combined with multiple family units, with 27% of the land area being occupied by such structures.

SCHOOLS. The Safford High School site is in a strategic location close to the center of population on fourteen acres of land. Part of this site is occupied by the elementary school with classrooms for grades four through eight.

The primary school is located on the southwest edge of town at Tenth Avenue and Eleventh Street. This school accommodates grades one through three and one section of the fourth grade. It is located on thirteen and three-fifths acres, of which three and one-half acres are within the corporate limits of Safford.

Safford School District is a long, narrow strip extending through the county from the Cochise to the Apache County line. It is estimated that approximately 25% of the school children live outside the City of Safford. The total area of land owned by the school district for educational purposes is adequate on a statistical basis, but there is no provision for children living north of the highway. All elementary school children must come to either of the two locations.

PARKS. The only publicly-owned park in the entire area is Firth Park located on the south side of U.S. Highway #70 near the west city limits of Safford. The park has approximately five acres with a swimming pool which is operated by the American Legion. While the city is making the most of available facilities, the space devoted to parks and recreation is insufficient when compared to other cities or according to national standards.

COMMERCIAL. Prior to 1947, the commercial district was concentrated along the former route of U.S. Highway #70. This entered the city at the east end of Main Street and, after four right angle turns, left the city on the west via Thatcher Boulevard. Because the four, sharp, 90-degree turns and diagonal parking prohibited the smooth flow of traffic, the present route was constructed in 1947. The realignment of Highway #70 through Safford has solved the problem of moving traffic through the city.

Most of the businesses that had been established along the old route remained where they were. As the city grew, new businesses were established along the present highway. This change in highway location created a commercial district of greater depth and substance than is found in most cities of 5,300 population. The solution of the traffic problem has provided a commercial district which has the earmarks of good design.

There is now a tendency for newly created businesses to develop in a linear or ribbon fashion along the highway. Motels, service stations, and cafes have moved out beyond the city limits primarily to the east. Because of the compactness of the city and the relatively high population density, no neighborhood shopping centers have been developed.

Within the corporate limits there are fifty-four acres devoted to commercial uses including gasoline service stations, hotels, motels, and trailer parks. Most of this commercial use is devoted to retail businesses serving the trade area.

INDUSTRY. The City Council has designated 770 acres of city-owned property as industrial. These sites are well outside the corporate limits. One of the larger sites, containing a total of 370 acres, lies directly south of Thatcher and is reached by a dirt road from Safford. A golf course was built on part of this land several years ago. South of the city, on Highway #666, a block plant and a sand and gravel pit are operated on city property which adjoins land set aside as a city cemetery. Surrounding the municipal airport are another 293 acres which have been reserved for industry.

Within the city a few warehouses and other industrial operations occupy relatively small parcels south of the Southern Pacific Railroad right-of-way. This is where oil company bulk plants and commercial warehouses are located. These parcels involve a total area of approximately thirteen acres.

QUASI-PUBLIC USES. There are sixteen churches within the city limits, occupying five and a half acres of land. Other buildings of a quasi-public nature include the Boy Scout Headquarters, Masonic Lodge, Labor Union Building, Odd Fellows Lodge, Woman's Club, Elks Club, and the Chamber of Commerce. A private hospital is situated on three-tenths of an acre.

AIRPORT. The Municipal Airport is approximately two miles north and four miles east of Safford. This air facility, with improved schedules, could enjoy substantially more air traffic than it does at the present time. The two runways are 4,800 feet long and both could be lengthened. The industrial lands consist of 140 acres to the south of the runways and 153 acres to the north.

PROJECTED LAND USE-SAFFORD

The city limits of Safford now encompass one square mile. Within its corporate limits there are approximately 5,500 people, or a population density of about 8 1/3 persons per acre. New residences that have been built beyond the city limits accommodate fewer persons per acre because the lot sizes are considerably larger than those within the corporate limits and occupants of these new homes tend to have somewhat smaller families than those within the city.

The growth to the south and southwest of the city will be of lighter density than past growth since it will follow present trends of construction and family occupancy. In addition, increasing numbers of retired people, will be attracted to Safford. The parks and playgrounds will reduce the acreage used per family. The future city will likely have an average of seven people per acre, or nearly 5,000 per section of land, with moderate commercial and no industrial use in residential areas.

These figures do not include residences that might be built around the golf course to the southwest or in the Hillcrest addition and undetermined areas north of the river if mining operations begin prior to 1975. By state law outlying residential areas must conform to city zoning and building ordinances.

While most of the future city will occupy land now used for farming, one subdivision is planned for the mesa southwest of the city. The natural growth is in that direction and the desert mesa will become a logical site for future expansion. It should be planned as an integral part of the city. General projected land use classifications for the community are presented in PLATE 9.

MAJOR STREETS AND HIGHWAYS. The average daily traffic on U.S. Highway #70 through Safford is now about 13,000 vehicles. From historical statistical data it is estimated that the 1975 average daily traffic volume at this point will be 16,000. It should be noted that in the future, highway authorities might find it advisable to change this highway route to avoid congestion created by conflicts between local and through traffic. It appears that such an alignment would leave the present route in the neighborhood of the town of Pima or Central on a line following the base of the mesa north of the Gila River. It rejoin the present alignment near the towns of Solomon or San Jose in the immediate future.

SCHOOLS, PARKS AND RECREATION. This section is primarily concerned with the location, kind and extent of the various types of schools, parks and recreational areas that are presently needed and will be needed in the future to serve Safford and Thatcher. It is recognized that recreation facilities must be provided for all age groups. This is especially important as Safford and Thatcher begin to more fully attain their potential as tourist and retirement communities and as a residential area serving new mining operations north of the Gila River.

It is not economically sound to provide separate play facilities for children attending school and for separate recreational use during the summer months. The current practice is to design playgrounds, fields, and neighborhood parks to meet the needs of all age groups within the various neighborhoods. The parks, playgrounds and schools recommended in this report should be designed in accordance with commonly recognized standards and adjusted to meet local conditions that are present or are potentially important to both Safford and Thatcher.

The elementary schools should have a site of five acres plus one acre for each 100 pupils enrolled. No elementary school should be located on a major street. The area serviced

by each elementary school should approximate a one-half mile radius. As the communities grow, provisions should be made for additional enrollment by acquiring sites of sufficient size to accommodate the future maximum of pupils. The formula of five acres plus one acre for each 100 of enrollment will provide sufficient playground space during both the school year and as a neighborhood recreation area for children during summer and other vacation periods. School buildings should have facilities that can serve as a community center.

While the growth to the south and southwest will necessitate an elementary school site to accommodate the children there is a serious need for a small elementary school in the northern part of the city. A school in the northern part of the city would immediately relieve congestion and eliminate the undesirable features of the children crossing a busy highway.

In the near future it will be necessary for the school district to build a school north of the river, as mining operations take on full production schedules and attract to the valley additional personnel. It is too early to determine the patterns that land usage might take and it is not appropriate to try to select a proper site for such a school at this time.

If growth continues at the present rate and direction, an expansion to the southwest will be required. While the necessity is several years in the future the projected future land use map provides for this site. Later, the agricultural land southwest of the present city will fill up and those areas to the south and slightly east of the present City of Safford will become residential subdivisions. This area will also need elementary school facilities. This site is in partially vacant land at the edge of the present corporate limits. A site for the fifth elementary school should be located east of First Avenue just below the Union Canal. This school would primarily serve the families now living east of this highway, plus those who will move into this area in the future.

All elementary school sites should be sufficiently large to accommodate playgrounds for summer activities, with facilities in the school buildings that can serve as neighborhood community centers. The school sites should serve as small recreation centers for the families of the neighborhoods. In addition to the recreation provided by school sites, however, the City of Safford should have one large park for recreational purposes.

COMMERCIAL. Because Safford serves a trade area with a population base more than twice that of the city, a large commercial area has developed. The sources of the growth that is projected for Safford will tend to retain a higher-than-average percent of land devoted to business and commerce.

Safford now has a large but cohesive business section which should be retained. Within the present corporate limits, commercial expansion is planned for Blocks 34, 35, 36 and 37, and the unnumbered parcels on the east side of First Avenue, or U.S. Highway #666, between Seventh Street and Fifth Street. Parcels along the north side of U.S. Highway #70 will very naturally become commercial over a period of years.

The residential sections of the city do not have a planned neighborhood shopping center. A few small stores serving neighborhoods with convenience items now operate in the south part of the city. To provide for the increasing population, four neighborhood shopping centers should be developed which should include gasoline service station, retail grocery store, a variety of general merchandise retailer. Small convenience goods centers should also be provided in the Hillcrest area and at the present golf course site when these areas develop sufficiently to support such establishments.

Beyond the present city limits to the east, a number of lots are not occupied by commercial establishments. One of the problems of nearly all cities is the maintenance of suitable approaches to the city and the control of the appearance and the use of land on the highway beyond the city limits. Commercial sectors containing motels, restaurants and service stations will expand on the north side of U.S. Highway #70 on the east of Safford and on both sides for one-half mile beyond the present city limits to the west.

INDUSTRIAL. The City of Safford currently owns three widely separated land areas which have been designated for future industrial use.

One large parcel of industrial property, is four miles from downtown and lies south of the Town of Thatcher. The Mt. Graham Golf Course occupies eighty acres of this 370-acre parcel. The golf course is a asset to the entire valley community. Cities have found that residential locations adjoining golf courses have high values; residential use seems more logical than industrial.

Lying to the west of the city limits of Safford, between the railroad and the Union Canal, are forty-four acres of land, five of which are now occupied by industry. Because this parcel is isolated from the rest of the community by the rail on one side and the canal on the other and is relatively narrow making it undesirable for either residential or commercial use. Its logical use is for light industry with an access road paralleling and adjacent to the canal. The airport site contains approximately 290 acres of industrial property.

The city also owns approximately 150 acres just west of Highway #666 south of town, with forty-two acres reserved for a cemetery. At present a sand and gravel pit and a block plant occupy about sixty acres of this land. The remainder of this parcel acres, has potential for industrial uses and should be retained.

It is estimated that 177 acres, or 6% of the total land area within the projected corporate limits of Safford, are devoted to industrial use. The industrial areas described comprise 525 acres and should accommodate all of the industrial needs of the city for many years.

EXISTING LAND USES - THATCHER

When the Town of Thatcher was established in the 1880's, the town site was planned on a grid pattern approximately 1.5 miles square. Of the original 1,000 acres within the corporate limits of the town, only 242 acres are occupied. Most of the city blocks are 528 feet square, while those along the north border of the occupied area are 528 feet wide and 726 feet long. (PLATE 10).

STREETS. Most streets have a 99-foot right-of-way and account for a total of 116 acres (TABLE III-10). Few small towns have as good a street pattern as Thatcher. The width is adequate for all foreseeable requirements.

RESIDENCES. The residences of Thatcher occupy relatively large lots which are interspersed frequently with garden plots, small cotton fields, pastures, pecan groves and other agricultural uses. The small parcels of agricultural land should be put to higher and better use as residential property prior to any expansion beyond the corporate limits. In addition to the intermingling of agriculture in the built-up section of the town there are a number of large acreages within the corporate limits that are used for farming. These substantial acreages will move slowly to other uses.

TABLE III-10
EXISTING LAND USE IN THATCHER

Land Use	Number of Acres	Percent of City Area
Residential		
Single Family	82	8.2%
Multi-family	3	0.3
Commercial	6	0.6
Industrial	2	0.2
Public	20	2.0
Quasi-Public	4	0.4
Streets & Alleys	116	11.6
Canals & Waterways	2	0.2
Railroad R/W	7	0.7
Agriculture	682	68.2
Vacant	76	7.6
Total	1,000	100.0%

Source: Office of Economic Planning and Development

SCHOOLS. The Thatcher School District extends from a line at the foot of the mountains north of the Gila River south through the town to the county line. Most of the students come from the farms in the valley and from the town. The high school and elementary school occupy a city square block north of Highway #70 close to the center of town. The total area devoted to public elementary and high school use is approximately eight acres and is somewhat short of national standards.

Eastern Arizona Junior College occupies twelve acres in two city blocks. The absence of adequate classrooms and other facilities has been resolved in recent years through expansion.

PARKS. Thatcher has no publicly owned park at the present time. Because of the rural characteristics of the community this has not appeared necessary due to the proximity of parks in Safford.

COMMERCIAL. The business section of Thatcher in many ways typifies the suburban shopping center with most of the merchandise of the convenience nature. The commercial area is concentrated along U.S. Highway #70 close to the center of town. Service stations are scattered along the highway primarily to the east of the principal commercial block. Six acres, or 0.6 percent are devoted to commercial uses, which is well below the average, but it will likely remain in this proportion unless, the student body of the college expands rapidly, creating a market for enlarged retail spaces.

INDUSTRY. There are four or five small industrial operations within the corporate limits of Thatcher which account for 0.15 percent of the total city area. Just south of the corporate limits, the Gila Valley Concrete Company occupies a total of twenty-eight acres. Also in this same area are the El Paso Gas Company pump station, Southwestern Agrochemical and maintenance yards of the Gila Valley Soil Conservation District.

QUASI-PUBLIC USES. The one church in the community occupies approximately four acres. There are no private schools, hospitals, or clubs within the corporate limits.

PROJECTED LAND USE - THATCHER

The corporate limits contain 1-56 square miles, which can accommodate a much greater population. Projected land use classifications for Thatcher are presented on PLATE 11.

The Town of Thatcher has not yet felt the effect of the influx of the population which is favoring Safford. The town is growing slowly, with the net addition of approximately fifty people each year. Seeds for immediate growth are to be found in the potentials of Eastern Arizona College.

A total enrollment of close to 2,000 could eventually be realized at the college. It is rapidly becoming more than a local school and can become an important part of the state's higher educational facilities.

Thatcher will also receive benefits as the total population of the valley grows under the impetus of copper mining activities north and east of Safford. All growth factors affecting Safford will have some influence on Thatcher.

The original townsite of Thatcher was laid out to include 1,000 acres in a perfect square. It is doubtful that this incorporated area will be fully occupied by urban uses at any time in the next twenty years. The movement of the community is likely to be confined north of the Southern Pacific Railroad tracks. The desert area in the southwest corner of the corporate limits and much of the farm land south of the Southern Pacific tracks will, in all probability, remain undeveloped.

Most urban communities in the western states average approximately ten people per acre. Because the lot size in Thatcher will remain large, the density of population will be closer to seven people per acre. To accommodate four thousand people at this density, about 570 acres will need to be developed for urban use. A substantial proportion will be in single family residences, though the percentage of multiple family units will certainly increase. Multiple family units should be in the neighborhood of the college and the commercial area.

STREETS AND HIGHWAYS. The streets of Thatcher were laid out with foresight and have sufficient width to adequately carry any local or residential traffic that can be projected for the future community. It essential to any long-range plan that the streets specified in the original plat be dedicated to the Town of Thatcher and opened up as the community grows and has need for them. The only possible exceptions are those cases where schools might be divided by a traffic thoroughfare. This is particularly true in the case of the college.

As the agricultural areas yield to residences, the original grid pattern of the streets should be maintained n the residential section north of Church Street.

In 1971, U.S. Highway #70 had an average twenty-four-hour traffic volume of 7,111 vehicles through Thatcher. This had grown from 6,249 in 1969. From 1971 to 1973 the volume decreased to 6,075. By projection, using historical data it is estimated that the average annual daily traffic volume will be 7,200 vehicles in 1975. In the light of possible developments of an industrial and commercial nature in the Safford Valley, this estimate could be low. In any event, the highway traffic through Thatcher will not become unmanageable through the projected period of this study.

SCHOOLS, PARKS AND RECREATION. The present school site accommodating both the elementary and the high school is located on the highway. This has undesirable aspects for smaller children. The high school should be retained on this site and the city block containing 9.6 acres directly to the north be acquired for a play field and other physical education purposes.

U.S. Highway #70 divides the town and makes it undesirable for smaller children to cross this thoroughfare to and from school. Elementary schools are planned for both the north and south sides. With a population growth of 1,500 to 4,200, (high projection level) the school population will increase from 604 to 1,600. The three sites should accommodate the school-age children when Thatcher has a population of 4,200 people. A high school with a campus of seventeen acres will approximate national standards, while the two elementary schools of 9.6 acres and nine acres appear adequate for the school population projection.

The three school sites should be designed so they can be utilized by adults as neighborhood community centers for meetings affecting the affairs of the neighborhood. There will also be need for vacation recreational programs for children which can best be provided by school facilities. The proximity of the elementary school to the high school is an asset insofar as supplementary uses of the school facilities are concerned. As the town grows park facilities of approximately ten to fifteen acres should be allocated for recreational facilities for all age groups. A site consisting of ten acres has been designated for a park adjoining Highway #70 at the east limits of the town.

COMMERCIAL. Because the major shopping district of Safford is nearby, there has been very little growth of retail establishments selling goods. The merchandise available in the Town of Thatcher is of a convenience nature.

The beginning patterns of commercial development have direct bearing on patterns of the future. Most of the merchandise inventories in Thatcher will remain of a convenience nature. While it is difficult to avoid continuous growth of the retail development, it would be good to encourage solid developments in any one block rather than have retail establishments and service stations interspersed with residences. Plans for a future Thatcher should call for the commercial development of the entire block west of the present commercial district. Additional commercial areas should be encouraged across the street and to the east. The commercial establishments in the block with the post office have pre-empted this land which could be better used for strictly public purposes.

In addition to the planning for commercial land uses in the western portion of the town, some provision should be made for retail shopping near the eastern town limits the direction in which the Town of Thatcher is expected to grow.

INDUSTRIAL. Only one and one-half acres are in industrial use in the town limits of Thatcher. The one and a half acres is divided in seven separate and isolated parcels. New industries and those that are smaller will probably prefer to be closer to the work force of the residential areas. Thatcher should not overlook the advantages of industrial payrolls, however the future lies in that of a residential community and a college town. Nevertheless a land area for industrial use could be preserved. For this purpose 20 acres south of the tracks and bordering the town or corporate limits has been designated on PLATE 11.

EXISTING LAND USE - PIMA

Pima is a small service center supporting the adjacent agricultural activity. The townsite is laid out in a modified grid pattern with the Southern Pacific Railroad tracks and U.S. Highway 70 being the two major deviations to this street pattern. (PLATE 12)

RESIDENTIAL. The residential uses are predominately single family houses situated on large individual lots. Many of these single family residential units are interspersed with secondary agricultural uses of as small gardens, corrals, and pastures.

MULTI-FAMILY. Pima has a relatively large amount of land used for multi-family residential units when compared to other towns of equivalent population. These units are primarily duplexes and small apartment complexes. There are no large apartment complexes located within the town.

COMMERCIAL. Retail business development has concentrated along U.S. 70 between Second West Street and Main Street. The businesses in this area are predominately of the convenience type, i.e. food stores, clothing and specialty shops. Those commercial uses which have located outside of this core area are mostly highway oriented, i.e. service stations and restaurants, which require large frontages on the highway.

QUASI-PUBLIC. Institutional and public lands are indicated on PLATE 12. The school is located between Main and First East Streets. This site appears to be sufficient to accommodate present and projected enrollments for the near future. The Town Hall is west of Second West Street with the town maintenance facilities located south of the railroad tracks and east of Second East Street. The remaining uses in this category are mostly churches and nonprofit institutions.

INDUSTRIAL. The single industrial use is situated south of the railroad tracks, a cotton gin and compress which serves the local farm cooperative. The equipment repair and farm supply facilities have been classified as commercial due to retail trade activities.

OTHER USES. There is a significant amount of open space and vacant land within the town limits. This should allow for future land development within the existing town limits.

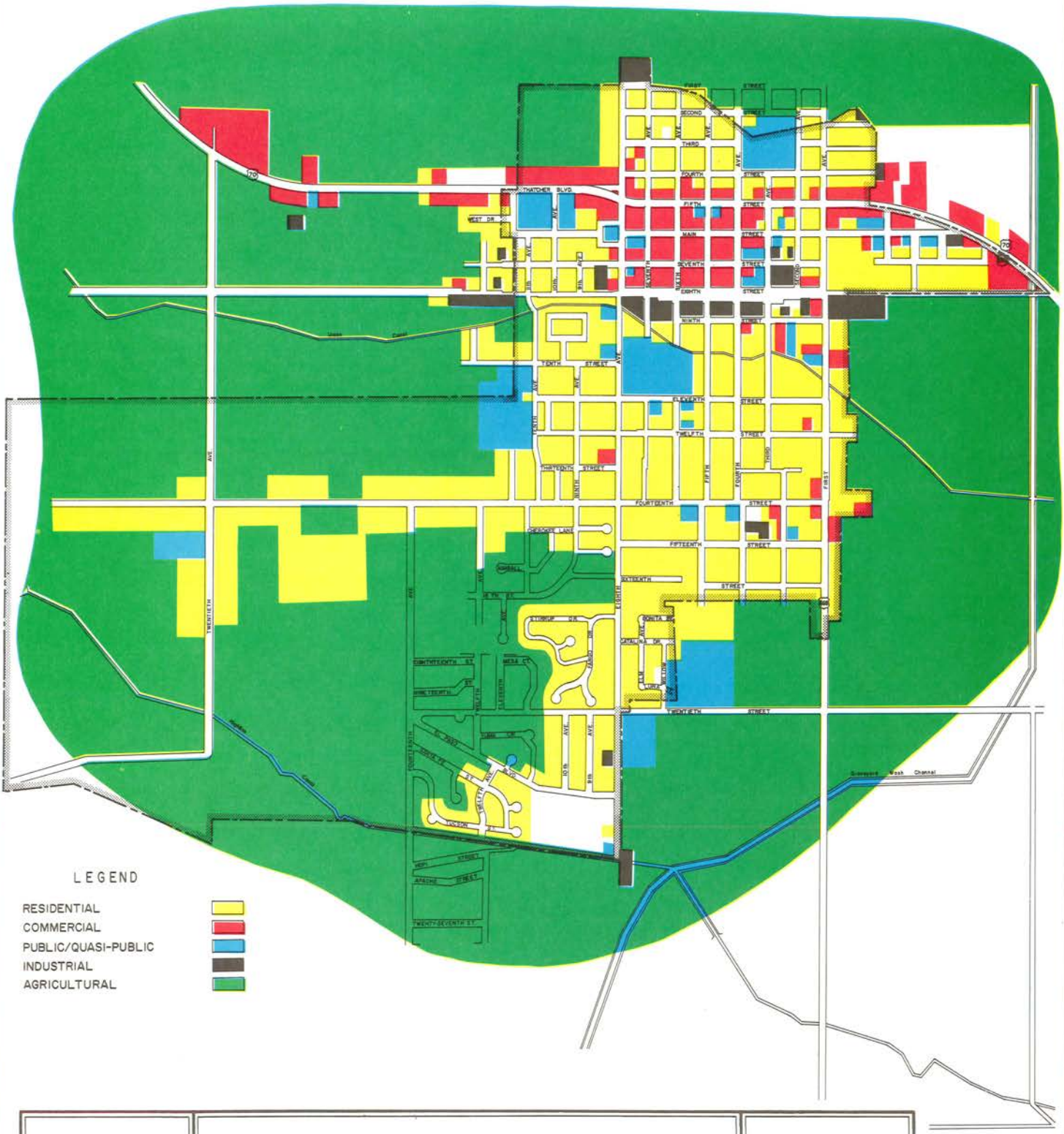
Agricultural land uses account for the largest amount of developed land both within and adjacent to the town boundaries. The principles crops are sorghams, cotton, alfalfa and small feed grains.

PROJECTED LAND USE - PIMA

The trend of large lot residential development will probably continue thereby keeping densities relatively low. This type of development is encouraged by the rural style of living.

PLATE 13 indicates the projected areas of development by broad land use category. This is a representation of the possible directions and type of development which could take place during the next twenty years. The projections are based upon established population growth trends, past patterns of land development and only a slight increase in the density of residential development.

Residential development will probably continue to be primarily single family dwellings with multi-family dwellings retaining its present percentage of the developed residential land area. Recent residential development has been south of the townsite and will probably continue in this direction. Some attempt should be made to develop the vacant land within the existing town limits before additional farm land is subdivided.



ENVIRONMENTAL SERVICES NEEDS STUDY

PREPARED BY

OFFICE OF ECONOMIC PLANNING AND DEVELOPMENT

SAFFORD, ARIZONA

LAND USE

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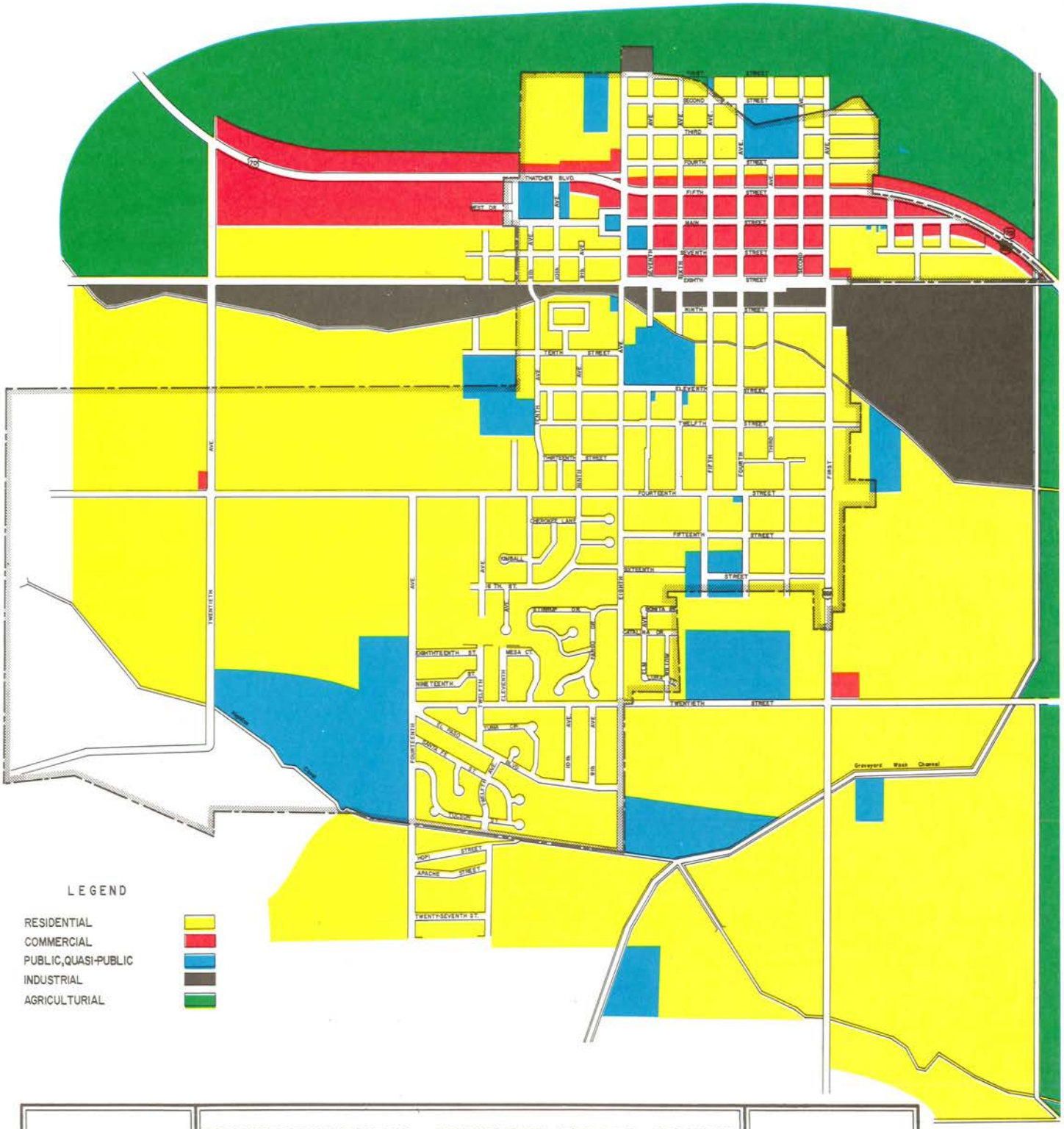
PLATE 8



ENVIRONMENTAL SERVICES NEEDS STUDY

PREPARED BY

OFFICE OF ECONOMIC PLANNING AND DEVELOPMENT

SAFFORD, ARIZONA

PROJECTED LAND USE

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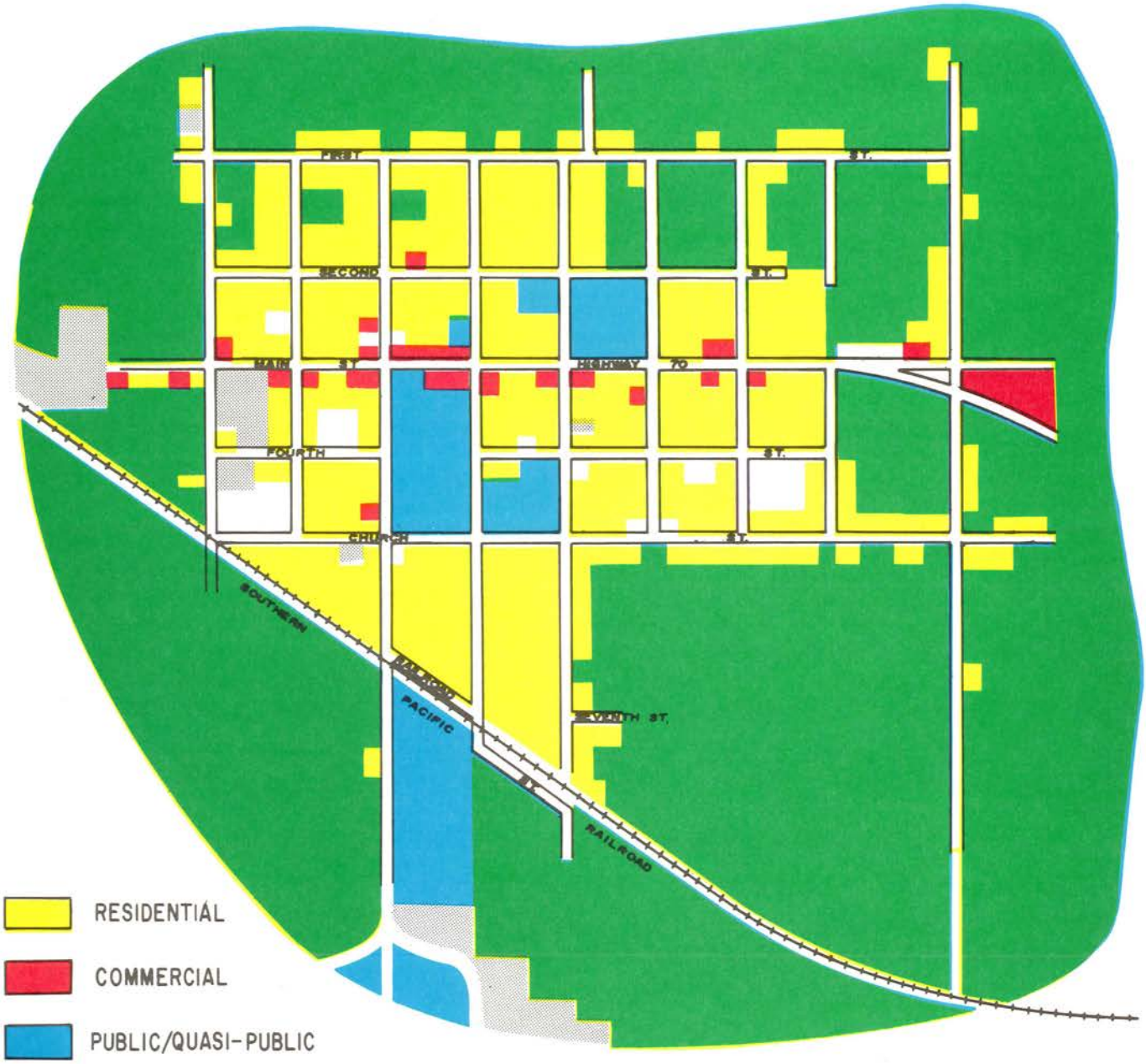
PLATE 9



RESIDENTIAL

COMMERCIAL

PUBLIC/QUASI-PUBLIC

INDUSTRIAL

AGRICULTURE

ENVIRONMENTAL SERVICES NEEDS STUDY

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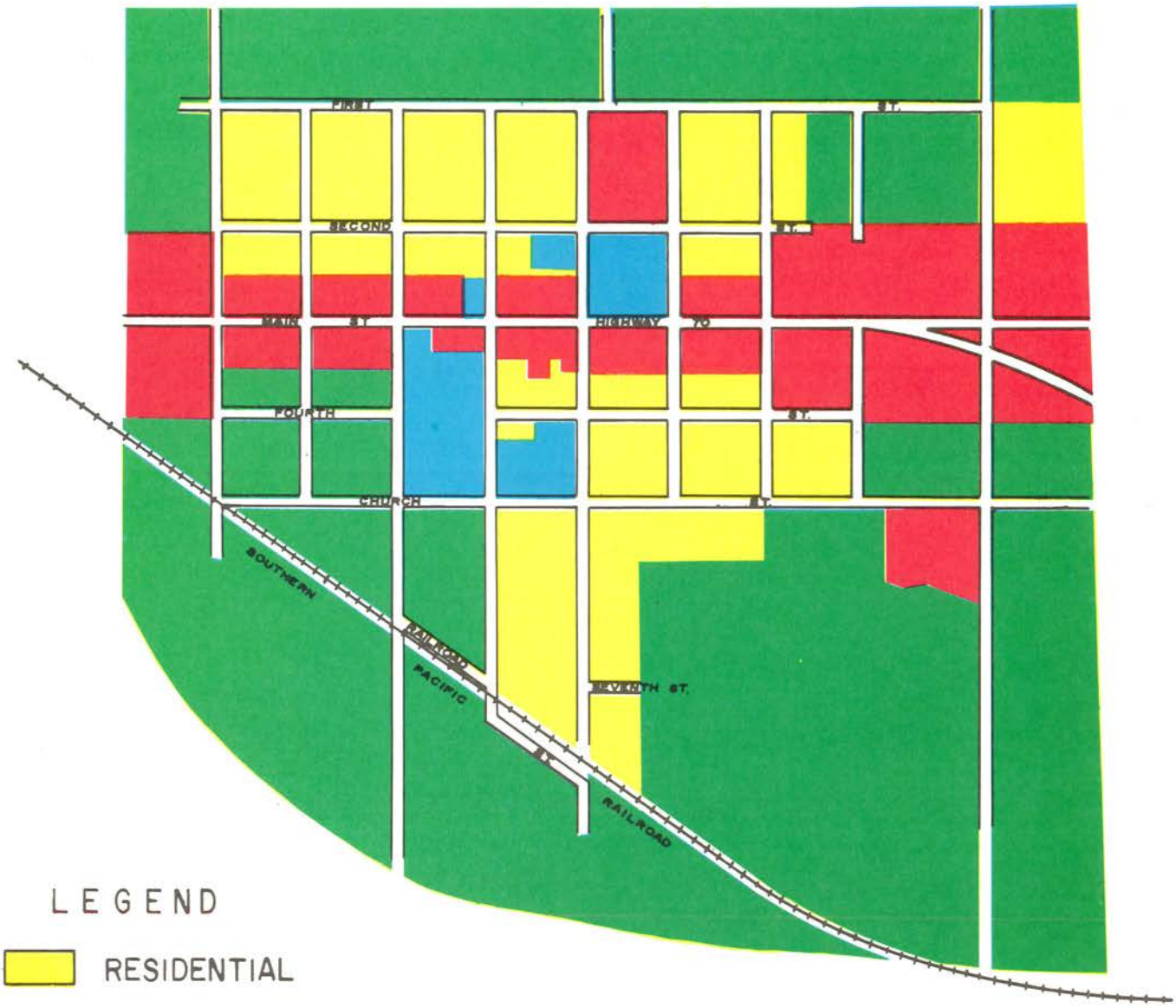
THATCHER, ARIZONA

LAND USE

N

PLATE 10



LEGEND

- RESIDENTIAL
- COMMERCIAL
- PUBLIC/QUASI PUBLIC
- AGRICULTURE

ENVIRONMENTAL SERVICES NEEDS STUDY

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THATCHER, ARIZONA

PROJECTED LAND USE

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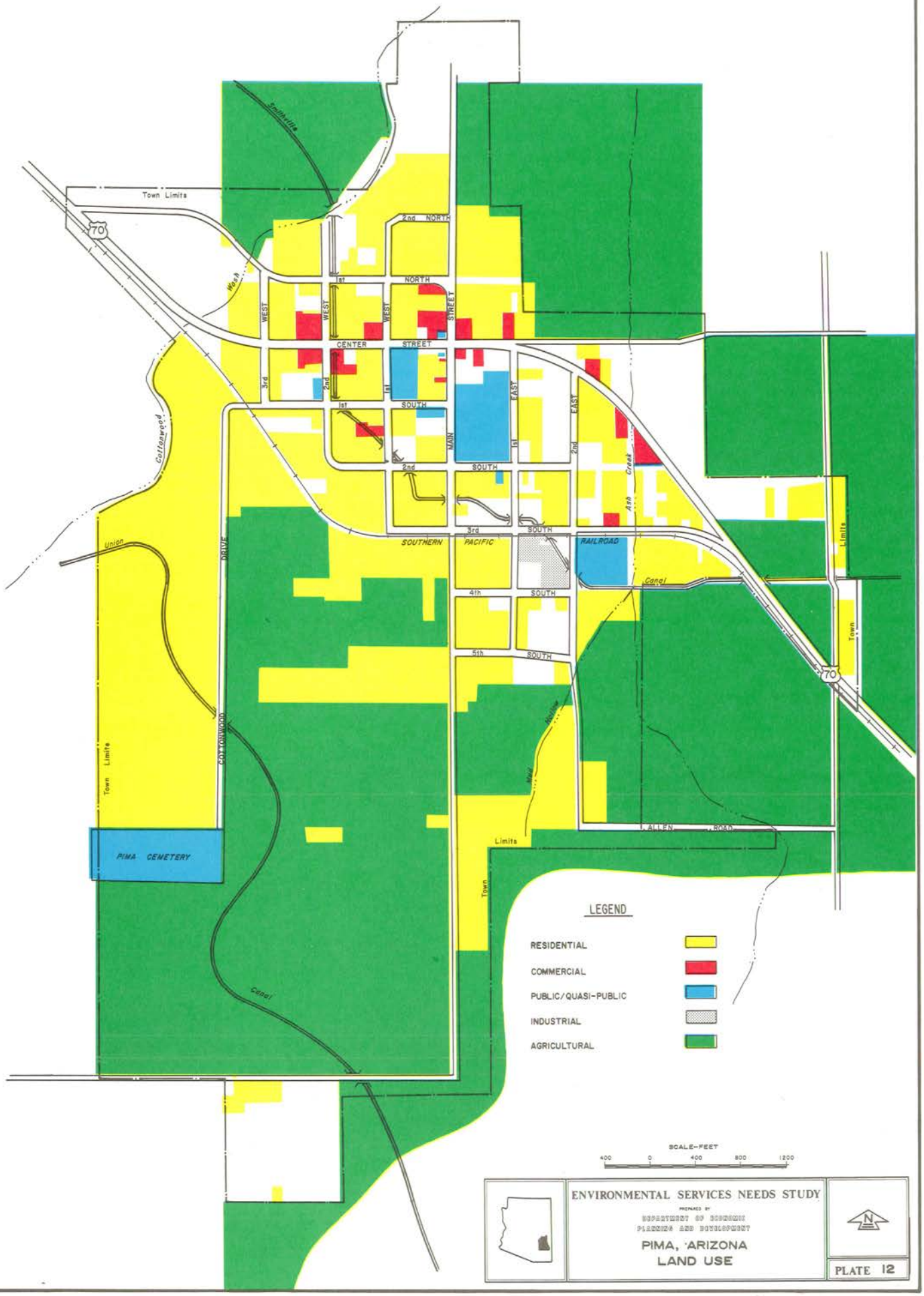
PLATE 11


Town Limits
70
Southside
Wash
Cottonwood
Union
2nd NORTH
1st NORTH
WEST
WEST
WEST
STREET
CENTER STREET
3rd
2nd
1st
1st SOUTH
2nd SOUTH
MAIN
1st
EAST
2nd
EAST
Ash Creek
3rd SOUTH
SOUTHERN PACIFIC RAILROAD
Canal
4th SOUTH
5th SOUTH
DRIVE
COTTONWOOD
Town Limits
PIMA CEMETERY
Wash
Northern
Canal
ALLEN ROAD
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70
LEGEND
RESIDENTIAL
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ENVIRONMENTAL SERVICES NEEDS STUDY
PREPARED BY
DEPARTMENT OF ECONOMIC
PLANNING AND DEVELOPMENT
PIMA, ARIZONA
LAND USE
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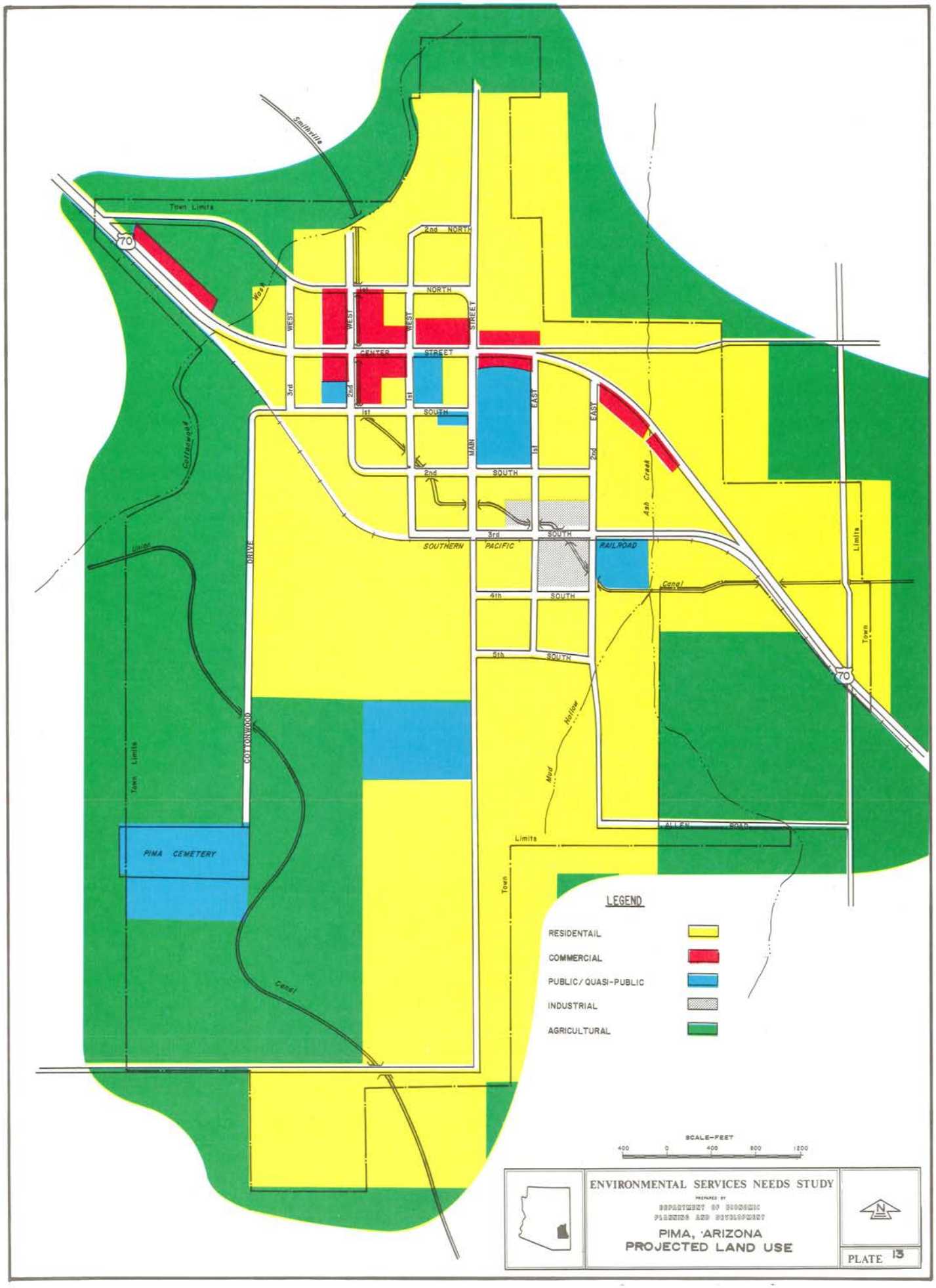
PLATE 12


Smithville
Town Limits
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2nd NORTH
1st NORTH
WEST
WEST
WEST
STREET
CENTER STREET
3rd
2nd
1st
SOUTH
EAST
EAST
MAIN
1st
2nd
2nd SOUTH
3rd SOUTH
SOUTHERN PACIFIC RAILROAD
4th SOUTH
5th SOUTH
Ash Creek
Canal
Limits
Town
Hollow
Mud
ALLEN ROAD
Limits
Town
Cottonwood
Union
DRIVE
GOODMAN &
Town Limits
PIMA CEMETERY
Canal
LEGEND
RESIDENTAIL
COMMERCIAL
PUBLIC/QUASI-PUBLIC
INDUSTRIAL
AGRICULTURAL
SCALE-FEET
400 0 400 800 1200
ENVIRONMENTAL SERVICES NEEDS STUDY
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PLANNING AND DEVELOPMENT
PIMA, ARIZONA
PROJECTED LAND USE
N
PLATE 13

Commercial development will likely continue to remain along U.S. 70. The businesses are expected to be convenience oriented with major purchases being made in Safford and Thatcher. Highway commercial users are likely to locate towards the edges of town.

Public and institutional land uses will increase proportionately with the expansion of the community. As the town grows a second school site will probably be required in the general area indicated, although it may not be at the designated location. This second school site should be located near the residential growth area and away from U.S. 70.

Water Supply and Distribution Systems

The largest supplier of domestic water in the Safford Valley is the City of Safford which also serves the community of Thatcher. Water supply for the combined systems is drawn from the surface and groundwater resources of the valley. Surface water is obtained from artesian springs located in the Pinaleno Mountains approximately six miles south of Safford. The spring supply consists primarily of a series of infiltration galleries connected by pipelines to a collection reservoir. From the reservoir the water flows through a 12 inch diameter transmission main to the community water treatment facilities which consist of sand filtration (pressure) and chlorination equipment.

The groundwater portion of the supply is produced from a well field (three wells) located along Bonita Creek which is a tributary to the Gila River. The principal supplier in the field is the Morris well. The chemical character of the surface and groundwater sources is presented in TABLE III-11. Also noted in TABLE III-11 are water quality data for water supply systems serving Pima and Fort Thomas.

TABLE III-11
REPRESENTATIVE WATER QUALITY DATA FOR
WATER SUPPLY SOURCES IN THE SAFFORD VALLEY
(Concentration expressed in milligrams/liter)

Chemical Constituent	COMMUNITY Pima	Fort Thomas	Fort Thomas	Safford (Springs)	Safford (Well Blend)	Safford (Morris Well)
Total Dissolved Solids	264.0	150.0	250.0	117.0	400.0	750.0
Hardness	112.0	110.0	142.0	100.0	220.0	304.0
Calcium	37.0	37.0	46.0	17.0	56.0	92.0
Magnesium	5.0	4.0	6.0	16.0	19.0	18.0
Sodium	61.0	19.0	34.0	4.0	79.0	197.0
Iron	---	---	---	1.5	0.1	1.0
Total Alkalinity	158.0	84.0	98.0	20.0	212.0	130.0
Chlorides	30.0	8.0	32.0	3.0	76.0	290.0
Fluorides	1.2	0.7	0.6	0.5	1.2	2.6
Nitrates	4.0	2.0	1.0	1.0	2.0	1.0
Sulfates	31.0	53.0	58.0	28.0	40.0	210.0

Sources: Arizona State Department of Health, Southern District Office, Tucson, Arizona

For the Safford supply, a significant difference exists between the spring and well source water quality, particularly with respect to iron, fluoride and total dissolved solids concentrations. The spring supply is high in iron making it necessary to blend the spring water with well water. Blending results in decreasing the iron content from 1.5 to 0.1 milligrams per liter. Likewise, the well sources are high in fluorides, where blending results in a decrease in concentration from 2.6 to 1.2 milligrams per liter.

The Safford-Thatcher distribution network contains two booster pumps and water storage facilities (PLATE 14). The storage reservoirs consist of a one million gallon steel tank in the vicinity of Thatcher and a 10 million gallon concrete tank reservoir south of Safford. Current peak demands for the entire system are 3,000,000 gallons per day which occur in the summer months. Average daily demand amounts to approximately 1.5 million gallons for the year.

The communities of Pima and Ft. Thomas are served by an investor owned utility. Water for the Pima system is obtained from the Bonita Creek watershed through wells (PLATE 15). Water quality is also noted in TABLE III-11. The distribution network contains two storage reservoirs with a total capacity of 150,000 gallons. Presently the distribution network provides water to about 500 customers. Water consumption data for the system is shown in TABLE III-12.

TABLE III-12
WATER CONSUMPTION DATA
PIMA WATER SYSTEM
GENERAL UTILITIES COMPANY
(gallons)

Month	Year 1971	Year 1970
January	3,547,000	3,122,700
February	3,675,100	2,609,300
March	4,087,500	2,920,600
April	4,451,000	4,344,500
May	4,730,000	4,899,900
June	5,720,000	5,942,300
July	6,281,700	6,060,100
August	5,542,000	5,890,700
September	5,237,700	4,637,100
October	3,921,100	4,366,000
November	4,339,600	2,988,100
December	31,150,000	2,812,400

Source: General Utilities Company

Future Water Supply Needs

The individual water systems existing in the Safford Valley region will experience moderate pressures in the next five year period related to community growth. These expansion pressures will be the result of a growing economic base and population.

Private water companies in the valley will be required, under the terms of respective franchises, to provide additional supply capabilities both in terms of quantity and quality. It is difficult to assess or recommend the planning goals which private water companies should strive for in future years due in part to changing ownerships and personnel.

The larger community systems under municipal control, invariably will and should establish planning policies and goals for water supply and service network needs in the Safford Valley.

The community of Safford should establish a coordinated planning schedule for expansion of the service network, development of new supply sources and acquisition of private water franchises in growth areas projected to eventually be annexed into the community or communities they presently serve. Such activities should result in cost effective (and efficient) delivery of service in future years.

The areas which will possibly experience the predominance of growth in the valley are Safford, Thatcher, Ft. Thomas and Pima. Projected water supply demands for these communities are noted in Tables III-13, 14, 15 & 16.

The demand levels projected for the Safford area suggest water supply augmentation in the near future. Further development of Bonita Creek springs would be the ideal source for additional supply. Ground water supplies adjacent to the Gila River are substantial. However, the water quality would approach the limits of U.S. Public Health Service drinking water standards. (TABLE III-5 and TABLE II-11).

TABLE III-13
PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR SAFFORD IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer High	962,000	816	1,084,000	928	1,372,000	1,195	
Winter	554,000		637,000		838,000		
Summer Median	942,000	800	1,040,000	890	1,264,000	1,100	
Winter	543,000		612,000		772,000		
Summer Low	925,000	784	1,000,000	857	1,172,000	1,020	
Winter	533,000		589,000		716,000		

TABLE III-14
PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR THATCHER IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer High	465,000	405	555,000	490	787,000	695	
Winter High	229,000		281,000		419,000		
Summer Median	443,000	390	504,000	445	648,000	580	
Winter Median	218,000		255,000		345,000		
Summer Low	422,000	370	456,000	400	532,000	475	
Winter Low	207,000		230,000		283,000		

TABLE III-15
PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR FT. THOMAS IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer High	48,000	50	59,400	62	93,500	98	
Winter High	32,900		44,000		71,000		
Summer Median	45,000	46	54,000	56	76,900	80	
Winter Median	31,000		40,000		58,300		
Summer Low	42,900	44	48,600	50	63,800	67	
Winter Low	29,700		36,000		48,400		

TABLE III-16
PROJECTED AVERAGE DAILY AND YEARLY WATER DEMANDS FOR PIMA IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day	1980 Gallons/day	1990 Gallons/day	Acre-feet Per Year
Summer High	248,000	310,000	480,000	
	217	273	429	
Winter	122,000	157,000	256,000	
Summer Median	236,000	280,000	395,000	
	206	247	353	
Winter	116,000	142,000	210,000	
Summer Low	225,000	255,000	324,000	
	196	224	290	
Winter	111,000	129,000	173,000	

Water supply capability for sustained fire flow within the distribution networks of Safford, Thatcher, Ft. Thomas and Pima should be in the range of 2740 gpm, 2045 gpm, 815 gpm and 1600 gpm respectively for 1975 high population projections. These flow capabilities are recommended by the National Board of Fire Underwriters' standards and consist of combined delivery capability of the supply sources and water held in storage tanks and/or reservoirs. Additional fire hydrants are recommended for the Pima and outlying areas of Ft. Thomas.

Sewerage and Wastewater Treatment

Safford and Thatcher provide sewage collection and treatment services to residents. The individual systems consist of numerous collection laterals and transmission mains (PLATE 16 & 17).

The Safford collection network terminates at a recently completed oxidation reservoir equipped with aerators. This five acre facility is followed by a polishing pond with approximately 1.5 acre surface area. Effluent is discharged to the Gila River at this time without additional treatment. Although the facilities are providing treatment efficiencies, chlorination equipment will be provided in the near future prior to effluent discharge to the Gila River and/or reuse.

Rather than continued discharge of effluent the City of Safford has finalized plans to use the effluent on a community golf course. It is presently anticipated that 80 percent of the flow will be utilized for this beneficial purpose. There is also the possiblity that the City of Thatcher may have a use for effluent at a recreational complex which is roughly one quarter mile from the pipeline which transports effluent to Safford's new golf course. Present average yearly sewage flows at the Safford facility are estimated at 490,000 gallons per day.

The Thatcher collection network terminates at a 1.5 acre reservoir which is adjacent to the Smithville canal into which effluent is discharged. Current sewage flows are estimated at 280,000 gallons per day.

The communities of Pima and Ft. Thomas and other communities found in the Safford Valley utilize the septic tank-leachfield concept of sewage waste treatment. There have been sporadic problems with leaching networks effluent disposal. However, the seriousness is minimal due to the alluvial soils in these areas. Cumulative sewage flows in Pima and Ft. Thomas are currently estimated at 150,000 and 28,000 gallons per day respectively.

Future Sewerage Needs

Recent urban growth of the Thatcher-Safford area has resulted in needs for expanded collection networks and treatment facilities for both communities. Safford is at this time in a position where implementation planning for expanded and/or upgraded treatment facilities is necessary. The currently planned use of effluent on a golf course suggests the consideration of upgrading the treatment capabilities of existing facilities.

Projected sewage flows for the communities of Safford, Thatcher, Pima and Ft. Thomas are presented in TABLES III-17, 18, 19 & 20 respectively.

TABLE III-17
PROJECTED AVERAGE DAILY AND YEARLY
SEWAGE FLOWS FOR SAFFORD IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer	496,000		574,000		762,000		
High		490		571		768	
Winter	350,000		414,000		572,000		
Summer	485,000		551,000		702,000		
Median		480		548		707	
Winter	343,000		398,000		527,000		
Summer	476,000		530,000		651,000		
Low		470		528		656	
Winter	336,000		383,000		488,000		

TABLE III-18
PROJECTED AVERAGE DAILY AND YEARLY
SEWAGE FLOWS FOR THATCHER IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer	301,000		365,000		511,000		
High		265		325		460	
Winter	148,000		187,000		268,000		
Summer	287,000		331,000		420,000		
Median		250		295		380	
Winter	141,000		170,000		224,000		
Summer	273,000		300,000		345,000		
Low		240		270		310	
Winter	134,000		154,000		184,000		

TABLE III-19
PROJECTED AVERAGE DAILY AND YEARLY
SEWAGE FLOWS FOR PIMA IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer	161,000		204,000		312,000		
High		141		181		280	
Winter	79,000		104,000		166,000		
Summer	153,000		184,000		256,000		
Median		134		164		230	
Winter	75,000		95,000		137,000		
Summer	146,000		167,000		210,000		
Low		128		149		189	
Winter	72,000		86,000		112,000		

TABLE III-20
PROJECTED AVERAGE DAILY AND YEARLY
SEWAGE FLOWS FOR FT. THOMAS IN 1975, 1980 AND 1990

Projection Level	YEAR 1975 Gallons/day		YEAR 1980 Gallons/day		YEAR 1990 Gallons/day		Acre-feet Per Year
Summer	31,200		39,600		64,500		
High		32		39		65	
Winter	21,300		28,600		48,400		
Summer	29,000		36,000		53,000		
Median		30		35		53	
Winter	20,000		26,000		39,800		
Summer	28,000		32,400		44,000		
Low		28		32		44	
Winter	19,800		23,400		33,000		

Solid Waste Management Facilities

The City of Safford provides the most extensive garbage and trash collection service within the Safford Valley. Currently the city operates and maintains fifteen trash and three garbage collection vehicles. These units provide bi-weekly collection in residential areas and daily service in the commercial areas of the community.

Collected waste materials are transported to a sanitary landfill three miles north of the community (PLATE). The landfill is maintained with a D-8 tractor equipped with blade and ripper. The basic mode of operation utilizes the trench-fill-and-cover technique of control for accumulated solid wastes.

The community of Thatcher maintains a collection schedule similar to Safford. However, the service network is on a much smaller scale. Presently the city utilizes two collection vehicles with an additional one available for backup. Solid waste materials are transported to a sanitary landfill located three miles west of the community which is maintained by the Graham County Department of Health and Highway Department.

Pima and Ft. Thomas have not developed full scale garbage collection of disposal services. In these communities as well as the remaining developed rural areas of the Safford Valley, solid waste disposal is an individual responsibility. This is often accomplished by burning and/or burying waste materials on site rather than transport to an outlying dumpsite or sanitary landfill.

Present solid waste production levels for the communities of Safford, Thatcher, Pima and Ft. Thomas are estimated at 5,200, 2,600, 1,260 and 300 tons per year, respectively.

Future Solid Waste Management Needs

The indicators of anticipated urban growth of the Safford Valley will be exemplified in needs for expanded solid waste collection networks in the larger communities which now provide services and the less populated areas where initiation of collection services will be necessary. Where growth occurs, solid wastes problems become very obvious, particularly in those areas where disposal services are not available. In this context "developing" problems can be avoided by application of planning and contingency budgeting procedures. The communities of Safford, Thatcher and Pima will undertake planning programs for future needs more effectively as they are incorporated municipalities. Other areas, however, cannot do so because of an unincorporated status. It therefore becomes the responsibility of the county to undertake the development of needed facilities.

The Graham County Department of Health has effectively developed a comprehensive program of solid waste management throughout the county. As a consequence, future problems will be minimized provided sufficient funds are available to initiate the proper development and operation of needed facilities. The magnitude of potential solid waste disposal problems is indicated in terms of the projected tonnages for Safford; Thatcher, Ft. Thomas and Pima in TABLES 21, 22, 23 & 24.

Considering the accumulative character of solid wastes it is estimated that Safford, Thatcher, Ft. Thomas and Pima will require 132, 81, 10 and 32 acre feet of sanitary landfill volume by 1990 (high projection levels). These are significant volume requirements which support early planning for the cost effective acquisition of sites to meet the future needs of the public.

TABLE III-21
PROJECTED AVERAGE YEARLY SOLID WASTES
PRODUCTION LEVELS FOR SAFFORD
IN 1975, 1980 AND 1990
(ton per year)

PROJECTION YEAR	SOLID WASTE PROJECTION LEVELS		
	LOW	MEDIAN	HIGH
1975	5,200	5,290	5,405
1980	6,190	6,430	6,700
1990	8,460	9,120	9,900

TABLE III-22
PROJECTED AVERAGE YEARLY SOLID WASTES
PRODUCTION LEVELS FOR THATCHER
IN 1975, 1980 AND 1990
(ton per year)

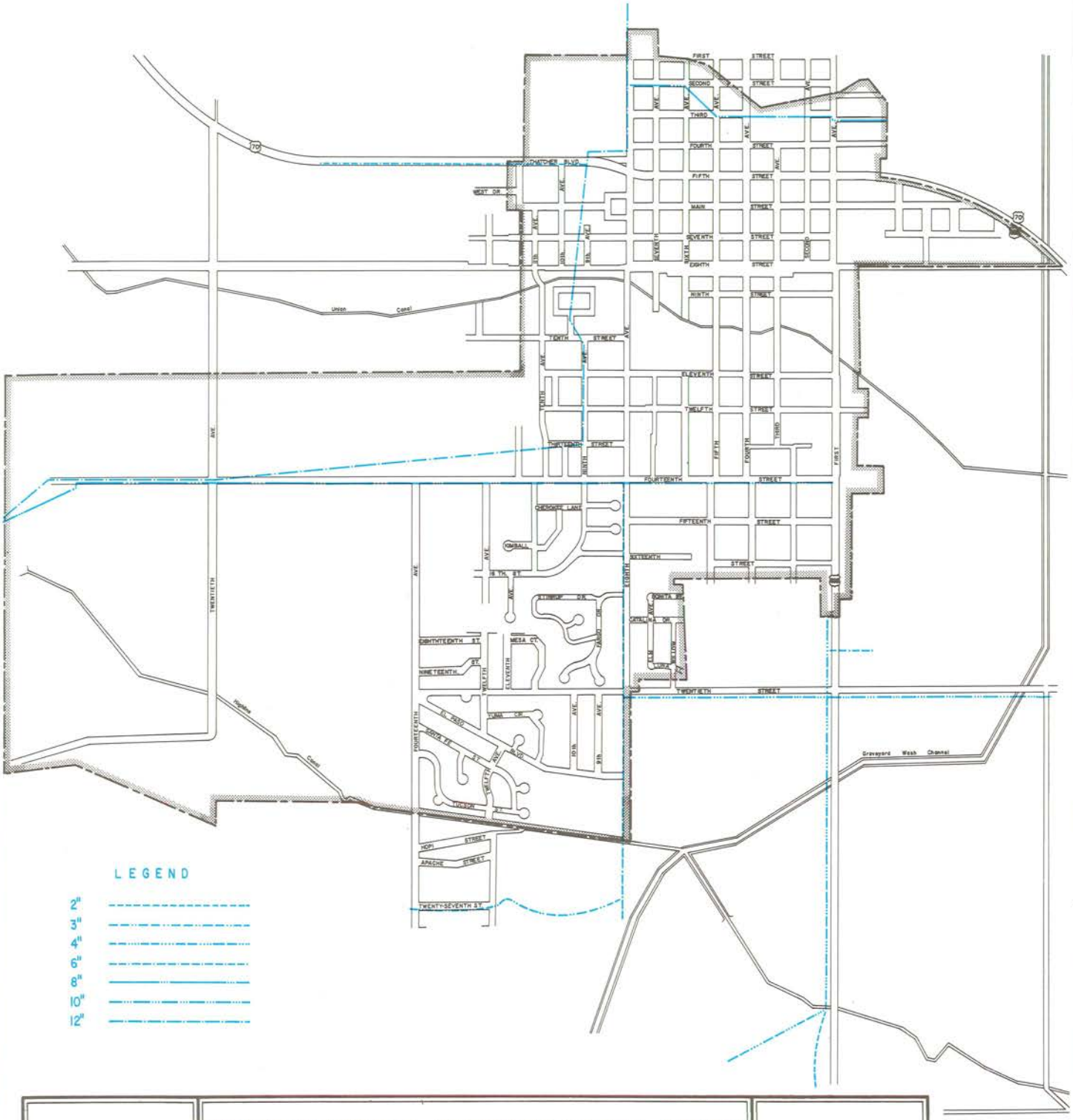
PROJECTION YEAR	SOLID WASTE PROJECTION LEVELS		
	LOW	MEDIAN	HIGH
1975	2,270	2,690	3,675
1980	2,380	2,975	4,780
1990	2,500	3,280	5,380

TABLE III-23
PROJECTED AVERAGE YEARLY SOLID WASTES
PRODUCTION LEVELS FOR FT. THOMAS
IN 1975, 1980 AND 1990
(ton per year)

PROJECTION YEAR	SOLID WASTE PROJECTION LEVELS		
	LOW	MEDIAN	HIGH
1975	305	320	340
1980	380	420	460
1990	570	690	840

TABLE III-24
PROJECTED AVERAGE YEARLY SOLID WASTES
PRODUCTION LEVELS FOR PIMA
IN 1975, 1980 AND 1990

PROJECTION YEAR	SOLID WASTE PROJECTION LEVELS		
	LOW	MEDIAN	HIGH
1975	1,205	1,265	1,330
1980	1,500	1,655	1,830
1990	2,240	2,730	3,320



ENVIRONMENTAL SERVICES NEEDS STUDY

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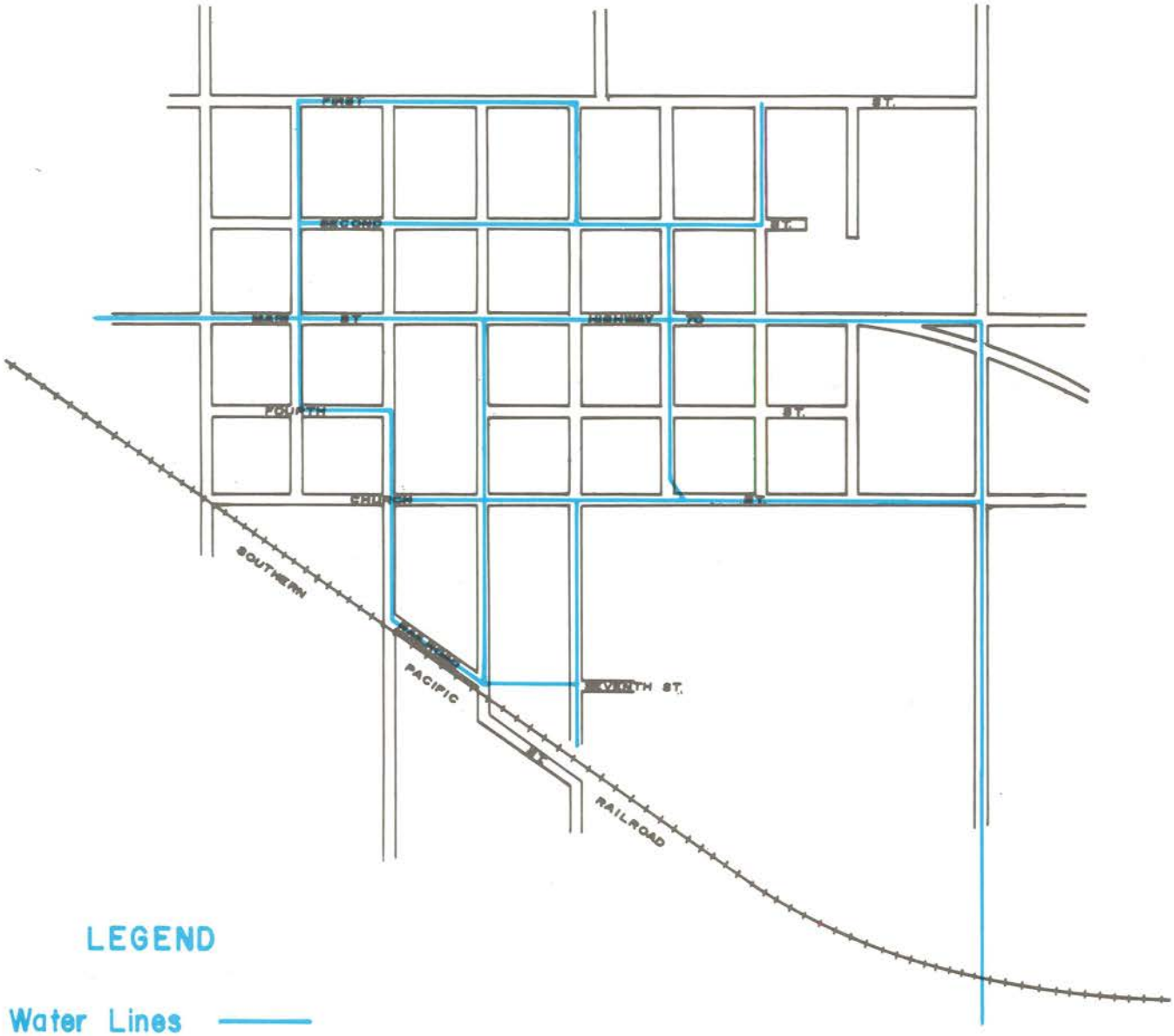
SAFFORD, ARIZONA

WATER SYSTEM

N

PLATE 14a



LEGEND

Water Lines ——

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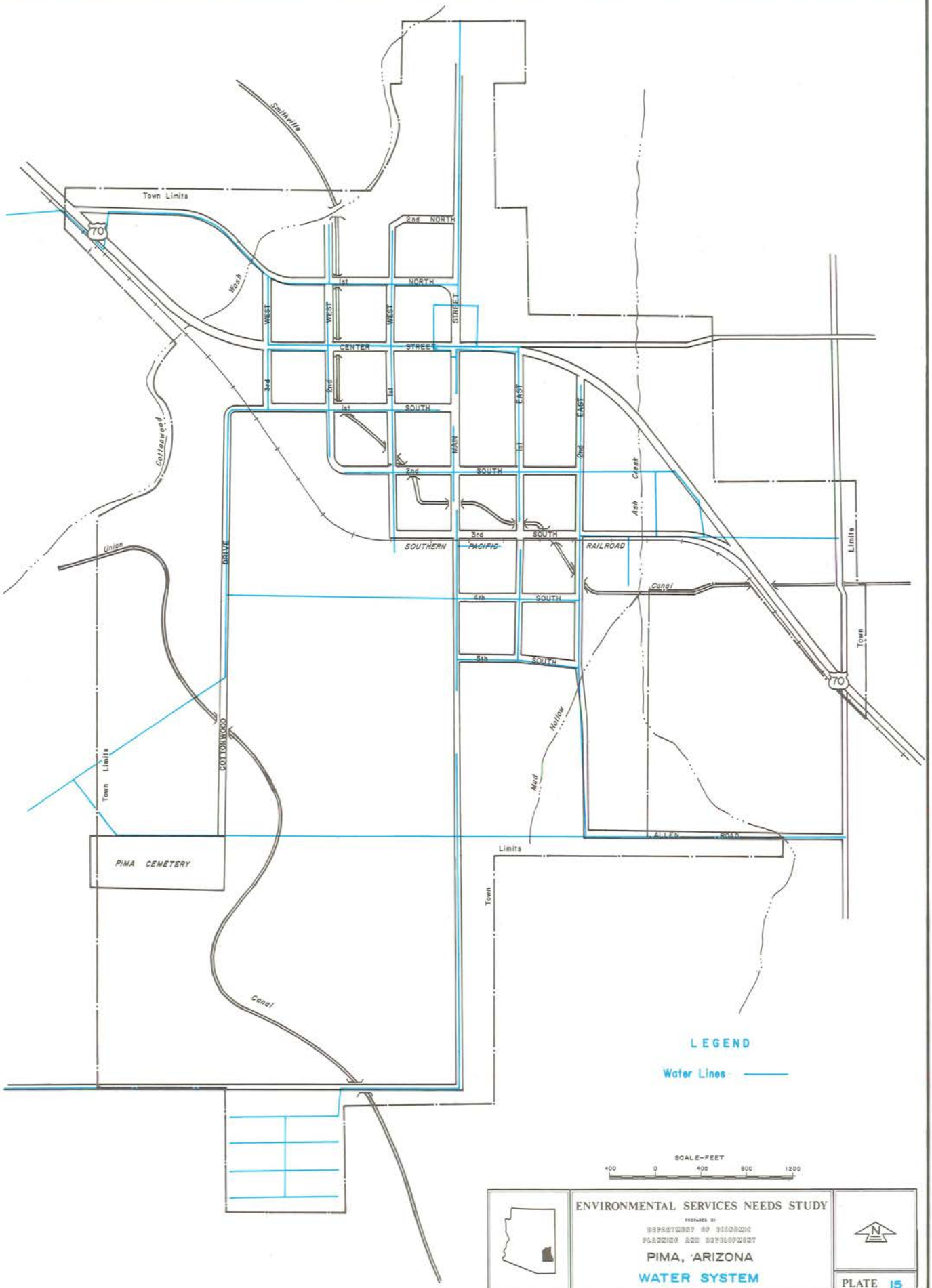
THATCHER, ARIZONA

WATER SYSTEM

N

PLATE 14b


Town Limits
70
Smithville
Wash
2nd NORTH
1st NORTH
WEST STREET
CENTER STREET
3rd
2nd
1st
SOUTH
MAIN
EAST
Cottonwood
Union
DRIVE
COTTONWOOD
SOUTHERN PACIFIC RAILROAD
Ash Creek
Canal
4th SOUTH
5th SOUTH
Hollow
Mud
ALLEN ROAD
Town Limits
PIMA CEMETERY
LEGEND
Water Lines
SCALE-FEET
400 0 400 800 1200
ENVIRONMENTAL SERVICES NEEDS STUDY
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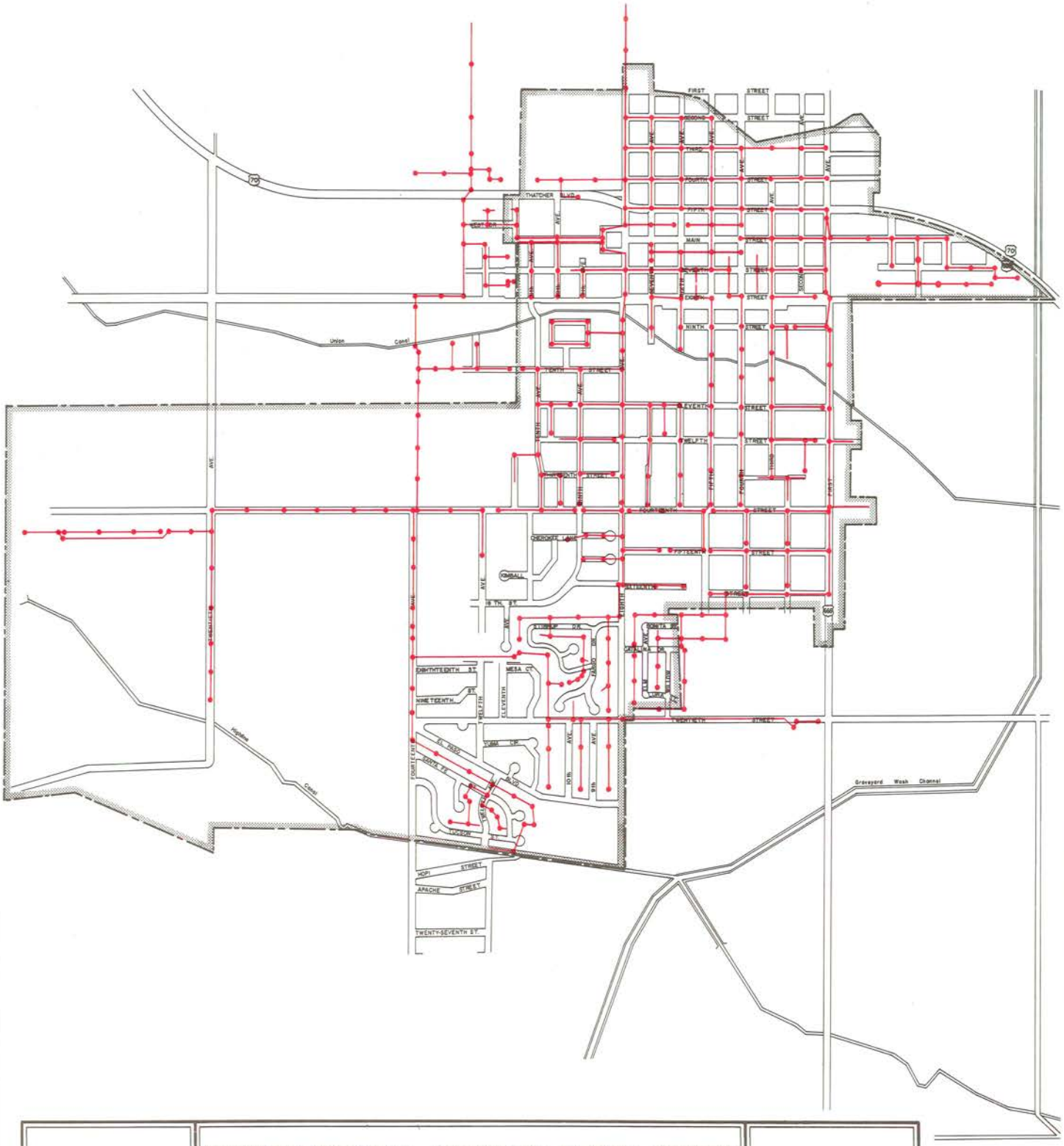
PLANNING AND DEVELOPMENT
PIMA, ARIZONA
WATER SYSTEM
N
PLATE 15



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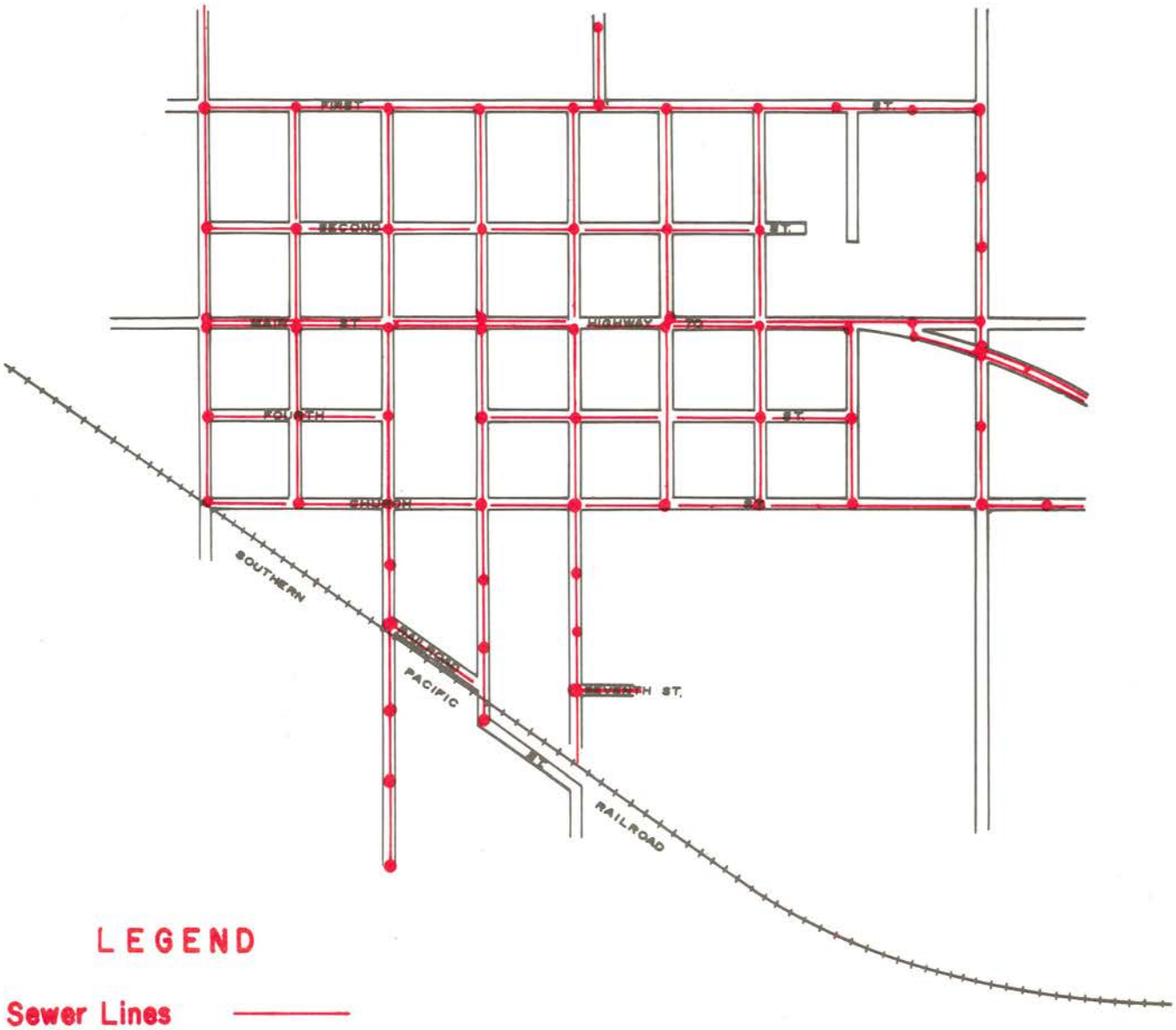
SAFFORD, ARIZONA

SEWER SYSTEM

N

PLATE 16



LEGEND

Sewer Lines ———

Manholes •

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THATCHER, ARIZONA

SEWER SYSTEM

N

PLATE 17

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 suggested 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 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 construction should be phased out in stages rather than on a single project 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 long-range financing.

–Cost estimates can serve as a guide in judging the validity of competitive bids.

–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. It should be noted the above examples can also serve as warnings in 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)

Item	Material	Labor	Contractors Plants	and Profit
Sewage Treatment Plants	54.49	25.33	6.45	13.73
Sewers	35.42	18.48	31.30	14.70

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

The costs estimates for 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 foundation cradle or encasement of pipe and surface restoration are excluded. The ranges of costs depicted are based on construction cost indexes for July, 1972. 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.

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	$3.87 - $4.82	8	$3.98 - $4.86
10	$6.36 - $7.95	10	$5.23 - $6.54
12	$8.49 - $10.63	12	$6.66 - $8.32
15	$12.78 - $16.02	15	$9.83 - $12.31

Source: Project Staff Estimates.

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 wastewater 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). 1,8/

Generalized costs for basic wastewater treatment processes are presented in TABLE I-3. The costs for wastewater 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/

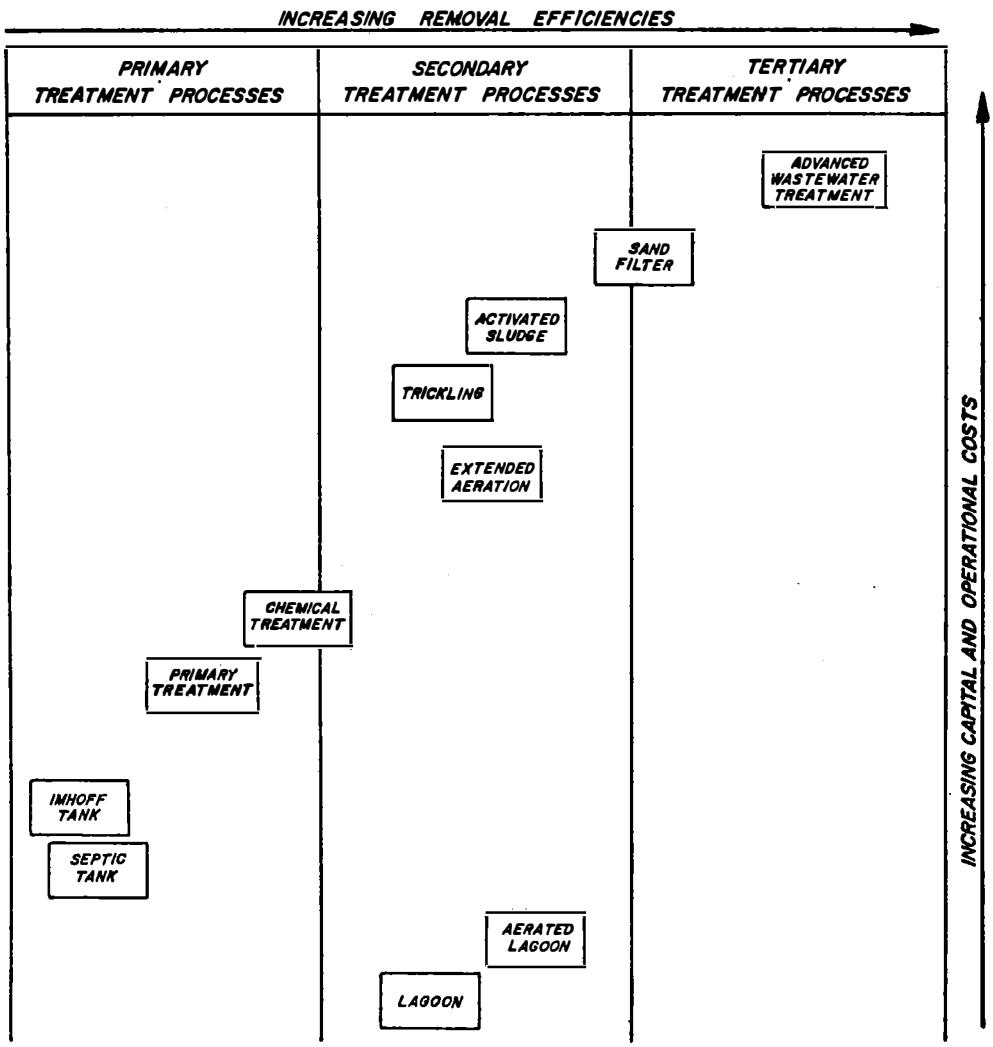


FIGURE I-1. GENERALIZED RANKING OF UNIT COST AND REMOVAL EFFICIENCIES OF CONVENTIONAL WASTE TREATMENT PROCESS.

TABLE I-3

GENERALIZED COST TO SIZE RELATIONSHIPS OF BASIC WASTE TREATMENT PROCESSES

	Million Gallons Per Day Capacity				
	.01	.10	1.0	10.0	100.0
	Construction Cost, $1000*				
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 and 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 1968-1969 conditions by use of BLS Craftsmen's median earning, 1968 + craftsmen's median earnings, 1963 x table value.

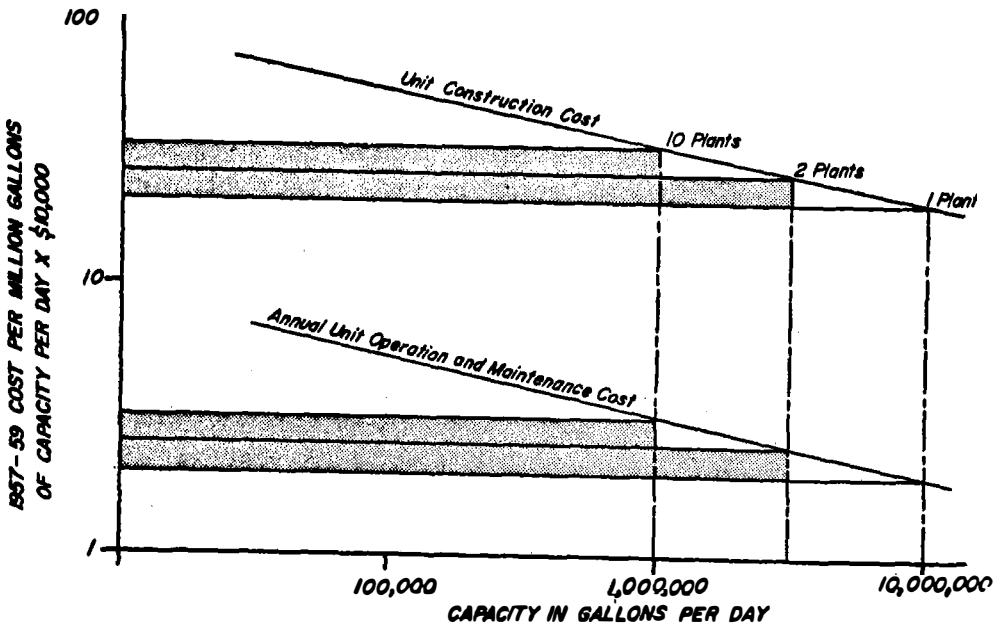


FIGURE I-2. APPLICATION OF ECONOMIES OF SCALE THROUGH CONSOLIDATION OF WASTE SOURCES PRODUCING 10 MILLION GALLONS PER DAY OF SEWAGE'.

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 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, captial outlay generally 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/

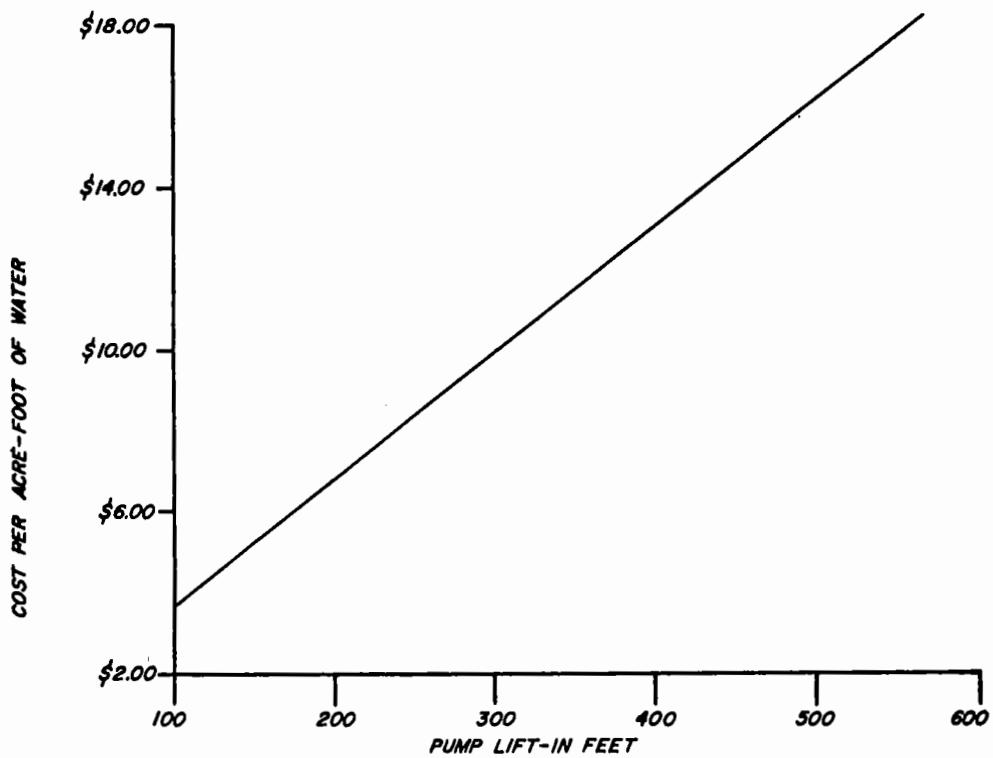


FIGURE I-3. RELATIONSHIP BETWEEN LIFT AND COST PER ACRE-FOOT OF GROUNDWATER PUMPED.

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.

The cost of water treatment by coagulation and sedimentation followed by rapid sand filtration for thirty water treatment plants across the country are noted in TABLES I-4 & 5. 9/The costs presented are the result of comparative cost engineering audits made in 1965. (The term "cost engineering audit" means a detailed investigation and analysis of the physical characteristics, the operating data, and the costs of a plant or other operating installation and the presentation of these in a standardized manner so that internal and external comparisons can be made.)

TABLE I-4

WATER TREATMENT PLANT DESIGN FACTORS

Plant No.	Design Capability (Qd) mgd	Year Of Last Major Addition To Plant	Mixing Basin Detention min	Flocculation Basin Detention min	Sedimentation Basin or Clarifier: Detention min	Surface Loading gpm/sq ft	Average Transport Rate fpm	Clarifier Loading gpm/sq ft	Basins Housed or Covered **	Filters Rate gpm/sq ft	Filters Housed or Covered **	Design Manpower man-hr/mg	Days 32° and Below days/year
1	6.00	1959	1.3	30	391	0.651	0.102		o	1.70	o	3.1	11
2	9.00	1953	5.0	30	240	0.313	0.430		o	1.65	½o	9.8	17
3	8.00	1950	0.6	40	283	0.333	0.588		o	1.85	½o	6.6	48
4	6.00	1952	-	65	288	0.366	0.327		o	2.00	h	10.0	33
5	0.500	1953	MI‡	51	305	0.329	0.199		o	1.93	h	48.0	81
6	0.500	1951	MI‡	52	346	0.386	0.221		o	1.93	h	48.0	63
7	0.500	1950	10.0	43	315	0.273	0.144		o	1.72	h	48.0	63
8	0.500	1939	with floc	20	240	0.345	0.184		o	1.93	h	48.0	80
9	6.00	1957	-	57	447	0.225	0.278		o		h	4.0	37
10	0.300	1962	with floc	18	220	0.284	0.251		o	1.64	h	15.0	85
12	12.00	1958	-	17†	206† 81†#	0.290#	0.580		o	3.31	h	2.53	94
13	4.00	1946	MI‡	10	212	0.495	1.16		o	1.96	h	7.5	100
14	0.432	1947	†	†	67†	†		1.59	h	1.85	h	23.1	148
15	12.00	1960	†	†	102†	†	0.161†	1.10	h	1.87	h	5.1	144
17	12.00	1961	with floc‡	23	202	0.778	0.448		c	1.54	h	9.6	144
18	0.300	1948	†	†	47†	†	0.262† 0.262	2.19	h	0.075	c	12.0 7.9	144 144
19	8.00	1946	1.6	33	125	0.702	0.925 0.127		o	1.93	½c		
21	7.50	1955	0.7	51	335	0.321			o	1.94	o	6.8	11
22	6.81*	1955	†	†	102†	†	0.800†	1.18	o	2.00*	c	5.0	65
23	0.576	1938	-	7	327	0.177	0.566 0.352		o	1.94	h	42.0	65
24	0.504	1930	MI	22	249	0.326			o	1.82	h	47.0	83
25	0.504	1937	MI	20	283	0.298	0.340		o	1.82	h	48.0	73
26	0.500	1965	†	†	229†	†	0.092†	0.491	o	1.62	h	28.0	70
27	0.486	1948	1.1	142	6960	0.011	0.033		o	3.00*	h	18.0	70
28	1.00	1964	†	†	280†	†	0.161† 0.427	0.354	o	1.49	o	26.6	66
29	8.00	1958	2.4	39	261	0.457			o	1.95	o	7.9	59
30	6.81*	1955	0.18		102		0.80		o	2.00*	c	5.0	65

*Based on an arbitrary design filter rate as shown.
†Suspended solids contact clarifer.
‡MI signifies mixing basins detention could not be computed because mixing is done in the line. "With floc" indicates mixing basin not separated from flocculation basin and flocculation detention includes both.
#This plant operates sedimentation basins and a clarifer in parallel. Data applicable to the clarifier are shown in the right hand column. Certain dimensions of the Clarifier were not available.
**Housed, covered, open.
SOURCE: After 9/

The data illustrated in TABLE I-5 can give a general idea of the costs associated with the different operational functions of a water treatment facility.

TABLE I-5

WATER TREATMENT PLANT COSTS

	Investment, ¢/gpd of Qd		Labor			Energy			Chemicals, ¢/lb							
									Coag.		Alkali		Dis-infect.	Taste and Odor		
Plant No.	Adjusted to 1964	Deregionalized and Adjusted to 1964	Supervisor, $/hr	Operator and Maint. $/hr	General Labor, $/hr	Elec. ¢/KWH	Oil (for heat) ¢/gal	Gas (for heat ¢/Kcf	Alum	Iron Sulfate	Hydrated Lime Equiv.	Type	Cl	Carbon	$KMnO_4$	$NaClO_2$
1	15.1	16.6	3.64	2.05	1.54	0.92	-	-	2.76	2.60	0.88	h	4.9	9.6	36	
2	-	-	3.99	2.01	1.17	0.77	-	-	2.61	1.81	1.20	h	6.5	-		
3	16.0	17.3	3.72	1.79	1.19	1.71	-	33.3	2.51	-	0.78	q	6.5	-		
4	34.5*	37.3	3.14	2.05	1.24	1.00	-	-	2.43	-	1.19	h	9.6	12.5		
5	-	-	1.91	1.62	-	1.40	-	-	3.40	-	2.90	s	8.7	-		
6	32.2*	32.2	-	1.24	-	1.40	-	-	3.78	-	0.33	h	9.0	-		
7	48.6	48.6	-	1.63	-	1.00	-	-	3.55	-	1.50	h	9.0	-		
8	39.0	42.2	-	1.55	-	2.00	-	-	4.92	-	1.65	h	12.7	-		
9	-	-	2.31	2.26	-	1.04	-	-	2.48	-	1.50	h	4.7	-		
10	65.3	63.7	-	2.03	-	2.00	-	-	4.10	-	3.33	s	13.0	12.0		
12	5.6	5.5	5.50	3.38	-	1.00	-	-	4.79	-	4.55	c	3.7	-	32	
13	10.4	10.1	3.03	2.84	-	1.30	-	-	2.58	-	1.10	h	7.0	10.0		
14	54.9	47.0	2.70	1.83	-	1.90	15	-				none	17.5	-		
15	18.0*	17.7	11.10‡	3.19	-	0.77	9.6	705#	2.56	-	-	none	5.4	-		
17			4.70	2.84	2.23	0.69	10.5		2.68	-	-	none	7.9	-		70
18	30.1	29.5	3.08	2.62	2.15	2.00	16.9		4.1	-	-	none	12.5	-		
19	14.0	13.7	3.32	3.05		0.91	9.9		2.37	-	-	none	5.6	11.6		70
21	12.5	24.6	4.47 =	3.14	2.07	0.89		76		2.60	0.54	q	4.9	7.5	40	
22	12.5	13.7	1.91	1.70	-	0.70	-		2.92	-	1.27	h	8.2	14.7		
23	-	-	1.93	1.93	-	1.33	-	-	3.25	-	1.70	h	13.5	12.2		
24	21.8	23.8	1.51	1.38	-	-	-	-	4.10	-	3.80	s	12.5	-		
25	29.0	30.0	-	1.55	-	-	-	-			-	h		-		
26	28.4	31.0	-	1.72	-	1.20	-	-	4.00	-	3.50	h	13.5	-		
27	37.6	41.2	-	1.72	-	1.20	-	-	4.00	-	3.50	h	13.5	-		
28	24.8	27.1	1.93	1.70	1.54	1.04	-	30	3.35	-	0.80	h	13.5	-		
29	20.7	22.6	3.74	2.18	1.92	0.91		47	2.34	-	1.23	h	4.8	13.6		
30			1.91	1.70	-	0.70	-	-	2.92	-	1.27	h	8.2	14.7		

*The cost of a pipoline of length to constitute and appreciable fraction of plant plus pipeline cost was estimated from author's data and removed from total cost.

†A raw water pump station exists but costs for it were not obtainab b. Quantity shown is for cost of plant plus pump station estimated.

‡Plant at present operating without a supervisor, but this role is filled by a consultant. The rate shown is the consultant's rate.

#Plant uses LPG and price is per liquid cubic foot.

SOURCE: After 91

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, salvage and reclamation and open burning. Land filling and salvage operations appear 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 capital 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 pretreatment 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 or recycling of waste materials such as metals and glass.

If funds are not available for the proposed investment, consideration should be 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 depreciation, 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 sanitary landfill 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 $1.25 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 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.

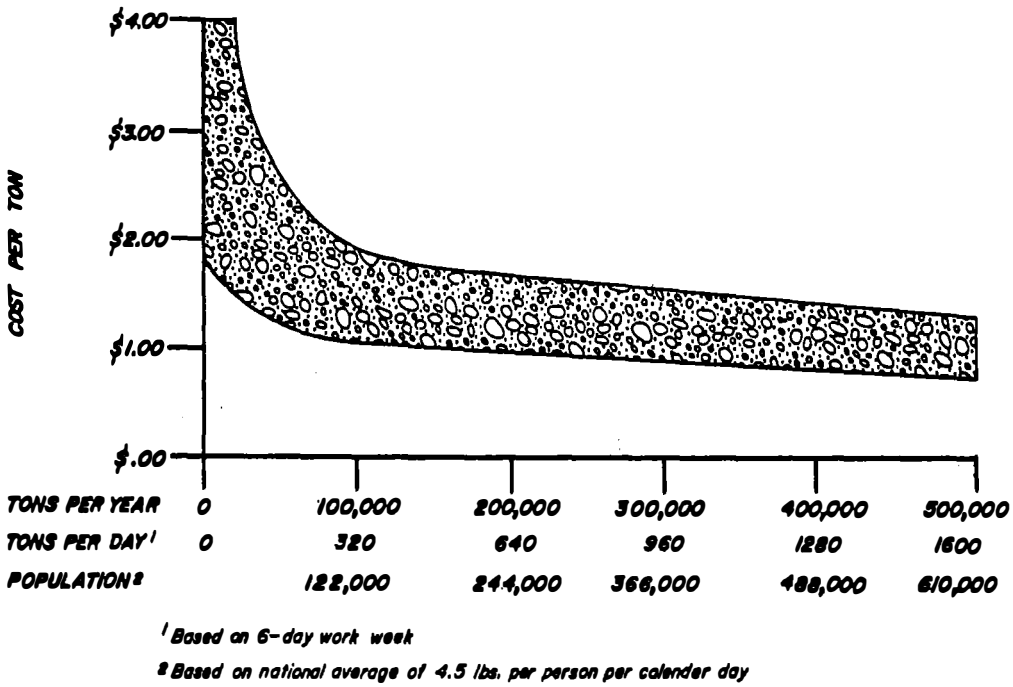


FIGURE I-4. SANITARY LANDFILL OPERATING COSTS

CHAPTER II. FINANCING ENVIRONMENTAL SERVICES

INTRODUCTION

The intent of this chapter is to acquaint community officials 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, 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 cost effectively.

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 a number of bond types which can be used for financing capital improvements for environmental systems. Examples are: general obligation bonds, revenue bonds and special improvement bonds.

General Obligation Bonds

The most common method of bonding for 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 are based on 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. Also, 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 the 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. These issuing communities must meet specific conditions to qualify for 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.

Issuance of revenue bonds are authorized 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 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 improvemetns 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 district is formed by the County Board of Supervisors for a defined geographic area and for special 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 a city or town council by its own initiative or by petition of the local property owners.

FEDERAL GRANTS AND LOAN PROGRAMS

The Federal Government has a multitude of programs for assisting local governments in financing public facilities. There are five federal agencies which make monies available specifically for water systems and waste disposal facilities.

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

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, state and nonprofit 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 Environmental Protection Agency (EPA) 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. The EPA also administers grants for the construction of sewage treatment facilities and outfalls which are needed to prevent inadequately treated sewage from being discharged into the environment.

TABLE II-1 provides an overall outline of the federal programs available to assist rural communities in procuring the basic environmental services 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 & Waste Disposal Assistance	Consolidated Farmers Home Administration	Farmers Home Admin., U.S. Dept. of Agri. Andrew J. Mayberry Rm.6026, Federal Bldg.,230 N. 1st Ave., Phoenix Arizona 85025	Loans, grants & technical assistance are made available to towns under 5,500 population or profit & non-profit organizations for the engineering, construction, repair or expansion of domestic water, sewage treatment & solid waste disposal facilities.
Public Works Planning Advances	Section 701 Housing Act	Community Resources Develop. Admin., Dept. of Housing & Urban Development 2500 Wilshire Blvd. Los Angeles California 90056	Interest-free advances are to states, municipalities & other public bodies to aid in financing the engineering & architectural design work which is preliminary to the construction of a public works project.
Advance Acquisition of Land	Section 704 Housing & Urban Dev. Act	Community Resources Dev. Admin., Dept. of Housing & Urban Dev., 2500 Wilshire Blvd., Los Angeles California 90056	Grants for interest charges on funds borrowed to provide for the propitious acquisition of land needed up to five 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 Dev. Admin., Dept. of Commerce 522 N. Central Phoenix, Arizona 85025	Grants up to 50% of project costs & loans up to 100% of land acquisition & 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 Dev.	Community Resources Dev. Admin., 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 Admendments of 1955	Community Resources Dev. Admin., 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 Construc - tion	Section 8, FWPC Act 33 U.S.C. 466 et seq	Environmental Protection Agency c/o Ariz. State Dept. of Health, Water Supply and Water Pollution Control Div. Bob Follett 4019 N. 33rd 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, Environmental Protection Agency 100 California St. San Francisco California 94101	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 & ultimate disposal.
Grants & Loans Waste Treatment Works, Solid Wastes Planning, Pollution Abatement, Planning Grants Water Improve - ments	Rural Development Act of 1972	Farmers Home Administration	Grants and loans made to rural communities for essential environmental services.

REFERENCES

1. U.S. Department of Interior, FWPCA, The Economics of Clean Water - Vol. I, April 1970.

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

3. 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.

8. "Cost of Conventional and Advanced Treatment of Wastewater," Smith, R. Water Pollution Control Federation Journal, September 1968.

9. "The Cost of Water Treatment by Coagulation Sedimentation and Rapid Sand Filtration." Koenig, L. American Water Works Association Journal, March 1967.

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

The method used to project county population growth was based on a ratio of the county population to the state total. The method is explained below with Graham County 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	-4.6
1960	1,306,161	14,045	1.08	-1.48
1970	1,777,482	16,578	0.93	-0.98
1975	2,081,500	18,525	0.89	-0.48
1980	2,381,500	21,195	0.89	-0.15
1990	3,108,500	27,355	0.88	

Table I- 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 -4.82 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 of the state still declined, but not as fast as it did from 1950 to 1960. The projected annual average rate of growth of the ratio between 1970 and 1975 is -0.98 percent per year and 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 judgment of the researcher is required to anticipate the magnitude and direction of these changes. There is no "formula" available to accomplish this, and often times 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 development.

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 median 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 PROJECTION 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 Graham County is related to the 1990 median population and labor force projections. The labor force is projected as a percentage of the population. In 1970, the labor force participation rate was approximately 28.6 percent. This unusually low figure is partially explained by the number of workers living in the Safford-Thatcher area who commute to work at the Phelps Dodge mines in Greenlee County. This type of inter-county commuting will still be a factor in 1990. In recognition of this, a relatively low labor force participation rate of 31 percent was used for the county projection.

The percent of the population which might be unemployed was applied to the projected civilian work force to obtain an estimate of unemployment. A four percent unemployment rate was used which assumes near full employment in the economy. This results in a projection of 8,060 total employment in Graham County in 1990.

The distribution of employment among the broad industry groups is based primarily on 1967 through 1970 trends of employment data by industry and the 1950-1969 labor earnings distribution. However, knowledge of local plans and conditions and the judgment of the analyst have been used to modify statistical trends.

The finance, insurance, real estate, transportation, communication and public utilities, and manufacturing industries, wholesale and retail trade, government, and agriculture reflect a reasonably stabile employment to population ratio; therefore the ratio is projected forward with some confidence. In the case of services, the average annual numerical increase provides what is believed to be a reasonable estimate of future employment. In the two remaining sectors, mining and contract construction, dynamic factors are apparent from the industry analysis which are certain to cause significant deviation from the 1967 through 1970 employment trends. Mining was increased significantly to reflect the opening of mining operations in Graham County that are presently under exploration. Contract construction was increased to reflect the increased demand for housing which will follow from this increased mining activity and general growth within the county.

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

GENERAL DISCUSSION

Good management and design of water-supply and wastewater treatment 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 II - 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, and (8) 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 I - 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 quantities 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, Arizona 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.

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

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 supply capabilities. 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.

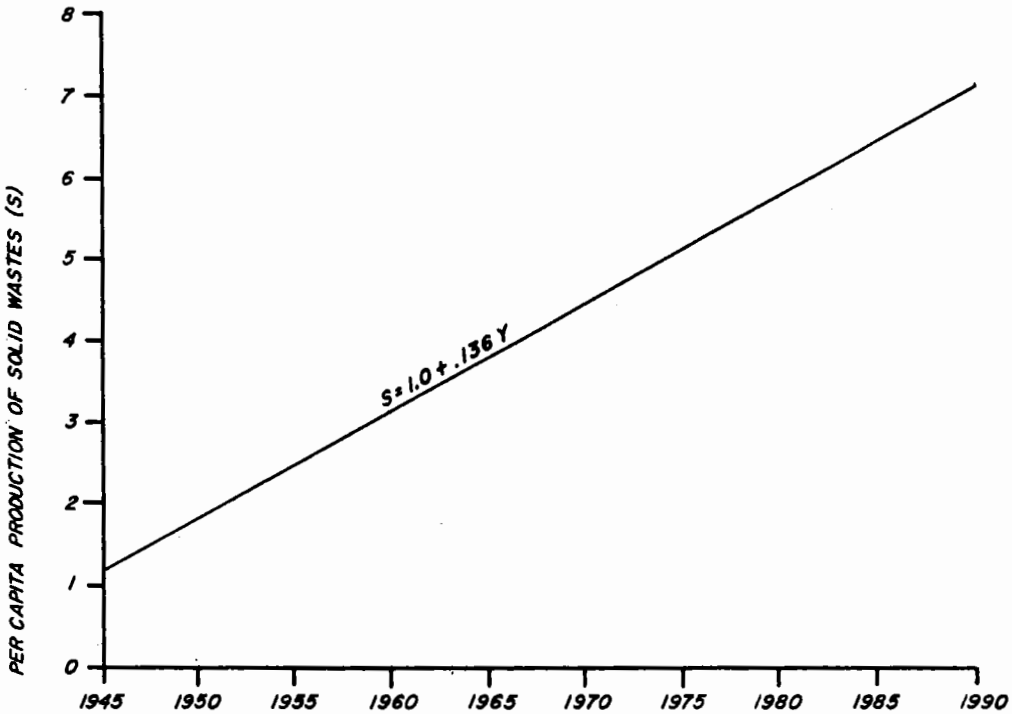
Generally solid wastes are defined as those materials that are solid or semi-solid consisting of refuse, garbage and rubbish. Solid wastes and by-products related to their breakdown constitute one of the forms of environmental pollution that is growing at an alarming rate. It is estimated that per capita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

REFERENCES

1. Proges, R. "Factors in Per Capita Water Consumption," Water and Sewage Works, Sept., 1958.

2. Anon "Present and Future Estimates of Water Consumption," Public Works, Dec., 1956.

3. Fair, G.M.; J.C. Geyer and D.A. Okun, Water and Wastewater Engineering, Volume 1. Water Supply and Wastewater Removal, 1966, John Wiley and Sons.

4. Sewage Treatment Plant Design, American Society of Civil Engineers, Manual of Practice No. 36, 1959.

5. Restoring the Quality of Our Environment, Report of the Environmental Pollution Panel Presidents Science Advisory Committee - 1965.

6. Future Solid Waste Accumulation, Report by the U.S. Department of the Interior, Bureau of Mines, Washington, D.C., 1968.

7. Anon "Plastics Pose a Solid Waste Disposal Problem," Environmental Science and Technology, 2:89, February 1968.

8. Anon "Per Capita Figure of 5.1 pounds of Matter Daily Indicated By National Survey," Solid Wastes Management - Refuse Removal Journal, 11:14, March 1968.

9. Eliot, G.F. "Garbage is a Nasty Word....But" Reprint - Suburbia Today, May 1961.

10. Mix, S.A. "Solid Wastes: Every Day Another 800 Million Pounds," Todays Health, p. 46, March 1966.

11. Anon "Refuse Quantities and Characteristics," In, Municipal Refuse Collection and Disposal, pp. 6-10, Issued by Office for Local Government, New York State Executive Department, 1964.

12. Rogus, C.A. "Refuse Collection and Refuse Characteristics," Public Works, 97:96, March 1966.

13. Kunsch, W.M. "Planned Refuse Vehicle Replacement: Better Service, Lower Maintenance," Public Works, 95:105, March 1964.

14. Hayden, I.L. "Incinerator Model Convinces Public," Public Works, 95:94, July 1964.

15. Gruenwald, A. and J.A. Reynolds, "Less than $3,000 Per Ton," The American City, 80:99, October 1965.

16. Kaiser, E.R., I. Halitsky, M.E. Jacobs, and L.C. McCabe, "Performance of a Flue Fed Incinerator," Air Pollution Control Association Journal, 9:85, February 1959.

17. Cohn, Morris M., "Effect of Food Wastes on Sewers and Sewage Treatment," Sewage Works Journal, 18:477, 1946.

18. Status of Solid Waste Management in California, California State Department of Public Health - 1970.

19. A Program Plan for Solid Waste Management in California, California State Department of Public Health - 1970.

20. Weaver, L. "Refuse and Litter Control in Recreation Areas," Public Works, 98:4, April 1967.

21. Munich, A.J., A.J. Klee, P.W. Britton, Preliminary Data Analysis; 1968 National Survey of Community Solid Waste Practices. Public Health Service Publication No. 1867, 1968.