SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

PRC Toups

lanning Research Company

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

APACHE JUNCTION PROJECT NO. PL80-1 (IN PART)

MAY 1981

Prepared By:

PRC TOUPS
4131 North 24th Street
Suite 110
Phoenix, Arizona 85016
(602) 954-9191

(This report was funded in part by grant FCRC No. 101-811-082-2 awarded to the City of Apache Junction, Arizona, by the Four Corners Regional Commission, Albuquerque, New Mexico.)

Registered Professional Engineer (Sanitary) CERTIFICATE NO. 12204 WOODROW C. SCOUTTEN, JR. DATE SIGNED 5-28-81 Arizona U. S. A.

Registered Professional Engineer (Civil) CERTIFICATE NO. 12908 PAUL S. SKAGER Date Signed ARIZONA, U.S.A.

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

AUTHORIZING CITY COUNCIL

Virginia Seeman
(Mayor)

John Granillo
(Vice Mayor)

Jerry Burgess

Thomas Damiano

Jimmy Eidson

Norman Hill

Marie Shanks

G. Ray Lee
City Manager

Joseph Gero
Director of Planning
(Project Manager)

Richard Broman
Director of Public Works

SEWAGE DISPOSAL ALTERNATIVES

FOR

APACHE JUNCTION, ARIZONA

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APPENDIX

Registered Professional Engineer (Sanitary) CERTIFICATE NO. 12204 WOODROW C. SCOUTTEN, JR. DATE SIGNED 5-28-81 Arizona U. S. A.

Registered Professional Engineer CERTIFICATE NO. 12208 PAUL S. SKAGER Date Signed ARIZONA, U.S.A.

CHAPTER 1
INTRODUCTION

HISTORY OF PROJECT.

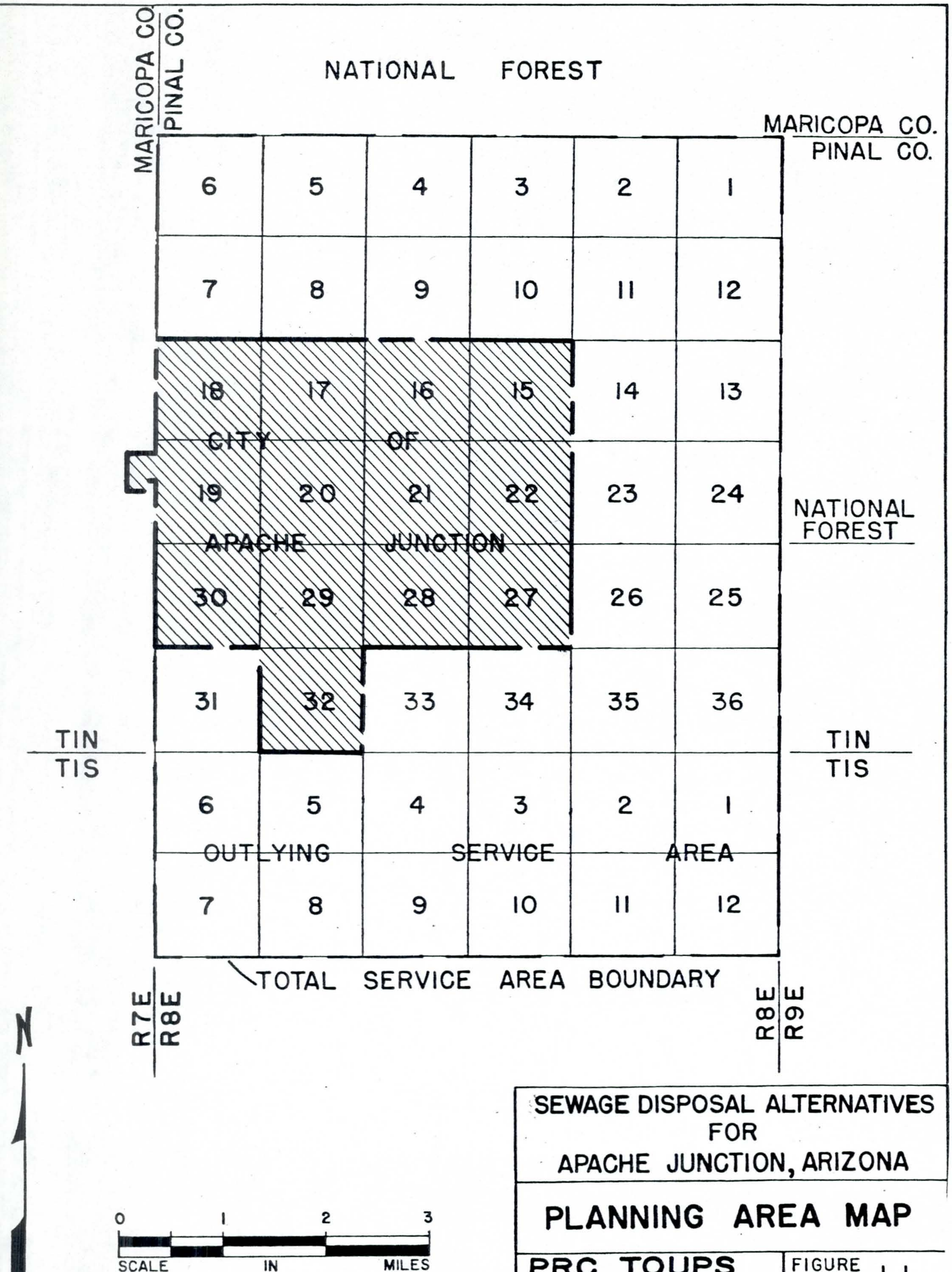
Apache Junction is a rapidly growing community located slightly over thirty miles east of downtown Phoenix, Arizona. It is situated principally in Pinal County; however, a 1980 annexation added a small area in Maricopa County. The permanent population in 1980 is approximately 10,500 persons. It is estimated that winter visitors to Apache Junction raise the population to over 30,000 persons.

The City of Apache Junction was incorporated in November, 1978. Since that time, the need to establish staff and procedures has dominated the program agenda of the City. City officials are desirous of establishing a General Plan for the Apache Junction service area, defined in Figure 1-1. With this goal in mind, the City applied for and on June 1, 1980, received a grant from the Four Corners Regional Commission to assist in the development of a general plan. The areas specifically addresssed in the terms of the grant included the following:

1) Sewer Needs Determination
2) Water Systems Evaluation
3) Transportation Facilities Plan
4) Municipal Complex Development
5) Land Use Plan

AUTHORIZATION.

Upon receipt of the planning grant, the City was authorized by the Four Corners Regional Commission to proceed with the selection of a consultant to perform those parts of the scope of work set forth in "Bid Specifications for Apache Junction General Plan of Selected Elements, Project No. PL-80-1". Through a competitive bid process, PRC Toups was chosen to perform all of the items listed in the scope of work. The term and effective date of the contract with PRC Toups was from October 29, 1980, through September 30, 1981.



SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

PLANNING AREA MAP

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 1-1

PURPOSE AND SCOPE OF STUDY.

The purpose of this particular report is to address the first of the above listed topics, namely 1) Sewer Needs Determination. The City of Apache Junction is rapidly approaching a decision point relative to wastewater planning. The major issue is whether the City should continue with individual septic tank/disposal systems for wastewater management or if a gravity sewer system feeding a central wastewater treatment facility should be constructed to serve the City and the surrounding service area. The final decision will depend in part on a determination of the threshold level at which wastewater treatment using septic systems can be permitted without creating a hazard to the public health, safety and general welfare. This report describes the work performed in assessing the alternatives and the conclusions reached as a result of the study.

Topics covered in this report include the following:

- Existing Conditions
- Future Conditions
- Development of Alternatives
- Evaluation of Alternatives
- Selection of Best Alternative

In addition, to assist the layman in understanding the contents of the report, a list of abbreviations and a glossary of terms commonly used in the sanitary engineering field are included in the Appendix.

This report is an independent analysis by the consulting engineering firm of PRC Toups. Conclusions and recommendations contained herein are those made only by the consultant after consideration of all the data, and do not represent individual views of the staff of the City of Apache Junction.

CHAPTER 2

MAJOR ASSUMPTIONS, CONCLUSIONS AND RECOMMENDATIONS

MAJOR ASSUMPTIONS.

1. This report takes a somewhat conservative look at the potential for population growth in the Apache Junction service area. Major factors which could increase the rate of growth include completion of the Superstition Freeway, development of a municipal airport, opening of a community college, and the further development of industrial parks and shopping centers.

2. When comparing population densities in the report, it is important to keep in mind that they are gross averages based on the conservative projection described above. Individual sections of the outlying service area, for example, may develop rather quickly, while other sections may not develop at all.

3. Wastewater flow and strength projections are based on conveying sanitary sewage only; collection and conveyance of stormwater is not considered in the analysis. Also, residential sewage flows make up the majority of the total; the contribution from commercial and industrial sources is a relatively insignificant portion of the total.

4. The design and installation of septic systems is generally not considered to be an exact science. Rather, the accepted techniques are based on empirical data which have been gathered over a number of years, such as the percolation rate, the size of the dwelling to be served, and the replacement capacity required.

5. It is assumed that the shallower and more land-intensive leach field method of effluent disposal must be used with septic tanks in the northern and eastern parts of the service area, resulting in a desirable lot size of one acre for a single-family residence.

6. Desirable lot sizes in the southwestern part of the service area are 14,000 square feet for a single-family residence, 6,000 square feet per unit in a mobile home park, and 3,000 square feet per unit in a travel trailer park. It must be kept in mind that these are very conservative figures and attempt to account for the varieties in sizes of dwellings for a given category.

7. The city planning staff perceives that long-range development will occur as a more even distribution of the types of residences than exists at present. This report assumes that, over the long term, development will evolve into a ratio of 60 percent single-family, 20 percent mobile home and 20 percent travel trailer.

CONCLUSIONS AND RECOMMENDATIONS.

EXISTING CONDITIONS.

1. The final 1970 census listed Apache Junction as having 2,390 persons and 1,161 housing units. The preliminary report of the 1980 census showed that Apache Junction has a population of 9,935 and a total of 6,837 housing units. However, the preliminary 1980 report also indicated that 2,632 housing units were vacant at the time of the survey, leaving 4,205 occupied units for an average of 2.36 persons per occupied unit.

2. A report entitled "Population Analysis for the City of Apache Junction, Arizona", completed by PRC Toups in December, 1980, estimated the total 1980 population for the Apache Junction service area to be 30,348, comprised of the following:

    1) A permanent resident population of 10,500 within the city limits.
    2) A permanent resident population of 2,200 in the outlying service area.
    3) A seasonal resident population of an additional 17,648 persons in the city and outlying service area.

3. Due to the low population density historically present in Apache Junction, nearly all of the community's wastewater is handled by individual septic systems. The majority of these systems utilize a septic tank with the disposal pit method for treated effluent disposal. However, in the poorer soil areas near the Goldfield and Superstition Mountains, a septic tank is usually combined with a leach field for treated effluent disposal. Conversations with representatives of the Pinal County Health Department indicate that design and installation practices in the Apache Junction area have generally been acceptable.

4. The larger systems in the Apache Junction service area generally utilize some form of secondary biological treatment to decompose and stabilize the organic matter in the wastewater. At the present time, there are four establishments which operate actual wastewater treatment facilities: Superstition Inn (20,000 gallons per day); Mining Camp Restaurant (10,000 gallons per day); Sierra Entrada Subdivision (60,000 gallons per day); and Rock Shadows Travel Trailer Park (40,000 gallons per day).

FUTURE CONDITIONS.

1. According to the previously mentioned report, "Population Analysis for the City of Apache Junction, Arizona", the population of the service area is expected to grow at a rate of 5 percent per year for the next ten years, 4 percent per year for the years 1991-1995, and 3 percent per year for the years 1996-2000. By the year 2000, there is projected to be 60,161 permanent and seasonal residents in the city and 8,268 permanent and seasonal residents in the outlying service area, for a total population of 68,429.

2. Based on a developable land area within the city limits of 11 square miles, population density will rise from 2,427 persons per square mile in 1980 to 5,469 persons per square mile in 2000. For comparison, the average population density for the major valley cities of Glendale, Mesa, Phoenix and Tempe (based

on the preliminary report of the 1980 census) is about 2,400 persons per square mile. Thus, population density within the city limits of Apache Junction is comparable to these other larger valley cities, where complete municipal services have been provided for many years. On the other hand, based on a developable land area in the outlying service area of 13 square miles, population density will rise from 281 persons per square mile in 1980 to only 636 persons per square mile in 2000.

3. Generally speaking, the soil in the southwest portion of the study area is a sandy loam with moderate permeability, while the soil in the northern and eastern portions of the study area is a loam containing a relatively high percentage of gravel, cobbles, and clay with a lower permeability. As a result, septic tanks with the deep pit method of disposal can be readily utilized in the southwest part of the area; however, the shallower and more land-intensive leach field method of disposal must be used with septic tanks in the northeast part of the area.

4. In the poorer soil area, a lot size of one acre would probably be needed for a single-family septic system (mobile home or conventional construction). When subtractions for street rights-of-way and other open spaces are considered (which account for approximately 25 percent of the gross land area), a total of 480 one-acre units can be constructed per square mile of gross land area. Using the 2.36 persons per unit from the existing population analysis yields an overall population density figure of *1,120 persons per square mile as the threshold level in the poorer soil area.*

5. Assuming that in the better soil area development will evolve into a ratio of 60 percent single-family, 20 percent mobile home, and 20 percent travel trailer gives an average lot size of 10,200 square feet. When subtractions for street rights-of-way and other open spaces are considered (which account for approximately 35 percent of the gross land area), a total of 1,760 lots

of 10,200 square feet can be constructed per square mile of gross land area. Using the 2.36 persons per unit figure from the existing population analysis yields an overall population density figure of *4,100 persons per square mile as the threshold level in the better soil area.*

6. The population density in the outlying service area remains low enough through year 2000 to continue to successfully utilize onsite methods for wastewater management. Within the city limits, on the other hand, unless the population is more evenly distributed according to the threshold capacity, the population density will surpass even the threshold limit in the better soil area in about the year 1996.

DEVELOPMENT OF ALTERNATIVES.

1. Alternative 1 is basically the provision for the "no action" plan mentioned at the end of Chapter 4. Individual homes and businesses in the entire Apache Junction service area would continue to utilize onsite techniques as the primary method of wastewater treatment. In good soil areas, septic tank effluent would flow to seepage pits for ultimate disposal. In poorer soil areas, leach fields or mound systems could be utilized. Evapotranspiration systems following septic tanks might find use on unusually large lots in the better soil areas. Institutional, commercial and industrial establishments could investigate use of aerobic treatment with an absorption bed, as is currently in use at the Superstition Inn (Chapter 3).

2. Alternative 2 allows homes in the low-density outlying service area to utilize any of the acceptable individual treatment/disposal methods, including septic tank with absorption bed, septic tank mound system, aerobic treatment with absorption bed, and evapotranspiration system. Homes and businesses within the higher-density city limits would be served by a gravity sewer system which would convey raw wastewater to a 5.4 mgd WWTP located roughly at the southeast corner of Elliot and

Meridian Roads. The plant would be capable of providing secondary treatment plus disinfection, with the effluent either reused or discharged to Siphon Draw. Dried sludge would be hauled away and disposed of in an acceptable landfill.

3. <u>Alternative 3</u> allows homes in the low density outlying service area to utilize any of the acceptable individual treatment/disposal methods, including septic tank with absorption bed, septic tank mound system, aerobic treatment with absorption bed, and evapotranspiration system. Homes and businesses within the higher density city limits would be served by a gravity sewer system. Wastewater would be conveyed out of the Apache Junction service area by a 27-inch diameter interceptor sewer, which would eventually combine with an interceptor sewer in eastern Mesa and proceed to a 17.4 mgd WWTP located in the vicinity of Higley and Recker Roads just north of Baseline Road. The plant would be capable of providing secondary treatment plus effluent filtration and disinfection, with the effluent pumped to a Roosevelt Water Conservation District canal for reuse. Dried sludge would be hauled away and disposed of in an acceptable landfill.

EVALUATION OF ALTERNATIVES.

1. The wastewater management alternatives were compared and evaluated using the following parameters: annual costs, ability to implement, flexibility and reliability, system experience, land requirement, and environmental assessment. In terms of annual costs, Alternatives 2 and 3 are initially about 63 percent *more* costly than Alternative 1; however, by the year 2000, they are about 27 percent *less* costly than Alternative 1, with the break even point occurring about 1991. At that time, the cost to an individual homeowner for a new septic tank/disposal system would be about the same as that for a complete gravity sewer/WWTP system. At any time after that, the latter system becomes more economical.

2. Table 2-1 shows the "Technical and Environmental Evaluation Matrix" used to compare the alternatives in terms of the above parameters. The point totals and relative standing of the three alternatives are 15 for Alternative 1 (third), 20 for Alternative 2 (first), and 19 for Alternative 3 (second).

SELECTION OF THE BEST ALTERNATIVE PLAN.

1. The major conclusion which can be drawn from the alternatives evaluation is that, over the long term, pursuit of either Alternative 2 or Alternative 3 is a wiser choice than continued reliance on Alternative 1. Beside having the lowest point total in Table 2-1, it is shown in Chapter 4 that Alternative 1 would exceed the threshold level of development within the Apache Junction city limits in the middle 1990's. Furthermore, Alternative 1 loses its economic advantage to the individual homeowner over the other alternatives in about 1991, as shown in Chapter 6.

2. It should be emphasized here that elimination of Alternative 1 does not mean that onsite methods for wastewater management within the city limits must be abandoned overnight. On the contrary, with proper supervision, onsite methods should continue to adequately serve the Apache Junction area for another ten years. The point to be made is that at the end of that period, Apache Junction should at least be in the position where it could pursue construction of an alternative wastewater management system.

3. If an alternative wastewater management system is eventually pursued, it is recommended that Apache Junction present a copy of this report to the Central Arizona Association of Governments (CAAG) and get on the construction grants priority list no later than the middle 1980's. It is important for the city to remember that its plan must be in compliance with the CAAG 208 Plan to be approved by the federal government.

TABLE 2-1

TECHNICAL AND ENVIRONMENTAL EVALUATION MATRIX

SHOWING RELATIVE STANDING OF ALTERNATIVES

ALTERNATIVE	ANNUAL COSTS	ABILITY TO IMPLEMENT	FLEXIBILITY AND RELIABILITY	SYSTEM EXPERIENCE	LAND REQUIREMENT	ENVIRONMENTAL ASSESSMENT	POINT TOTAL	RELATIVE STANDING
ALTERNATIVE 1	D	B	D	B	E	D		
	2	4	2	4	1	2	15	3
ALTERNATIVE 2	B	C	B	C	C	C		
	4	3	4	3	3	3	20	1
ALTERNATIVE 3	B	C	C	C	C	C		
	4	3	3	3	3	3	19	2

4. If a sewer system is eventually constructed in Apache Junction, it is recommended that bonding be required to cover damage to existing utilities from sewer and other new utility construction.

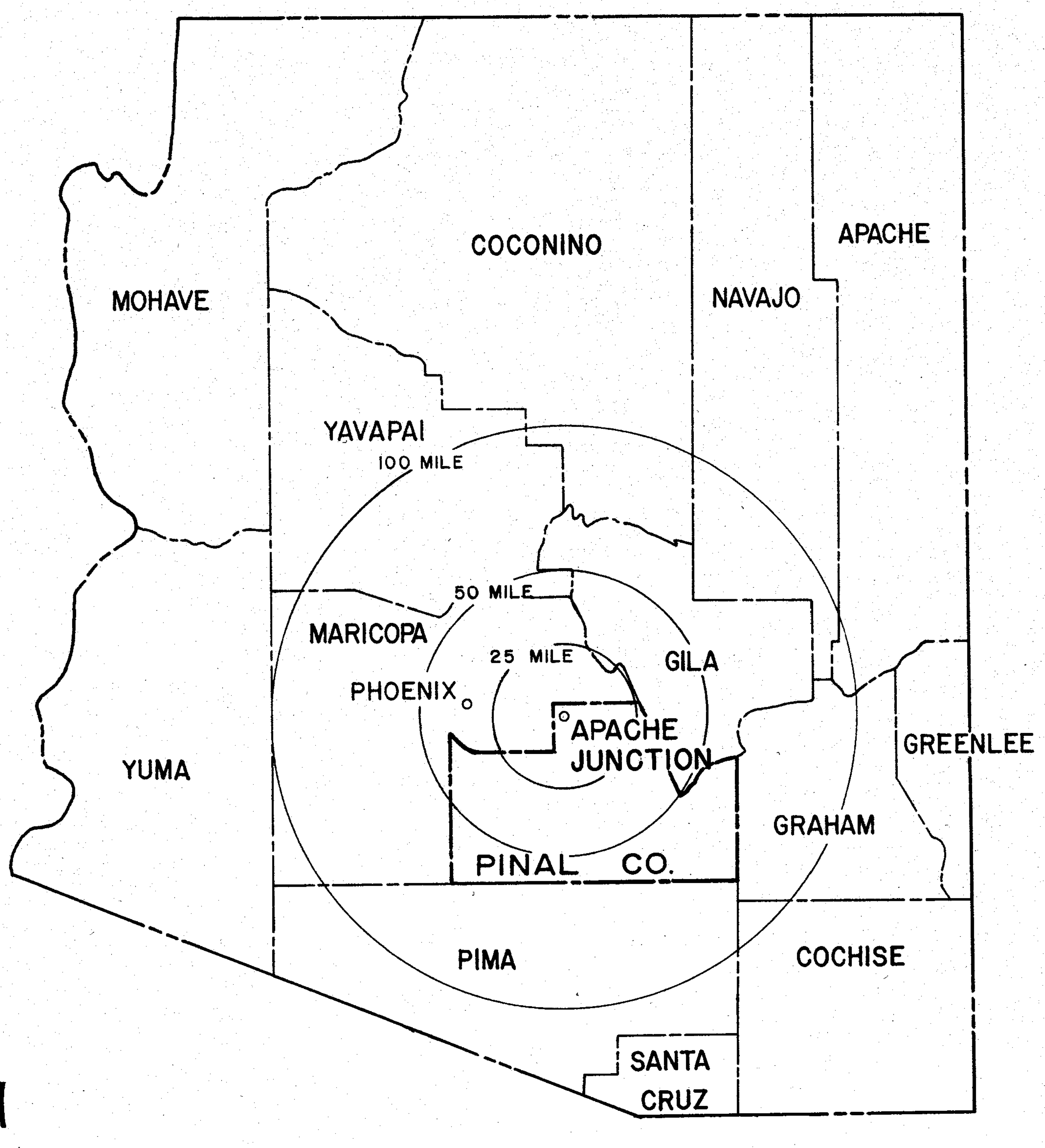
CHAPTER 3
EXISTING CONDITIONS

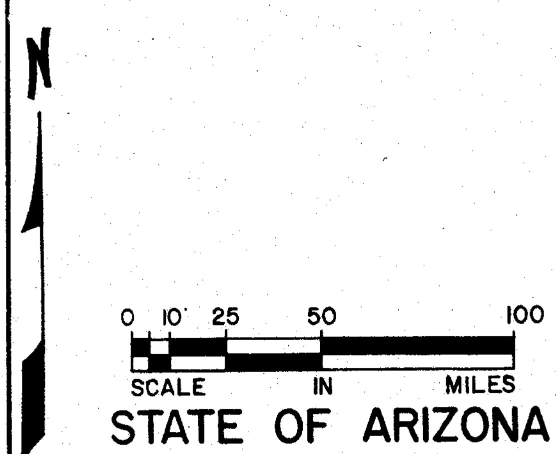
SERVICE AREA DESCRIPTION.

GENERAL. The City of Apache Junction is located in central Arizona slightly over thirty miles east of downtown Phoenix, as shown in Figure 3-1. For purposes of this report, the Apache Junction service area consists of slightly greater than 48 square miles, as shown in Figure 3-2. The service area includes: all of Township 1 North, Range 8 East and the northern one-third of Township 1 South, Range 8 East of the Gila and Salt River Baseline and Meridian in Pinal County, Arizona; and a 20-acre area in Maricopa County added by a 1980 annexation. The 20-acre parcel is a mobile home park located just west of Meridian Road between Apache Trail (U.S. Highway 60) and Superstition Boulevard. The area included in the city limits is slightly more than thirteen (13.03) square miles, also shown in Figure 3-2. Two square miles of state land and a school are located within the city limits and only about half (6.5 ± square miles) of the area is actually developed. Most of the 35-square mile area in the service area but beyond the city limits (22 ± square miles) is either land in trust to the Arizona State Land Department or land controlled by the United States Bureau of Land Management, as presented in Figure 3-3.

As used hereafter in this report, the term "city" will be used to describe the 13.03 square miles actually within the present city limits. The term "outlying service area" will designate the remaining 35 square miles which are outside of the city limits but still within the overall service area of the study. The term "total service area" will refer to the total 48.03 square miles.

CLIMATE. The weather in Apache Junction reflects the city's location in the central Arizona desert and is characterized by hot summers and mild winters. High diurnal temperature variations are common. The prevailing winds are from the east and are usually light, although severe windstorms occur at rare intervals. The mean annual precipitation is approximately 7-1/2 inches, equally divided between summer and winter seasons. Three types of storms produce precipitation in the Apache Junction area: general winter storms, general summer storms, and local summer storms. Significant climatological data for Apache Junction is summarized in Table 3-1.





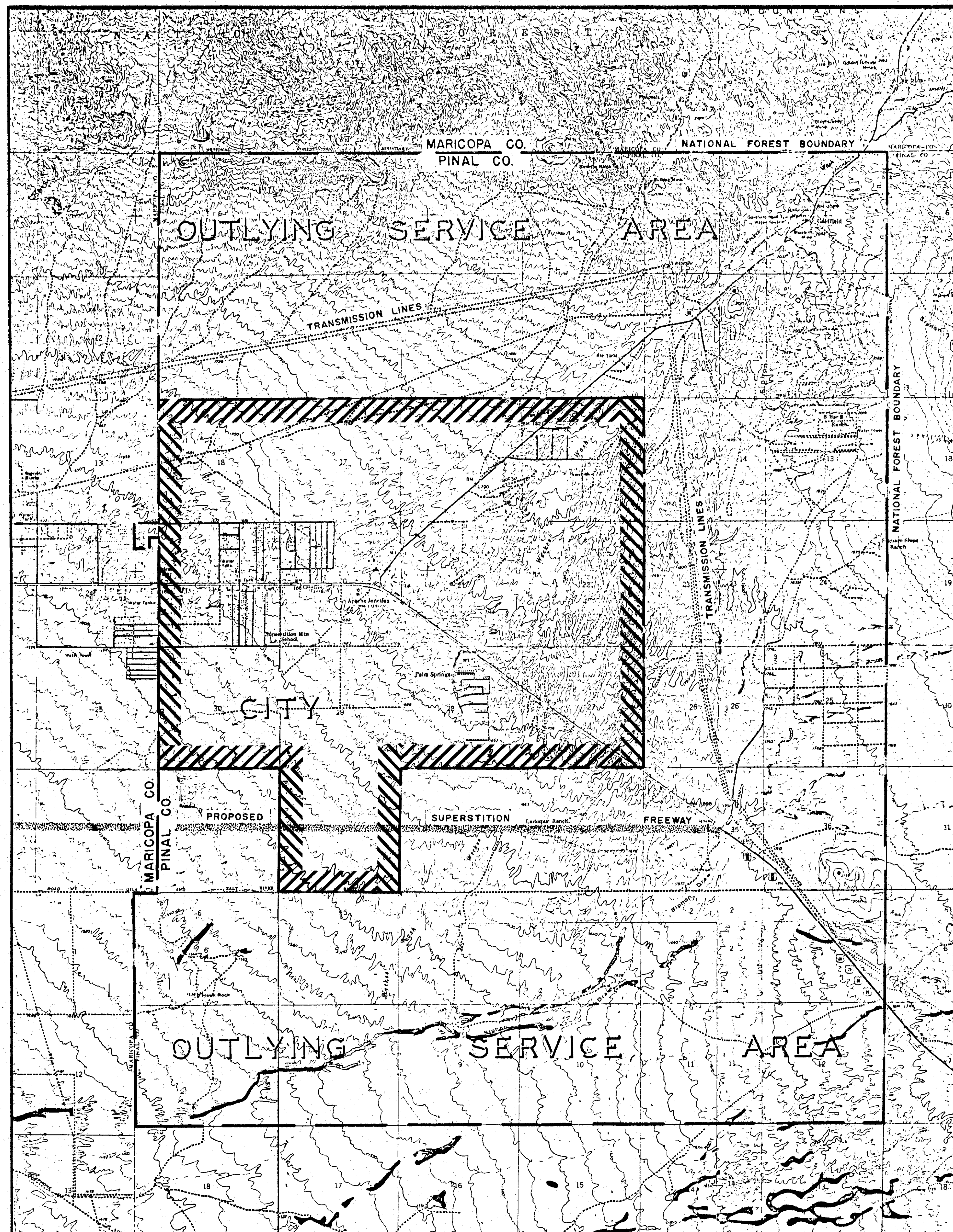
STATE OF ARIZONA

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

GENERAL LOCATION MAP

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 3-1



LEGEND

— — — TOTAL SERVICE AREA BOUNDARY

——— — — AREA WITHIN CITY LIMITS

N

0 ¼ ½ ¾ 1

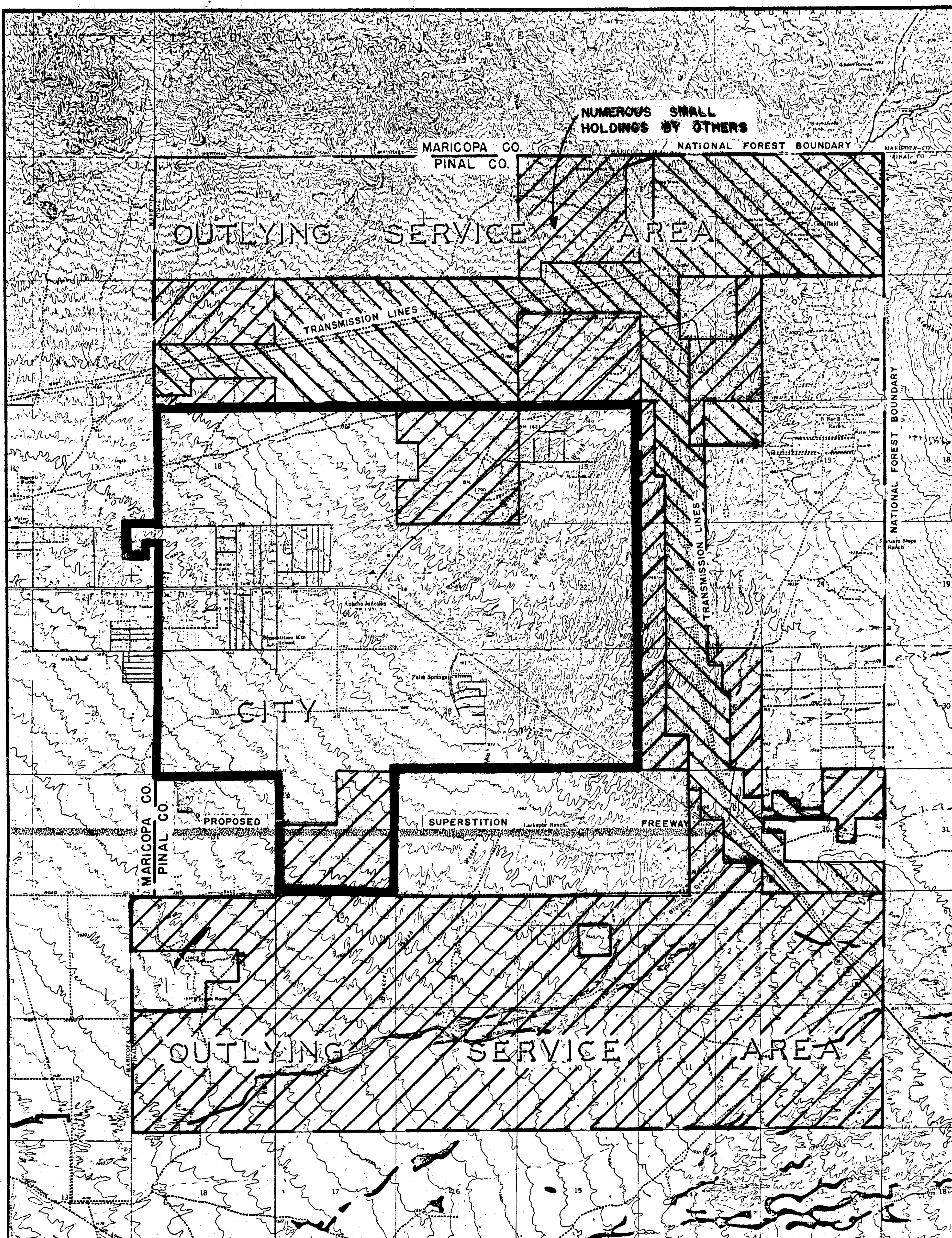
SCALE IN MILES

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

SERVICE AREA MAP

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 3-2



LEGEND

— — — TOTAL SERVICE AREA BOUNDARY

AREA WITHIN CITY LIMITS

\\\\\\ BUREAU OF LAND MANAGEMENT

////// ARIZONA TRUST PROPERTIES

N

0 ¼ ½ ¾ 1

SCALE IN MILES

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

FEDERAL AND STATE LAND OWNERSHIP

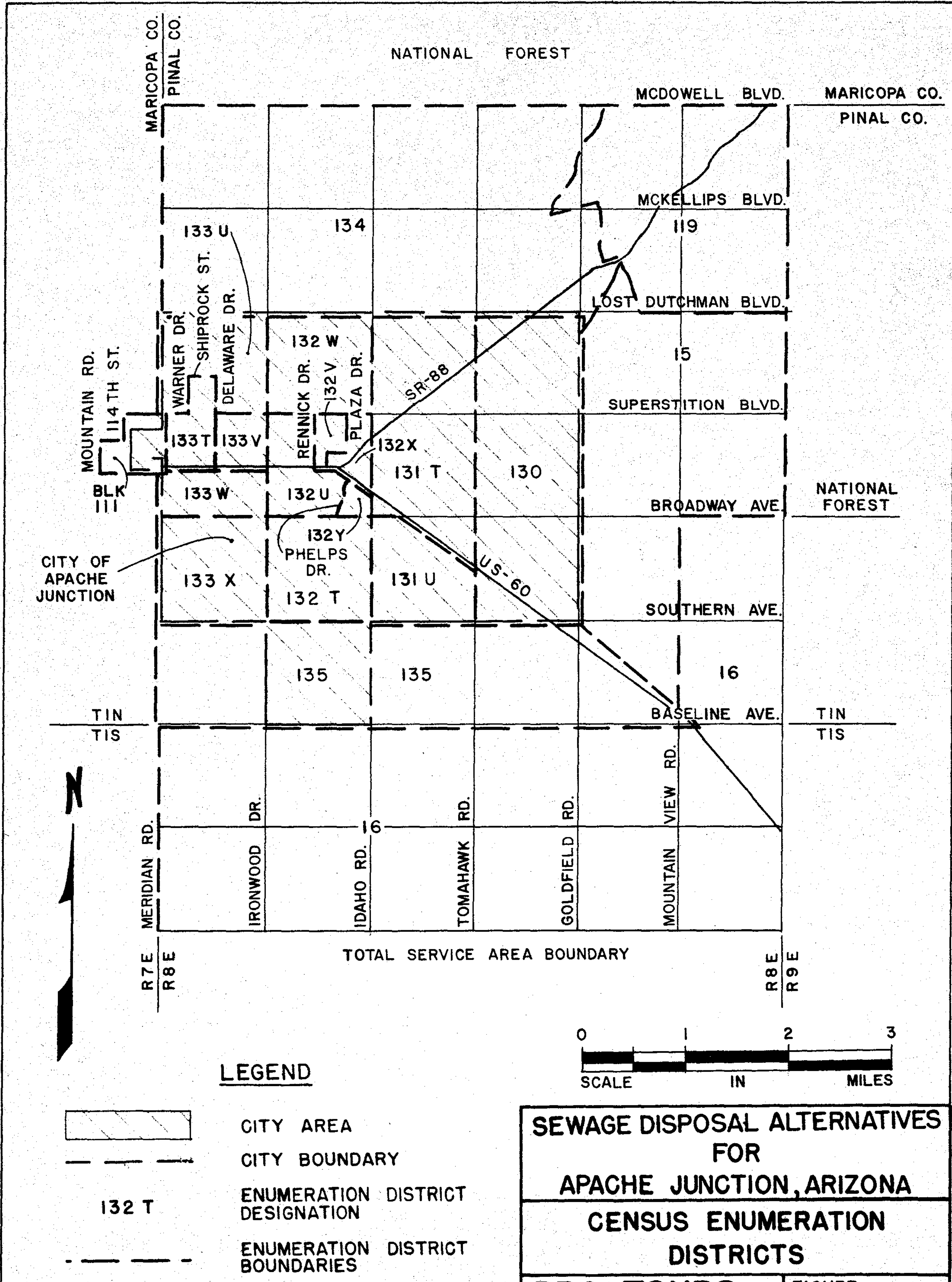
PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 3-3

TABLE 3-1

SIGNIFICANT CLIMATOLOGICAL DATA

MONTH	AVERAGE TEMPERATURE (°F) DAILY MAX.	DAILY MIN.	AVERAGE HEATING DEGREE DAYS	TOTAL PRECIPITATION (INCHES)
January	66.9	35.8	400	0.92
February	71.7	38.8	267	0.76
March	76.8	42.9	168	0.69
April	86.0	49.2	42	0.34
May	94.9	56.9	4	0.10
June	103.2	65.1	0	0.09
July	106.8	75.3	0	0.74
August	104.5	73.7	0	1.24
September	101.0	66.1	0	0.74
October	90.2	53.7	13	0.44
November	77.0	42.1	160	0.57
December	68.2	36.2	391	0.93
YEARLY	87.3	53.0	1,445	7.56



SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

CENSUS ENUMERATION DISTRICTS

PRC TOUPS
4131 N 24 ST., PHX., AZ.

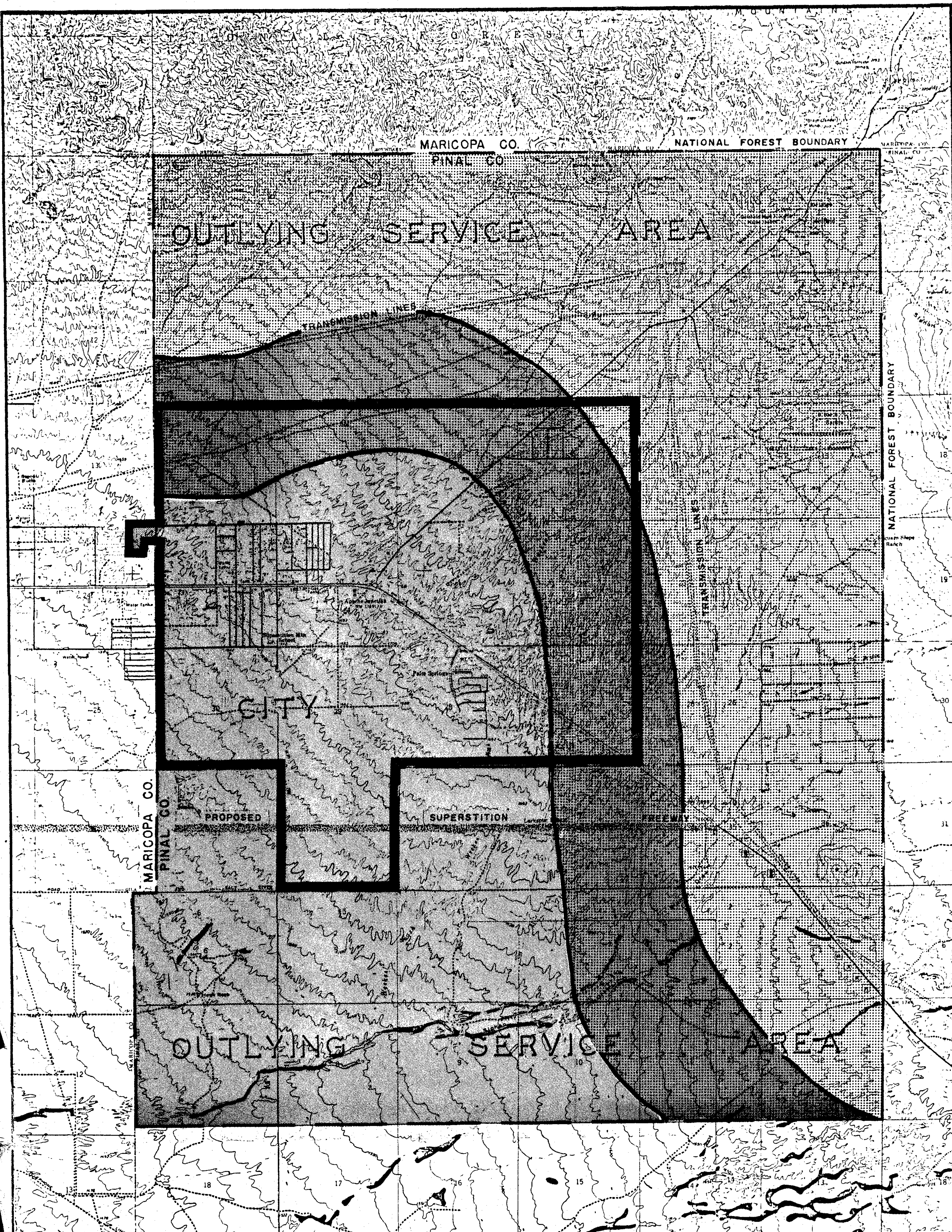
FIGURE NO. E-1

GEOLOGY. The rock materials in the higher regions vary widely. The materials include fine grained, coarse grained, and metamorphosed granites including gneiss and schist, sandstones, breccias, and metamorphosed sedimentary rocks. Various lava rocks including the basalt, andesite, rhyolite, volcanic glass, and white tuff are also present. The soils are typical of desert and semi-desert regions, being mostly shallow, rocky and poorly developed. The northern and eastern portions of the study area lie in the foothill ranges of the Goldfield and Superstition Mountains. The remainder of the Apache Junction area occupies an alluvial plain built up from water deposited, soil-forming materials and rock debris. These soils consist of various forms of clays and loams.

SOILS. The soil in Apache Junction is of the hyperthermic arid variety and is characterized by either of two major types: HA-1, the torrifluvents association; and HA-3, the mohall-vecont-pinamt association. Generally speaking, the torrifluvents association is found in the southwest portion of the service area, with the mohall-vecont-pinamt association occupying the northern and eastern portions, as shown in Figure 3-4. Table 3-2 presents distinguishing characteristics of the two soil types. Conclusions which can be drawn from Table 3-2 are that the soil in the southwest portion is basically a sandy loam with moderate permeability, while the soil in the northern and eastern portions is a loam containing a relatively high percentage of gravel, cobbles and clay with a lower permeability.

VEGETATION. Natural vegetation is sparse at best. Cacti grow throughout the area along with other desert shrubs. Native trees such as Paloverde, Mesquite, and Ironwood are scattered among the shrubs. In uncultivated areas, good covers of annual grasses occur after winter rains. The vegetation tends to be somewhat thicker along and adjacent to washes in the area.

RUNOFF CHARACTERISTICS. Little flow occurs except during and immediately following heavy precipitation because climatic and drainage characteristics are not conducive to continuous runoff. Due to the



LEGEND

— — — TOTAL SERVICE AREA BOUNDARY

——— - - ——— AREA WITHIN CITY LIMITS

SOIL TYPE HA-1: TORRIFLUVENTS ASSOCIATION BETTER SOIL AREA

SOIL TYPE HA-3: MOHALL-VECONT-PINAMT ASSOCIATION POORER SOIL AREA

TRANSITION ZONE

N

0 1/4 1/2 3/4 1

SCALE IN MILES

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

SOIL DISTRIBUTION MAP

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. **3-4**

TABLE 3-2

DISTINGUISHING CHARACTERISTICS OF APACHE JUNCTION SOILS

SOIL TYPE AND CLASSIFICATION	DOMINANT SLOPE (percent)	DEPTH TO HARDPAN (feet)	REPRESENTATIVE PROFILE TEXTURES	PERMEA-BILITY	CORRO-SIVITY	LIMITATION FOR SEPTIC SYSTEMS
HA-1 Torrifluvents Association	0 to 3	>60	Mainly sandy loam with some sandy clay loam	Moderate	Low	Moderate
HA-3 Mohall-Vecont-Pinamt Association	0 to 5	>60	A mixture of gravelly, cobbly, and clay loam with some sandy clay loam	Moderately slow to slow	Moderate	Moderately severe

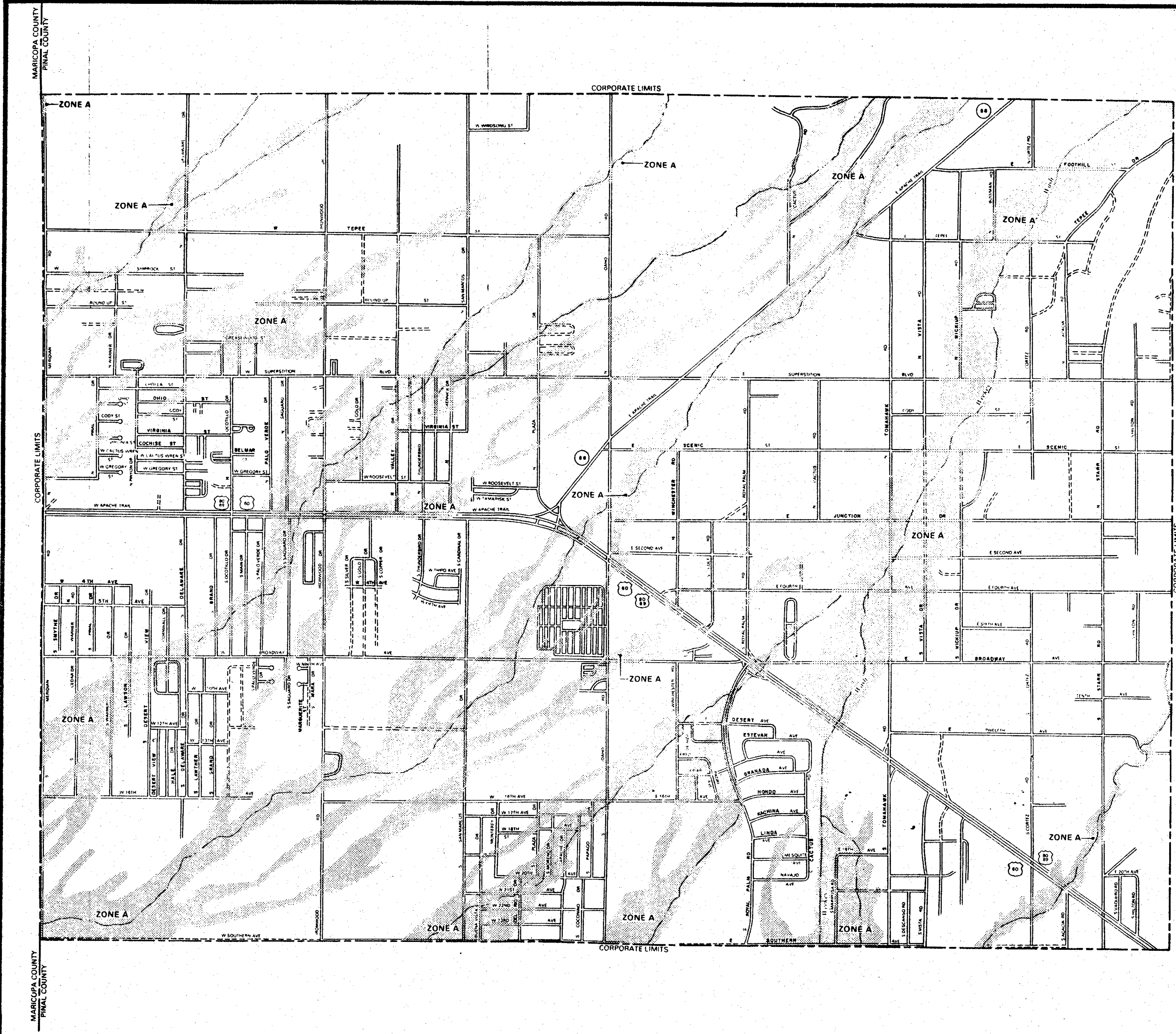
relatively flat slope, wide overflow area, and lack of defined channels, floods on the valley plain spread out overland and cause existing channels and washes to shift over time. As one moves toward the mountains, however, stream channels are more defined and generally deeper. Flow velocities and depths are relatively small compared to runoff concentrated in stream channels and washes.

FLOOD HAZARD POTENTIAL. Proposed flood control structures which will regulate the drainage area include the Weekes Wash Dam, the Apache Junction Floodway, and the Apache Junction Dam. These structures are under the jurisdiction of the Flood Control District of Maricopa County. The runoff generated by the drainage area flows in a southwest direction, where ground slopes are normally less than one percent (except in foothill areas of the mountains).

A vast network of intermingling washes is found throughout the alluvial fan. These erodable channels do not allow an accurate account of flooding limits, but lead to the conclusions that overland flow and channel flow will coexist for the 100-year storm discharges. The preliminary flood hazard boundary map for Apache Junction, dated June 10, 1980, is presented in Figure 3-5. This map identifies the special flood hazard area, Zone A, which is defined as an area inundated by the 100-year flood, determined by approximate methods. With the preliminary map, no base flood elevations are shown and no flood hazard factors are determined. The final map, which will present a much more detailed breakdown of flood hazard zones, is being prepared by the firm of Cella Barr Associates and will be available within the next few months.

POPULATION ANALYSIS.

The final 1970 census listed Apache Junction as having 2,390 persons and 1,161 housing units. The preliminary report of the 1980 census showed that Apache Junction has a population of 9,935 and a total of 6,837 housing units. Thus, according to the census figures, population in the City increased at a rate of 15 percent per year over the last decade, while the number of housing units increased even faster, at a rate of about 20 percent per year. However, the preliminary 1980 report also



KEY TO MAP

SPECIAL FLOOD HAZARD AREA — ZONE A

Note: These maps may not include all Special Flood Hazard Areas in the community. After a more detailed study, the Special Flood Hazard Areas shown on these maps may be modified, and other areas added.

TO DETERMINE IF FLOOD INSURANCE IS AVAILABLE IN THIS COMMUNITY, CONTACT YOUR INSURANCE AGENT, OR CALL THE NATIONAL FLOOD INSURANCE PROGRAM, AT (800) 638-6620, OR (800) 424-8872.

INITIAL IDENTIFICATION DATE

JUNE 10, 1980

FHBM COMMUNITY-PANEL NUMBER 040120-0001-A (1 OF 1)

NOTE: MAP DOES NOT INCLUDE AREAS ANNEXED TO THE CITY OF APACHE JUNCTION AFTER JANUARY 1, 1980.

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

PRELIMINARY FLOOD HAZARD BOUNDARY MAP

PRC TOUPS 4131 N 24 ST. PHX., AZ.

FIGURE NO. 3-5

indicated that 2,632 housing units were vacant at the time of the survey leaving 4,205 occupied units for an average of 2.36 persons per occupied unit. A further breakdown of the census count by enumeration district is included in the Appendix.

Seasonal residents, who have not been included in the above figures, account for a large number of Apache Junction's total population. In fact, it is quite likely that the 2,632 housing units reported vacant at the time of the census are actually occupied during the tourist season. Whether these residents should be classified as permanent residents from a federal census definition is difficult to determine. For the most part, these seasonal residents live in mobile home or travel trailer parks while in Apache Junction and reside from anywhere between one week and six months from September through March. They consider some other location, where they may own property, as being their permanent place of residency.

A survey carried out by the City in November, 1980, showed that there are 80 separately-owned mobile home or travel trailer parks located within the city limits, containing 1,263 mobile home spaces, 4,427 travel trailer spaces, and 473 spaces of unknown type. Seven additional parks, containing 761 mobile home spaces, 441 travel trailer spaces, and 38 spaces of unknown type, are located in the outlying service area. The survey estimated that 90 percent of all mobile home and travel trailer spaces are filled during the peak of the winter season. Consequently, it appears that the seasonal resident population in mobile home and travel trailer parks could be as high as 10,850 within the city limits, with an additional 1,450 in the outlying service area.

A report entitled "Population Analysis for the City of Apache Junction, Arizona," completed by PRC Toups in December, 1980, estimated the total 1980 population for Apache Junction to be 30,348, comprised of the following:

1) A permanent resident population of 10,500 within the city limits.

2) A permanent resident population of 2,200 in the outlying service area.

3) A seasonal resident population of 17,648.

Table 3-3 on the following page regroups these figures to yield a total 1980 population in the City of 26,697, and a total population in the outlying service area of 3,651. Population projections through year 2000 using this same method will be presented in the following chapter.

EXISTING WASTEWATER FACILITIES.

SEPTIC SYSTEMS. Due to the low population density historically present in Apache Junction, nearly all of the community's wastewater is handled by individual septic systems. The majority of these systems utilize a septic tank with the disposal pit method for treated effluent disposal. The disposal pit is generally a circular hole drilled vertically into the ground and backfilled with a durable material such as rock or gravel. Where the soil is suitable, the disposal pit method is preferred as it can be accomodated on an average size lot, with an increase in absorption area being obtained by simply drilling deeper. As one moves north and east through the service area toward the Goldfield and Superstition Mountains, however, the deeper soil deteriorates to the point where disposal pits can no longer be utilized. In these cases, a septic tank is combined with a leach field for treated effluent disposal. The leach field is most commonly a series of distribution pipes set in shallow trenches backfilled with rock or gravel. The shallower nature of the leach field requires a much larger surface area than the disposal pit and, thus, its use is usually restricted to those areas where the soil is too hard or rocky to permit deep drilling.

Properly designed, installed and maintained septic systems using either the disposal pit or the leach field method for treated effluent disposal should have a useful service life of at least twenty years. To date, septic systems in the Apache Junction service area have apparently been performing adequately. The Central Arizona Association of Governments (CAAG) 208 Project, "Areawide Water Quality Management Plan", published October 1, 1978, does not identify Apache Junction a high priority

TABLE 3-3

1980 POPULATION IN THE APACHE JUNCTION

SERVICE AREA

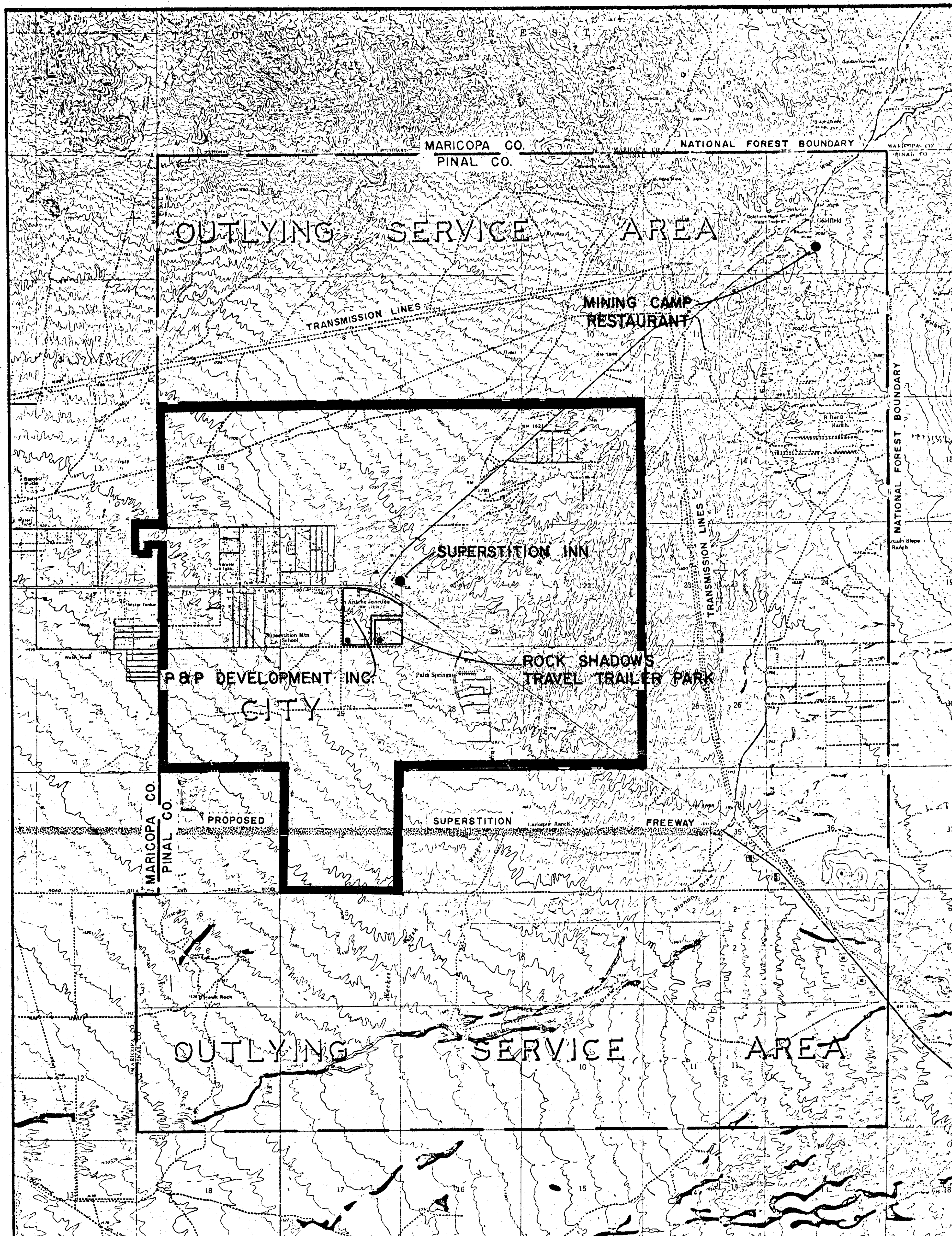
CATEGORY	POPULATION		
Permanent Population in City	10,500		
Seasonal Population in City	16,197		
Total Population in City	26,697		
Permanent Population in Outlying Service Area		2,200	
Seasonal Population in Outlying Service Area		1,451	
Total Population in Outlying Service Area		3,651	
Total Population in Service Area			30,348

problem area with regard to onsite treatment/disposal systems. In addition, conversations with representatives of the Pinal County Health Department indicate that design and installation practices in the Apache Junction area have generally been acceptable.

LARGER TREATMENT SYSTEMS. The larger systems in the Apache Junction service area generally utilize some form of secondary biological treatment to decompose and stabilize the organic matter in the wastewater. Activated sludge is a secondary treatment process that removes organic matter from sewage by saturating it with air and adding biologically active sludge. The activated sludge process is reliable and capable of providing a high degree of treatment provided that the characteristics of the influent wastewater do not change drastically over a short period of time. A rapid increase in influent flow may wash the microorganisms right out of the system, while a rapid decrease in influent flow can starve the organisms and cause many of them to die off. This is an important constraint in Apache Junction, where large numbers of people move into the area in the fall and move out again in the spring, and it makes the provision for knowledgeable plant operators a necessity.

At the present time, there are four establishments in the total service area which operate actual wastewater treatment facilities: Superstition Inn, Mining Camp Restaurant, Sierra Entrada Subdivision and Rock Shadows Travel Trailer Park. The locations of these facilities are shown in Figure 3-6. The Superstition Inn has a revitalized 20,000 gallon per day (gpd) package treatment plant consisting of a lift station, an extended aeration unit, and clarifier. Effluent is disposed of in four dry wells, each 4 feet in diameter by 100 feet deep; thus, the plant has no discharge. The effluent is routinely sampled for dissolved oxygen content; however, other effluent quality data are not available.

The Mining Camp Restaurant, located northeast of the city, has a forced-air type package treatment plant, recently upsized from 5,000 to 10,000 gpd. Treated effluent is discharged to two aerated lagoons. Although the restaurant does have a National Pollutant Discharge Elimination System (NPDES) Permit, the lagoons are large enough to hold all the effluent without discharging. Since the facility does not discharge, effluent values are not available.



LEGEND

— — — TOTAL SERVICE AREA BOUNDARY

—— - —— AREA WITHIN CITY LIMITS

● WASTEWATER TREATMENT PLANT

N

0 ¼ ½ ¾ 1

SCALE IN MILES

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

EXISTING WASTEWATER TREATMENT FACILITIES

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 3-6

P&P Development, Inc., is the developer of the Sierra Entrada Subdivision, located as shown in Figure 3-6. Included in the service area are a number of single-family residences, a small car washing facility, and the Superstition Plaza, which is a multi-service commercial shopping area. All establishments in the subdivision are served by a gravity sewer system, with pipes either 6-inches or 8-inches in diameter. Two of the major 8-inch lines convey raw wastewater to a 60,000 gpd activated sludge treatment facility in the southwest corner of the property. Treatment units consist of one bar screen and one aerated grit chamber, (for removal of large, coarse solids), six aeration basins in series, two final settling tanks, one sludge holding tank, and a disinfection facility. Treated effluent flows to either of two storage lakes in the subdivision, while the sludge is periodically pumped from the holding tank and hauled away for disposal. The two lakes are designed to hold all of the treated effluent without discharging; however, if a plant emergency does occur, treated effluent can also flow to a 50-foot deep disposal pit adjacent to the treatment plant. Twenty homes out of a projected total of 136 homes are presently connected to the sewer system. The wastewater treatment plant has space available to expand to a capacity of 100,000 gpd once the remaining homes are connected.

The Rock Shadows Travel Trailer Park has a 40,000 gpd activated sludge facility located in the southwest corner of the property. Treatment units consists of one grit chamber, eight aeration basins in series, one final settling tank, and one sludge holding tank. Treated effluent flows alternately to two drain fields, while sludge is pumped periodically and hauled away. The WWTP has been in service since 1972. Complete cleaning and maintenance is performed once a year, usually early in the fall.

CHAPTER 4
FUTURE CONDITIONS

POPULATION.

According to the previously mentioned report, "Population Analysis for the City of Apache Junction, Arizona", the population of the service area is expected to grow at a rate of 5 percent per year for the next ten years, 4 percent per year for the years 1991-1995, and 3 percent per year for the years 1996-2000. Table 4-1 shows the projected populations for the City itself, the outlying service area, and the total service area through the year 2000. As shown, there is projected to be 60,161 residents and 8,268 residents in the City and the outlying service area, respectively, for a total year 2000 population of 68,429. The report took a somewhat conservative look at the potential for population growth in the service area. Major factors which could increase the rate of growth include completion of the Superstition Freeway, development of a municipal airport, opening of a community college, and the further development of industrial parks and shopping centers.

As important for this study as the total population is the population density in the two major areas. The upper half of Table 4-2 shows the population densities through year 2000 based on land area within the city limits of 13.03 square miles and a land area of 35 square miles in the outlying service area. The land area in the total service area is approximately 48.03 square miles. An important distinction between the City and the outlying service area is apparent from Table 4-2, which shows that the population density in the outlying service area is only about 5 percent of that in the City. By year 2000, population density in the City will have reached 4,617 persons per square mile, while the population density in the outlying service area will only be 236 persons per square mile.

The lower half of Table 4-2 presents a further comparison. Within the city limits, there are two square miles which are under public ownership. It therefore seems reasonable to use an eleven square mile figure

TABLE 4-1

APACHE JUNCTION POPULATION PROJECTIONS THROUGH YEAR 2000

	CITY			OUTLYING SERVICE AREA			TOTAL SERVICE AREA
YEAR	PERMANENT POPULATION	SEASONAL POPULATION	TOTAL POPULATION	PERMANENT POPULATION	SEASONAL POPULATION	TOTAL POPULATION	TOTAL POPULATION
1980	10,500	16,197	26,697	2,200	1,451	3,651	30,348
1985	12,762	20,669	33,431	2,806	1,851	4,657	38,088
1990	16,288	26,375	42,663	3,579	2,362	5,941	48,604
1995	19,816	32,085	51,901	4,294	2,873	7,167	59,068
2000	22,972	37,189	60,161	4,938	3,330	8,268	68,429

TABLE 4-2

APACHE JUNCTION POPULATION DENSITIES THROUGH YEAR 2000

(1) GROSS POPULATION DENSITIES

YEAR	CITY		OUTLYING SERVICE AREA		TOTAL SERVICE AREA	
	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 13.03 SQ. MI.	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 35 SQ. MI.	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 48.03 SQ. MI.
1980	26,697	2,049	3,651	104	30,348	632
1985	33,431	2,565	4,657	133	38,088	793
1990	42,663	3,274	5,941	170	48,604	1,012
1995	51,901	3,983	7,167	205	59,068	1,230
2000	60,161	4,617	8,268	236	68,429	1,425

(2) NET POPULATION DENSITIES

YEAR	CITY		OUTLYING SERVICE AREA		TOTAL SERVICE AREA	
	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 11 SQ. MI.	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 13 SQ. MI.	TOTAL POPULATION	POPULATION DENSITY (PERSONS PER SQ. MI.) 24 SQ. MI.
1980	26,697	2,427	3,651	281	30,348	1,265
1985	33,431	3,039	4,657	358	38,088	1,587
1990	42,663	3,878	5,941	457	48,604	2,025
1995	51,901	4,718	7,167	551	59,068	2,461
2000	60,161	5,469	8,268	636	68,429	2,851

to represent the area within the city limits which is actually developable. Likewise, in the outlying service area, 22 of the 35 square miles are either lands in trust to the Arizona State Land Department or are lands controlled by the United States Bureau of Land Management. Once again, it seems reasonable to use a thirteen square mile figure to represent the area within the outlying service area which is actually developable. Certainly, the state lands will be proposed for development in the future; however, for base statistical purposes and for the fact that the users today are unknown, it is felt that the statistics should be presented in terms of both the gross and net areas. The lower half of Table 4-2 shows that, by year 2000, population density in the city will have reached 5,469 persons per square mile, while the population density in the outlying service area will only be 636 persons per square mile, or about 12 percent of the city figure.

The density figures within the city limits become even more significant when the existing pattern of development is considered. Conservatively speaking, only about 6.5 square miles within the city limits is actually developed at present. Over this developed area, the population density is estimated to be 1,615 persons per square mile during the summer and 4,107 persons per square mile during the peak of the winter season. When comparing these population densities, it is important to keep in mind that they are gross averages based on the conservative projections contained in the 1980 population report. Individual sections of the outlying service area, for example, may develop rather quickly, while other sections may not develop at all. The major factors identified in the above paragraphs could have a significant effect on how the population actually distributes in the future.

For comparison, population density figures for the major valley cities of Glendale, Mesa, Phoenix, Scottsdale, and Tempe are presented in Table 4-3. With the exception of Scottsdale, which had a large quantity of recently annexed and generally undeveloped or sparsely developed land area included in its total, the average population density is about

TABLE 4-3

POPULATION DENSITY COMPARISON

COMMUNITY	POPULATION FROM PRELIMINARY 1980 CENSUS	LAND AREA (SQ. MI.)	AVERAGE POPULATION DENSITY (PERSONS/SQ. MI.)	MAXIMUM POPULATION DENSITY (PERSONS/SQ. MI.)	AVERAGE POPULATION DENSITY IN DEVELOPED AREA (PERSONS/SQ. MI.)
Glendale	92,809	40	2,320	--	--
Mesa	149,662	66	2,270	9,340	3,120
Phoenix	779,592	325	2,400	--	--
Scottsdale	87,700	89	990	--	--
Tempe	106,306	38	2,800	7,300	3,980
Apache Junction (1980) - Gross	26,697	13.03			2,049
Apache Junction (1980) - Net	26,697	11	955 (summer) 2,427 (winter)		1,615 (summer) 4,107 (winter)
Apache Junction (2000) - Gross	60,161	13.03			4,617
Apache Junction (2000) - Net	60,161	11	2,088 (summer) 5,469 (winter)		3,534 (summer) 9,256 (winter)

2,400 persons per square mile. Additional data received from the east valley cities of Mesa and Tempe shows maximum population densities of 9,340 and 7,300, respectively. The average population densities in the developed residential areas are about 3,120 and 3,980 persons per square mile for Mesa and Tempe, respectively. As can be seen from Tables 4-2 and 4-3, population density in the 1990's within the city limits of Apache Junction will become comparable to these other larger valley cities, where complete municipal services have been provided for many years.

WASTEWATER CHARACTERISTICS.

Wastewater flow and strength parameters are defined as part of the previously mentioned CAAG 208 Project, "Areawide Water Quality Management Plan". Table 4-4, which presents wastewater flow, biochemical oxygen demand (BOD), and suspended solids (SS) loadings for Apache Junction, is based on the following values from Chapter V of the 208 Report:

Average flow = 90 gallons per capita per day

BOD concentration = 0.20 pounds per capita per day
= 266 milligrams per liter (mg/l)

SS concentration = 0.25 pounds per capita per day
= 333 mg/l

Due to the fact that the vast majority of the population is expected to reside within the city limits, the average wastewater flows and loadings from the city are significantly greater than from the outlying service area.

THRESHOLD CAPACITY.

GENERAL. As described in Chapter 3, the majority of the population in Apache Junction is serviced for wastewater management by onsite septic tanks with leach fields or disposal pits. The septic system had done an

TABLE 4-4

APACHE JUNCTION WASTEWATER CHARACTERISTICS

	CITY			OUTLYING SERVICE AREA			TOTAL SERVICE AREA		
YEAR	AVERAGE FLOW (MGD)	BOD LOAD (lb/day)	SS LOAD (lb/day)	AVERAGE FLOW (MGD)	BOD LOAD (lb/day)	SS LOAD (lb/day)	AVERAGE FLOW (MGD)	BOD LOAD (lb/day)	SS LOAD (lb/day)
1980	2.40	5,340	6,680	0.33	730	910	2.73	6,070	7,590
1985	3.01	6,690	8,360	0.42	930	1,160	3.43	7,620	9,520
1990	3.84	8,530	10,670	0.53	1,190	1,480	4.37	9,720	12,150
1995	4.67	10,380	12,980	0.65	1,430	1,790	5.32	11,810	14,770
2000	5.42	12,030	15,040	0.74	1,650	2,070	6.16	13,680	17,110

adequate job of wastewater management to date, mainly due to the relatively sparse population of year-round residents in the service area. However, as the number of year-round and seasonal residents in Apache Junction continues to grow at a rapid pace, a logical question is how much longer the community can rely on the onsite methods to handle wastewater. Indeed, one of the major thrusts of this report is to determine what this "threshold capacity" for septic system utilization is and approximately when, if ever, it will be reached in the Apache Junction service area. As used in this report, "threshold capacity" will indicate the level at which wastewater treatment using septic systems can be permitted without creating a hazard to the public safety, health and general welfare.

SEPTIC SYSTEM FEASIBILITY. The design and installation of a septic system is generally not considered to be an exact science. Rather, the accepted techniques are based on empirical data which has been gathered over a number of years. The main items which have been found to influence septic system feasibility include:

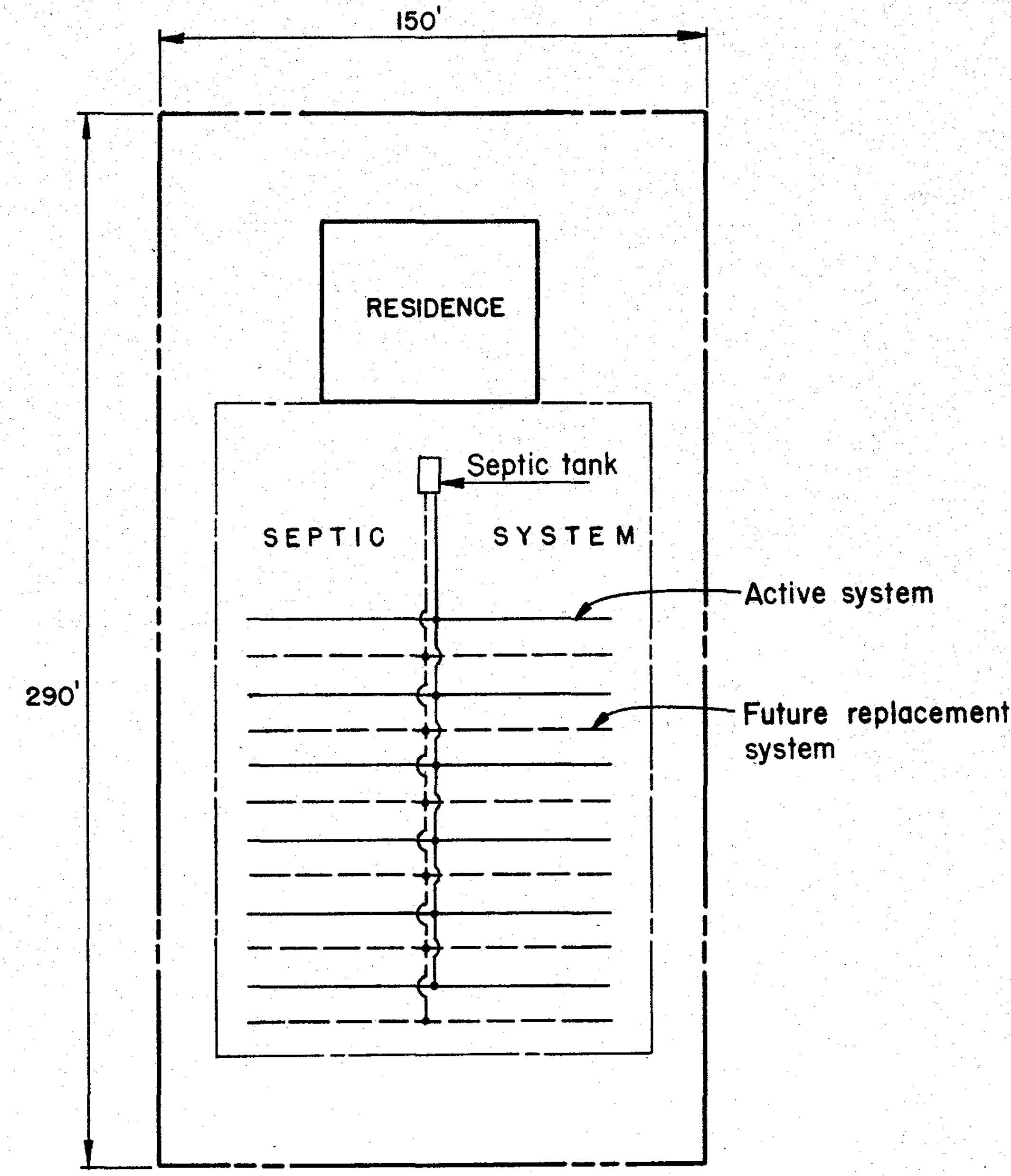
1) The percolation rate, or how fast treated wastewater is absorbed into the soil, which is directly related to the type of soil in a given area.
2) The size of the dwelling to be served, which is usually expressed as the number of contributing bedrooms.
3) Empirical engineering data showing the absorption area per bedroom required for a given percolation rate.
4) Standby or replacement capacity required (if any).
5) The amount and type of maintenance given to the system.

Proper design and installation in a good soil with adequate routine maintenance should insure proper performance of a septic system for at least twenty years. Septic systems which fail early are due more to careless installation with no thought given to maintenance than to any other condition.

CONDITIONS IN APACHE JUNCTION. The characteristics of the major types of soils present in the Apache Junction service area have been summarized previously in Chapter 3. The conclusions drawn in Chapter 3 were that the soil in the southwest portion is basically a sandy loam with moderate permeability, while the soil in the northern and eastern portions is a loam containing a relatively high percentage of gravel, cobbles and clay with a lower permeability. Drilling records from companies operating in Apache Junction bear out the conclusion that the southwest portion of the service area is better suited for septic tank/ disposal systems than the northeast part. As a result, septic tanks with the deep-pit method of disposal can be readily utilized in the southwest part of the area; however, the shallower and more land-intensive leach field method of disposal must be used with septic tanks in the northeast part of the area.

Once the soil type and permeability characteristics are known, the Arizona Department of Health Services Engineering Bulletin No. 12, *Guidelines for Installation of Septic Tank Systems*, can be utilized in the design and layout of a septic tank and disposal system for a given size residence. Figure 4-1 shows how a conventional septic tank and leach field could be designed for a typical single-family residence in the poorer soil area. As mentioned above, the leach field method of disposal is quite land-intensive and, as a result, Figure 4-1 indicates that a lot size of one acre would probably be needed for a single-family septic system in the poorer soil area. When subtractions for street rights-of-way and other open spaces are considered, (which account for approximately 25 percent of the gross land area), a total of 480 one-acre units can be constructed per square mile of gross land area. Using the 2.33 persons per unit from the existing population analysis (Chapter 3) yields an overall population density figure of 1,120 persons per square mile as the threshold level in the poorer soil area.

Determination of a threshold level for development in the better soil area is somewhat more complex, due to the fact that (a) the better soil covers most of the Apache Junction city limit and (b) approximately 90



Lot size = 43,500 sq. ft. ≈ 1 acre
Disposal system consists of 6 trenches, each 100 ft. long x 1 ft. wide x 2 ft. deep.
100% replacement trench capacity required

0 10 25 50 100
SCALE IN FEET

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION ARIZONA

SINGLE FAMILY RESIDENCE
POORER SOIL AREA

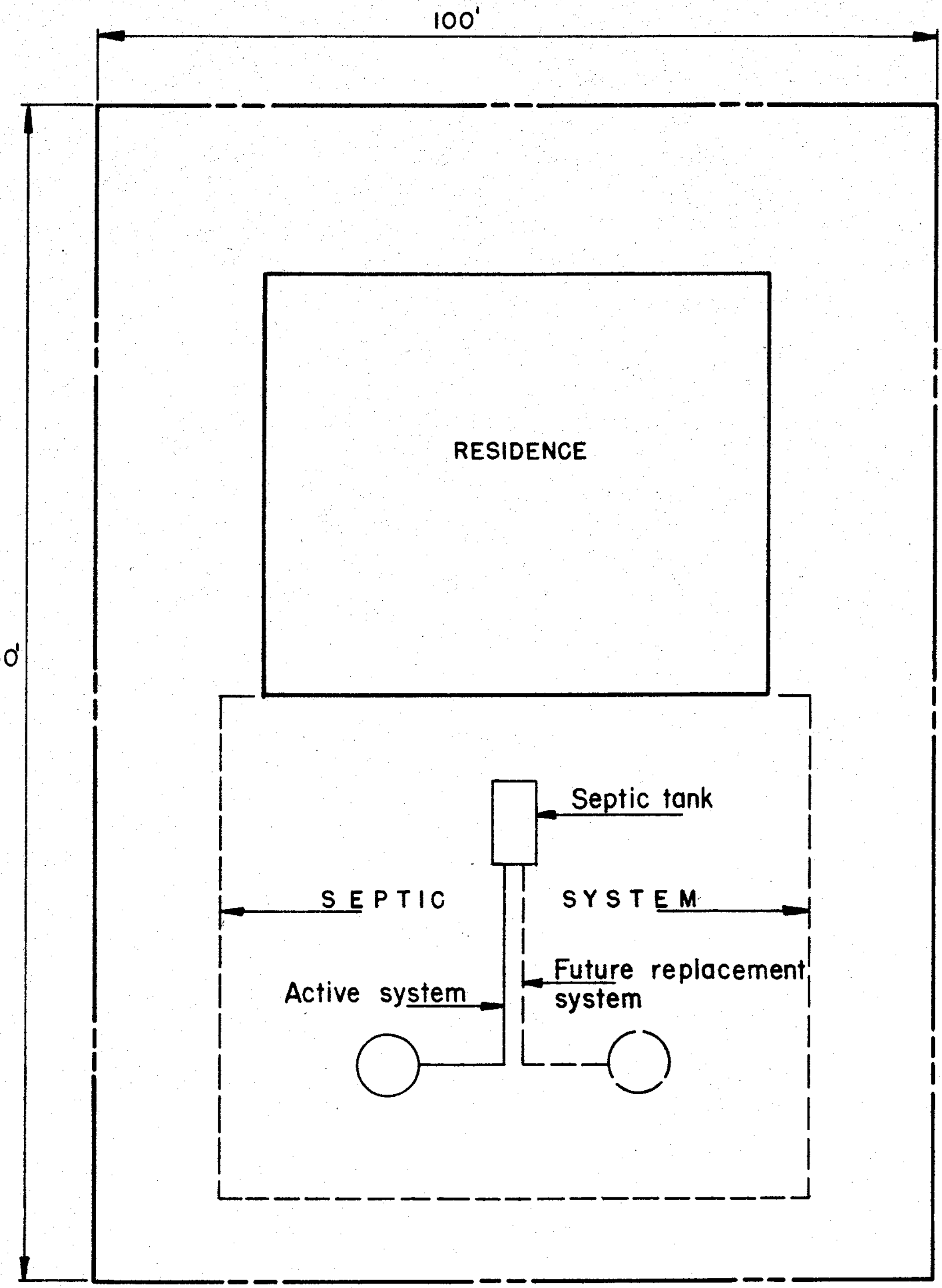
PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 4-1

percent of the mobile home and travel trailer parks (high-density development) are located within the city limits. Figures 4-2 through 4-4 show how a conventional septic tank and disposal pit could be designed for a single-family residence, mobile home unit and travel trailer unit in the better soil area, respectively. These figures indicate that a desirable lot size in the better soil area is on the order of 14,000 square feet for a single-family residence, 6,000 square feet per unit in a mobile home park, and 3,000 square feet per unit in a travel trailer park. It must be kept in mind that these are very conservative figures and attempt to account for the varieties in sizes of dwellings for a given category. For example, a single-family residence on the smaller end of the scale would most likely require something less than the 14,000 square foot lot identified above. Along the same lines, in the larger travel trailer parks, three or four units are often connected to the same system, rather than each unit having its own individual system.

Presently in Apache Junction, there are three major types of residential land uses: single family homes; mobile home and travel trailer parks; and a mixed use of single family homes, mobile homes, and travel trailers. Currently, mobile homes and travel trailers in parks or mixed use areas account for in excess of 70 percent of the total number of residences in the city. The true residential-type subdivisions in the city number only five: Apache Villa, Palm Springs, Sierra Entrada, Superstition Estates, and Superstition Villa. There are some older subdivisions, such as San Marcos, which began as the true residential-type, but over time they have evolved into the mixed use type described above.

The city planning staff perceives that long-range development will occur as a more even distribution of types of residences than exists at present. This will be at least somewhat of a natural occurrence as the Phoenix metropolitan area continues to grow eastward, thereby attracting more year-round residents to Apache Junction. For purposes of this report, it will be assumed that over the long term, development will evolve into a ratio of 60 percent single-family, 20 percent mobile home, and 20 percent travel trailer. Utilizing the individual lot sizes for septic systems identified above, the average lot size in the better soil area becomes 10,200 square feet, as follows:



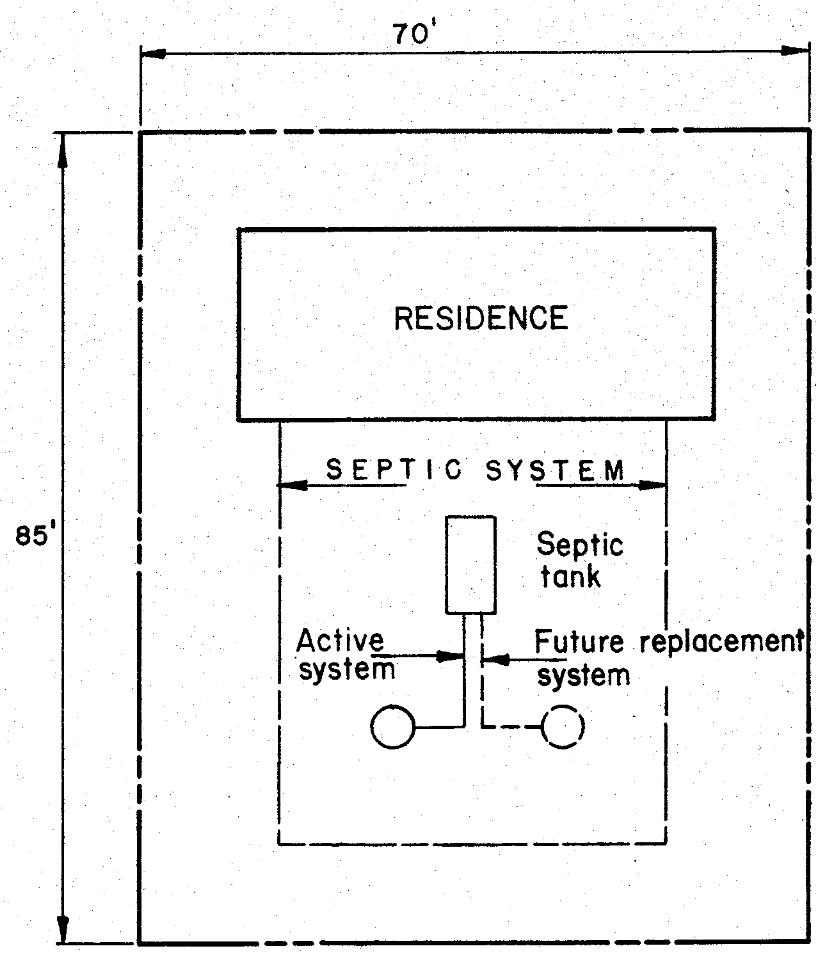
Lot size = 14,000 sq. ft. ≈ 1/3 acre
Disposal system consists of 1 pit:
6 ft. diameter x 50 ft. deep.
100 % replacement pit capacity required

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

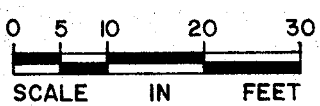
SINGLE FAMILY RESIDENCE BETTER SOIL AREA

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 4-2



Lot size = 5950 sq. ft.
Disposal system consists of 1 pit, 4 ft. diameter x 50 ft. deep.
100% replacement pit capacity required.

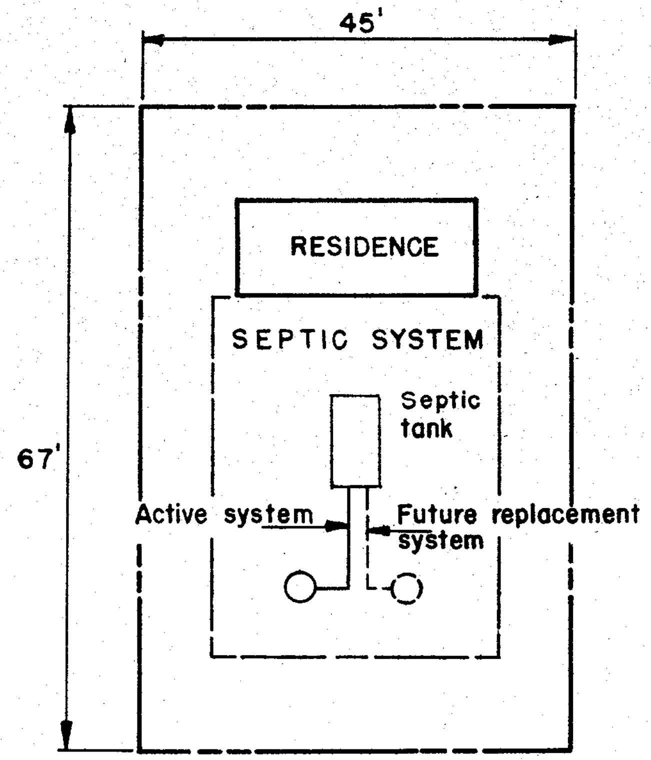


SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

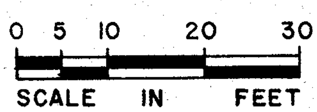
MOBILE HOME RESIDENCE BETTER SOIL AREA

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 4-3



Lot size = 3,015 sq. ft.
Disposal system = 1 pit, 2 ft. diameter x 75 ft. deep.
100% replacement pit capacity required.



SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

TRAVEL TRAILER RESIDENCE
BETTER SOIL AREA

PRC TOUPS
4131 N 24 ST., PHX., AZ.

FIGURE NO. 4-4

0.6 x 14,000 = 8,400
0.2 x 6,000 = 1,200
0.2 x 3,000 = 600
AVERAGE = 10,200 square feet

When subtractions for street rights-of-way and other open spaces are included, (which account for approximately 35 percent of the gross land area), a total of 1,760 lots of 10,200 square feet can be constructed per square mile of gross land area. Using the 2.33 persons per unit figure from the existing population analysis in Chapter 3 yields an overall population density of 4,100 persons per square mile as the threshold level in the better soil area.

IMPACT OF "NO ACTION".

A "no action" plan is normally developed to establish a suitable "control" against which other alternatives may be compared and evaluated. It is felt that pursuit of a "no action" philosophy by the City of Apache Junction would result in a number of highly undesirable impacts, the most significant of which would be: 1) allowing population growth to continue at a more or less uncontrolled rate; 2) opening the door for a haphazard mixture of mobile homes, travel trailers, and single-family residences in the developing areas; 3) leaving provision for wastewater management up to the whim of the individual builder or developer; and 4) allocating review of wastewater management plans to an already over-burdened Pinal County Health Department staff. The end result would undoubtedly be the continued proliferation of individual onsite septic systems, with little or no thought given to alternative methods of wastewater collection and treatment for the more densely populated areas.

The preceeding section of this chapter identified threshold levels of development using the septic system method for wastewater management to be 1,120 persons per square mile in the poorer soil area and 4,100 persons per square mile in the better soil area. For comparison, earlier in the chapter, Table 4-2 showed the population density in the outlying service area rising from a level of 104 persons per square mile in 1980 to 236 persons per square mile in year 2000. Over the same period of time, the population density within the Apache Junction city limits is expected to rise from 2,049 to 4,617 persons per square mile. It becomes apparent that the population density in the outlying service area remains low enough through year 2000 to continue to successfully utilize onsite methods for wastewater management. Within the city limits, on the other hand, unless major areas are annexed, the population density will surpass even the threshold limit in the better soil area in about the year 1996.

Thus, it appears that individual septic systems cannot be utilized indefinitely in the Apache Junction service area and that consideration should be given to having available an alternative wastewater collection and treatment system in the middle 1990's. In addition, existing high-density areas which may already be exceeding the above limits need to be restricted to avoid developing into localized trouble spots. The remaining chapters of this report will develop and evaluate different plans for effectively meeting Apache Junction's wastewater needs through the year 2000 and will culminate in a recommendation of the best alternative plan.

CHAPTER 5

DEVELOPMENT OF ALTERNATIVES

INTRODUCTION.

Based on the analysis of "threshold capacity" completed in Chapter 4, three major alternatives will be developed in this chapter for management of Apache Junction's wastewater through the year 2000. These alternatives are:

1) Continued use of individual on-site systems for treatment and disposal of the majority of the wastewater in the total service area.

2) Continued use of individual on-site systems in the low-density outlying service area; provision for gravity sewer collection of wastewater from within the high-density city limits, with treatment at a facility in the Apache Junction service area.

3) Continued use of individual on-site systems in the low-density outlying service area; provision for gravity sewer collection of wastewater from within the high-density city limits, with treatment at a facility in eastern Mesa.

Before these three alternatives can be developed in detail, a discussion of the applicable regulations and design criteria with respect to wastewater management is necessary.

APPLICABLE REGULATIONS AND DESIGN CRITERIA.

The bulk of wastewater management regulations is promulgated at three levels of government: federal, state and county. Wastewater management alternatives specific to Apache Junction come under the jurisdiction of the United States Environmental Protection Agency (EPA), the State of Arizona Department of Health Services (ADHS), and the Pinal County Health Department. In recent years, both the EPA and the county health department have turned much of their regulatory function over to the state, such that two state engineering bulletins can now be utilized in the planning and design of wastewater management systems: Engineering Bulletin No. 11, *Minimum Requirements for Design, Submission of Plans and Specifications of Sewage Works;* and, Engineering Bulletin No. 12, *Guidelines for Installation of Septic Tank Systems.* Using these two bulletins as a guide, basic design criteria were developed specific to this project for septic systems, interceptor sewers, wastewater treatment plants, and wastewater reuse systems, and are presented in Table 5-1.

DESCRIPTION OF ALTERNATIVE 1.

GENERAL. The first alternative involves continued use of individual on-site systems for treatment and disposal of the majority of the wastewater in the total service area. Although the most widely used method of individual treatment is the septic tank with an absorption bed, other options are available, including mound systems, aerobic treatment, and evapotranspiration systems. Simplified diagrams for these processes are presented in Figures 5-1 through 5-4. These options have seen limited use in Arizona to date; however, the technology level has now increased to the point where their use will undoubtedly become more widespread. A brief description of these available individual systems is presented henceforth.

SEPTIC TANK WITH ABSORPTION BED.

Description. A septic tank connected to a soil absorption bed (seepage pit or leach field) is the traditional on-site system for the treatment and disposal of domestic wastewater from individual households or establishments. The system consists of a buried tank where wastewater is collected and scum, grease, and settleable solids are removed by gravity separation, and a sub-surface drainage system where clarified effluent percolates into the soil. Precast concrete tanks with a capacity of 1,000 gallons are commonly used for household systems. Solids are collected and stored in the tank, forming sludge and scum layers. Anaerobic digestion occurs in these layers, reducing the overall volume. Effluent is discharged from the tank to one of two basic types of subsurface systems: absorption trenches (leach field) or seepage pits. Sizes are usually determined by percolation rates, soil characteristics, and site size and location.

TABLE 5-1

WASTEWATER SYSTEM DESIGN CRITERIA

ITEM	DESIGN VALUE
SEPTIC SYSTEMS	
Septic Tank Capacity, gal.	
1-3 bedrooms	960
4 bedrooms	1,200
5 bedrooms	1,500
6 bedrooms	1,800
Setback Requirements, ft.	
Buildings	10
Property Lines	5
Water lines	10
INTERCEPTOR SEWERS	
Peak flow determination, Q_{max}, in terms of average flow, Q_{ave}, and population in thousands, P	$\frac{Q_{max}}{Q_{ave}} = \frac{5}{P^{0.167}}$
Acceptable slope for gravity flow, ft./100 ft. (minimum 2.0 fps velocity)	0.56
WASTEWATER TREATMENT PLANTS	
Preliminary Treatment	
Screenings from Bar Rack and Grinder, cu.ft./mgd	2
Grit from Grit Chamber, cu.ft./mgd	4
Primary Sedimentation	
Overflow rate, gpd/sq. ft.	800
Surface area, sq. ft./mgd	1,250
Activated Sludge	
Organic load, lb. BOD/1,000 cu.ft./day	40
Detention time, hours	6
Volume, cu. ft./mgd	33,400
Extended Aeration (Oxidation Ditch)	
Organic load, lb. BOD/1,000 cu.ft./day	25
Detention time, hours	24
Volume, cu. ft./mgd	133,400

TABLE 5-1 (cont'd)

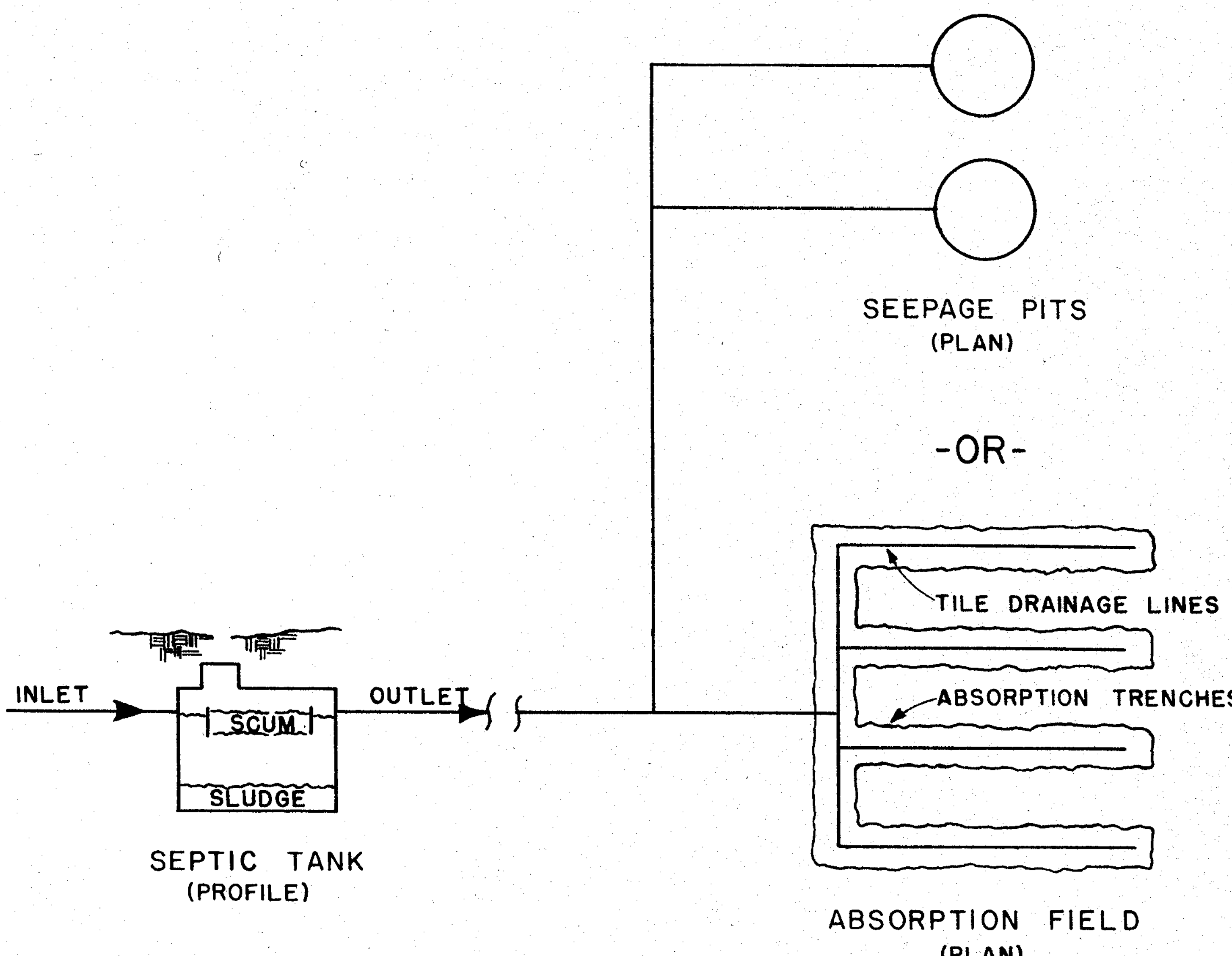
WASTEWATER SYSTEM DESIGN CRITERIA

ITEM	DESIGN VALUE
Secondary Sedimentation	
Overflow rate, gpd/sq. ft.	600
Surface area, sq. ft/mgd	1,670
Filtration	
Flow rate, gpm/sq. ft.	4
Surface area, sq. ft./mgd	175
Disinfection	
Chlorine dose, mg/l	10
Chlorine load, lb./mgd	83
Detention time, minutes	30
Volume, cu.ft./mgd	2,800
Anaerobic Digestion	
Solids load, lb. VS/cu. ft./day	0.08
Detention time, days	30
Volume, cu. ft./mgd	12,200
Heat Treatment	
Heat reactor detention time, minutes	30
Heat reactor volume, cu. ft./mgd	10
Dewatering	
Operating time, hours/day	12
Solids load, lb./sq. ft./mgd	10
Surface area, sq. ft./mgd	12
Aerobic Digestion	
Solids load, lb. VS/cu.ft./day	0.05
Detention time, days	18
Volume, cu. ft./mgd	20,000
Solar Drying	
Solids load, lb./sq. ft./year	10
Surface area, sq. ft./mgd	1,670
WASTEWATER REUSE SYSTEMS	
Storage Ponds	
Winter storage duration, months	2
Pond depth, feet	10
Surface area, acres/mgd	19

TABLE 5-1 (cont'd)

WASTEWATER SYSTEM DESIGN CRITERIA

ITEM	DESIGN VALUE
Slow Rate (Crop Irrigation) System	
Application rate, ft./year	6
Surface area, acres/mgd	190
High Rate (Rapid Infiltration) System	
Application rate, ft./year	60
Surface area, acres/mgd	19



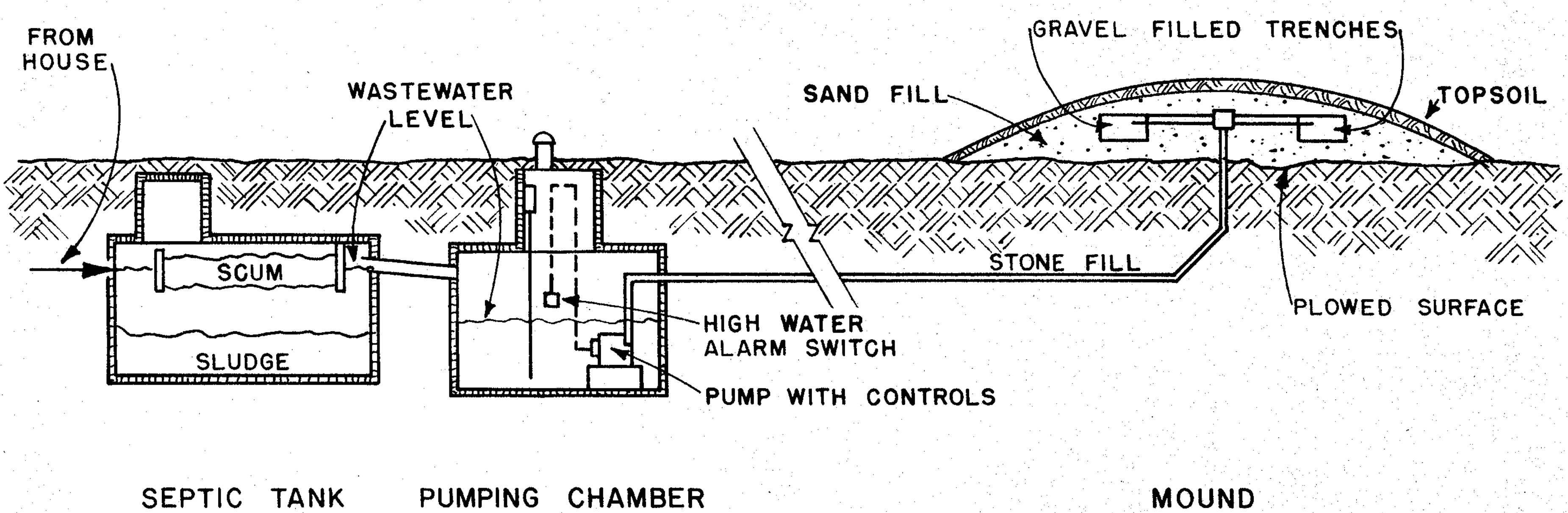
SIMPLIFIED DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

SEPTIC TANK WITH ABSORPTION BED

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 5-1



(PROFILE)

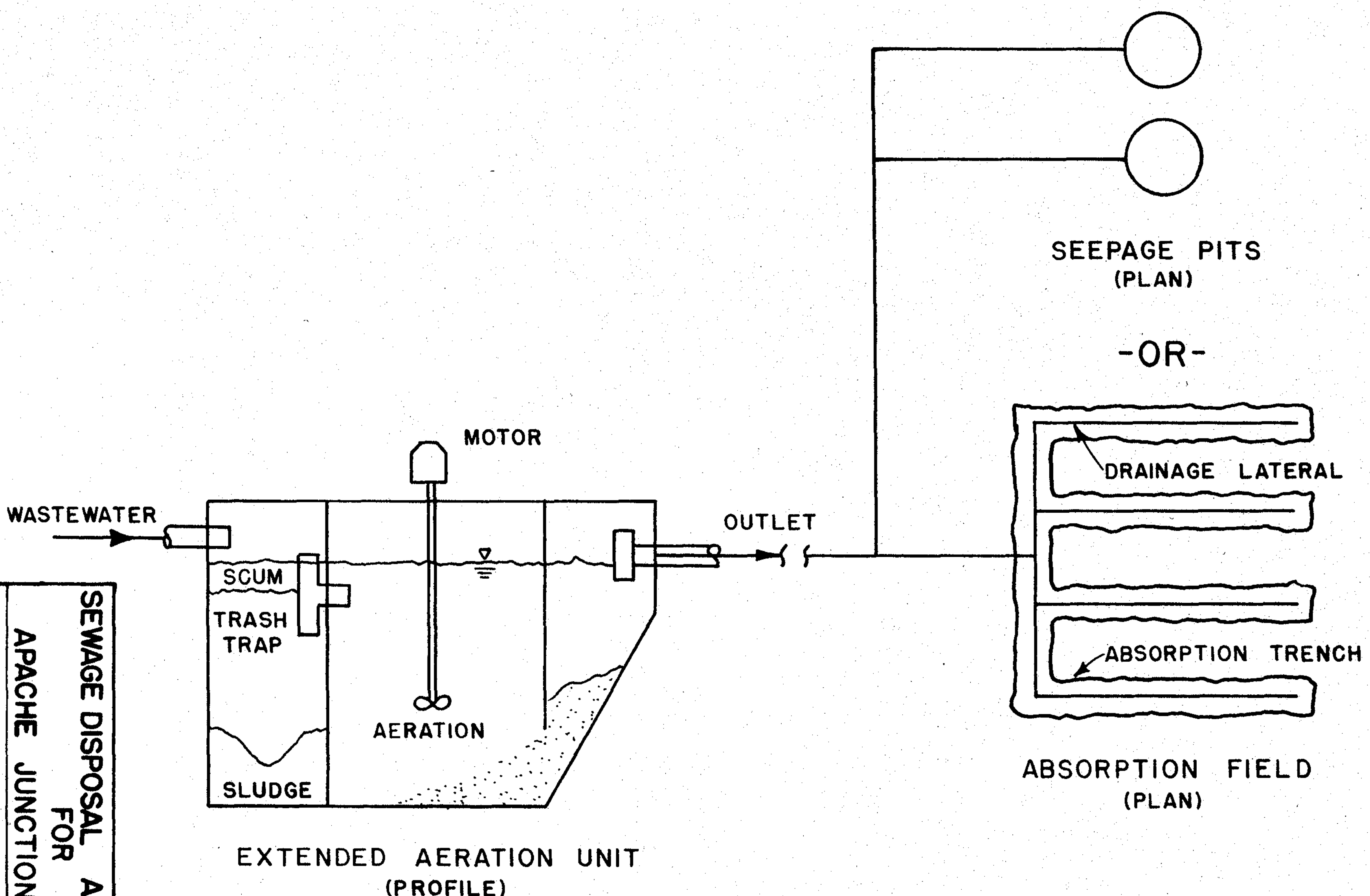
SIMPLIFIED DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

SEPTIC TANK MOUND SYSTEM

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 5-2



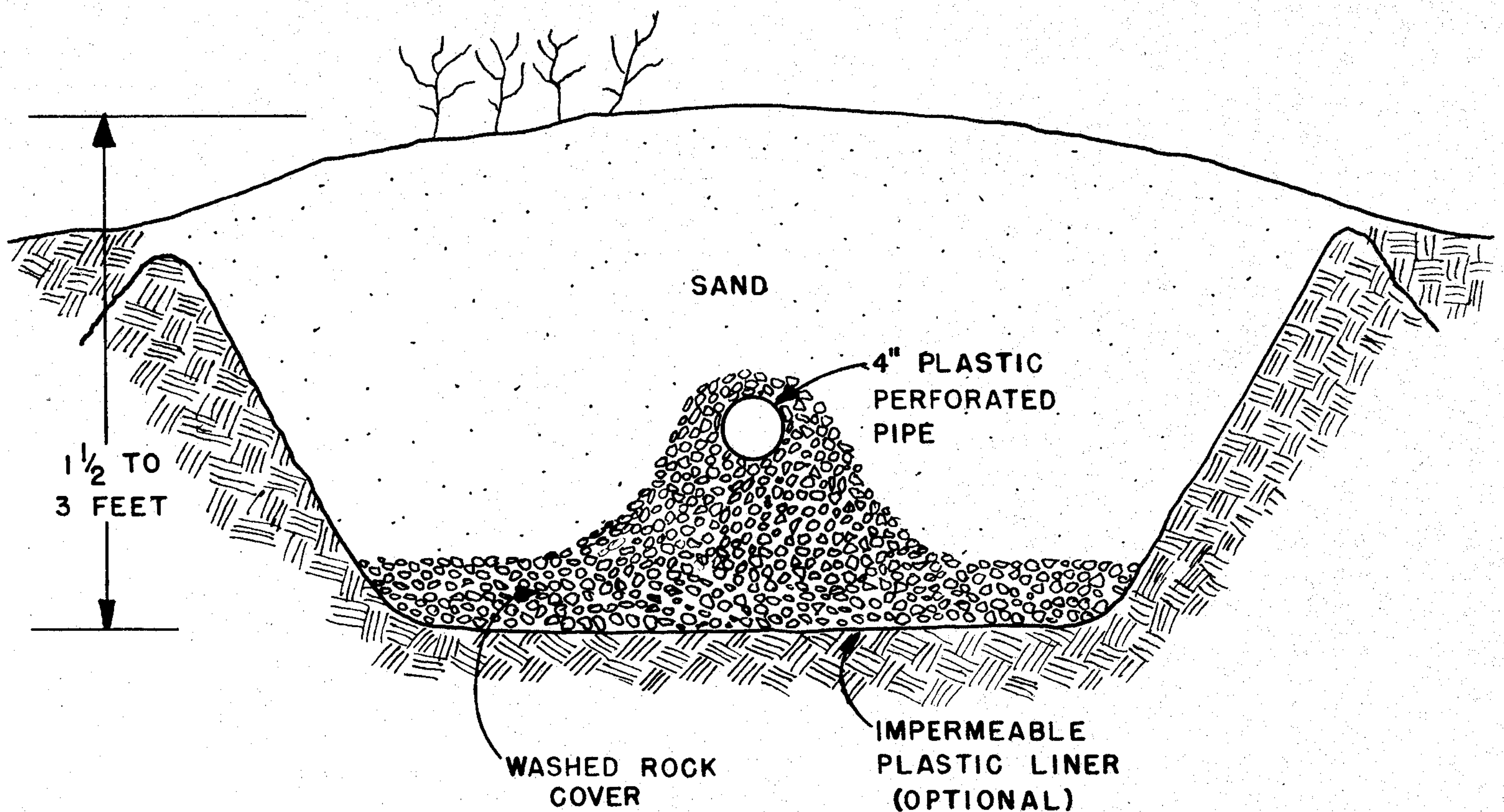
SIMPLIFIED DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

AEROBIC TREATMENT WITH ABSORPTION BED

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 5-3



EVAPOTRANSPIRATION BED
(PROFILE)

SIMPLIFIED DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

EVAPOTRANSPIRATION SYSTEM

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 5-4

Technology Status. Septic tank-soil absorption systems are the most widely used method of on-site domestic waste disposal. Almost one-third of the United States population depends on such systems.

Limitations. Septic systems are dependent on soil and site conditions, the ability of the soil to absorb liquid, depth to groundwater, nature of and depth to bedrock, seasonal flooding, and distance to well or surface water. A percolation rate of one inch per hour is often used as the lower limit or minimum of permeability. The limiting value for seasonal high groundwater should be two feet below the bottom of the drainfield. When a soil system loses its capacity to absorb septic tank effluent, (from overloading or poor maintenance), there is a potential for effluent surfacing, which often results in odors and, possibly, health hazards.

Residuals Generated. The sludge and scum layers accumulated in a septic tank must be removed every three to five years.

Process Reliability. Properly designed, constructed, and operated septic tank systems have demonstrated an efficient and economical alternative to public sewer systems, particularly in rural and sparsely developed areas. System life for properly sited, designed, installed and maintained systems may equal or exceed twenty years.

Environmental Impact. Leachate can contaminate groundwaters when pollutants are not effectively removed by the soil system. In many well aerated soils, significant densities of homes with septic tank-soil absorption systems have resulted in increasing nitrate content of the groundwater. Soil clogging may result in surface ponding with potential aesthetic and public health problems.

SEPTIC TANK MOUND SYSTEMS.

Description. A septic tank and mound system is a method of on-site treatment and disposal of domestic wastewater that can be used as an alternative to the conventional septic tank-soil absorption system. In areas where problem soil conditions preclude the use of subsurface trenches or seepage beds, mounds can be installed to raise the absorption field above ground, provide treatment and distribute the wastewater to the underlying soil over a wide area in a uniform manner.

The three main elements of the system are the septic tank, dosing chamber, and the mound. The relative dimensions and location of the septic tank, the type of control structures, the size and loading of inspection ports, and the materials of construction are dictated by state and local codes. A pressure distribution network should be used for uniform application of clarified tank effluent to the mound. A subsurface chamber can be installed with a pump and high water alarm to dose the mound through a series of perforated pipes. Where sufficient pressure is available, a dosing siphon may be used.

The design of a mound is based on the expected daily wastewater volume it will receive and the natural soil characteristics. As with the conventional subsurface disposal system, pollutants are removed by natural absorption and biological processes in the soil zone adjacent to the seepage bed. The mound must provide an adequate amount of unsaturated soil and spread septic tank effluent over a wide enough area so that distribution and purification can be effected before the water table is reached.

Technology Status. Septic tank mound systems have proven to be successful alternatives for difficult soil conditions. They have been in use for more than twenty years in various forms and for nearly ten years with the design described herein.

Limitations. A mound system requires more space and periodic maintenance than a conventional subsurface disposal system, along with higher construction costs. The system cannot be installed on steep slopes, nor over highly (1/2 inch per hour) impermeable subsurface. Seasonal high groundwater must be deeper than two feet to prevent surfacing at the edge of the mound. Pumping is usually required to distribute tank effluent throughout the mound, necessitating operation and maintenance requirements.

Residuals Generated. A septage volume equal to the septic tank capacity is generated every three to five years, requiring treatment and disposal.

Process Reliability. Septic tank-mound systems that are properly designed and constructed are viable alternatives to centralized treatment facilities. Dosing equipment should be routinely maintained, and septic tanks must be periodically pumped out for systems to operate effectively. Long term service life data is not available as yet, but projections suggest mound life to be about the same as that of a properly designed soil absorption system.

Environmental Impact. Visual impact can raise major aesthetic issues, particularly in suburban areas, due to the shape, size and proximity of mound systems. Drainage patterns and land use flexibility may also be affected.

AEROBIC TREATMENT WITH ABSORPTION BED.

Description. An aerobic treatment unit followed by a soil absorption bed is an on-site system for the treatment and disposal of domestic wastewater. Various aerobic suspended and fixed growth processes are available alternatives to the conventional septic tank. The activated sludge process employs high concentrations of microorganisms under aerobic conditions in a batch or flow-through, extended aeration operation. Forced air diffusion or mechanical aeration is followed by clarification, whereby the biomass is separated from the treated wastewater. A portion of the separated biomass is recycled back to the aeration chamber in the flow-through mode. Fixed film treatment processes employ a large surface area upon which microorganisms grow and over which wastewater is distributed so that the biomass may contact and metabolize pollutants within the waste stream. Aeration may be provided by natural convection, mechanical aeration, or forced air ventilation. A solid-liquid separation step normally follows, along with recycling of treated wastewater back to the fixed media. Examples of fixed film systems include the packed tower, rotating contactor, and submerged media system. Treated effluent can then be discharged to a soil absorption field for disposal.

Technology Status. Aerobic units are used extensively in package plants for institutional and commercial on-site treatment, but their share of the individual home treatment market is quite small.

Limitations. On-site aerobic processes potentially produce a higher degree of treatment than septic tanks, but periodic carryover of solids due to sludge bulking, toxic chemical addition, or excessive sludge buildup can result in substantial variability in effluent quality. Regular, semi-skilled operation and maintenance is required to ensure proper functioning of moderately complex equipment, and inspections every two months are recommended. Power is required to operate aeration equipment and pumps. Absorption beds are dependent upon site and soil conditions, and are generally limited to sites with percolation rates greater than one inch per hour, depth to water table or bedrock of at least two to four feet, and level or slightly sloping topography.

Residuals Generated. Excess sludge containing organics, grease, hair, grit, and pathogens must be removed from aerobic units and disposed of every eight to twelve months.

Process Reliability. Aerobic processes are sensitive to microbial upsets and effluent quality is dependent upon supervised operation. Proper design and maintenance of mechanical equipment is necessary for effective treatment.

Environmental Impact. Sludge is generated, requiring approved treatment and disposal. Effluent can contaminate groundwaters when pollutants are not effectively removed by the aerobic unit or the soil system. Aeration equipment can be noisy. Poorly maintained units may produce odors.

EVAPOTRANSPIRATION SYSTEMS.

Description. Evapotranspiration (ET) is a means of on-site wastewater disposal that may be utilized in some localities where site conditions preclude soil absorption. Evaporation of moisture from the soil surface and/or transpiration by plants is the mechanism of ultimate disposal. Thus, in areas where the annual evaporation rate equals or exceeds the rate of annual added moisture from rainfall and wastewater applications, ET systems can provide a means of liquid disposal without danger of surface or groundwater contamination.

If evaporation is to be continuous, three conditions must be met. First, there must be a continuous supply of heat to meet the latent heat requirement (approximately 590 calories per gram of water evaporated at 15° C). Second, a vapor pressure gradient must exist between the evaporative surface and the atmosphere to remove vapor by diffusion, convection, or both. Meteorological factors, such as air temperature, humidity, wind velocity and radiation influence both energy supply and vapor removal. Third, there must be a continuous supply of water to the evaporative surface. The soil material must be fine textured enough to draw up the water from the saturated zone to the surface by capillary action but not so fine as to restrict the rate of flow to the surface. Evapotranspiration is also influenced by vegetation on the disposal field and can theoretically remove significant volumes of effluent in late spring, summer and early fall, particularly if large silhouette, good transpiring bushes and trees are present.

A typical ET bed system consists of a one and one-half to three foot depth of selected sand over an impermeable plastic liner. A perforated plastic piping system with rock cover is often used to distribute pretreated effluent in the bed. The bed may be square shaped on relatively flat land, or a series of trenches on slopes. The surface area of the bed must be large enough for sufficient ET to occur to prevent the water level in the bed from rising to the surface.

Beds are preceded by septic tanks or aerobic units to provide the necessary pretreatment.

Technology Status. There are estimated to be 4,000 to 5,000 year-round evapotranspiration beds in operation in the United States, particularly in the semi-arid regions of the Southwest.

Limitations. The use of an evapotranspiration system is limited by climate and its effect on the local ET rate. In practice, lined ET bed systems are generally limited to areas of the country where pan evaporation exceeds annual rainfall by at least 24 inches. The decrease of ET in winter at middle and high latitudes greatly limits its use. Snow cover reflects solar radiation, which reduces ET. In addition, when temperatures are below freezing more heat is required to change frozen water to vapor. When vegetation is dormant, both transpiration and evaporation are reduced. An ET system requires a large amount of land in most areas. Salt accumulation may eventually eliminate vegetation and thus, transpiration. Bed liner (where needed) must be kept water-tight to prevent the possibility of groundwater contamination. Therefore, proper construction methods should be employed to keep the liner from being punctured during installation.

Residuals Generated. The sludge and scum layers accumulated in the septic tank must be removed every three to five years.

Process Reliability. An ET system that has been properly designed and constructed is an efficient method for the disposal of pretreated wastewater and requires a minimum of maintenance.

Environmental Impact. Healthy vegetative covers are aesthetically pleasing. Large land requirement conserves open space, but limits use of land.

SUMMARY. Implementation of Alternative 1 is basically the provision for the "no action" plan mentioned at the end of Chapter 4. Individual homes and businesses in the entire Apache Junction service area would continue to utilize onsite techniques as the primary method of wastewater treatment. In good soil areas, septic tank effluent would flow to seepage pits for ultimate disposal. In poorer soil areas, leach fields or mound systems could be utilized. Evapotranspiration systems following septic tanks might find use on unusually large lots in the better soil areas. Institutional and commercial establishments could investigate use of aerobic treatment with an absorption bed, as is currently in use at the Superstition Inn (Chapter 3).

An evaluation of cost-effectiveness and other important factors for this alternative as compared with Alternatives 2 and 3 will be carried out in the following chapter.

DESCRIPTION OF ALTERNATIVE 2.

GENERAL. The population data presented in Chapter 4 showed a distinct difference in population density between that area within the city limits and the outlying service area. By the year 2000, population density in the city will have reached 4,617 persons per square mile, a figure comparable to that in other larger Phoenix area cities. At the same time, the population density in the outlying service area will be only 236 persons per square mile. Alternative 2 recognizes this distinction and allows for continued use of individual on-site systems in the low-density outlying service area, but provides for gravity sewer collection of wastewater from within the high-density city limits, with treatment at a facility in the Apache Junction service area.

Individual treatment/disposal methods which could be utilized under this alternative in the outlying service area include septic tank with absorption bed, septic tank mound system, aerobic treatment with absorption bed, and evapotranspiration system. Since these methods were presented previously for Alternative 1, the discussion will not be repeated here.

A discussion of the gravity sewer system and the type of wastewater treatment plant (WWTP) which could be utilized by that area within the city limits is presented in the following paragraphs.

GRAVITY SEWER SYSTEM. The year 2000 population density within the Apache Junction city limits is great enough to permit utilization of a conventional gravity-flow sanitary sewer system*. In such a system, use is made of the natural slope of the land to provide for transport of wastewater from individual homes and businesses to a central treatment facility. The several types of sewers commonly used in a gravity system are defined as follows:

- Building Sewer - The extension from the building drain to the lateral sewer in the street or alley; usually limited to the property owner's lot line.
- Lateral Sewer - A sewer that discharges into a submain sewer and has no other common sewer tributary to it.
- Submain Sewer - A sewer into which the wastewater from two or more lateral sewers is discharged and which subsequently discharges into a main, a trunk, or other collector.
- Main Sewer - In larger systems, the principal sewer to which submains are tributary; also called trunk sewer.
- Interceptor Sewer - A large sewer that receives dry weather flow from a number of transverse sewers or outlets and conducts such waters to a point for treatment or disposal.

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*The more innovative types of sewer systems, such as pressure sewers and vacuum sewers, will not be addressed here as they are normally applicable in only low population density areas which are attempting to connect into an existing treatment system.

According to ADHS standards, sewers should be sized on the basis of a peak flow contribution determined by the formula:

$$\frac{Qmax}{Qave} = \frac{5}{P^{0.167}}$$

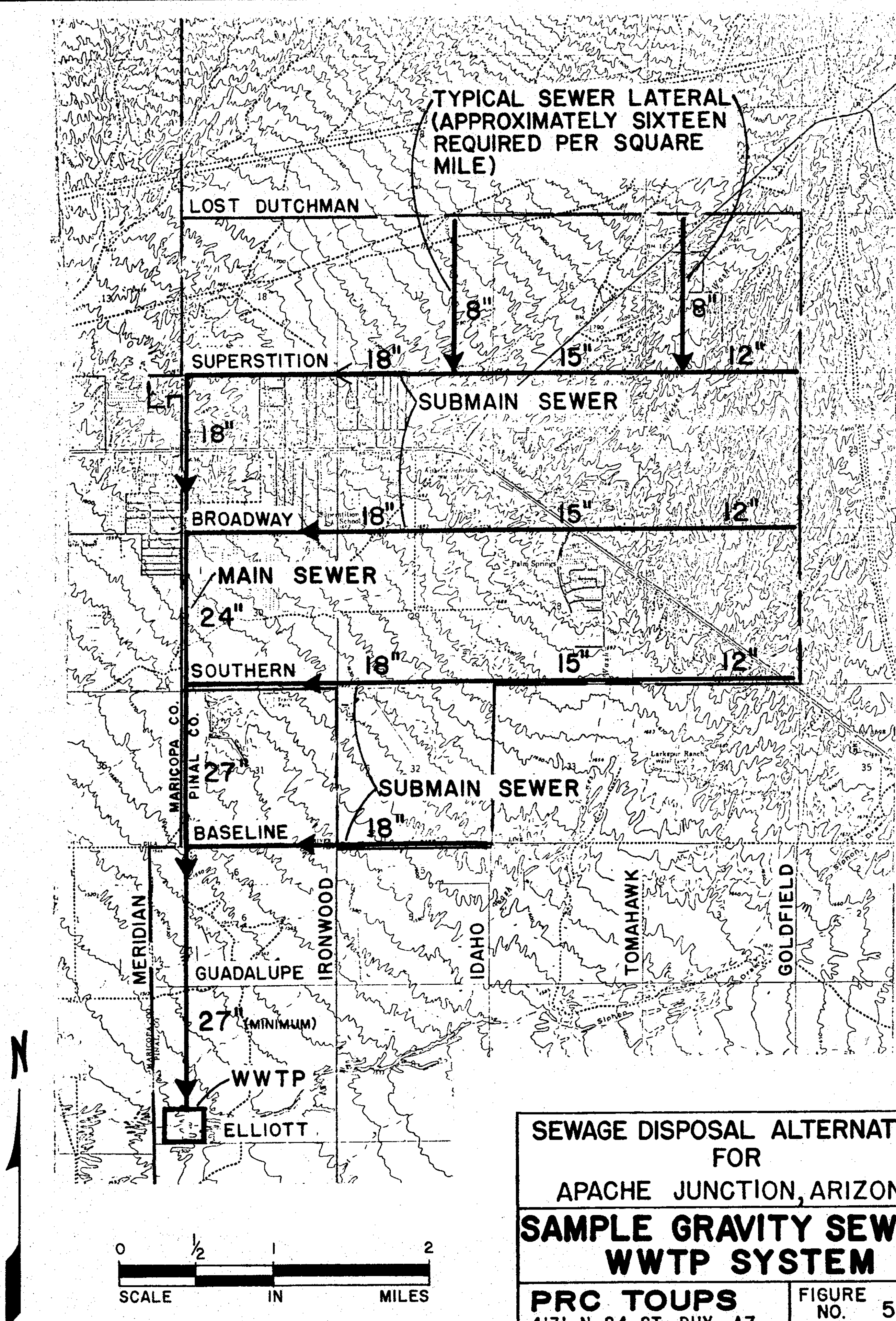
where Q represents flow and P represents population in thousands.

Although there are a number of different methods available for computing peak sewage flow, this method has received widespread use for a number of years. Use of this formula results in a smaller peaking factor as the contributing population increases. For example, a community with a population of only 2,000 would have a peaking factor of about 4.5, whereas a city of 50,000 people would have a 2.6 factor. A peaking factor of 2.0, which indicates a doubling of the average flow, would not occur until the city's population had grown to about 240,000 persons.

Except for the foothills of the Goldfield and Superstition Mountains, the land in the Apache Junction area slopes generally at about 30 feet per mile downward to the southwest. Gravity sewers can, therefore, be laid at a slope of approximately 0.56 foot per 100 feet of pipe. This slope is adequate to insure a velocity of at least two feet per second in pipe eight inches in diameter and larger when flowing at least half full, as shown in the following table.

PIPE DIAMETER (inches)	MINIMUM SLOPE (ft./100 ft.)	PIPE DIAMETER (inches)	MINIMUM SLOPE (ft./100 ft.)
8	.4	18	.12
12	.22	24	.09
15	.15	27 & larger	.08

Figure 5-5 shows how a gravity sewer system could be laid out to serve the area within the Apache Junction city limits and convey the wastewater flow to a WWTP situated at the lower end (the southwest corner) of the system, near the intersection of Elliot and Meridian Roads. It is assumed that the lateral sewers would be a minimum of 8 inches in diameter. The submain sewers would progress in size from 12 inches to 18



SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

SAMPLE GRAVITY SEWER/ WWTP SYSTEM

PRC TOUPS
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FIGURE NO. 5-5

inches in diameter while the main sewer would gradually expand from 18 inches to 27 inches in diameter. The pipe sizing is based on conveying sanitary sewage only; collection and conveyance of stormwater is not considered in the analysis. Also, the sizing is a direct function of the population density within the city limits. For the sewer system to operate properly, the city must decide on a maximum allowable population density. If this density is exceeded, either larger or parallel pipes would be required.

It should be emphasized that other layouts for the sewer system and treatment plant are possible; the layout shown is simply one method of effectively conveying the wastewater while attempting to utilize a minimum amount of pipe. The WWTP was shown near the intersection of Elliot and Meridian Roads simply to keep it within the total service area for purposes of this analysis. Another option which should be pursued in more detail at the EPA 201 Facility Plan level would be to locate the WWTP much further to the south, perhaps as much as ten miles. At this location, the plant would be able to serve a much larger area on a gravity-flow basis, including not only the present Apache Junction service area, but also existing portions of eastern Maricopa County plus new development which might take place south of the present service area.

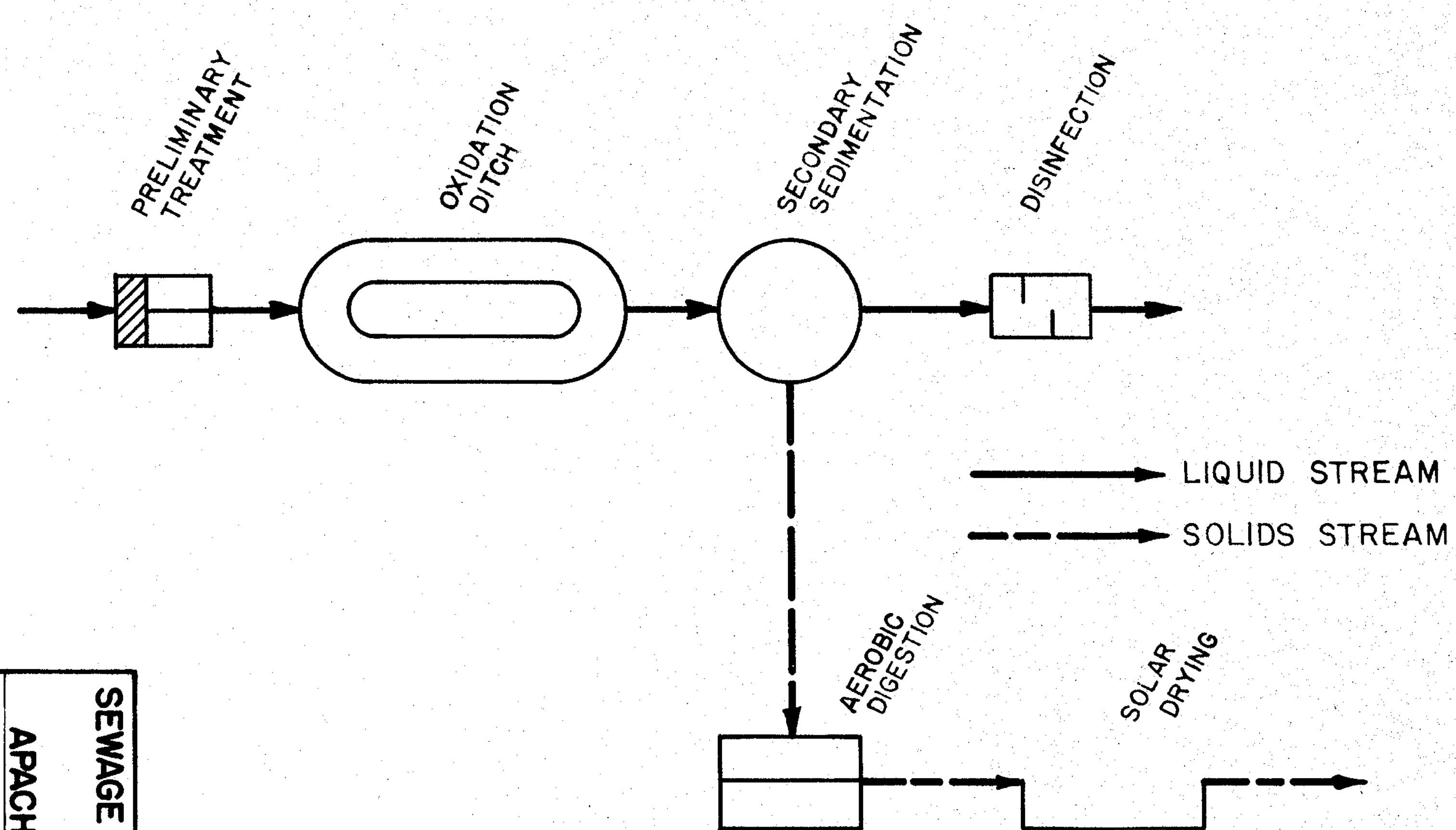
WASTEWATER TREATMENT PLANT. Table 4-4 showed that year 2000 wastewater parameters from within the city limits will be a flow of 5.42 mgd, a BOD load of 12,030 lb/day (266 mg/l), and an SS load of 15,040 lb/day (333 mg/l). Discussions with the Arizona Department of Health Services have led to the conclusion that, on a preliminary basis, a WWTP in Apache Junction should be designed to provide a minimum of secondary treatment plus disinfection. The ADHS is currently reviewing its regulations regarding levels of treatment required for wastewater reuse; however, until these revisions have been promulgated in final form, the department advised that a secondary plus disinfection level of treatment would put the WWTP on the "safe" side for either wastewater reuse or discharge. In numerical terms, this means that both BOD and SS loads would have to be reduced to 1,360 lb/day (30 mg/l, or about 90 percent removal), plus the disinfected effluent could contain no more than 200 MPN/100 ml of fecal coliform bacteria.

With this in mind, the following processes were investigated as possible treatment options for the Apache Junction WWTP:

- Stabilization Ponds
- Aerated Lagoons
- Conventional Activated Sludge
- Oxidation Ditch

Stabilization ponds and aerated lagoons were eliminated early in the analysis due to a) the large land area required to treat 5.4 mgd of average daily flow; b) the inability to consistently meet the effluent standards associated with secondary treatment; and c) the generally negative aesthetics associated with these types of treatment processes. On the other hand, either conventional activated sludge or the oxidation ditch would be capable of providing the necessary level of treatment without using an excessive quantity of land. For the purpose of this report, the oxidation ditch process was selected for further analysis because its costs are often slightly less than conventional activated sludge, it is generally more reliable than conventional activated sludge, and it provides for a relatively simple system which is easily operated and maintained.

Processes which would be needed in a complete oxidation ditch WWTP include preliminary treatment, oxidation ditch, secondary sedimentation, disinfection, aerobic digestion, and solar drying. Of these processes, the first four are associated with treatment of the liquid stream, while the last two are associated with treatment of the solids stream. Figure 5-6 shows a simplified flow diagram for the plant. One possible configuration for the treatment units is presented in Figure 5-7, which shows that the 5.4 mgd WWTP can fit easily on a 20-acre site. Additional area would be required around the perimeter of the actual plant to provide for a buffer zone. ADHS usually requires that the treatment units be set back 1,000 feet from the nearest property line.



SIMPLIFIED FLOW DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

OXIDATION DITCH PROCESS
APACHE JUNCTION WWTP

PRC TOUPS
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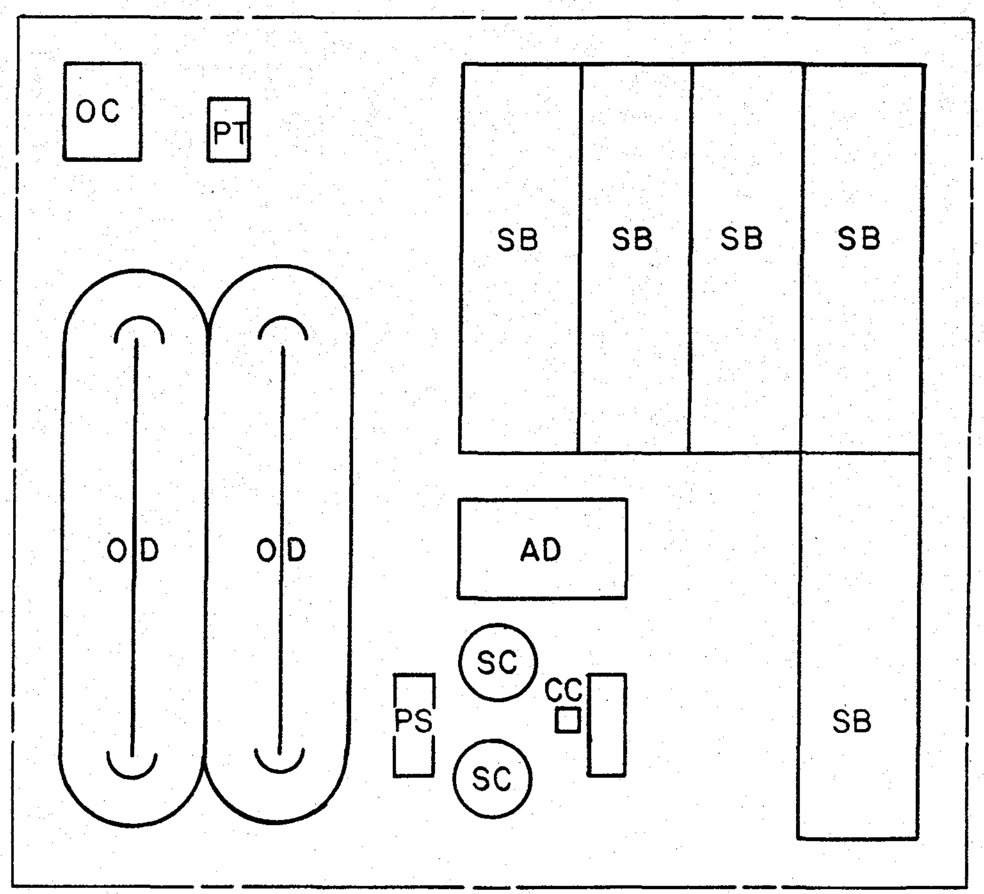
FIGURE NO. 5-6



LEGEND

AD - Aerobic Digesters

CC - Chlorine Contact

OC - Operations Center

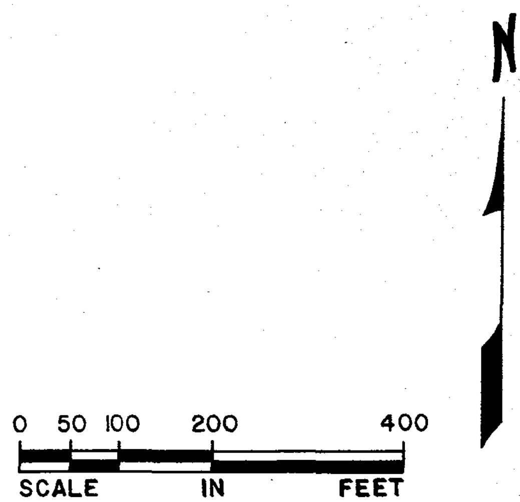
OD - Oxidation Ditch

PS - Pump Station (Sludge)

PT - Preliminary Treatment

SB - Sludge Drying Beds

SC - Secondary Clarifiers



SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

OXIDATION DITCH WWTP PLANT LAYOUT

PRC TOUPS
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FIGURE NO. 5-7

The treatment process assumes that dried sludge would be disposed of in an acceptable landfill, presumably located within the Apache Junction service area. The liquid stream effluent could either be discharged or reused in a slow rate (crop irrigation) or a high rate (rapid infiltration) process. For WWTP effluent to be discharged, an NPDES Permit would have to be obtained from the state ADHS. Reuse of the wastewater would not require a discharge permit; however, additional quantities of land might have to be acquired for winter storage of the effluent and for implementation of the reuse process itself. Tables 5-2 and 5-3 compare a number of the design features and site characteristics for the slow rate and high rate wastewater reuse processes.

For the purpose of this report, it will be assumed that Apache Junction would be able to obtain an NPDES Permit for discharging into Siphon Draw, a wash running along the southern edge of the service area boundary (as shown in Figure 5-5). However, since the plant effluent has potential reuse value for agricultural and greenbelt irrigation or as a trade item for surface and groundwater, a more detailed comparison between discharge and reuse options should be carried out as part of the EPA 201 Facility Plan process, should Apache Junction elect to pursue its own gravity sewer/WWTP system.

<u>SUMMARY.</u> Implementation of Alternative 2 allows homes in the low-density outlying service area to utilize any of the acceptable individual treatment/disposal methods, including septic tank with absorption bed, septic tank mound system, aerobic treatment with absorption bed, and evapotranspiration system. Homes and businesses within the higher-density city limits would be served by a gravity sewer system which would convey raw wastewater to a 5.4 mgd WWTP located roughly at the southeast corner of Elliot and Meridian Roads. The plant would be capable of providing secondary treatment plus disinfection, with the effluent discharged to Siphon Draw. Dried sludge would be hauled away and disposed of in an acceptable landfill.

An evaluation of cost-effectiveness and other important factors for this alternative as compared with Alternatives 1 and 3 will be carried out in the following chapter.

TABLE 5-2

COMPARISON OF DESIGN FEATURES FOR
WASTEWATER REUSE PROCESSES

FEATURE	SLOW RATE PROCESS	HIGH RATE PROCESS
Application techniques	Surface or sprinkler	Usually surface
Annual application rate, ft.	2 to 20	20 to 560
Field area required, acres/mgd	56 to 560	2 to 56
Typical weekly application rate, inches	0.5 to 4	4 to 120
Disposition of applied wastewater	Evapotranspiration and percolation	Mainly percolation
Need for vegetation	Required	Optional

TABLE 5-3

COMPARISON OF SITE CHARACTERISTICS FOR WASTEWATER REUSE PROCESSES

FEATURE	SLOW RATE PROCESS	HIGH RATE PROCESS
Slope of Land	Less than 2% on cultivated land; less than 4% on noncultivated land	Not critical; however, excessive slopes require much earthwork
Soil Permeability	Moderately slow to moderately rapid	Rapid (sands, loamy sands)
Depth to Groundwater	2 to 3 feet (minimum)	10 feet (lesser depths are acceptable where underdrainage is provided)
Climatic Restrictions	Storage often needed for cold weather and precipitation	None (possibly modify operation in cold weather)

DESCRIPTION OF ALTERNATIVE 3.

GENERAL. The major thrust of Alternative 3 is similar to that of Alternative 2, in that both alternatives recognize the distinction in population density between the city limits and the outlying service area and, thus, provide for continued use of individual onsite systems in the low-density area, but provide for gravity sewer collection of wastewater from within the higher-density area. The difference is that Alternative 2 has wastewater flowing to a treatment facility in the Apache Junction service area, while Alternative 3 has the wastewater conveyed to a WWTP located in eastern Mesa, under an agreement between the two cities.

The individual treatment/disposal methods and the gravity sewer system which could be utilized for this alternative are the same as those for Alternatives 1 and 2 and, therefore, the discussion will not be repeated here. The remainder of this section is concerned with the likelihood of entering into an arrangement with the City of Mesa for treatment of Apache Junction's wastewater, the size of the treatment facility required, and the method by which the wastewater would be transported to the WWTP.

HISTORY OF THE EAST MESA WWTP CONCEPT. Projected future wastewater flows indicate that the City of Mesa will need additional sewage collection and treatment capacity beyond that which is currently planned in about ten years. By year 2000 wastewater flows in Mesa will have reached 26.3 mgd, and by year 2020 they will be 36.7 mgd. By 1983, Mesa will have purchased 19.2 mgd worth of capacity in the Multi-Cities 91st Avenue WWTP in Phoenix. Thus, in looking forty years to the future, Mesa will need to have about 17.5 mgd of additional sewage treatment capacity. Additional interceptor capacity will also be required to transport the sewage.

In a December, 1980 report entitled "Wastewater Management Plan, City of Mesa", the joint venture of Logan, Fulton & Associates/John Carollo Engineers identified five alternative ways to meet Mesa's future wastewater collection and treatment needs. Of the five, the following two alternatives were considered by Mesa staff to be the most feasible:

1) Construction in stages of a new 17.5 mgd wastewater treatment plant in eastern Mesa and maintenance of the 19.2 mgd capacity in the 91st Avenue WWTP.
2) Purchase in stages of an additional 17.5 mgd capacity in an enlarged 91st Avenue WWTP or the 23rd Avenue WWTP, for a total of 36.7 mgd capacity in the City of Phoenix and Multi-Cities systems.

The 91st Avenue WWTP expansion is viewed as desirable because it removes the responsibility of sewage treatment from Mesa. However, an important consideration in the construction of an eastern Mesa facility is the opportunity for reuse of the effluent. An analysis of reuse opportunities in the east Mesa area revealed that irrigation on land owned by the Roosevelt Water Conservation District (RWCD) may be a viable and profitable option. Effluent may either be sold to the District, traded for groundwater, or traded for Salt River Project surface water.

The report indicated that before any final decision is made regarding which alternative to pursue, more research is needed to determine whether the East Mesa WWTP is viable legally, politically, and economically. However, it is the opinion of all concerned that the Mesa staff must make a decision by the latter part of 1981. In essence, then, the feasibility of combining wastewater flows from eastern Mesa and Apache Junction depends entirely upon the selection by the City of Mesa of the first of the two above alternatives. Mesa officials have informally indicated that, should the first alternative in fact be chosen, they would be interested in investigating the desirability of accepting flow from Apache Junction.

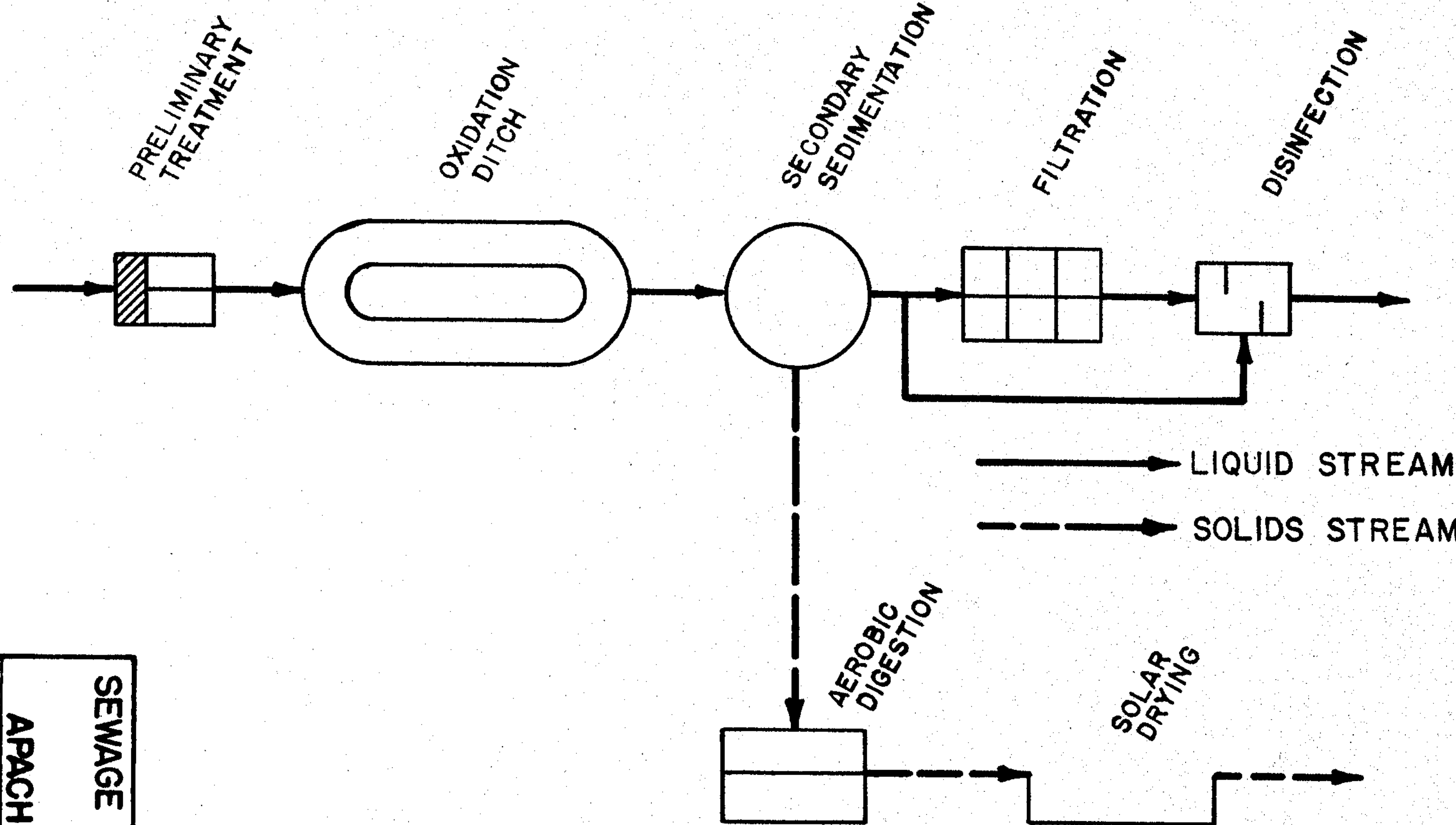
TREATMENT FACILITIES REQUIRED. The estimated flows to the East Mesa WWTP from the City of Mesa in the years 2000 and 2020 are 10.7 mgd and

17.5 mgd, respectively. In the above-mentioned report, it was decided that it would be more beneficial to stage the construction for the year 2000 flow than to size and cost a facility required through the year 2020. Therefore, the first stage of the plant to handle Mesa's flow would consist of two 6.0 modules to give 12.0 mgd. Addition of the year 2000 Apache Junction flow of 5.4 mgd raises the size of the total WWTP required to 17.4 mgd.

In the Mesa report, it was assumed that the East Mesa WWTP would utilize an oxidation ditch type of secondary treatment process, for reasons similar to those given earlier in this report for the Apache Junction WWTP. The oxidation ditch would be followed by an effluent filtration process to polish the effluent prior to discharging to the RWCD canal during times of low canal flow or poor treatment. Effluent would be transported to the canal via a pump station and force main originating on the WWTP site. The report also assumes that the dried sludge would be disposed of in an acceptable landfill, presumably located within the City of Mesa. A simplified flow diagram for the plant is presented in Figure 5-8.

INTERCEPTOR SEWER REQUIREMENTS. The site proposed for the East Mesa WWTP is located between Higley and Recker Roads just north of Baseline Road, as shown in Figure 5-9. This plant site has the advantage of being in close proximity to the RWCD canal where the treated effluent ultimately would be discharged. In addition, this site location would allow necessary interceptor sewers to be constructed such that a large portion of the wastewater flow could be conveyed to the WWTP by gravity, thus reducing the number of pump stations required.

Also shown in Figure 5-9 are the locations for the interceptor sewers proposed to serve the eastern Mesa service area. The terrain of the service area slopes to the southwest such that the majority of the flow can be collected by two major peripheral interceptors aligned on the south and west along Baseline Road and Val Vista/Lindsay Roads, respectively. The upper set of numbers along the Baseline Road interceptor



SIMPLIFIED FLOW DIAGRAM

SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA
OXIDATION DITCH PROCESS
EAST MESA WWTP

PRC TOUPS
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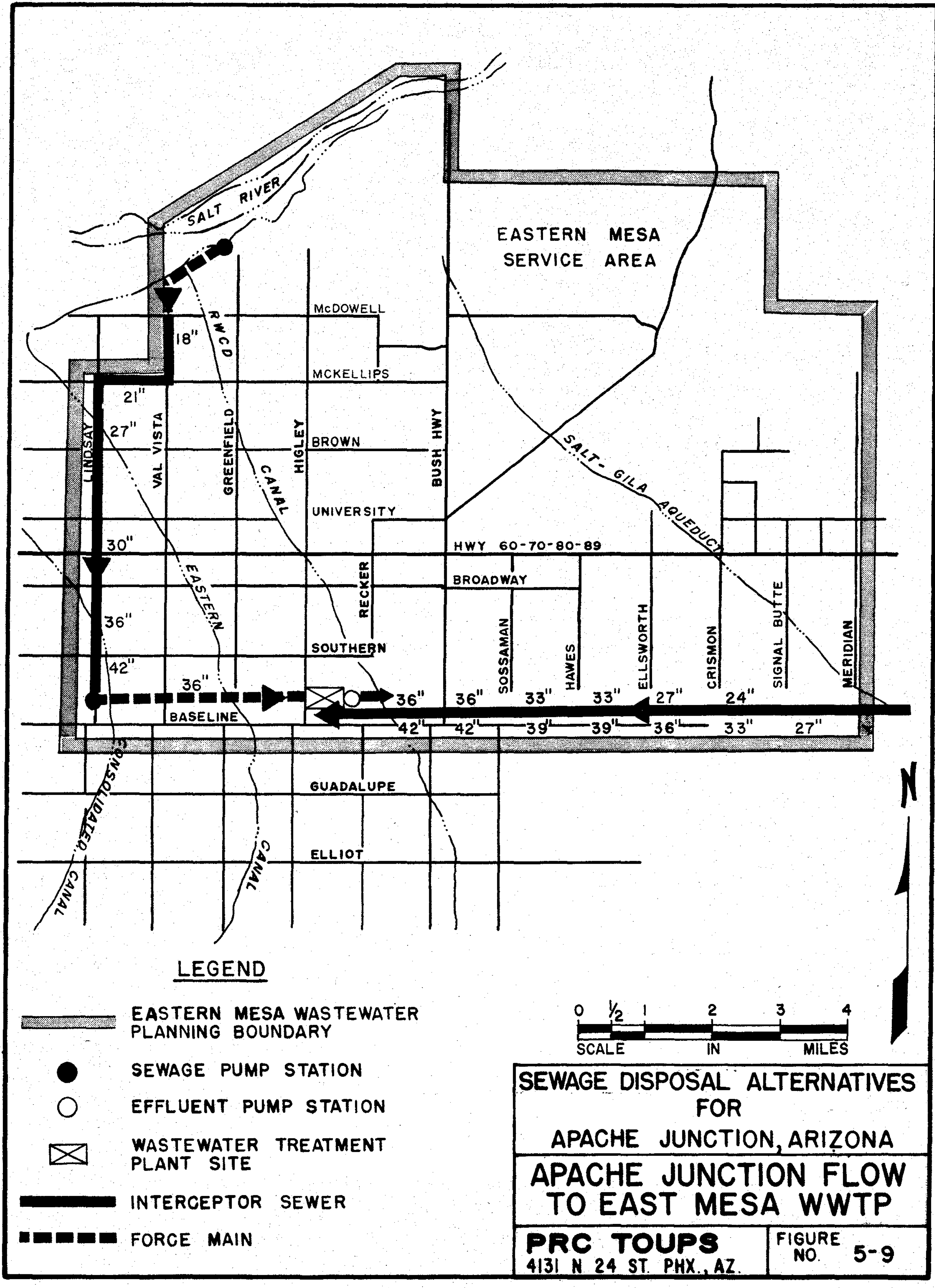
FIGURE NO. 5-8



SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

APACHE JUNCTION FLOW TO EAST MESA WWTP

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 5-9

shows the size of pipe required to transport flows from eastern Mesa's service area only. The lower set of numbers shows the corresponding size of pipe required to transport flows from both eastern Mesa's service area and Apache Junction. As can be seen, the pipe diameter would increase by 9 inches during the early stages and by 6 inches during the latter stages of transfer to the WWTP. In addition, Apache Junction would be required to furnish approximately one mile of 27-inch diameter pipe from the end of its gravity sewer system to Signal Butte Road in eastern Mesa.

<u>SUMMARY.</u> Implementation of Alternative 3 allows homes in the low-density outlying service area to utilize any of the acceptable individual treatment/disposal methods, including septic tank with absorption bed, septic tank mound system, aerobic treatment with absorption bed, and evapotranspiration system. Homes and businesses within the higher-density city limits would be served by a gravity sewer system. Wastewater would be conveyed out of the Apache Junction service area by a 27-inch diameter interceptor sewer, which would eventually combine with an interceptor sewer in eastern Mesa and proceed to a 17.4 mgd WWTP located between Higley and Recker Roads just north of Baseline Road. The plant would be capable of providing secondary treatment plus effluent filtration and disinfection, with the effluent pumped to a Roosevelt Water Conservation District canal for reuse. Dried sludge would be hauled away and disposed of in an acceptable landfill.

An evaluation of cost-effectiveness and other important factors for this alternative as compared with Alternatives 1 and 2 will be carried out in the following chapter.

CHAPTER 6

EVALUATION OF ALTERNATIVES

INTRODUCTION.

In this chapter, the wastewater management alternatives which were developed in Chapter 5 will be compared and evaluated using the following parameters:

° Capital Costs	Comprises the construction costs for all wastewater transport and treatment facilities, plus an allowance for contingency, engineering, legal and administrative costs.
° Operation and Maintenance (O&M) Costs	Comprises the costs for energy, chemicals, salaries and wages, and replacement materials, supplies and parts for all wastewater transport and treatment facilities.
° Annual Costs	Comprises the amortized capital costs plus the operation and maintenance costs.
° Ability to Implement	Considers the number and size of wastewater facilities required, time duration anticipated for construction, necessity for city financing, and public and agency acceptability.

° Flexibility and Reliability	Considers the percent loss in capacity with a major treatment unit out of service, the ability to accomodate modifications for future conditions, and the ability to consistently provide treatment conforming to the requirements.
° System Experience	Considers the term and level of development of treatment technology involved and the operational complexity of the total treatment system.
° Land Requirement	Considers the relative quantity of land necessary for implementation.
° Environmental Assessment	Considers the relative adverse impact on each of a series of significant environmental parameters.

The results of this evaluation will be presented in a "Technical and Environmental Evaluation Matrix" at the end of this chapter. This matrix will be used in Chapter 7 to identify the apparent best alternative and to formulate the recommended plan of action.

COST ANALYSIS

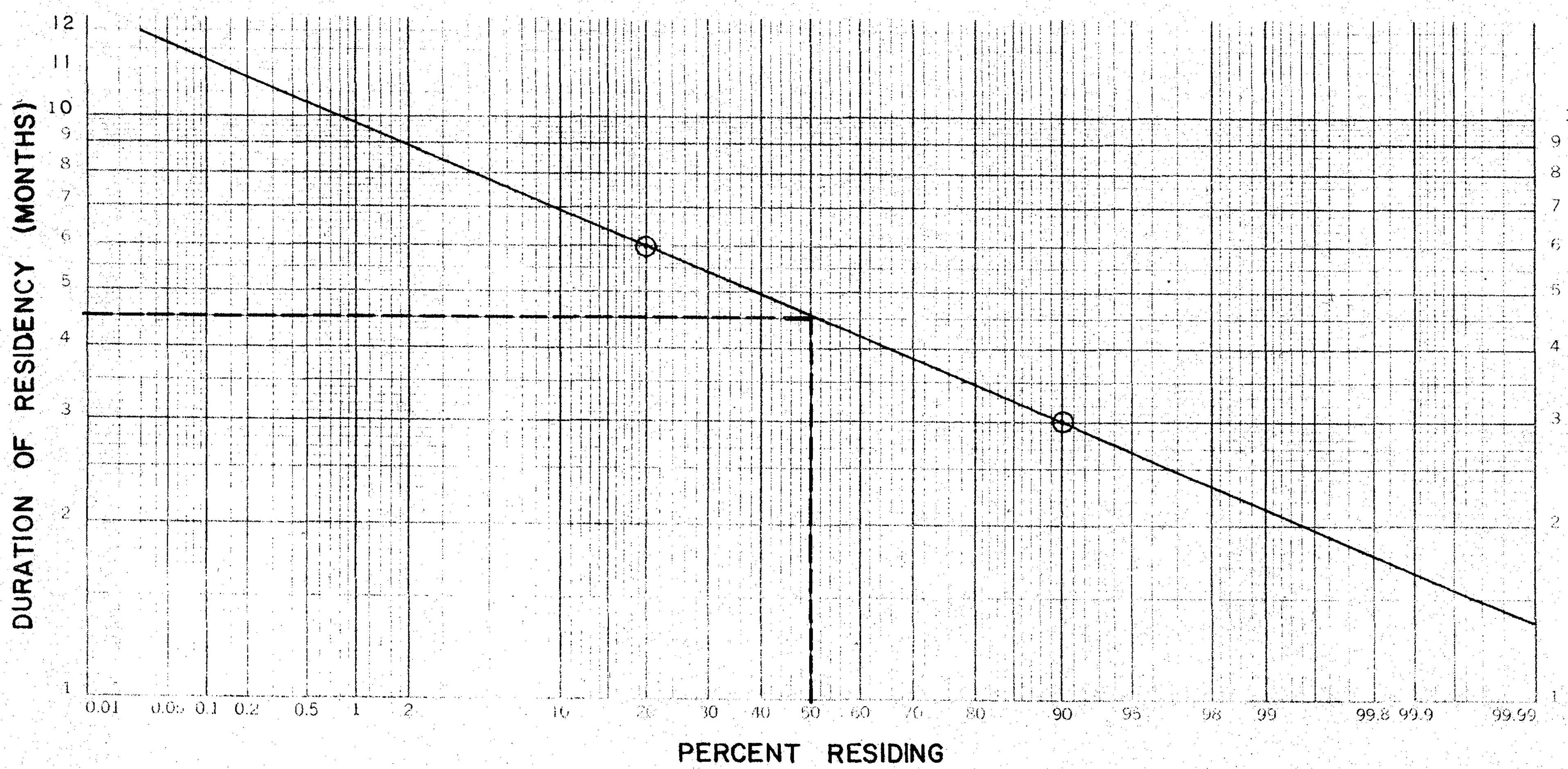
GENERAL. Costs were developed for the various alternatives based on four cost estimating manuals available through EPA:

1. Innovative and Alternative Technology Assessment Manual
2. Construction Costs for Municipal Wastewater Conveyance Systems: 1973-1977

3. Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978
4. Analysis of Operation and Maintenance Costs for Municipal Wastewater Treatment Systems

Because all costs undergo significant changes in accordance with upswings or downturns in the national economy, a cost index is normally utilized to reflect the conditions under which cost estimates are presented. The most widely used index in the United State is the Construction Cost Index published by Engineering News Record magazine (ENRCCI), which is computed from prices of construction materials and labor and based on a value of 100 in year 1913. All costs in this report are adjusted to reflect the January 1, 1981 ENRCCI of 3,370 for the Phoenix area. The total capital cost is amortized by applying a capital recovery factor of 0.10185 for 8 percent interest over a 20-year repayment period. Although an 8 percent interest figure is at present somewhat below the prime lending rate, it is recommended by EPA for use in large public works projects with long-term financing. For purposes of this report, all costs are projected in terms of 1981 dollars.

DETERMINATION OF ASSESSMENT POPULATION. To provide a meaningful comparison of costs between alternatives, all costs will be presented in terms of dollars per person per year. However, in order that this might be done for the community-wide alternatives (Alternatives 2 and 3), it became necessary to determine what portion of the population in Apache Junction should be assessed for improvements. Past statistical data has shown that 90 percent of the seasonal residents spend at least three months in the area, but that only about 20 percent spend as much as six months in the area. Figure 6-1 shows this data plotted on a "log-probability" graph, in which the y-axis shows the duration of residency in months and the x-axis shows the percent of seasonal population residing in the area for the specified duration. The median length of stay for 50 percent of the seasonal population is four and one-half months, or 37.5 percent of the total twelve months of the year. Table 6-1 uses this 37.5 percent factor to determine what will be referred to as the "asesssment population", or that number of people which will be



SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

SEASONAL POPULATION RESIDENCY DISTRIBUTION

PRC TOUPS
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FIGURE NO. 6-1

TABLE 6-1

ASSESSMENT POPULATION DETERMINATION

YEAR	(A) PERMANENT POPULATION IN CITY	(B) SEASONAL POPULATION IN CITY	SEASONAL POPULATION IN CITY X 37.5%	(C) ASSESSMENT POPULATION IN CITY
1980	10,500	16,197	6,074	16,574
1985	12,762	20,669	7,751	20,513
1990	16,288	26,375	9,891	26,179
1995	19,816	32,085	12,032	31,848
2000	22,972	37,189	13,946	36,918

NOTE: Assessment population (C) = Permanent population (A) + Seasonal population (B) x 37.5%.

used to provide a basis of comparison between the community-wide alternatives (Alternatives 2 and 3) and the individual alternative (Alternative 1). In any given year, the assessment population is approximately 61 percent of the total (permanent plus seasonal) population.

ALTERNATIVE 1. Tables 6-2 through 6-5 present the cost estimates for the four individual treatment/disposal systems developed in Chapter 5. As shown, the total annual costs are $212 per person for septic tank with absorption bed, $295 per person for septic tank mound system, $502 per person for aerobic treatment with absorption bed, and $355 per person for an evaportranspiration system. Since the conventional septic tank system is presently the most popular individual treatment/disposal method in Apache Junction and since the above annual costs are the lowest for this method, septic tank with absorption bed will be used as the standard of comparison with Alternatives 2 and 3.

ALTERNATIVE 2. As shown in Table 6-6, the capital cost for the gravity sewer system within the city limits of Apache Junction is estimated to be $37,296,000. The O&M cost is estimated at $194,000 per year, making for an annual cost for the gravity sewer system of $3,993,000. The Apache Junction WWTP is estimated to cost $12,599,000 initially, with a yearly O&M cost of $364,000. The annual cost for the WWTP is estimated to be $1,647,000. The total annual cost for the complete gravity sewer/WWTP system is estimated at $5,640,000.

In Table 6-7, the total annual cost is apportioned among the assessment population (from Table 6-1) for the years 1980-2000. As shown, the annual cost per person declines from $340 in 1980 to $153 in 2000.

ALTERNATIVE 3. The costs for Alternative 3 are made up of three main elements as shown in Table 6-8. The capital, O&M and annual costs for the gravity sewer system within the city limits of Apache Junction are the same as for Alternative 2, with the annual cost again being $3,993,000. The capital cost for Apache Junction's share of the Baseline Road interceptor to the East Mesa WWTP is estimated at $4,562,000. Apache Junction's share of the O&M cost is estimated to be $8,000 per year, making

TABLE 6-2

ALTERNATIVE 1 COST ESTIMATE

SEPTIC TANK WITH ABSORPTION BED

Capital Cost	$4,600	
Amortized Capital (Fixed) Cost (20-year period)		470
O&M Cost		24
Annual Cost		494

ANNUAL COST @ 2.33 PERSONS PER UNIT = $212 per person

TABLE 6-3

ALTERNATIVE 1 COST ESTIMATE

SEPTIC TANK MOUND SYSTEM

Capital Cost	$6,200	
Amortized Capital (Fixed) Cost (20-year period)		627
O&M Cost		60
Annual Cost		687

ANNUAL COST @ 2.33 PERSONS PER UNIT = $295 per person

TABLE 6-4

ALTERNATIVE 1 COST ESTIMATE

AEROBIC TREATMENT WITH ABSORPTION BED

Capital Cost	$8,800	
Amortized Capital (Fixed) Cost (20-year period)		900
O&M Cost		270
Annual Cost		1,170

ANNUAL COST @ 2.33 PERSONS PER UNIT = $502 per person

TABLE 6-5

ALTERNATIVE 1 COST ESTIMATE

EVAPOTRANSPIRATION SYSTEM

Capital Cost	$7,900	
Amortized Capital (Fixed) Cost (20-year period)		804
O&M Cost		24
Annual Cost		828

ANNUAL COST @ 2.33 PERSONS PER UNIT = $355 per person

TABLE 6-6

ALTERNATIVE 2 COST ESTIMATE

APACHE JUNCTION GRAVITY SEWER SYSTEM		
Capital Cost	$37,296,000	
Amortized Capital (Fixed) Cost (20-year period)		3,799,000
O&M Cost		194,000
Annual Cost		3,993,000
APACHE JUNCTION WASTEWATER TREATMENT PLANT		
Capital Cost	$12,599,000	
Amortized Capital (Fixed) Cost (20-year period)		1,283,000
O&M Cost		364,000
Annual Cost		1,647,000
TOTAL ANNUAL COST		$5,640,000

TABLE 6-7

ALTERNATIVE 2 COST ESTIMATE PER PERSON

TOTAL ANNUAL COST = $5,640,000

YEAR	ASSESSMENT POPULATION	ANNUAL COST PER PERSON
1980	16,574	$340
1985	20,513	275
1990	26,179	215
1995	31,848	177
2000	36,918	153

TABLE 6-8

ALTERNATIVE 3 COST ESTIMATE

APACHE JUNCTION GRAVITY SEWER SYSTEM		
Capital Cost	$37,296,000	
Amortized Capital (Fixed) Cost (20-year period)		3,799,000
O&M Cost		194,000
Annual Cost		3,993,000
APACHE JUNCTION'S SHARE OF INTERCEPTOR TO EAST MESA WWTP		
Capital Cost	$4,562,000	
Amortized Capital (Fixed) Cost (20-year period)		465,000
O&M Cost		8,000
Annual Cost		473,000
APACHE JUNCTION'S SHARE OF EAST MESA WWTP		
Capital Cost	$9,655,000	
Amortized Capital (Fixed) Cost (20-year period)		983,000
O&M Cost		340,000
Annual Cost		1,323,000
TOTAL ANNUAL COST		$5,789,000

for an annual cost for the interceptor of $473,000. Finally, Apache Junction's share of the East Mesa WWTP is estimated to cost $9,665,000 initially, with a yearly O&M cost of $340,000. Apache Junction's share of the annual cost for the East Mesa WWTP is estimated to be $1,323,000. The total annual cost for the complete gravity sewer/interceptor/WWTP system is estimated at $5,789,000.

In Table 6-9, the total annual cost is apportioned among the assessment population (from Table 6-1) for the years 1980-2000. As shown, the annual cost per person declines from $349 in 1980 to $157 in 2000.

GRAPHICAL COMPARISON OF ALTERNATIVES. The total annual cost data discussed above is presented graphically in Figure 6-2. As shown, the annual cost for Alternative 1 remains constant over the 20-year study period. This is because the cost of a septic system is an individual cost to each homeowner and is independent of the total number of people residing in the community. On the other hand, the annual costs for Alternatives 2 and 3 decline dramatically as the service population increases. Initially, these alternatives are about 63 percent *more* costly than Alternative 1; however, by the year 2000, they are about 27 percent *less* costly than Alternative 1. The graph shows that the break even point occurs in about 1991. At that time, the cost to an individual homeowner for a new septic tank/disposal system would be about the same as that for a complete gravity sewer/WWTP system. At any time after that, the latter system becomes more economical. It is important to note, however, that a conflict will exist for those homeowners who have already paid for a septic system at the time a sewer system is being considered.

ABILITY TO IMPLEMENT

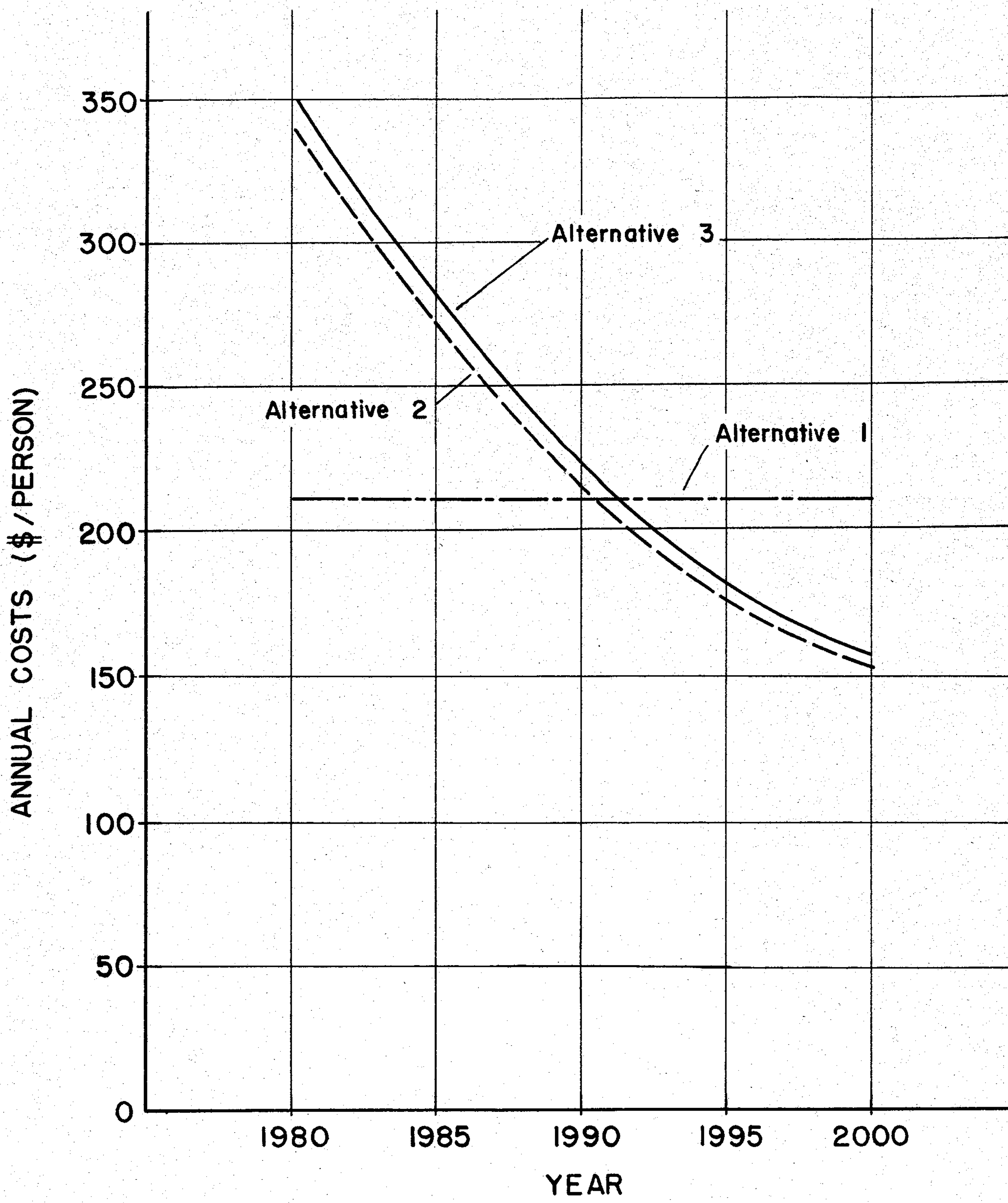
The easiest of the three alternatives to implement would probably be Alternative 1. Since the majority of the population in the Apache Junction service area has relied on individual septic systems for a number of years, implementation of Alternative 1 would require little, if any, change in attitude on the part of the residents. Design and construction of septic systems could continue in the same manner as in the past, with review and approval of the systems continuing to be a function of the Pinal County Health Department.

TABLE 6-9

ALTERNATIVE 3 COST ESTIMATE PER PERSON

TOTAL ANNUAL COST = $5,789,000

YEAR	ASSESSMENT POPULATION	ANNUAL COST PER PERSON
1980	16,574	$349
1985	20,513	282
1990	26,179	221
1995	31,848	182
2000	36,918	157



SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

ECONOMIC COMPARISON OF ALTERNATIVES

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FIGURE NO. 6-2

Both Alternatives 2 and 3 would be somewhat more difficult to implement. Initially, they would require the majority of the population to accept a different type of sewage collection and treatment philosophy than has been prevalent in the past. The economics of either alternative would probably come under fire, particularly from seasonal residents who would not be able to realize the benefits of the system year-round. On a different level, implementation could be hindered by involvements with other governmental agencies. Pursuit of an individual WWTP under Alternative 2 may involve the City of Apache Junction in the lengthy EPA process for planning, design and construction of wastewater facilities. While direct involvement with EPA could be avoided with Alternative 3, it would still be necessary for Apache Junction to work closely with the City of Mesa on the details of the combined WWTP/interceptor system.

The limited bonding capacity of the city could also provide a hindrance to implementation of either Alternative 2 or Alternative 3. The present bonding capacity of Apache Junction is four percent of the net assessed valuation, or approximately $620,000. Since this figure is so much less than the multi-million dollar committment needed for sewage collection and treatment facilities, a special bond issue designed specifically for construction of sewage related facilities would probably be required.

FLEXIBILITY AND RELIABILITY.

Alternative 2 is believed to be the option best suited for flexibility and reliability. Under this alternative, where two smaller WWTP's would be provided (one each for Apache Junction and eastern Mesa), each plant can be tailored to the individual needs of its community and units out of service at one plant have no effect on the other plant. With one large regional WWTP (Alternative 3), however, the whole area can be affected when treatment units are out of service or when an interceptor is undergoing emergency repairs. Also, smaller local plants can generally be expanded more readily than a larger regional plant and, as such, are better able to accomodate future population changes. This distinction aside, it is felt that either WWTP would be able to consistently provide treatment conforming to the requirements.

Alternative 1, on the other hand, has limited flexibility and reliability. It has already been shown in this report that its ability to accomodate modifications for future conditions is severely restricted by the available land area. In addition, continual failing of septic systems often leads to the provision for a completely different type of wastewater management scheme, such as a gravity sewer/WWTP system. Conversely, in a treatment plant, an additional process can usually be added to increase the degree of treatment or improve the reliability.

SYSTEM EXPERIENCE.

The treatment schemes for all three alternatives were developed with system experience in mind. All treatment processes have at least an adequate level of development and successful operating history. On a site-specific level, however, it is felt that Alternative 1 has a slight advantage. The septic tank/disposal system is the most familiar method of wastewater management in Apache Junction and involves a very low degree of operational complexity and sophistication.

LAND REQUIREMENT.

Alternative 1 possesses a basic difference in land-use philosophy from either Alternative 2 or Alternative 3. The on-site methods called for in Alternative 1 rely on having relatively large quantities of land available for treatment and disposal of the wastewater. Alternatives 2 and 3, however, are designed to remove the wastewater from the heavily developed areas and transport it to a site where treatment units can be concentrated on a relatively small land area. As shown earlier in this report, the land required for implementation of Alternative 1 would eventually limit the level of development within the city limits of Apache Junction.

ENVIRONMENTAL ASSESSMENT.

To assist in the environmental assessment, an Environmental Indicator Outline was developed as a means of simply and understandably comparing each wastewater management alternative in terms of potential adverse environmental impacts. An environmental assessment using the Indicator Outline format is presented for Alternatives 1 through 3 in Figures 6-3, 6-4, and 6-5, respectively. As shown, each alternative was evaluated for obvious, adverse environmental impacts associated with the type of process and location being considered.

Four basic categories are included in the outline: physical, biological, socio-economic, and cultural, each expanded into sub-categories and then further refined. Within each indicator sub-category, an assesment was made using three broad classifications for degree of adversity:

- Major Impact
- Minor Impact
- Insignificant Impact

Based upon the degree of cumulative comparative impact within the various sub-categories, an "Environmental Assessment Index" letter was assigned for each of the alternatives. The index letters are relative indicators that compare the cumulative impacts of each alternative process. For example, a wastewater management scheme may have a number of minor adverse impacts, but its overall evaluation (Environmental Assessment Index) may not necessarily be adverse. Also included in each outline is the column "Assessment Summary", which highlights the specific environmental impacts for each alternative.

In general, Apache Junction is expected to benefit most from an environmental standpoint from those alternatives (2 and 3) which remove the wastewater from the developed areas and transport it to a centralized plant for treatment and disposal. On the Indicator Outlines, these two alternatives are shown as having a few minor adverse impacts, but no major adverse impacts, and so are given an overall assessment index of "C", or neutral. Apache Junction is expected to benefit least environmentally from continued reliance on individual on-site wastewater manage-

ENVIRONMENTAL INDICATOR OUTLINE

ENVIRONMENTAL INDICATORS		ADVERSE IMPACT MAJOR	ADVERSE IMPACT MINOR	ADVERSE IMPACT INSIGNIF.	ASSESSMENT SUMMARY
PHYSICAL	SURFACE WATER			O	
	GROUNDWATER		O		*Possible impacts from failing septic systems.*
	SOIL CHARACTERISTICS		O		*Impacted during construction and by effluent discarge.*
	GEOLOGY			O	
	AIR QUALITY			O	
	CLIMATE			O	
BIOL.	TERRESTRIAL		O		*May be impacted during construction.*
	AQUATIC			O	
SOCIOECONOMIC	LAND USE AND ZONING	O			*Zoning dictated by land required for treatment.*
	PUBLIC HEALTH		O		*Potential impacts from failing septic systems.*
	TRANSPORTATION			O	
	POPULATION	O			*Density limited by large lot sizes.*
	ENERGY AND UTILITIES			O	
	ECONOMICS			O	
CULTURAL	ARCHAEOLOGICAL		O		*May be impacted during construction.*
	HISTORICAL			O	
	AESTHETICS			O	
	ACCEPTABILITY			O	

ASSESSMENT INDEX	
A-HIGHLY BENIFICIAL	
B-SOMEWHAT BENIFICIAL	
C-NEUTRAL	ASSESSMENT INDEX D
D-SOMEWHAT ADVERSE	
E-HIGHLY ADVERSE	

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

ALTERNATIVE I

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FIGURE NO. 6-3

ENVIRONMENTAL INDICATOR OUTLINE

	ENVIRONMENTAL INDICATORS	ADVERSE IMPACT: MAJOR	ADVERSE IMPACT: MINOR	ADVERSE IMPACT: INSIGNIF.	ASSESSMENT SUMMARY
PHYSICAL	SURFACE WATER		O		*WWTP may discharge into a surface watercourse.*
	GROUNDWATER			O	
	SOIL CHARACTERISTICS			O	
	GEOLOGY			O	
	AIR QUALITY			O	
	CLIMATE			O	
BIOL.	TERRESTRIAL			O	
	AQUATIC		O		*WWTP may discharge into a surface watercourse.*
SOCIOECONOMIC	LAND USE AND ZONING		O		*May be impacted in immediate vicinity of WWTP.*
	PUBLIC HEALTH			O	
	TRANSPORTATION		O		*Temporary dislocations during construction.*
	POPULATION			O	
	ENERGY AND UTILITIES		O		*Power and city water demands.*
	ECONOMICS		O		*Temporary business impacts during construction.*
CULTURAL	ARCHAEOLOGICAL			O	
	HISTORICAL			O	
	AESTHETICS		O		*Negative social stigma associated with WWTP.*
	ACCEPTABILITY		O		*WWTP located in Apache Junction service area.*

ASSESSMENT INDEX	
A-HIGHLY BENIFICIAL	
B-SOMEWHAT BENIFICIAL	
C-NEUTRAL	ASSESSMENT INDEX C
D-SOMEWHAT ADVERSE	
E-HIGHLY ADVERSE	

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

ALTERNATIVE 2

PRC TOUPS
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FIGURE NO. 6-4

ENVIRONMENTAL INDICATOR OUTLINE

	ENVIRONMENTAL INDICATORS	ADVERSE IMPACT: MAJOR	ADVERSE IMPACT: MINOR	ADVERSE IMPACT: INSIGNIF.	ASSESSMENT SUMMARY
PHYSICAL	SURFACE WATER			O	
	GROUNDWATER			O	
	SOIL CHARACTERISTICS		O		*Soil erosion likely during storage pond construction.*
	GEOLOGY			O	
	AIR QUALITY			O	
	CLIMATE			O	
BIOL.	TERRESTRIAL		O		*May be impacted by storage pond and interceptor construction.*
	AQUATIC			O	
SOCIOECONOMIC	LAND USE AND ZONING		O		*May be impacted in immediate vicinity of WWTP.*
	PUBLIC HEALTH			O	
	TRANSPORTATION		O		*Temporary dislocations during construction.*
	POPULATION			O	
	ENERGY AND UTILITIES		O		*Power and city water demands.*
	ECONOMICS		O		*Temporary business impacts during construction.*
CULTURAL	ARCHAEOLOGICAL			O	
	HISTORICAL			O	
	AESTHETICS		O		*Negative social stigma associated with WWTP.*
	ACCEPTABILITY			O	

ASSESSMENT INDEX	
	A-HIGHLY BENIFICIAL
	B-SOMEWHAT BENIFICIAL
	C-NEUTRAL
	D-SOMEWHAT ADVERSE
	E-HIGHLY ADVERSE

ASSESSMENT INDEX C

SEWAGE DISPOSAL ALTERNATIVES FOR APACHE JUNCTION, ARIZONA

ALTERNATIVE 3

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 6-5

ment techniques. In addition to several minor adverse impacts on the Indicator Outline, Alternative 1 is shown as having two major adverse impacts, and thus this alternative is indexed as "D", or somewhat adverse.

SUMMARY OF ALTERNATIVES EVALUATION.

The ranking of the three alternatives in the areas just discussed is summarized in terms of a "Technical and Environmental Evaluation Matrix", presented in Table 6-10. The values for the letters A through E are defined below the matrix.

This matrix will be used in the following chapter to identify and select a recommended plan of action for future wastewater management in the Apache Junction service area.

TABLE 6-10

TECHNICAL AND ENVIRONMENTAL EVALUATION MATRIX

ALTERNATIVE	ANNUAL COSTS	ABILITY TO IMPLEMENT	FLEXIBILITY AND RELIABILITY	SYSTEM EXPERIENCE	LAND REQUIREMENT	ENVIRONMENTAL ASSESSMENT
ALTERNATIVE 1	D	B	D	B	E	D
ALTERNATIVE 2	B	C	B	C	C	C
ALTERNATIVE 3	B	C	C	C	C	C

A = Very Good

B = Good

C = Average

D = Below Average

E = Poor

CHAPTER 7

SELECTION OF THE BEST ALTERNATIVE PLAN

MATRIX EVALUATION.

Table 7-1 is an enhanced version of the "Technical and Environmental Evaluation Matrix" appearing at the end of Chapter 6. Table 7-1 takes the letter values assigned previously for comparison purposes and assigns a number to each letter based on the following point system:

A = 5

B = 4

C = 3

D = 2

E = 1

The numbers are then added and the totals show the final relative standing of the three alternatives. The point totals are 15 for Alternative 1 (third), 20 for Alternative 2 (first), and 19 for Alternative 3 (second).

The major conclusion which can be drawn from the alternatives evaluation is that, over the long term, pursuit of either Alternative 2 or Alternative 3 is a wiser choice than continued reliance on Alternative 1. Beside having the lowest point total in Table 7-1, it was shown in Chapter 4 that Alternative 1 would exceed the threshold level of development within the Apache Junction city limits in the middle 1990's. Furthermore, Alternative 1 loses its economic advantage to the individual homeowner over the other alternatives in about 1991, as shown previously in Figure 6-2.

It should be emphasized here that elimination of Alternative 1 does not mean that on-site methods for wastewater management within the city limits must be abandoned overnight. On the contrary, with proper supervision, on-site methods should continue to adequately serve the Apache Junction area for another ten years. The point to be made is that at the end of that period, Apache Junction should at least be in the posi-

TABLE 7-1

TECHNICAL AND ENVIRONMENTAL EVALUATION MATRIX

SHOWING RELATIVE STANDING OF ALTERNATIVES

ALTERNATIVE	ANNUAL COSTS	ABILITY TO IMPLEMENT	FLEXIBILITY AND RELIABILITY	SYSTEM EXPERIENCE	LAND REQUIREMENT	ENVIRONMENTAL ASSESSMENT	POINT TOTAL	RELATIVE STANDING
ALTERNATIVE 1	D	B	D	B	E	D		
	2	4	2	4	1	2	15	3
ALTERNATIVE 2	B	C	B	C	C	C		
	4	3	4	3	3	3	20	1
ALTERNATIVE 3	B	C	C	C	C	C		
	4	3	3	3	3	3	19	2

tion where it could pursue construction of an alternative wastewater management system. The remainder of this chapter is concerned with how Apache Junction might handle the arrangements for such an alternative system.

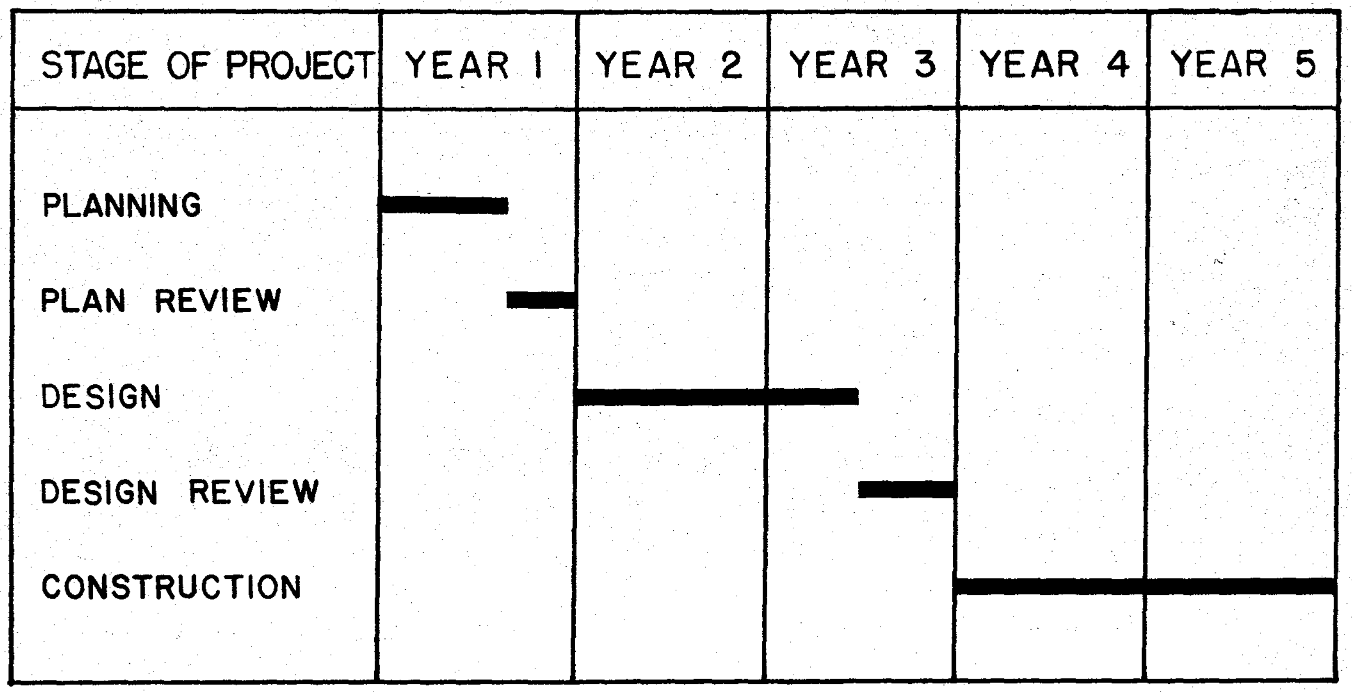
ARRANGEMENTS FOR IMPLEMENTATION.

Implementation of Alternative 2 would involve the City of Apache Junction in the construction of a gravity sewer and wastewater treatment plant system to serve the area within the city limits. Since passage of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), the most popular way for a community to plan, design and construct wastewater facilities has been to participate in the EPA Construction Grants Program. This program generally provides for 75 percent federal funding at all three levels (planning, design and construction) of wastewater collection and treatment facilities, provided that EPA approval is granted on each of the three outputs. The million-dollar magnitude of the projects involved usually requires significant lead time between initial planning and an on-line collection or treatment facility, with 5 years being a common figure (shown in Figure 7-1):

Planning	1 year
Design	2 years
Construction	2 years
TOTAL	5 years

If Alternative 2 is eventually pursued, it is recommended that Apache Junction initiate the EPA procedure no later than the middle 1980's. In fact, the CAAG 208 Plan suggests investigating the "Step 1 Facility Plan" process for the most heavily developed areas as early as 1982. In any case, it is important for the city to remember that its plan must be in compliance with the 208 Plan to be approved by the federal government.

Under Alternative 3, Apache Junction could still utilize federal funds for a gravity sewer system; however, it would not be involved directly in the EPA procedure for a WWTP. In its place, the City of Mesa would



SEWAGE DISPOSAL ALTERNATIVES
FOR
APACHE JUNCTION, ARIZONA

IMPLEMENTATION SCHEDULE

PRC TOUPS
4131 N 24 ST. PHX., AZ.

FIGURE NO. 7-1

be operating with a time-frame similar to the above and possibly longer because of the larger nature of the treatment facilities involved. It is expected that Mesa will make a decision on the East Mesa WWTP during the latter part of 1981. If the decision is in the affirmative, Apache Junction would need to determine immediately what the actual agreement would be for buy-in of interceptor and WWTP capacity and exactly when that capacity would be available. Then once that information was in hand, Apache Junction would be able to make a true comparison and decide whether it would be in its best interests to go in with the City of Mesa or remain on its own for wastewater management.

APPENDIX A

LIST OF ABBREVIATIONS

ac-ft	acre feet
ADHS	Arizona Department of Health Services
AWT	advanced waste treatment
BOD	biochemical oxygen demand
°C	degrees Celsius
cfs	cubic feet per second
DO	dissolved oxygen
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
°F	degress Fahrenheit
FCRC	Four Corners Regional Commission
fps	feet per second
gpad	gallons per acre per day
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
hp	horsepower
kw	kilowatt
mgd	million gallons per day
ml	milliliter
mg/l	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
PE	population equivalent
PL 92-500	Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972
PL 95-217	Public Law 95-217, Clean Water Act of 1977
PWT	primary waste treatment
SS	suspended solids
SWT	secondary waste treatment
TDS	total dissolved solids
USGS	United States Geological Survey
WWTP	wastewater treatment plant

APPENDIX B

GLOSSARY OF TERMS

ACRE-FOOT - The quantity of water required to cover one acre of land to a depth of one foot. Equivalent to 43,560 cubic feet or 326,000 gallons.

ACTIVATED SLUDGE - Process that removes organic matter from sewage by saturating it with air and adding biologically active sludge.

ADSORPTION - An advanced way of treating wastes in which carbon removes organic matter from wastewater.

ADVANCED WASTEWATER TREATMENT (AWT) - Additional sewage treatment steps beyond primary and secondary treatment to remove organic or inorganic compounds. Usually, additional biochemical oxygen demand (BOD) and suspended solids (SS) are removed and nutrients (such as phosphorus, nitrogen and potassium) are taken out. AWT is also known as tertiary treatment.

AERATION TANK - A chamber for injecting air into wastewater. The addition of oxygen breaks down organic wastes by bacterial action.

AEROBIC - Living or active in the presence of free ocygen.

AESTHETICS - Of or pertaining to the beautiful; pleasing to the senses. In this report, aesthetic consideration include elements of sight and smell.

ALLUVIUM - Material deposited by running water; alluvial deposits usually result from the action of rivers, including ephemeral streams.

ANAEROBIC - Living or active in the absence of free oxygen.

AQUATIC - Consisting of or pertaining to water.

AQUIFER - A water-bearing rock or rock formation.

BACTERIA - Small, living organisms. In wastewater treatment, bacteria consume organic (both liquid and solid) constituents in sewage.

BENTHIC ORGANISMS - Organisms that live on the bottoms of water bodies.

BIOTIC COMMUNITY - An assemblage of populations (plant and animal) occupying a particular area of physical habitat.

BOD - Biochemical oxygen demand. The amount of idssolved oxygen required for the decomposition of organic matter in water. BOD is used as a measure to determine the efficiency of a sewage treatment plant or to determine the potential of an effluent to degrade a stream. The lower the BOD measurement, the cleaner the effluent.

BUFFER ZONE - An area used to separate components of a sewage treatment system from the public, e.g., a land strip around a treatment plant.

CFS - Cubic feet per second. A unit of measure used to describe volume of streamflow, equal to 1 cubic foot in 1 second (also called "second-foot").

CLARIFIER - A component of a treatment plant, consisting of one or more tanks that contain partially treated wastewater, in which sewage is allowed to settle out.

CO - Carbon monoxide. A very toxic, colorless, and odorless gas; one product of combustion of gasoline in automobile engines.

CONFLUENCE - The point at which a tributary converges into or joins the main stream, or where two tributaries come together.

DEMOGRAPHY - Study of population and population changes.

DENSITY - Demographic term referring to the number of people in a specified area.

DEPENDABLE SUPPLY - The estimated amount of water that can be depleted annually without lowering storage levels in either surface or ground-water reservoirs over a long period of time.

DEPLETION - The measure of the amount of water removed from the water supply system for a use; synonymous with "consumptive use".

DISCHARGE - A term for flow rate as a ratio of volume over a given time period, usually measured in cubic feet per second (cfs).

ECOLOGY - The totality or pattern of relations between organisms and their environment.

ECOSYSTEM - A system formed by the interaction of a community of organisms with their environment.

EFFLUENT - The liquid that comes out of a wastewater treatment plant after completion of the treatment process.

ENVIRONMENT - This all-embracing term generally includes natural (physical and biological) elements and human (socio-economic and cultural) elements.

ENVIRONMENTAL ASSESSMENT - A study to determine harmful or beneficial changes to the human and natural environmental system resulting directly or indirectly from changes imposed on that system.

ENVIRONMENTAL IMPACT - Effect upon the physical, biological, socio-economic and cultural characteristics of an area produced by an action.

EPHEMERAL STREAM - A stream that flows only during and following a period of rainfall.

EROSION - The detachment of soil and rock particles by water, wind, ice or gravity.

EVAPORATION - The process of converting a liquid to a vapor.

FAUNA - Animals or animal life of a region.

FLOOD - An overflow from the designated channel of a river or other body of water.

FLOODPLAIN - The land area adjoining a river, stream or watercourse that has been or may be covered by floodwaters.

FLOODWAY - The channel of a river or other watercourse and the adjacent land areas required to carry and discharge a flood of a given magnitude.

FLOODWAY FRINGE - The portion of a floodplain between the floodway and the normal outline of a flood of a certain magnitude.

FLORA - Plants of a given region.

GROUNDWATER - The body of water beneath the surface of the ground, found in aquifers. It is made up primarily of water that has seeped down from the surface.

HABITAT - The environment in which the life needs of a plant or animal are supplied.

IMPOUNDMENT - A basin or other area surrounded by physical structure(s) in which water is contained.

INFLUENT - Sewage flowing into a treatment plant.

INTERMITTENT STREAM - A stream that flows only during part of the year, in contrast with perennial streams, which flow all year, and ephermal streams, which carry only stormflows.

INVERSION - An increase in air temperature with an increase in altitude. An event associated with air pollution.

LEACH - An action which separates soluble components such as salts, out of a medium, such as soil, by the action of percolating water.

LEACHATE - The liquid, including chemical components, which is a product of the leaching process.

MATRIX - A figure consisting of rows and columns, which portrays information where items in rows and items in columns interact.

MITIGATE - To alleviate or modify adverse or negative impacts resulting from a specific action.

MITIGATIVE MEASURE - A step taken to moderate the severity of the effects of a proposed action.

NON-CONSUMPTIVE USE - Water use that does not reduce the water supply available for other purposes. Examples of non-consumptive water use are: generation of hydroelectric power, fishing, boating and swimming.

NON-POINT SOURCE - Generalized discharge of waste into a water system which cannot be located as to a specific source. Examples are street runoff, agricultural irrigation return flow, etc.

NPDES - National Pollution Discharge Elimination System. An environmental program, administered by EPA, in accordance with the Federal Water Pollution Control Act (PL 92-500), as amended, to control discharge of wastes into waters of the United States.

OVERDRAFT - Term used to identify groundwater supplied when more groundwater is being pumped and used from an area that is returned to replenish the groundwater in the area. The difference between consumptive use and dependable supply.

OXIDATION - Addition of oxygen which breaks down organic wastes or chemicals in sewage by bacterial and chemical means.

PACKAGE TREATMENT PLANT - A small wastewater treatment plant partially or completely preassembled by a manufacturer and shipped to the designated location. Most package plants provide secondary treatment.

PARTIAL BODY CONTACT - A level of water quality where the human body may come in direct contact with the water, but normally not to the point of complete submergence. Sensory organs will not be exposed to water of this quality.

PARTICULATE - Of or pertaining to particles or occurring as minute particles.

PERCOLATION - Movement of water through subsurface soil layers, usually continuing downward to the groundwater table.

POINT SOURCE - A stationary, readily identifiable source of pollution.

POTABLE WATER - Drinkable water.

PROCESS TRAIN - The order in which sewage is treated as it flows through a treatment plant.

RECHARGE - Process by which water is absorbed and added to the groundwater aquifer, either directly into a particular water-bearing formation, or indirectly by way of another formation.

RIPARIAN - Pertaining to the banks of a body of water.

RIVERINE - Living or situated on the banks of a river.

RUNOFF - That portion of precipitation not initially captured by soil or vegetation to cause flow across a land surface.

SCOUR - The powerful and concentrated clearing and digging action of flowing water, especially the downward erosion by stream water in sweeping away sediments during time of flood.

SEDIMENT - Fragmented material that originates from weathering of rocks and is transported by, suspended in, or deposited by water and air or is accumulated in beds by other natural agencies.

SEPTAGE - The residual wastes resulting from the operation of onsite wastewater treatment systems.

SEPTIC TANK - A method of treating sewage, characterized by an underground tank, usually concrete, to which sewage is discharged and digested. Septic tanks are normally used in lower-density areas to treat sewage from a small group of people, for example, a family.

SEWAGE - Wastewater that flows in sewers from residential, commercial, and industrial establishments to wastewater treatment plants.

SEWER - Pipe, conduit or other physical facility used to carry wastewater.

SEWERAGE - System of sewers; physical facilities employed to transport, treat and discharge sewage.

SITE-SPECIFIC - Pertaining only to individual areas.

SLUDGE - Solid matter in sewage that settles to the bottom, floats, or becomes suspended in sedimentation tanks during wastewater treatment.

STREAM BED - Channel that contains the stream's waters; all the space ordinarily covered by water and lying between the lands on each side of the stream.

SUBSIDENCE - Settling of the surface of the ground to a new level.

TERRESTRIAL - Consisting of or pertaining to the land.

201 PLAN - A plan developed under Section 201 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) for constructing and operating wastewater treatment facilities.

208 PLAN - An areawide waste treatment management plan developed under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500).

VELOCITY - The speed of movement given as a ratio of length over time, usually measured in feet per second (fps).

WASTEWATER - Any water derived from one or more previous uses.

WASTEWATER TREATMENT PLANT (WWTP) - A facility consisting of a series of tanks, screens, filters and other components that process wastewater so that pollutants are removed.

WATER SUPPLY - A volume of water that is ready for use, either in its natural state or through treatment.

WATER TABLE - The upper limit of that portion of the ground wholly saturated with water.

WITHDRAWAL - The process of capturing or acquiring water either by diversion from a surface water source or by pumping from the ground-water basin.

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APPENDIX D

ADHS ENGINEERING BULLETIN NO. 12

Engineering Bulletin No. 12

GUIDELINES FOR INSTALLATION OF SEPTIC-TANK SYSTEMS

ARIZONA DEPARTMENT OF HEALTH SERVICES

Division of Environmental Health Services

Bureau of Water Quality Control

MAY 1976

FOREWORD

The following guidelines are intended as an aid for installation of septic-tank systems pursuant to Rules and Regulations for Sewerage Systems and Treatment Works (Chapter 8, Article 3). Recommendations found in this bulletin are to assist in compliance with Regulation Chapter 8, Article 3. These guidelines do not supplant or supersede any of the rules and regulations of the Arizona Department of Health Services. Copies of this bulletin and Arizona Department of Health Services regulations may be obtained from the county health department or the Arizona Department of Health Services.

TABLE OF CONTENTS

PART I - GENERAL

A. PURPOSE OF GUIDELINES

1. The information contained in this bulletin is intended as guidelines for the construction of individual resident septic-tank systems. Design information for systems to serve multiple units can be obtained from the Arizona Department of Health Services and county health departments.
2. Recommendations are found in this Engineering Bulletin to assist in compliance with Arizona Department of Health Services rules and regulations, specifically Chapter 8, Article 3, adopted December 11, 1973.
3. To improve understanding and operation of septic tank systems.

B. APPROVALS REQUIRED

1. Application to construct a septic-tank disposal system to serve a private residence, a hotel, motel, restaurant, trailer park, service station, picnic ground, recreational area, camp or other similar place shall be submitted to the local (county) health department for approval prior to construction. (R9-8-314A)
2. Approval to construct a system using an alternate method of sewage disposal must be obtained from both the local county health department and the Arizona Department of Health Services.

C. PROHIBITIONS

1. The use of cesspools for waste disposal is prohibited. (R9-8-313B)
2. Individual disposal systems (septic-rank systems) are prohibited under the following conditions (R9-8-313C)
   a. Where connection to a public sewer system is determined by the Department to be practical.
   b. Where soil conditions or topography are such that individual disposal systems (septic-tank systems) cannot be expected to function satisfactorily, or where groundwater conditions are such that individual disposal systems (septic-tank systems) may cause pollution of the groundwater supply.
   c. Where such installations may create an unsanitary condition or public health nuisance.
3. No privy contents, drainage from a building or the effluent from any waste treatment device shall be discharged into any crevice, sink-hole or other opening, either natural or artificial, or in a rock formation which will or may permit the pollution or contamination of ground water. (R9-8-332)

D. DEFINITIONS

1. Effective absorption area - the sidewall area below the top of the distribution pipe of a disposal trench or pit acceptable for effluent disposal. Areas of rock or poor permeability are not included. For calculation of, see Part III, D., 2.
2. Distribution pipe - the network of pipe used for distributing septic tank effluent to the subsurface disposal system.
3. Disposal pit - a subsurface pit used for disposal of septic tank effluent, commonly called seepage pits or dry wells.
4. Disposal trench - a subsurface trench used for disposal of septic tank effluent. The area containing the disposal trench is commonly called a leach field.
5. Standard percolation test - the test used to determine the rate water is absorbed by the soil. From this data the design size for a subsurface disposal system is determined. Procedures are given in Part III, C.
6. Septic tank - a water-tight container which receives the raw sewage and discharges a settled, slightly treated effluent. Detention time is usually 24 hours.
7. Septic-tank system - a method used for treatment and disposal of sewage. It usually consists of a septic tank and subsurface disposal trench or pit.

8. Subsurface disposal system - a rock or gravel-filled underground pit or trench into which septic tank effluent is discharged for final treatment and disposal. Liquid seeps through the sidewalls of the trench or pit to the surrounding soil.
9. Impervious strata - a soil zone with a percolation rate greater than 60 minutes per inch.

PART II - BASIC OPERATION

A. A septic-tank system uses the principle of subsurface disposal of wastewater. A properly installed and maintained septic-tank will accomplish; (1) solids removal, (2) biological treatment, and (3) sludge and scum storage. The septic tank effluent passes into the subsurface disposal system for final treatment and disposal.

B. Septic-tank systems generally fail because of improper construction, inadequate subsurface disposal area or subsurface disposal system plugging. Pumping of the septic tank and strict adherence to proper construction of the subsurface disposal system should prolong the life of the system.

PART III - SITE SUITABILITY

A. GENERAL

Before designing any septic-tank system it must first be determined that soil conditions are suitable for absorption of the septic tank effluent. The soil shall have an acceptable percolation rate without interference from groundwater or impervious strata below the level of the absorption system.

B. SUBSURFACE FORMATIONS

1. Rock formations or other impervious strata and the maximum elevation of the groundwater table shall be at a depth greater than four feet below the bottom of each disposal trench or disposal pit.
2. Borings - To determine subsurface formations in a given area it may be necessary that subsurface explorations be made. A backhoe hole is adequate for determining subsurface formations for disposal trenches. Augers should be used for determining subsurface formations for disposal pits. Useful information can sometimes be obtained from road cuts, stream beds and building excavations. Depth to which borings shall be taken is dependent upon the type of subsurface disposal system proposed. Borings shall be made to a depth of four feet below the bottom of the proposed disposal system. Since subsoil strata may vary widely within short distances, additional borings at the site of the proposed subsurface disposal system may be necessary at the discretion of the local health department.

C. PERCOLATION TESTS

1. Requirements

The percolation tests should be performed as given in Part III, C., 2. Contact your county health department to find the number of percolation tests required.

Where soils are shallow, place percolation test holes at the depth of the proposed disposal trenches. In deeper soils, where deeper disposal trenches and disposal pits will be used, place percolation test holes at more than one level. Where very deep disposal pits are contemplated, place test holes in each stratum considered to be useful. Where economy and safety permit, a backhoe can dig holes to expose soils in profile and suitable substrata can be chosen. Then, dig other backhoe holes to the upper portions of suitable substrata. These holes lessen the work needed to dig percolation test holes which must be dug with hand tools.

2. Standard Percolation Test

A percolation test is used to identify a suitable soil stratum for a subsurface disposal system and to estimate the size a system should be to have a long life-span.

a. Disposal trenches

1) Digging the hole

With hand tools dig a 12" square or 15" round hole. If water is in short supply, or if soils tend to collapse, place a perforated pipe vertically in the hole and carefully pack gravel or some other supporting material between the pipe and the hole wall. Perform the test within the vertical pipe and adjust calculations to account for the displacement of water by the gravel used to support the sides of the hole.

2) Preparing the hole

Remove any smeared soil surfaces from the sides of the hole to provide as natural a soil interface as practical, to infiltrating waters. Remove loose material from the bottom of the hole. To protect the bottom from scouring, add an inch or two of coarse sand or fine gravel.

3) Presoaking the hole

Presoak the hole by filling it deeper than eight inches with clean water. Add the water gently so the bottom and sides of the hole are not damaged.

If it is known that the soil has low shrink-swell potential and low clay contents, 15% or less, proceed with the test. If not, let the hole rest overnight.

4) Percolation Rate

Fill the hole with clean water to exactly six inches above the soil bottom of the hole (do not consider the layer of protective gravel as the bottom of the hole). With a tape measure (1/32-inch calibration) or float gauge, and a timepiece, determine the time for the water to recede exactly one inch. Refill immediately and repeat the process until successive time intervals needed for a one-inch drop indicate that an approximately stabilized rate has been obtained.

Report the stabilized percolation rate in minutes per inch.

b. Disposal pits

1) Method

Various methods of performing percolation tests for disposal pits are under consideration. The method detailed below is preferred. If another method is used contact the local county health department for approval.

2) Digging the Hole

With an auger drill a hole 18 inches in diameter, or larger, to the depth of the contemplated disposal pits. The minimum acceptable depth is 30 feet. Add an inch or two of coarse sand or fine gravel to protect the bottom from scouring.

If several soil strata will be utilized for the absorption area a percolation test shall be required in each strata.

3) Presoaking the Hole

Presoak the hole by filling it deeper than 12 inches with clean water, but not above the soil strata being tested. Add the water gently so the bottom and sides of the hole are not damaged.

4) Percolation Rate

Fill the hole with clean water to approximately 12 inches above the soil bottom of the hole (do not consider the layer of protective gravel as the bottom of the hole). With a tape measure, or other measuring device determine the time for the water to recede exactly one inch. Refill immediately and repeat the process until successive time intervals needed for one-inch drop indicate that an approximately stabilized rate has been obtained.

Report the stabilized percolation rate in minutes per inch.

D. EFFECTIVE ABSORPTION AREA REQUIREMENTS

1. Effective absorption area requirements and allowable rate of application based on percolation tests are given in Table I.

2. The sidewall areas below the top of the gravel backfill in disposal trenches and pits are the effective absorption surfaces. Only consider sidewall areas in permeable substrata. **All bottom bottom surfaces are ignored** for trenches and pits.

3. Sufficient area shall be provided for at least two bedrooms. Design is based on the total number of bedrooms. Dens, garages, family rooms and similar areas that can be converted to bedrooms may be included at the discretion of the local county health department.

PART IV - SEPTIC TANK

A. DESIGN

1. Septic tank design should conform to that shown in Plate I. Minor variations in design may be permitted. See Table II for minimum design capacity.

2. The minimum liquid capacity of the septic tank shall be 960 gallons or 1.6 times the daily design flow, whichever is greater.

B. CONSTRUCTION

1. Septic tanks shall be of approved shape (Plate I), structurally sound, watertight and constructed of materials resistant to corrosion or decay, such as concrete, vitrified clay block, fiberglass, heavy-weight concrete block or burned hard brick.

2. The walls and base of all tanks shall be securely bonded together or shall be of monolithic or keyed construction. Walls and base of poured-in-place tanks shall have a minimum thickness of four inches throughout. A minimum thickness of three inches will be allowed in precast tanks which have been properly reinforced.

3. A septic tank installed under a driveway or parking area shall have adequate reinforcement to support any anticipated load, and access plugs brought up to grade.

4. Rectangular, elliptical and semi-elliptical septic tanks shall have a length of at least twice but not more than three times the width. The liquid depth of such tanks generally shall not be less than four feet nor more than six feet. Tanks of other shapes and dimensions will be considered for approval when accompanied by data substantiating their effectiveness.

5. Inlet and outlet connections of each compartment of a septic tank shall be so designed and installed as to retain sewage solids, scum and sludge effectively.

6. At least a 12-inch freeboard or void is required between the sewage level and the underside of the tank cover.

7. The invert, or flow line, of the outlet pipe shall be set a minimum of 12 inches below the bottom of the tank cover and the inlet pipe two inches higher.

8. Outlet control devices are required for each compartment and for the tank itself. These shall consist of baffles made of durable material extending from side wall to side wall, or of pipe tees not less than four inches in diameter. The bottom of the baffle or tee shall extend at least 12 inches below the surface of the liquid and the top shall be at least four inches above the invert of the outlet and not less than two inches below the bottom of the cover.

9. Approved methods shall be used to spread the influent as evenly as possible across the septic tank. (see Plate I)

10. Tank Cover - Septic tank covers shall be sufficiently strong to support whatever load may reasonably be expected to be imposed upon it and tight enough to prevent the entrance of dirt or other foreign matter and the escape of the odorous gases of digestion.

11. Each tank shall be provided with two or more access openings at least 20 inches in diameter or square (Plate I). The access openings shall be located over each inlet and outlet.

C. LOCATION

1. The septic tank shall be located in compliance with Tables III and V. Distances from trees, swimming pools, sidewalks, driveways, etc., shall be such to prevent cave-in during construction.

2. The septic tank shall be installed at such depth that the top, or an approved access manhole to the tank, will be not more than six inches below the ground surface. The tank cover shall be adequately reinforced to support the load imposed. If the pitch of the house sewer from the structure stubout to the tank is more than ¼ inch per foot, a method acceptable to the county health department must be employed to assure a moderate entrance velocity of the raw sewage into the tank.

PART V - DISPOSAL TRENCHES

A. ABSORPTION AREA - see Part III, D.

B. CONSTRUCTION

1. A disposal trench replacement area equivalent to 100% of the initial area shall be available for replacement disposal trenches. This space shall not be used for permanent structures.
2. The disposal trenches shall be constructed in two systems preceded by a diversion valve or equivalent device of approved design to allow for alternate use of each half of the disposal system. Each system of trenches shall contain one-half (½) the required absorption area and be serially loaded (See Plate II). The diversion valve shall be installed near the septic tank and the housing of the valve shall be easily accessible at the ground surface for periodic use.
3. Both distribution pipe and trench bottom shall be approximately level.
4. Disposal trenches shall be a minimum of 12 inches wide.
5. Bottom of the trench shall be a minimum of four feet above static groundwater level.
6. Rock or gravel fill shall extend from the bottom of the trench to four inches above the distribution pipe. Rock or gravel fill shall be clean and of uniform size, preferably ¾ inch to two inches in diameter. Volcanic cinders may be substituted for rock or gravel. Rock or gravel shall offer 30% or more void space.
7. Backfill shall be at least 12 inches of native soil over a protective layer of untreated building paper or other previous biodegradable material. Soil placed over trenches shall be compacted so that depressions will not occur.
8. Each trench shall be not more than 100 feet in length. Leave undisturbed material between trenches.
9. Each trench shall parallel contour lines. Minimum spacing between trenches on the same contour shall be two times the total trench depth. Trenches not on the same contour shall be spaced as follows:

SLOPE OF GROUND BETWEEN TRENCHES	MINIMUM SPACING BETWEEN TRENCHES
0% to 5%	2.0 times the total trench depth
5% to 10%	2.5 times the total trench depth
10% to 20%	3.0 times the total trench depth
Over 20%	4.0 times the total trench depth

10. A watertight line shall connect the septic tank, diversion valve and disposal trenches.
11. The outlet of the septic tank shall be a minimum of four inches above the bottom of the distribution pipe.
12. Disposal trenches shall be constructed in a manner which will prevent or correct any smearing of the sidewall surface areas. (This is a very important construction procedure.)
13. Breathers may be placed at all ends of absorption trenches. (Plate II) The breather shall consist of perforated pipe at least four inches diameter, placed vertically within backfill of the trench.
14. Distribution pipe shall run the length of each trench and connect each trench in series. Minimum diameter of the distribution pipe shall be two inches. Distribution pipe shall be a minimum of four inches from any soil surface (sidewall or soil cover).
15. Use of dynamite or jack-hammer is prohibited in construction of disposal trenches.
16. Use of V-shaped trenches is prohibited, except where soil conditions make construction of vertical walls impossible.

C. LOCATION

1. Setback requirements for disposal trenches are given in Tables III and V.
2. Construction should not be permitted over the disposal trenches.
3. Vehicular traffic should not be permitted in the disposal trench area at any time after its construction.

PART VI - DISPOSAL PITS

A. ABSORPTION AREA - See Part III, D., and Table IV.

B. CONSTRUCTION

1. A disposal pit replacement area equivalent to 100% of the initial area shall be available for a replacement disposal pit. This space shall not be used for permanent structures.
2. The disposal pits shall be constructed in two systems preceded by a diversion valve or equivalent device of approved design to allow for alternate use of each half of the disposal system. Each system of pits shall contain one-half (½) the required effective absorption area and be serially loaded. (See Plate II) The diversion valve shall be installed near the septic tank and the housing of the valve shall be easily accessible at the ground surface for periodic use.
3. Disposal pits shall terminate at least four feet above static groundwater level.
4. The disposal pit shall be backfilled with durable material such as rock or gravel. Rock or gravel fill shall be clean and of uniform size, preferably ¾ inch to two inches in diameter. Volcanic cinders may be substituted for rock or gravel. Materials used for backfill shall offer 30% or more void space.
5. Hollow disposal pits are prohibited.
6. Backfill shall be at least 12 inches of native soil over a protective layer of untreated building paper, or other pervious biodegradable material. Soil placed over trenches shall be compacted so that depressions will not occur.
7. A tight line shall connect the septic tank, diversion valve and disposal pits.
8. The outlet of the septic tank shall be a minimum of four inches above the bottom of the distribution pipe.
9. Open joint or perforated distribution pipe shall run across each pit, and then extend as a tight line pipe connecting pits in series. Minimum diameter of the distribution pipe shall be two inches. A vertical perforated pipe at least four inches in diameter shall be placed within the backfill of the pit. The pipe shall extend from the distribution pipe to the bottom of the pit.
10. Disposal pit shall be constructed in a manner which will minimize, prevent or correct any smearing of the sidewall surface areas.
11. Breathers or inspection pipes may be placed in all disposal pits. The breather shall consist of perforated pipe at least four inches diameter, placed vertically within backfill of the pit. The pipe shall extend from the bottom of the pit to several inches above ground level.
12. Minimum spacing between pits on the same contour shall be three times the pit diameter (12 foot minimum spacing). Pits not on the same contour shall be spaced as follows (12 foot minimum spacing):

SLOPE OF GROUND BETWEEN PITS	MINIMUM SPACING BETWEEN PITS
0% to 5%	3 times the pit diameter
5% to 10%	4 times the pit diameter
10% to 20%	5 times the pit diameter
Over 20%	6 times the pit diameter

13. Use of dynamite and jack-hammer is prohibited in construction of disposal pits.

C. LOCATION

Setback requirements are given in Tables III and V.

PART VII - REPAIR OF A FAILING SYSTEM

When a new subsurface disposal system is installed adjacent to an original subsurface disposal system that has failed, a diversion valve, or equivalent device should be installed between the new system and the old system to allow for alternate use of the new subsurface disposal system and the old system. (Note: The old system should recover some of its usefulness after several months of drying out.) Construction of the new subsurface disposal system should conform to criteria set forth in this bulletin.

PART VIII - RECORDS

A chart showing the location of the septic tank and the leach field or seepage pit shall be placed at a suitable location in dwellings and/or other buildings served by such a system. Whether furnished by the builder, contractor, septic tank installer, or owner, the chart should contain brief instructions as to the inspections and maintenance required, thus forestalling failures and assuring satisfactory operation. A copy of the chart should be filed with the county health department.

TABLE I

EFFECTIVE ABSORPTION AREA REQUIREMENTS AND ALLOWABLE RATE OF APPLICATION FOR SUBSURFACE DISPOSAL SYSTEMS BASED ON PERCOLATION TESTS

PERCOLATION RATE (Time in minutes required for water to fall 1 inch)	REQUIRED EFFECTIVE ABSORPTION AREA IN SQ. FT. PER BEDROOM (See 1, 2, & 3 below)	MAXIMUM RATE OF APPLICATION GALLONS PER SQ. FT. PER DAY (See 2 and 3 below)
1 or less	100	2.00
2	145	1.40
3	185	1.10
4	200	1.00
5	225	0.90
7	270	0.75
10	320	0.63
15	400	0.50
20	455	0.44
25	500	0.40
30	560	0.36
35	610	0.33
40	645	0.31
45	690	0.29
50	715	0.28
55	745	0.27
60 (4 below)	800	0.25

1 - Sufficient area shall be provided for at least 2 bedrooms
2 - Effective absorption surface are sidewalls of disposal trenches and pits
3 - Sidewall areas in permeable substrata only are considered, all bottom surfaces are ignored
4 - Over 60 minutes unsuitable for subsurface disposal systems

TABLE II

MINIMUM SEPTIC TANK CAPACITIES FOR SINGLE FAMILY DWELLINGS

BEDROOMS SERVED[1]	MINIMUM TANK LIQUID CAPACITY (Gallons)
1-3	960
4	1,200
5	1,500
6[2]	1,800

[1]Dens and garages that can be converted to bedrooms may be included at the discretion of the county health department
[2]For more than six bedrooms, use 1.6 x 200 x number of bedrooms for minimum tank capacity in gallons

TABLE III

MINIMUM SETBACK REQUIREMENTS FOR SEPTIC-TANK SYSTEMS[4]

	SEPTIC TANK	DISPOSAL TRENCH	DISPOSAL PIT
Buildings	10 feet	10 feet[3]	10 feet[3]
Property lines[1]	5 feet	5 feet	5 feet
Wells (Public Water Supplies)	100 feet	100 feet	100 feet
Wells (Private)	50 feet	50 feet	50 feet
Live streams[2]	100 feet	100 feet	100 feet
Dry wash	50 feet	50 feet	50 feet
Water lines	10 feet	10 feet	10 feet
Cuts on sloping terrain	-	50 feet	50 feet

[1]Lots with individual wells require setbacks of 50 feet
[2]200 feet on water supply watersheds
[3]Or minimum spacing between trenches (see Part V, B., 9) or disposal pits (see Part VI, B., 12) whichever is greater
[4]All distances are from edge to edge.

TABLE IV

EFFECTIVE ABSORPTION AREAS OF ROUND SEEPAGE PITS[1] (In square feet)

DIAMETER OF LEACHING PIT (feet)	VERTICAL PERMEABLE STRATA (In feet)									
	1	2	3	4	5	6	7	8	9	10
3	9.4	19	28	38	47	57	66	75	85	94
4	12.6	25	38	50	63	75	88	101	113	126
5	15.7	31	47	63	79	94	110	126	141	157
6	18.8	38	57	75	94	113	132	151	170	188
7	22.0	44	66	88	110	132	154	176	198	220
8	25.1	50	75	101	126	151	176	201	226	251
9	28.3	57	85	113	141	170	198	226	254	283
10	31.4	63	94	126	157	188	220	251	283	314
11	34.6	69	104	138	173	207	242	276	311	346
12	37.7	75	113	151	188	226	264	302	339	377

EXAMPLE: A pit of 5 foot diameter and 10 foot depth below the inlet with 4 feet of impermeable soil has an effective area of 94 square feet. A pit of 5 foot diameter and 16 foot depth of permeable soil has an area of 94 + 157, or 251 square feet.

[1]Effective absorption area must be in permeable strata

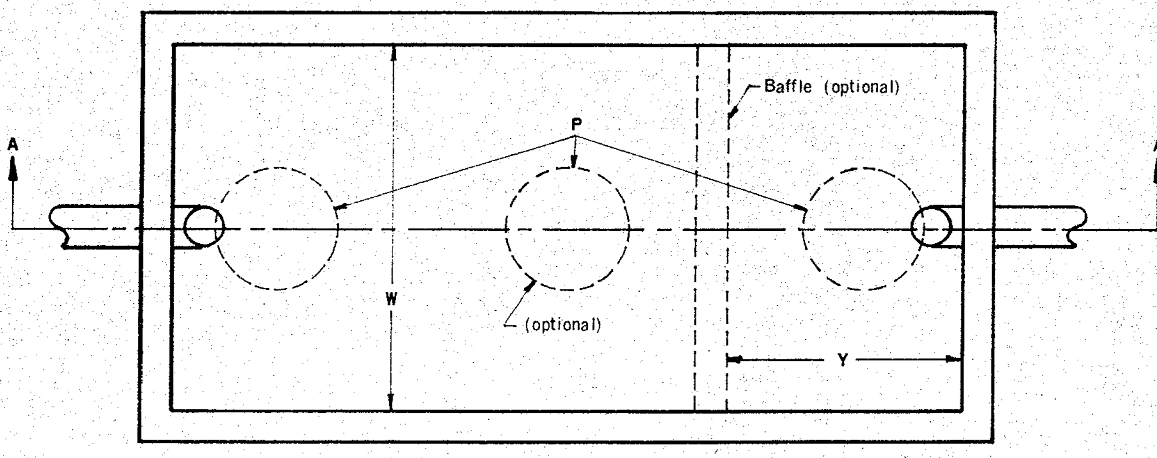
TABLE V

MINIMUM SETBACK REQUIREMENTS FOR SEPTIC-TANK SYSTEMS FROM CANALS

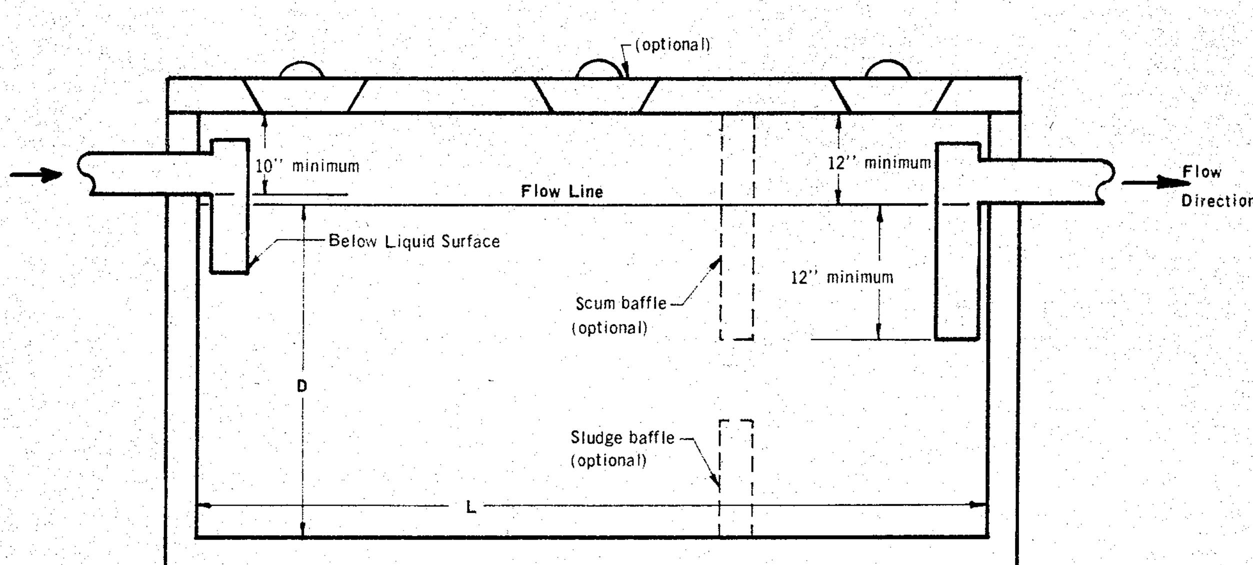
CANAL TYPE	SEPTIC TANK	DISPOSAL TRENCH[1]	DISPOSAL PIT[1]
Lined	10 feet	10 feet	10 feet
Unlined	100 feet[2]	100 feet[2]	100 feet[2]
Elevated (at or above ground level)	10 feet	10 feet	10 feet
Intermittent	100 feet	100 feet	100 feet
Abandoned	10 feet	10 feet	10 feet

[1]The bottom of the disposal trench or pit must be at least 4 feet above the high ground water table
[2]200 feet on water supply watersheds

PLATE I - SEPTIC TANK DETAILS



PLAN (Cover Removed)



SECTION A-A

D - Liquid Depth, generally not less than 4 feet or greater than 6 feet.

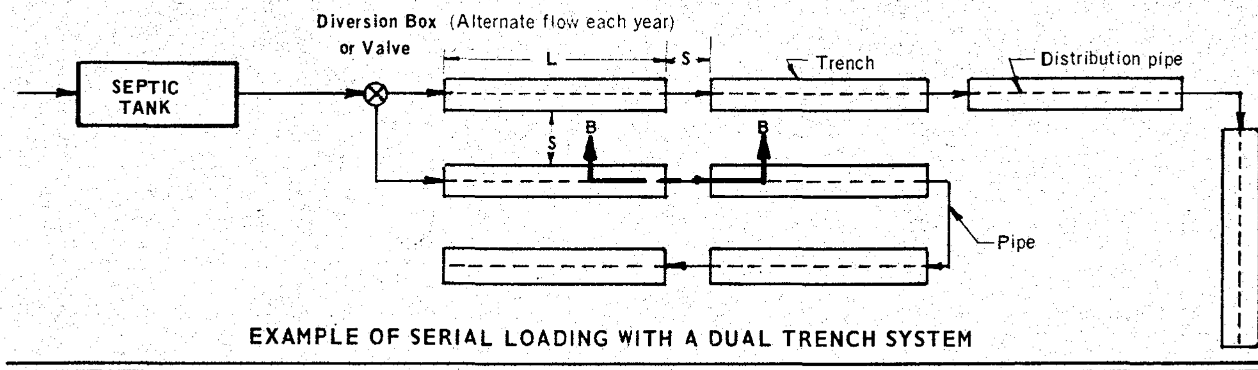
L - Tank Length, at least 2 times but not more than 3 times the width.

P - Position of inspection holes, minimum of 2 inspection holes, 20 inches in diameter, or square.

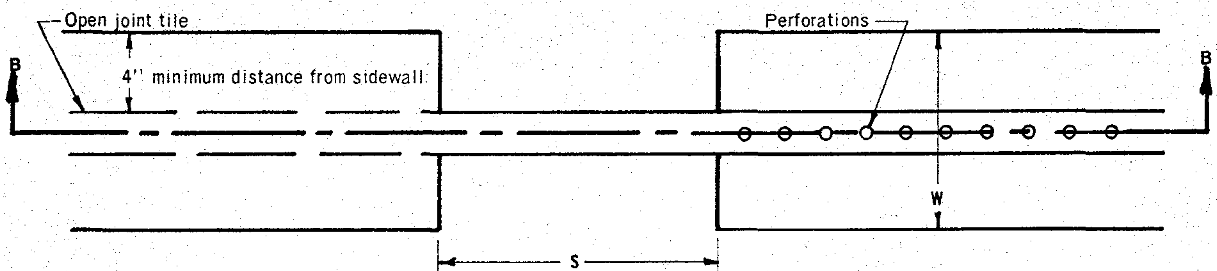
W - Tank width, at least 1/3 but not more than 1/2 the length.

Y - Position of baffles, 1/3 of tank length (L).

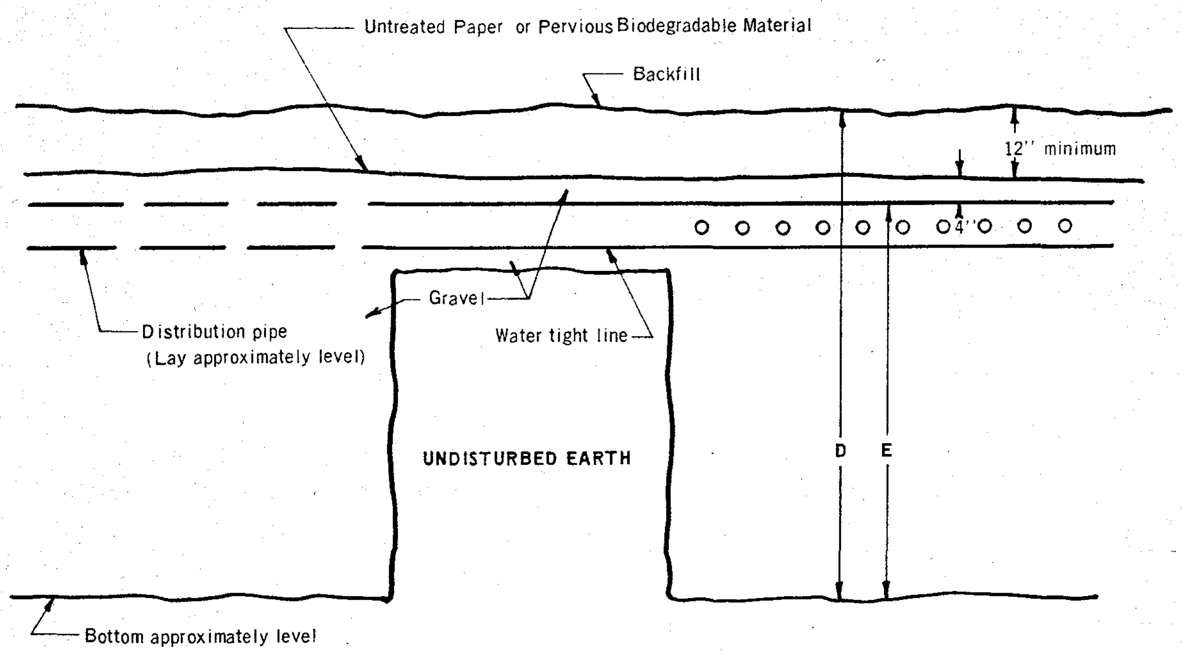
PLATE II - TRENCH DETAILS



EXAMPLE OF SERIAL LOADING WITH A DUAL TRENCH SYSTEM



PLAN DETAIL OF SECTION B-B



SECTION B-B

D - Total Trench Depth.

E - Effective sidewall for absorption, Absorption area per trench = 2 x E x L.

L - Trench Length, 100 feet maximum.

S - Trench spacing, minimum 2 times total trench depth (2 x D).

W - Trench width, 12 inch minimum.

APPENDIX E

PRELIMINARY 1980 CENSUS COUNT BY

ENUMERATION DISTRICT (ED)

APPENDIX E

PRELIMINARY 1980 CENSUS COUNT BY ENUMERATION DISTRICT (ED)

City of Apache Junction

ED NUMBER	POPULATION	HOUSING
130	1201	691
131 T	512	426
131 U	1035	488
132 T	639	331
132 U	835	424
132 V	233	246
132 W	631	510
132 X	145	139
132 Y	145	318
133 T	765	640
133 U	570	499
133 V	677	664
133 W	1023	609
133 X	1524	852
TOTAL (City)	9935	6837

Pinal County

ED NUMBER	POPULATION	HOUSING
15	482	
16	279	
119	201	
134 (400 series)	491	
135 (900 series)	537	
TOTAL (County)	1990	No Data

Maricopa County		
Block III*	182	

*Includes persons living outside city of Apache Junction city limits.

NOTES:

Annexation Into Maricopa County

Effective Date: February 15, 1980
Population (Est.): 150
Housing (Est.): 125

Annexation of Section 32

Effective Date: June 6, 1980
Population: 0
Housing: 0

Preliminary Count Indicated Vacancy Rate About 38.5%

Total Housing - Vacant (38.5%) = Total Occupied

6837 - 2632 = 4205

$$\frac{\text{Total Population}}{\text{Total Occupied Housing}} = \frac{9935}{4205} = 2.36 \text{ person/household}$$