

SUN CITY WEST

PHASE I

DEVELOPMENT MASTER PLAN

Prepared With and For

THE DEL E. WEBB DEVELOPMENT COMPANY

by

HENNINGSON, DURHAM & RICHARDSON

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FORWARD

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FOREWARD

Sun City West, Arizona is a planned new community which will be developed by the Del E. Webb Development Company on a tract of land owned by the Developer and located northwest of Phoenix, Arizona in Maricopa County.

This Development Master Plan report is a comprehensive description of the new community and the objectives guiding its development. The Master Plan report has been prepared for the following reasons:

1. To comply with the requirements of the zoning ordinance for unincorporated areas of Maricopa County, particularly relating to developments of large magnitude and which incorporate the Unit Plan of Development provisions contained in the Ordinance;
2. To present the specific zoning district change requests necessary to implement the plan; and
3. To convey to county officials, current residents of Maricopa County, and future residents of Sun City West the genuine intentions and proven capability of the Developer to create a totally planned and complete community -- one which will satisfy a recreation - retirement life style and which will become an asset to the Phoenix Metropolitan Area as well as a standard against which all such developments nationwide will be measured in the future.

The Development Master Plan is presented in three parts: Part I is the General Community Plan and includes land use, housing, circulation, community facilities and the proposed zoning; Part II is the Drainage Master Plan and Part III presents the Water and Sewer Master Plan.

Part I
GENERAL
COMMUNITY PLAN

Section A

INTRODUCTION

Section A

INTRODUCTION

Sun City West is a planned new recreation-retirement community which will be developed on a tract of land located approximately 12 miles northwest of Phoenix and one mile west of Sun City, Arizona. The total project area for this new community is approximately 13,300 acres and is roughly bisected by Grand Avenue. The entire project site is owned by the Del E. Webb Development Company.

Sun City West will be developed in two phases corresponding to the two parcels of land on either side of Grand Avenue. This Development Master Plan concerns only Phase I because of the project's magnitude and length of time required to reach full development. Although Sun City West will ultimately consist of the entire 13,300 acre tract, Phase I has been conceived and planned as a complete community. General reference to "project" and "Sun City West" in this report shall mean the Phase I planned new community.

The Phase I project area is approximately 5,700 acres and is generally bounded by Bell Road on the south, Grand Avenue on the west, Deer Valley Road on the north, and a proposed extension of El Mirage Road on the east. Plate 1 is a vicinity map showing the relationship of the proposed project site to the surrounding area. The Phase I site itself is depicted in greater detail by Plate 2.

Like the existing Sun City, Sun City West will be developed solely by the Del E. Webb Development Company. Sun City West will be geographically and organizationally distinct from Sun City but will be a continuation of Sun City's high quality planning, design and development and the resultant fulfillment of a satisfying recreation-retirement life style for its future residents.

By any standard, Sun City West will be a massive undertaking. The realization of approximately 17,000 units of housing and the supporting infrastructure of services and facilities in the Phase I project over a 7 to 9 year period will require a high level of competence, organization and management. The Del E. Webb Development Company possesses these qualities. Perhaps the greatest asset of the developer is the experience gained over the past 16 years with the development of Sun City. This community of approximately 40,000 persons will reach its ultimate size of 50,000 persons in 1978. The Del Webb people understand the



Sun City West

PHASE I

PHASE II

LUKE
A.F.B.

TO WICKENBURG

BEARDSLEY CANAL
MCKICKEN DAM OUTLET CHANNEL

IRILBY WASH. DETENTION BASIN

HORIZONTAL CLEAR ZONE

SURPRISE
E
MIR

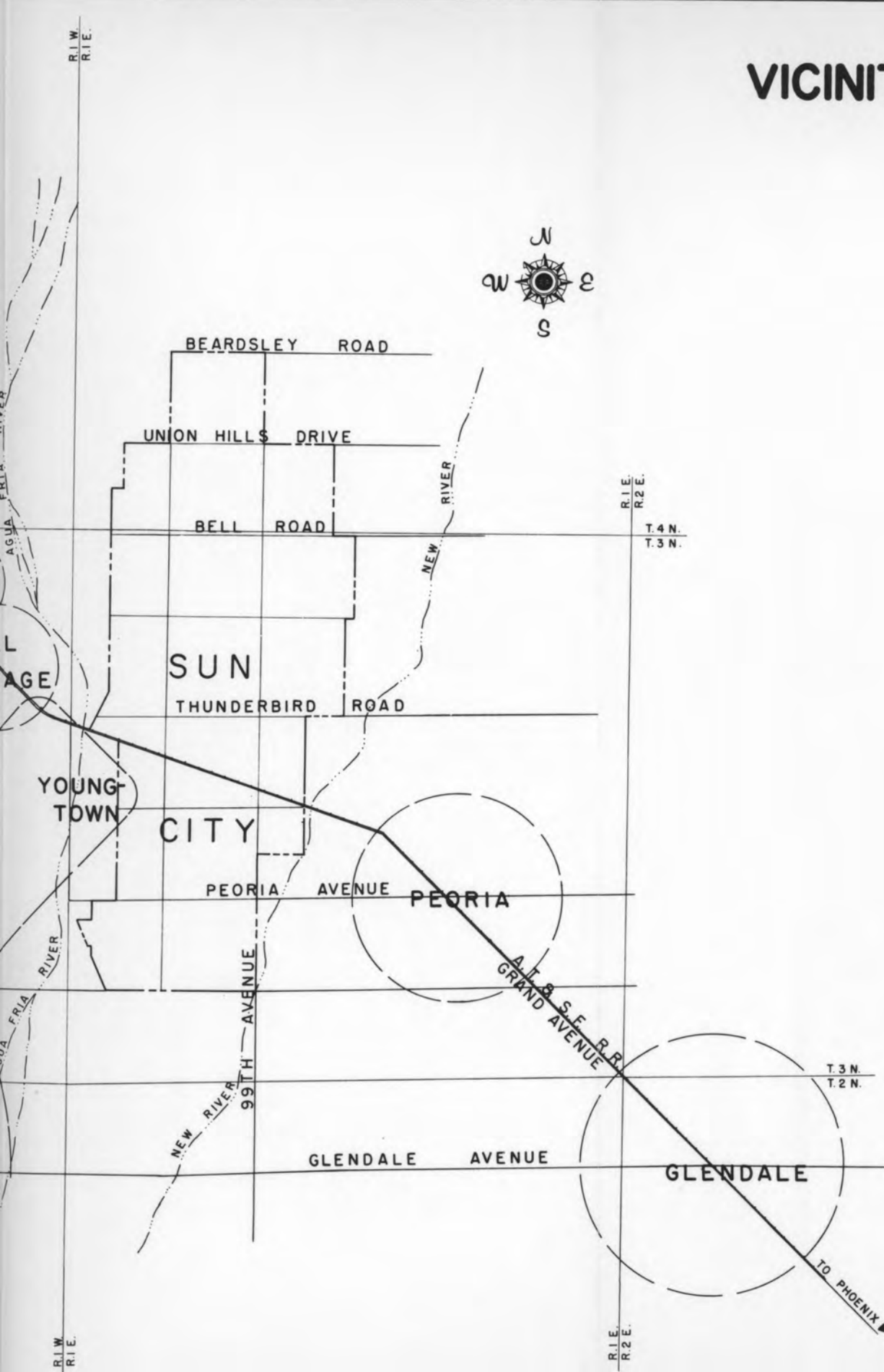
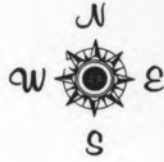
T.4 N.
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R.2 W.
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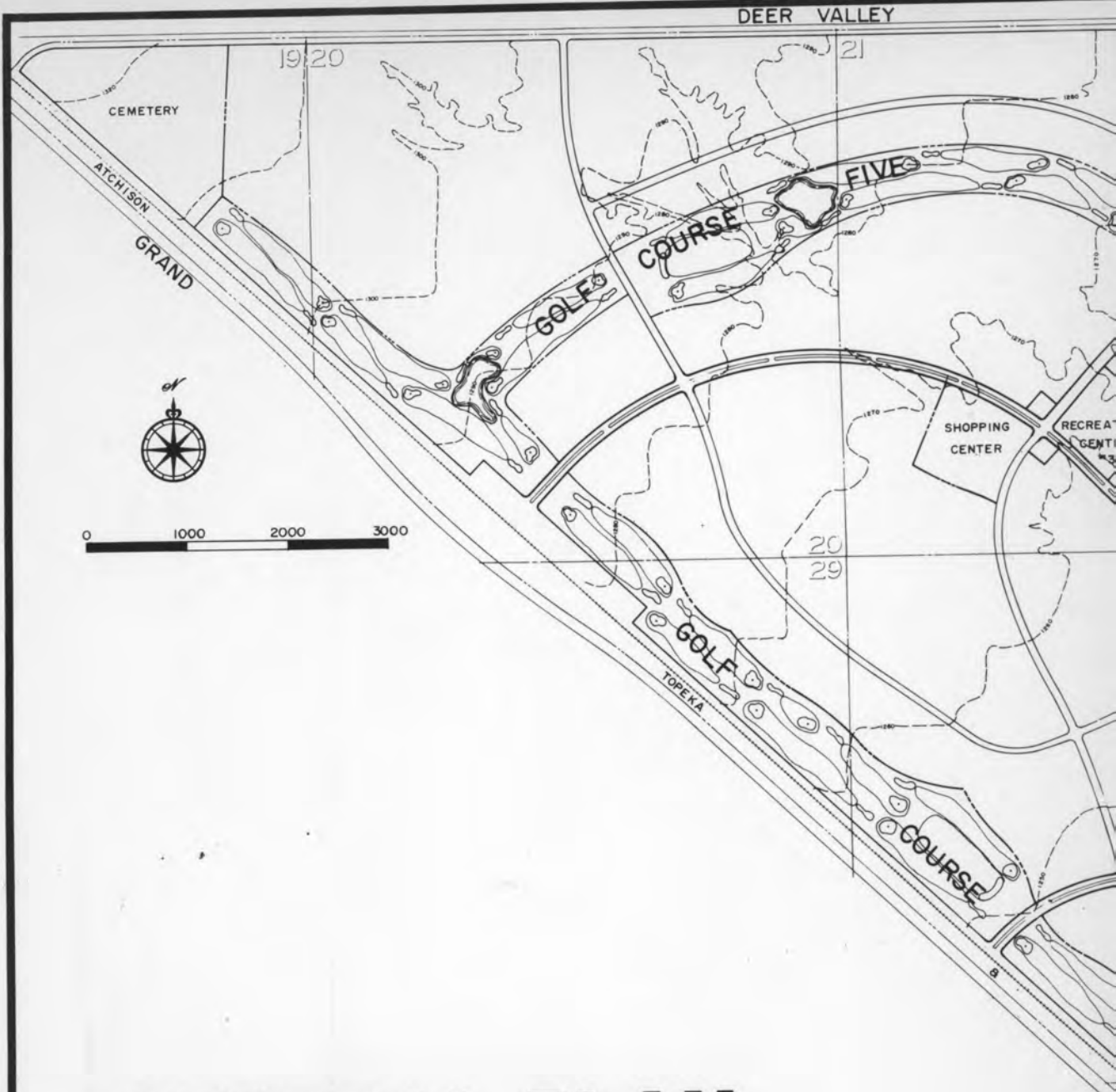
VICINITY MAP



market they are serving and are flexible to respond to its changes. Of no less importance, though, is the firm's stature in the financial community, its ability to obtain development financing, and its complete ownership of the tract of land proposed for development.

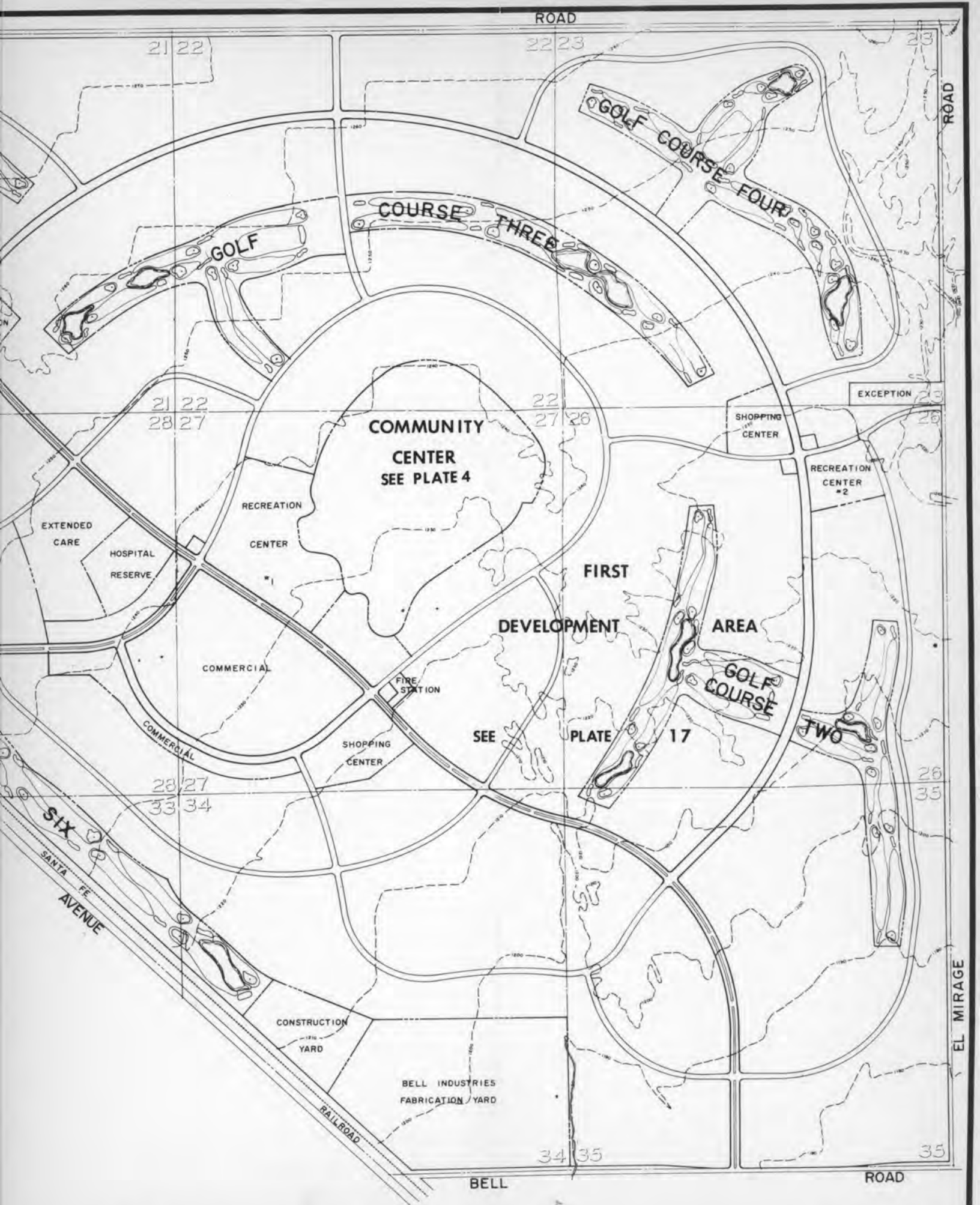
The most adequate description of the proposed new community -- its appearance; form; sensitivity to site, environment and market factors; quality of development; and quality of life within -- is the existing Sun City.

This is not to say that Sun City West will be a carbon copy reproduction, however. While the proven concepts, philosophy, and techniques will continue, fresh approaches to community design and development have been and will continue to be taken where appropriate. The planning process evidenced by this Development Master Plan document and the flexibility inherent in the proposed implementation strategy are strong indications of the Developer's purpose and intent to produce another high quality planned new community.



GENERAL PLAN

Sun City West



Dysmer
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Section B
ECONOMIC IMPACT

Section B

ECONOMIC IMPACT

Sun City West will have a significant and positive impact on the general economy of Maricopa County. In addition to the massive economic activity associated with constructing a new community of 17,000 homes and the related community facilities will be the goods and services demanded by an adult population of roughly 32,500 persons. Following historical patterns in the existing Sun City, it is estimated that 80% of this population will migrate from other states thereby resulting in an infusion of new dollars to the local economy and not merely a shifting of activity within the metropolitan region. Total development cost of the new community will be approximately one billion dollars (1976 dollars).

Although most residents of the new community will be retired, they will have higher than average incomes for the area and will channel this income into the local economy at a higher than average per capita rate. This is due primarily to the adult age composition and the minimization of certain financial obligations associated with younger families such as mortgage payments and college expenses which tend to reduce the level of spending on consumer goods and services. It is not unusual for residents of the existing Sun City to pay cash for their new home and other major local purchases such as automobiles, recreational vehicles and home appliances. Typically, new residents transfer all or a major portion of their liquid assets to their new community.

Sun City West will also result in a considerable broadening of the local tax base. Tax revenues generated by the new community and its population will far exceed the level of public services directly demanded thereby resulting in a contribution toward additional services and/or reduced tax rates to benefit all of Maricopa County.

1. INCOME OF THE POPULATION

A sample survey conducted among 1,495 Sun City households in November and December, 1975, indicated an average family income of \$16,588. Average annual income for those families moving into Sun City during 1975, though, was over \$18,000. Average income in the community is therefore increasing in spite of the generally accepted notion that retirees have "fixed incomes". Since Sun City West will be a continuation of the type of development occurring in the final stages of Sun City, average family income for the new community is conservatively estimated to be \$18,000, expressed in 1976 dollars.

Since a majority of the residents will be fully retired, income will be derived primarily from Social Security, pension and other retirement benefits as well as from personal investments. Although Sun City West will not have any basic industry in the traditional sense, most of the income generated by its residents will have origins external to the community. In other words, even though locally produced goods and services are not exported to other economic regions, an outside source of money flow does exist. This money is then spent locally and becomes the source of additional income, part of which in turn is again spent in the local economy. The externally produced dollar therefore goes through several rounds of local expenditure and the multiplier effect exists even in the absence of the traditional basic - nonbasic industry employment mix.

Total sales reported by retail stores located in the existing Sun City amounted to \$34 million during 1975 representing an expenditure of 11% of total gross personal income by Sun City residents. Assuming this same rate of expenditure, it is estimated that each family living in Sun City West will spend \$2,000 each year directly within their own community for an annual sales volume of \$34 million (1976 dollars) for the fully developed new city. Total retail sales impact of Sun City West will be much greater, since a significant level of additional shopping activity will occur in Phoenix and other parts of Maricopa County, particularly for high ticket items.

The level of deposits in local financial institutions will increase significantly as Sun City West becomes populated. As shown by Table 1 the six banks serving the existing Sun City listed total deposits of nearly \$300 million among the 16 branch office locations in the community and the six savings and loan institutions with 18 branch office locations serving Sun City had deposits of nearly \$410 million as of September 30, 1976. (Although Sun City represented only 1.6% of the State population in 1975, 4.7% of the State's total bank deposits and 13.3% of the State's savings deposits were held by Sun City Institutions.) The level of deposits by Sun City residents exceeds their borrowing requirements thereby creating a surplus of funds for home financing, auto and personal loans in other parts of the metropolitan area.) The 1976 estimated average personal net worth of Sun City residents is \$136,000 per family.

TABLE 1

BANK AND SAVINGS AND LOAN DEPOSITS

	Sept. 30, 1975 <u>Deposits</u>	Sept. 30, 1976	
		<u>Deposits</u>	<u>% of State Total</u>
Banks			
Sun City*	\$249,609,977	\$ 298,745,897	4.7%
Total Arizona		6,398,000,000	100.0%
Savings & Loan Associations			
Sun City**	\$344,388,632	\$ 409,367,298	13.3%
Total Arizona		3,085,000,000	100.0%

* Six banks, 16 offices including one each in Youngtown and Peoria with majority of depositors from Sun City.

** Six institutions, 18 offices including one in Youngtown with majority of depositors from Sun City.

2. EMPLOYMENT IMPACT

Total estimated development cost of Sun City West Phase I, including all housing, commercial, utility and recreational facilities, is \$817 million (1976 dollars). In addition to this direct investment will be a significant indirect impact throughout Maricopa County. Total impact is estimated by using a 2.7 multiplier determined by regional input-output analysis of the Maricopa County economy. The development of Sun City West Phase I over a seven-to-nine year period will therefore result in a total countywide real estate development and construction activity valued at approximately \$2.2 billion (1976 dollars).

This level of activity will result in approximately 55,880 jobs over the total Phase I development period for persons employed in the construction trades and those areas directly and indirectly effected by construction. Using an applicable earnings-to-output ratio of 0.3, this level of employment will receive total earnings, including benefits, of approximately \$662 million (1976 dollars) over the period during which Sun City West Phase I is being developed.

The completed new city will also result in the creation of permanent job opportunities directly within the community. Retail and service employment required by the planned commercial development will be approximately 2,100 and it is estimated that 350 jobs will be created in administrative and professional areas such as law, finance, health and medicine.

3. LOCAL TAX BENEFIT

Total assessed valuation of the completed Sun City West Phase I is conservatively estimated at \$101.0 million (1976 dollars) based on current assessing criteria and a development pattern as described in this master plan report. Approximately 92% of this assessed valuation is derived from owner-occupied housing with the balance coming from commercial properties. Not included in this valuation are churches, recreation centers, public golf courses and a hospital which will be owned by non-profit organizations and therefore exempt from property taxation. Also excluded from the above estimate is consideration of personal property such as automobiles, boats and recreational vehicles which would generate additional tax revenue.

At a current tax rate of \$10.96 per \$100 assessed value, the above assessed value figure would produce \$11.1 million annually (1976 dollars) in tax. This tax rate includes the current levy for the Dysart School District but excludes probable future levies for special districts such as fire protection and street lighting.

Tax proceeds directly earmarked for Maricopa County would amount to \$2.7 million based on the County's current tax rate of \$2.70 per \$100 assessed value. Whereas the 32,500 projected population would represent a 3% increase over current total County population, the new community would result in a 4% increase in current property tax revenues for Maricopa County.

Property tax accounts for 47% of current Maricopa County revenue. Additional sources of revenue include highway user fees, sales tax proceeds and miscellaneous department receipts and fees. The Sun City West development and its resident population will also generate revenue for the County in these other categories. For example, even assuming that each family in the new community spends only 15% of its income on taxable sales in the County and that only 1% of this sales dollar volume is returned to the County, annual sales tax proceeds to the County directly generated by the total new community population would amount to over \$459,000 (1976 dollars). Sun City West will also produce a significant level of tax revenue through the real estate development and incomes indirectly resulting from the new community.

As an unincorporated municipality, Sun City West will unquestionably require additional County expenditures in various areas ranging from police protection and street maintenance to administration and staff support services. However, Sun City West will contribute much more to County

revenue than it will directly require in County expenditures. For example, nearly one half of the County budget currently goes for health, hospital and school purposes, areas in which the new community will directly require very few services. The school age population in Sun City West will be negligible and considering the high average incomes in addition to federal health assistance programs, essentially all of the population will utilize private medical facilities and services.

In the area of recreation, the facilities and services directly provided by the developer and residents themselves will be so extensive that additional demand on the County will be insignificant. In fact, it is doubtful that in any area of County Government expenditure will the per capita requirements of Sun City West exceed the average for all unincorporated areas of Maricopa County. To be sure, the extent to which the new community financially supports all areas of public expenditure will also indirectly benefit Sun City West by helping to solve countywide problems and provide countywide benefits; but in terms of direct relationships, the new community will give far more than it will receive.

The net benefit of Sun City West to the Maricopa County budget can probably best be judged by looking at the existing Sun City in retrospect; few, if any, will say that County finances would be in better condition if Sun City were nonexistent.

4. ECONOMIC IMPACT SUMMARY

The positive impact of Sun City West will be of large magnitude and will be experienced in all sectors of the local economy. The development of the community will not result in a disruptive, burst of short duration activity but will be distributed over a number of years and will be phased in as the existing Sun City reaches full development. The completed new community and its resident population will also become a stable and permanent element, forever generating tax revenues and providing jobs. Table 2 summarizes the major components of economic impact from the planned new community.

TABLE 2
 ECONOMIC IMPACT SUMMARY
 SUN CITY WEST PHASE I
 AT FULL DEVELOPMENT

	1976 Dollars
Total annual personal income of residents:	\$306,000,000
Total annual retail sales directly within community	34,000,000
Retail and service employment within community	2,100 jobs
Professional and managerial employment within community	350 jobs
Total development cost of Sun City West Phase I	\$817,000,000
Total County development activity resulting from Phase I	\$2,200,000,000
Total County construction and related employment	55,880 jobs
Total County construction and related employment earnings	\$661,800,000
Total assessed valuation, Sun City West Phase I	\$101,030,000
Annual County property tax proceeds (\$2.70/\$100 AV)	\$ 2,728,000

\$10,000

Section C

DEVELOPMENT PLAN

Section C

DEVELOPMENT PLAN

Presented in this section is the general plan of proposed land use in Sun City West Phase I, the anticipated mix of housing types which will comprise the overall development, and the concepts and goals expressed by the general plan.

1. PLANNING CONCEPTS AND DEVELOPMENT GOALS

The overriding development goal of Sun City West is the provision of a high quality, year round living environment which satisfies the particular needs and desires of an active, mobile and growing segment of our population -- the retiree.

Community Planning Concept

Being a recreation-retirement community, Sun City West will be inherently unique. The community is planned for a resident population 50 years of age or over; most residents will no longer be actively employed. Sun City West will represent a new stage in life where former responsibilities of employment and family will be replaced by new challenges and opportunities in such pursuits as culture, education, civic activism, recreation and other leisure time activities.

These unique characteristics of the population carry strong implications for overall community planning, design and development. For example, the golf course plays a significant role in the master plan of development. The planning criteria for golf courses in traditional communities is one hole per 3,000 population. In Sun City West, there will be one hole for approximately every 300 residents or a factor of 10 times greater in recognition of the popularity of this sport and frequency of participation among retired persons who will be attracted to this planned new retirement community.

Fulfilling the demand for golf therefore stipulates a large designation of land area for this use. The golf course satisfies additional objectives, however. The golf course can provide a visual screen and noise buffer between residential development and major streets such as

Grand Avenue. In the traditional community, city parks with soccer and football fields, baseball diamonds, play grounds and the like serve an important secondary function of open space and green space vistas. In Sun City West, where such active sports have little purpose, the golf courses themselves provide the park-like open space settings. With a predominately linear pattern to the golf courses, residential unit exposure is maximized and whole areas of housing are linked together through the common green space medium.

In addition to its inherent uniqueness as a recreation - retirement community, it is significant that the Master Development Plan envisions Sun City West as a complete, self-contained city. Sun City West will not be just a residential subdivision, separated from the metropolitan core in a leap frog form of development, contributing to urban sprawl and its attendant high costs of service extensions, and placing excessive burdens on transportation facilities as residents daily seek their ways elsewhere to employment and commercial areas.

Sun City West will be a complete city. A full range of community, health and commercial services and facilities will exist within and as an integral part of the community. For those who desire some form of full or part-time employment, these opportunities too will exist among the various retail and service employers located in the city. Furthermore, the public utility systems will be developed specifically to serve the needs of the new city and will be complete systems unto themselves.

Neighborhood/Subarea Planning Concept

Residential subareas in Sun City West will achieve definition and varying degrees of identity through a variety of ways such as housing style groupings, the street network, security-visual screen walls, the golf course-green space system, and time phasing of development. On a slightly larger scale, neighborhood identities involving from 3,500 to 4,500 homes will tend to develop around focal points of commercial areas and recreation centers. This is a radical departure from the traditional neighborhood identity brought about by the elementary school.

In most cities, the school typically has produced a strong neighborhood concept. Geographically, definition is achieved through attendance boundaries and a central location of the school to balance walking distances. Socially, parents are drawn together through the friendship patterns of children and their schoolmates. From a civic action standpoint, parent-teacher organizations (PTA's/PTO's) focus neighborhood residents on a variety of issues, concerns and projects. However, no schools are planned for the new community because of the age composition of its population.

In Sun City West, the community recreation centers and shopping centers will provide focal points but will not produce the same degree of neighborhood cohesion and identity as does the elementary school. Although the subarea identity will exist and persons from each area will interact at the focal points, community-wide linkages will tend to take precedence. Friendship patterns based on such factors as hometowns and states, college alumni associations, former vocations and current avocations will transcend the boundaries of geographic neighborhood identities. Additionally, each community recreation center will not necessarily offer identical facilities and services. Recreation center memberships will be universal, and each center will therefore not only serve its immediate surrounding residential area but will also cater to the needs and desires of the entire community. Experience has shown from the existing Sun City that a high proportion of the residents are mobile and seek a variety of activities, interests and shopping opportunities located throughout the community.

The absence of a strong neighborhood identity is not considered a negative value. On the contrary, the ultimate size of Sun City West will be on a small enough scale that community-wide identity and cohesion is not only possible but desirable. It is the intent of the Development Master Plan that subarea identity will be strong enough to achieve a personal scale to visual and social order but not so definitive as to diffuse a total, balanced community perspective to the entire Sun City West development.

Community Design Criteria and Development Goals

When Sun City was originally planned in the late 1950's, it was not conceived at the scale of total community environment to which it has now grown. Sun City, as it is known today, therefore did not have the benefit of a total master plan of development from the very beginning. As the continued success and expansion of Sun City became evident, the total master plan concept did evolve. Many of the basic design criteria, which in the early stages were a part of the initial philosophy but were simply not documented, gradually came to be stated formally as development goals. And admittedly, some of the criteria and goals which are now incorporated as a foundation to the Sun City West Master Plan have been formulated in retrospect by interpreting various elements of the existing Sun City which have contributed toward making this community the success it is. Briefly discussed below are the basic design criteria and development goals which have guided the formulation of the Sun City West Phase I Master Plan.

Provide for a diversity of environment. While the recreation-retirement community as a whole has its own special and unique living environment, it is also important that diversity exist within the community. In this manner, people may exercise a choice in their immediate home environment based on their own established likes and dislikes. It will also enable the residents to experience variations in their general living environment as they move about the community from one section to another.

The most significant manner in which diversity will be afforded is through a range of available housing options. Families will be able to exercise choice of housing style, type and density. The basic housing type in Sun City West will be single family detached dwelling on deeded lots. Multiple unit housing structures will offer options requiring no personal lawn care and exterior maintenance responsibilities. For some, the duplex will be a desirable middle ground choice, offering certain advantages of both single and multi-family housing.

Additional diversity will be provided by the commercial developments, golf course-open space areas, recreation center developments and other public and semi-public land use. The recreation centers themselves provide a diversity of environment in terms of the range of active, passive, indoor and outdoor activities available. The street system has also been planned to produce variety, through its curvilinear layout and roadway designs.

Enhance and protect the natural environment. Although the site for the proposed new community is not considered to be environmentally fragile, the overall project will be developed with a sensitivity to the natural environment. Storm water runoff will be controlled to minimize soil erosion and provide protection against potential flood damage. Off-site benefits will also occur due to project drainage control. For example, flood damage potential to existing development in the community of Surprise, will be substantially reduced and additional land within this community will become more suitable for development. In addition, required maintenance of a natural drainageway in Surprise will be reduced and possibly eliminated due to the diversion of runoff to the Agua Fria River.

Water supply demands for the developed new city will be less than those of irrigation for the current agricultural land use on the site. Consideration is being given to recycling treated waste water for golf course irrigation purposes.

Except for construction requirements of Sun City West, there will be no industry in the community and thus no related contribution toward degradation of air and water quality. Although emissions from internal combustion engines will increase significantly, there will be no strong peak periods of automobile travel in the community. Overall, the vast amount of grassed open space and prolific landscaping will serve to enhance the natural environment from its current state.

Promote visual order. There will be a clear perceptual identity of features, subareas and districts within Sun City West with logical linkages and relationships between the elements. This will produce a positive "sense of place" and prevent the diversity of environment discussed earlier from turning into visual chaos. There will also be a strong physical definition to the new community as a whole, brought about by the core area commercial-recreation development with its vacation apartments and the clearly defined community boundaries with masonry walls and perimeter roadway system, exterior to the site.

High standards of structural design will be ensured by architectural review and unsightly utility poles and lines will be eliminated with underground wiring. The same outdoor sign control standards which exist in Sun City will be carried on in the new community.

Provide for vocal points of activity and interaction. Social interaction is healthy for persons of all ages and especially for the retiree and senior citizen. Interaction cannot be forced but community design can provide for opportunities to facilitate social and personal contact. The neighborhood and core area recreation centers and commercial developments have been conceived in the master plan as highly accessible and visible multiple nuclei of activity.

Maximize security -- real and perceived. Although crimes against person and property have been negligible in the existing Sun City, the Developer recognizes the importance residents of the new community will place in security. Sun City West has been planned for limited access into and out of the community proper. Access will be restricted to those arterial streets necessary for community traffic and the needs of adjacent property. Between access points, a six foot perimeter wall will be constructed along the entire boundary of the community. Walls will also exist at various locations within Sun City West. While primarily acting as visual screens and noise buffers, these walls will also afford a degree of security.

The street system in Sun City West is designed to promote exposure among the residents while providing for quick internal access. Street lighting will be provided on all residential streets by Arizona Public Service through Street Light Improvement Districts. Design of the new system will include light standards spaced at a frequency of from 200 to 300 feet to satisfy both safety and security objectives.

There will be little or no single family housing developed on large lots. Individual housing units will therefore be in close proximity to each other within the basic residential groupings and in many cases will be in the same structure. Observant neighbors are strong deterrents to crime, especially when families travel and leave their homes unattended for periods of time. Close neighbors can also make quick calls for fire fighting and emergency vehicles. Police and fire protection will be provided throughout the community.

Maximize accessibility for the handicapped. Nationwide approximately one-third of all elderly persons have physical disabilities which impair their mobility. This proportion will not be this high in Sun City West because the very nature of the recreation-retirement community will attract mobile and active retirees and furthermore, with a minimum age of 50, certainly not all the residents can be considered elderly. Nevertheless, considering the age mix of the population, the per capita rate of handicapped persons will be higher than in similar sized cities with a normal age range mix.

The Developer places a high priority on eliminating architectural barriers to mobility. Structure designs will be reviewed for maximizing accessibility and ensuring the provision of such things as reserved parking spaces, curb ramps and wide door openings. The flat terrain of the project site will be conducive to mobility by wheelchair bound and semi-ambulatory persons.

Provide opportunities for a full complement of community services. The Developer will directly provide for a wide range of services and facilities through the development of the several community-recreation centers. Within these centers will be such things as assembly halls, library, work shops, arts and crafts studios, physical therapy facilities, and meeting rooms.

The Master Plan recognizes, though, that other important services are needed to make Sun City West a balanced, well rounded community for

its inhabitants. While the Developer cannot be directly responsible for providing such things as dental and medical care, financial and legal services, and spiritual and counseling guidance, the opportunities for these services and their land and physical facility requirements will be made available as the Development Master Plan is implemented. Land will be reserved and appropriately released for development for such purposes as churches and synagogues, professional offices, banks and savings and loan institutions.

The Developer will also directly sponsor various cultural and entertainment events and assist residents in organizing themselves to bring about such activities on their own.

2. REGIONAL PERSEPCTIVES

Sun City West will be a self-contained community within the Phoenix metropolitan area. Unlike typical subdivisons and other major residential developments, the new community should not be considered as representing a part of the general growth and expansion related directly to Phoenix, Scottsdale, Tempe and other major cities in Maricopa County. Sun City West will grow to full planned development primarily on its own merits. Sun City and Sun City West are significant and integral elements in the overall metropolitan region development, though, and conformity to county planning and compatibility with surrounding land uses are important.

Maricopa County Future Land Use

Part Three of the County's Comprehensive Plan, entitled A Report Upon Future General Land Use for Maricopa County, Arizona, was prepared in 1975 by the Maricopa County Planning Department. Included as a part of the report is a map showing general categories of future land use as expected to exist by the year 1990.

The map depicts a major corridor of urbanization extending northwest from the Phoenix core area and centered along highway 60/89 (Grand Avenue). The outer extremity of this area of urbanization essentially corresponds to the northern boundary of the proposed new city. Although this plan was never adopted by the Board of Supervisors, Sun City West is contained within the area expected for urbanization by the Planning Department when the study was prepared.

Compatibility with Surrounding Land Uses

Being a self-contained community, functionally as well as physically (bounded by perimeter wall), Sun City West will actually have little impact on surrounding areas. A large portion of the surrounding area is or has been under the control of the Developer.

To the east, separated by the Agua Fria River, is the existing Sun City. Although the two communities will be separate, distinct development entities, there will be some mutual interaction. For example, the Boswell Memorial Hospital in Sun City is a regional facility and will serve the future population of Sun City West until such time as a hospital may be constructed in the new community. It is also expected that there will be some overlap of retail trade areas for the two communities. This interaction is planned and healthy for each of the two retirement communities considering the higher quality which can be achieved by certain region-serving facilities. The two communities will therefore be highly compatible. Access between the communities will be via Bell Road and Grand Avenue.

To the west, separated by Grand Avenue, is the remaining portion of the large tract of undeveloped land owned by the Developer. Currently this area is devoted primarily to agriculture and therefore compatible with the planned Sun City West. This land will be held in reserve for potential future development.

North of the proposed project are agriculture lands which pose no detrimental impacts on or from the planned new community. The new city will re-arrange some local travel paths. However, construction of the arterial street system through the site will actually improve local circulation to areas contiguous to Sun City West.

South of the new city are the small communities of Surprise and El Mirage. As presented earlier and in Part II of this report, implementation of the proposed drainage plan will beneficially impact Surprise by diverting runoff from the watershed to the north over to the Agua Fria River.

To the extent that there will be some travel between Sun City and Sun City West, traffic volumes will increase on Grand Avenue as it passes through and by Surprise and El Mirage. However, this increase is not expected to produce the traffic volumes experienced prior to the initiation of Interstate Highway 10. The eventual linkage of I-10 and I-17 in Phoenix will reduce traffic even further.

South of the new community is Luke Air Force Base. As shown on the Vicinity Map, the air traffic pattern for this facility is well beyond the new community's boundaries and no noise disturbance, safety hazard or other incompatibility exists with the proposed Sun City West.

3. LAND USE

The future land use plan for Sun City West, Phase I is a generalized representation of the various types and degree of land development which are envisioned for the new community in its fully developed state, a condition which will occur approximately 7 to 9 years after initial ground breaking. The land use plan also indicates the kinds of activities which will occur on the various parcels of land and their spatial relationships. Presented below is a brief description of the existing land use of the project site followed by a graphic and narrative description of the future land use for Sun City West.

Existing Land Use

The predominant existing land use in the project area is agriculture but the intensity of use has been declining over the last two years in anticipation of the transition to urbanized development. Roughly 70 percent of the total site has been farmed by irrigation, the primary crop being cotton. Located in the southeast portion of the tract is a cattle feeding lot comprising approximately 160 acres. Plans for phasing out this operation are already underway. The remainder of the site is in a natural desert state.

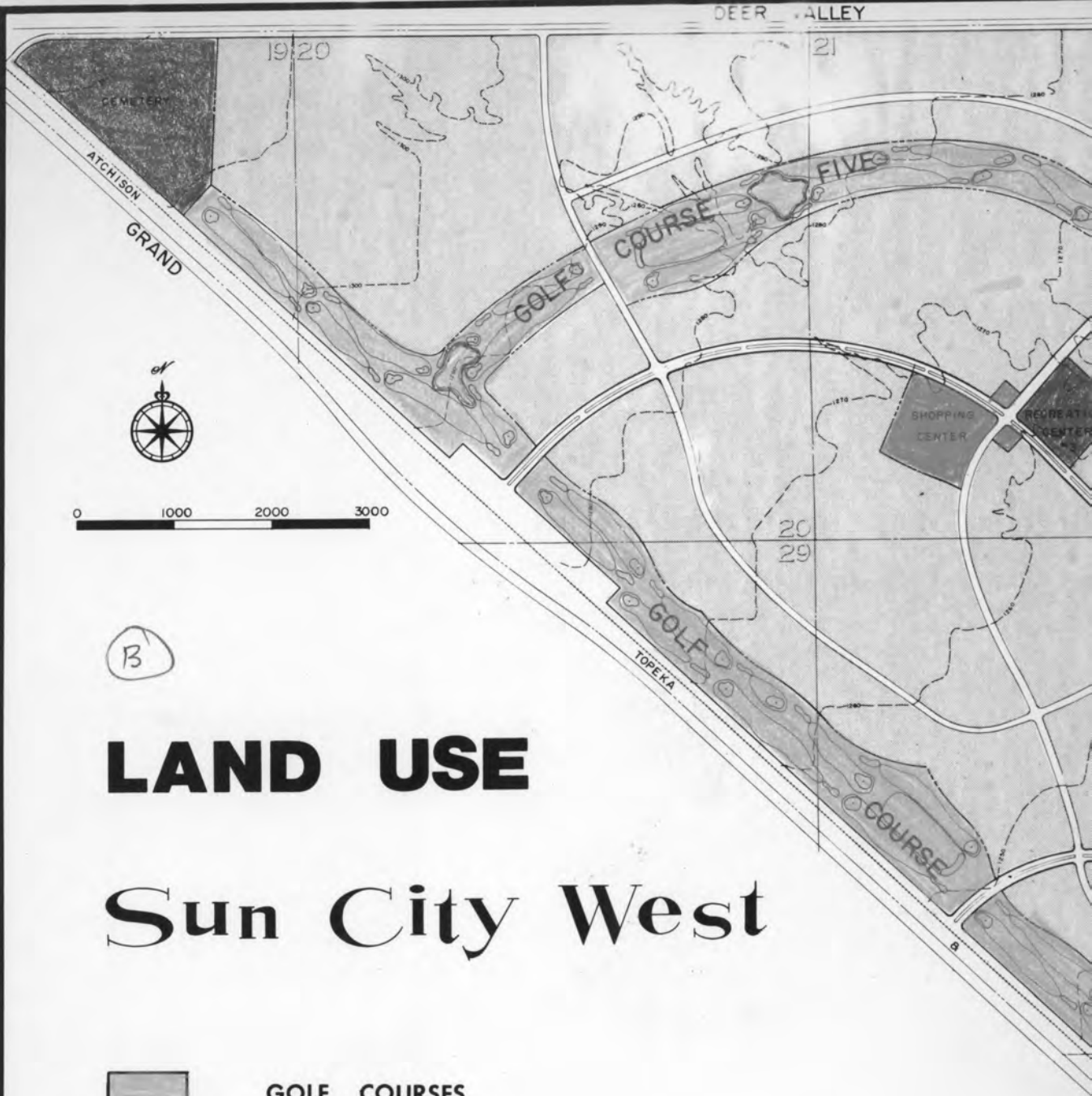
Future Land Use

Plate 3 is a map depicting proposed future land use for Sun City West Phase I. A brief description of each major land use category follows.

Residential. The predominant land use in Sun City West will be residential, accounting for a total of 4,126 acres of land in the Phase I development. This land area includes those streets which are an integral part of the residential areas as well as the common areas which are a part of the higher density housing.

Also included in the 4,126 acres of residential development is a 46 acre tract near the hospital site. This area will be developed for extended care and catered living housing. Although we have classified this use as residential, it will be developed under R-5 zoning and is not included in the Residential Unit Plan of Development presented later in this study.






The residential land use category accounts for approximately 72.4% of the total project area.

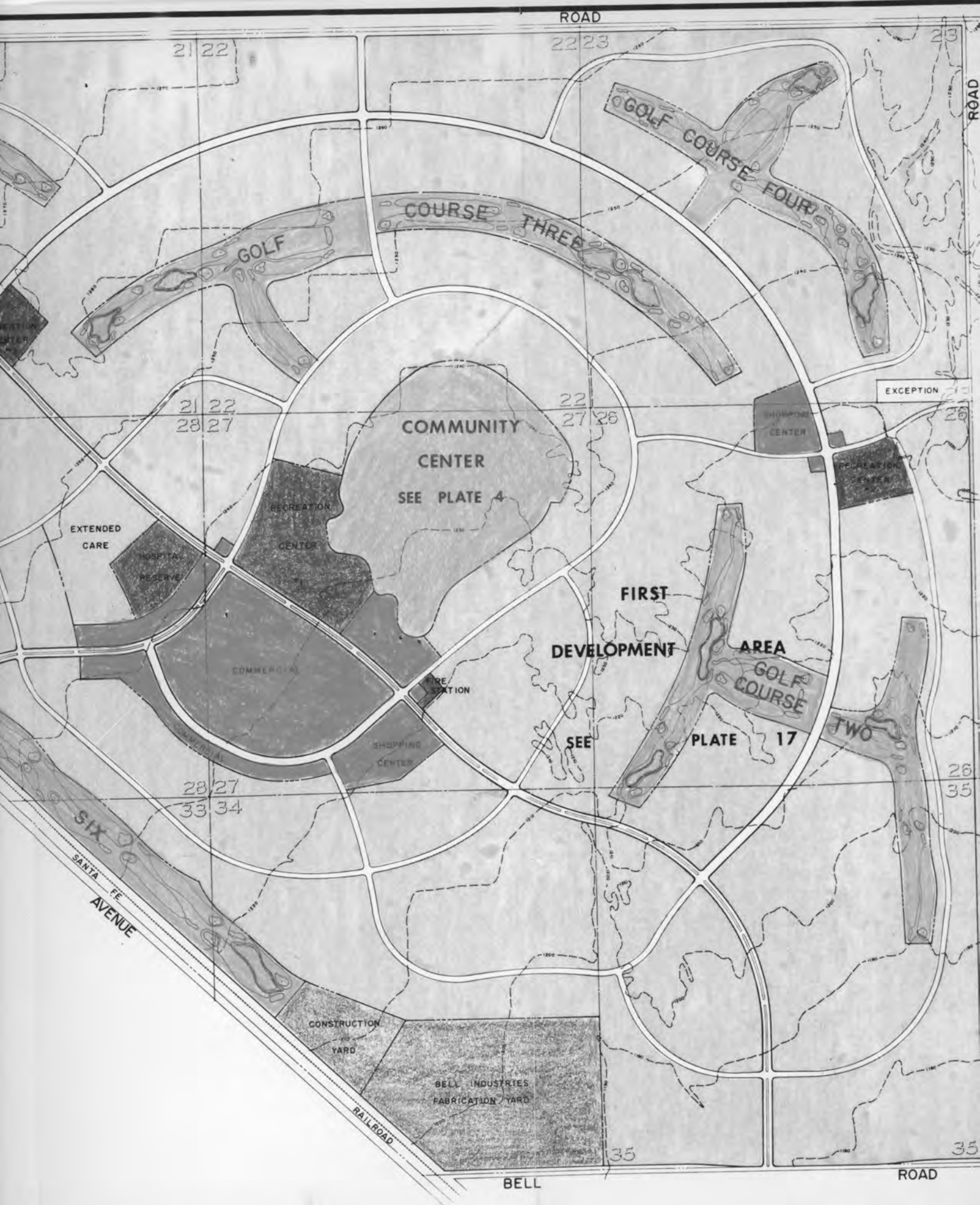


B

LAND USE

Sun City West

-  GOLF COURSES
-  RESIDENTIAL
-  PUBLIC & SEMI-PUBLIC
-  INDUSTRIAL
-  COMMERCIAL



Within the residential area will be major groupings of housing units by type and density; typical housing layouts are illustrated in Section G of this report. The major housing type is single family. Distributed throughout the single family areas will be numerous groupings of duplexes and condominium apartments. These higher density developments will be on a scale and situated so as to be completely compatible with nearby lower density housing.

It would be premature and in violation of the Master Plan concept to specify at this time the precise locations of these different housing types throughout the entire community. Specific site plans of this nature will be prepared as the total community is incrementally phased and platted.

Commercial. Approximately 277 acres (4.9% of the total area) will be developed for commercial purposes. Within this general category, the Master Plan envisions three neighborhood shopping centers of from 18 to 27 acres each including parking and adjacent streets. The primary elements of the neighborhood center will be the grocery and the drug store. Additional smaller businesses such as card and party shops, cafes and coffee shops, repair services, personal care services, and professional offices will typically be in these developments. The neighborhood shopping center in Sun City West will be on a similar scale as those in the existing Sun City. The total area planned for neighborhood shopping centers is 65 acres.

The core area commercial development will comprise roughly 198 acres and will take on the posture of a region-serving facility. Within the core area development will be a complete range of medical, dental and other professional offices. One or more general department stores will be the "anchor" retail outlets, supported by specialty shops for apparel, furniture, appliance sales and services and the like. The core area will also have full-service restaurants.

Distributed throughout the new community will be 6 commercial sites each with an area of approximately 1.4 acres. As generalized on the land use plan, these sites will be located at intersections along arterial and major collector streets. These sites will be used for banks, savings and loan institutions, and automobile service stations.

The zoning change request, presented in Section 7 of this report, also includes 6 one-acre parcels located in golf courses. This zoning is a technical requirement to permit the sale of alcoholic beverages at the golf course club houses. These sites have not been depicted as commercial areas on the land use map since the real use of the land will be the golf course-recreation function.

Industrial. Approximately 172 acres, 3% of the total land area, is designated industrial. This area will be used by the Developer for the storage of building materials and equipment for the manufacture of housing components and for other activities directly associated with the construction of Sun City West. No other industrial activity is planned for the community.

Public and semi-public. This land use classification includes a hospital, recreation centers, houses of worship and a cemetery for a total of 217 acres, 3.8% of the total project area.

The Development Master Plan envisions a core area recreation center requiring approximately 63 acres. In addition to the structure and its related parking lot, this main center will also include outdoor recreation areas (lawn bowling, tennis, etc.), park-like settings and other facilities such as an enclosed amphitheater.

Two satellite neighborhood centers will be similar in concept to the main facility but on a smaller scale. Each of these satellite centers will require from 16 to 20 acres. The total estimated land area for all recreation centers is 99 acres.

Other public and semi-public land uses will include a cemetery (55 acres) and approximately 10 church sites ranging in size from 3 to 5 acres for an estimated total of 40 acres.

A tract of 21 acres near the community center has been reserved for construction of a hospital when community growth requires such a facility. This tract is included in the public and semi-public use category, even though commercial zoning will be required for high rise construction.

Golf Course . Although actually a public land use, the golf course has been classified as a separate land use category because of its significance as a recreational feature and its value as general open space - green space. The six 18-hole golf courses planned for Sun City West will comprise approximately 905 acres, or about 15.9 percent of the total community land area.

Streets and utilities. The land use map does not include a classification for streets; instead, streets are indicated by the General Circulation Plan (Section D of this report). Streets do; however, account for a significant portion of the overall land area. It is estimated that approximately 20% of the total project area, or 1163 acres, will be devoted to street right-of-way. All areas referenced above for the various land use categories include those streets which are within or adjacent to the particular land uses.

There will be certain land requirements within the new community for utility purposes, primarily related to water supply and storage. This land area will be negligible in relation to the total community.

Development Pattern -- The Central Core

Initial development in Sun City West will involve the Central recreational core and the first stages of the utility and circulation systems infrastructure. The basic pattern of development will then proceed outward and around the core. It is anticipated that the areas south and east of the core will be developed before those on the north and west.

The central core is an important element of Sun City West. It not only serves as a primary focal point for the completed community but will also represent the serious intentions of the Developer during the initial stages of marketing and residential construction. The first prospective new residents of Sun City West will not be shown artist's rendering of project amenities but will be able to contemplate their retirement future while playing golf, enjoying other recreation facilities, inspecting model homes and vacationing in housing units which will be permanent features of the planned new community.

Because the central core is so important and will be the first actual development, the design of this area has progressed considerably and is represented by Plate 4. Primary features surrounding the 18-hole golf course are the model homes and marketing office, the main recreation center, an amphitheater, restaurants, golf clubhouse facilities and the vacation apartments.

The apartments are an important aspect of the Del E. Webb Development Company's popular and successful vacation plan. Under this plan, prospective new residents may vacation at the new community for up to two weeks at a time at very reasonable rates. Vacationers are thus afforded the opportunity to experience the recreation-retirement community at a leisurely pace and to meet current and other prospective residents. As Sun City West Phase I reaches full development, the apartments will be sold as permanent residences.

Although there will be some commercial establishments in the initial core development, the full scale shopping center and medical facilities developments will not materialize until there is sufficient market justification. Until this core area center is constructed, the needs of the residents will be met by smaller scale neighborhood centers and by the complete shopping and professional services located just a short distance away in Sun City.

COMMUNITY CENTER

Sun City West

- Ⓐ 18 HOLE GOLF COURSE
- Ⓑ RECREATION COMPLEX
- Ⓒ TENNIS & LAWN BOWLING
- Ⓓ SUN DOME THEATER
- Ⓔ RESTAURANT CLUB
- Ⓕ COFFEE SHOP
- Ⓖ LIBRARY
- Ⓗ FIRST MODEL AREA
- Ⓘ MODEL AREA RESERVE
- Ⓙ VACATION APARTMENTS
- Ⓚ VACATION APARTMENTS RESERVE
- Ⓛ SPECIAL VIEW APARTMENTS
- Ⓜ COMMERCIAL CENTER
- Ⓝ FIRE STATION





4. POPULATION AND HOUSING

Projected Population. It is projected that Sun City West Phase I will have a population of 32,500 persons when fully developed. This is based on an average family size of 1.9 persons per dwelling unit and an ultimate development of 17,100 housing units. The family size figure represents current conditions in the existing Sun City and is not expected to deviate for the new community.

Source of Growth

Sun City West will grow to its projected ultimate population and derive replacement population to maintain this size through immigration. The community will not have an internal natural growth simply because of the age of its residents.

Some of the immigration to Sun City West will come from the nearby Phoenix metropolitan area but the primary source of growth will be from areas beyond Maricopa County and the State of Arizona. Persons have moved from all of the United States and several foreign countries to live in the existing Sun City. Although the Developer conducts an active marketing program, the strongest drawing power comes from existing residents who convey personal satisfaction to friends residing in their pre-retirement communities.

The Housing Market

Retirees comprise the fastest growing segment of the population in the United States. From an age standpoint, this group is expanding in two directions. First, continually improving health and medical practices are gradually increasing average life spans. Secondly, more and more employers are offering early retirement plans with benefits and more and more people are exercising this option, thus reducing the average age at which one enters retirement.

A third source of expansion in the market is the existence of larger numbers of people in lower age groups who will be progressing into the retirement age category. Although it is still 20 to 30 years distant, the large bulge in our population created by the post WW II "baby boom" will have tremendous implications for the various elements of our economy which serve the retiree.

Certainly not all retired persons have either the resources or a desire to leave their home community. A growing number of persons are becoming well-traveled; however, both from business and family pursuits, and the change of moving to a retirement community is looked upon with eager anticipation. With lower long distance rates, a near fully developed interstate highway system and jet travel, contact with family and home-town friends is not lost.

The Sun Belt in general, and Arizona and Maricopa County in particular, are strong attractions to the retiree. Mild winter climate year round, recreation opportunities, and generally lower taxes and prices make the Sun Belt a highly attractive alternative to northern cities. That a market exists for Sun City West is undisputed. The challenge to the developer is to be responsive to the particular and varied desires of the market and to absorb the market in a steady, continual rate to maintain the high quality development goals embodied in the Development Master Plan.

Housing Opportunities

The Developer will offer a wide range of housing types and styles to the new resident of Sun City West and over a fairly broad range of cost. As an example, basic housing prices in the existing Sun City currently range from \$27,000 to \$59,000. Additional housing variation is possible through location, such as on a golf course or near a recreation center.

TABLE 3

HOUSING DENSITY

	UNITS/ACRE
Gross Project Area Density	3.0
Residential Area Densities*	
Single-Family	3.65
Duplex	4.65
Multi-Family	7.0

*Includes public right-of-ways

TABLE 4

ANTICIPATED HOUSING MIX BASED ON CURRENT SALES TRENDS

HOUSING TYPE	TOTAL NO. OF UNITS	% OF ALL UNITS	APPROX. LAND AREA REQ'D. INCL. STREETS	% OF GROSS RESIDENTIAL AREA	% OF GROSS PROJECT AREA
Single Family	11,115	65%	3,045 acres	74.5%	53.4%
Duplex	2,565	15%	552 acres	13.5%	9.7%
Multi-Family	<u>3,420</u>	<u>20%</u>	<u>489</u> acres	<u>12.0%</u>	<u>8.6%</u>
TOTAL	17,100	100%	4,086 acres	100%	71.7%

Table 3 presents maximum proposed housing densities in Sun City West Phase I. Table 4 presents the basic housing types and projected number of units and land area requirements for the fully developed new community based on current sales trends.

By submission of this Development Master Plan and its incorporated zoning change requests to the Maricopa County Planning and Zoning Commission, the Developer makes the commitment that the control densities for total gross project area and individual housing types will never be exceeded. The projected housing mix is subject to change depending on future market demand but densities can only decrease, not increase from the control densities stipulated by this plan.

Typical layouts for the various housing types are included in Section G, as part of the formal zoning change request.

Section D
TRANSPORTATION

Section D

TRANSPORTATION

It is well recognized that transportation and land use are highly interrelated. Land use places varying requirements on transportation system capacities and linkages; and the existence of transportation facilities strongly influences how and when land is developed. Since the establishment and improvement of major transportation arteries (thoroughfare streets, rail rapid lines, etc.) are usually within the purview of the public sector and land development is basically a private sector endeavor, the transportation system is often viewed by planners as a tool to help shape the urban environment.

Philosophical discussions of future land use transportation system interactions have little value for Sun City West. The Developer essentially has complete control over both land use and the circulation system. The two elements have been conceived in companion throughout all stages of planning.

In addition to providing for basic vehicular movement, the circulation system has been planned with other objectives in mind such as: minimize vehicle-pedestrian and vehicle-vehicle conflicts; enhance real and perceived security; provide for a diversity of view and pattern; promote clear identification of subareas and their linkages; and facilitate drainage control.

i. TRANSPORTATION MODES AND TRAVEL PATTERNS

Sun City West will clearly be an automobile oriented community. The high proportion of single family housing and low overall density of development precludes any significant mobility by other modes. Automobile ownership rates will be high given the general economic status of the residents.

Receptivity of fixed-route transit service in the existing Sun City has not been great. This is due in part to automobile availability, the lack of high density travel corridors and the decentralization of trip generators. If fuel prices increase significantly and/or supplies decline, public transit may indeed have a role in the new community. Because of the general land use pattern and diverse travel desires of the residents, a door-to-door, demand-responsive system may be more

suitable than fixed-route, fixed-schedule service. Paratransit services, in the form of traditional taxi cabs, will likely be available in the new community from the very beginning.

Electric golf carts, modified and licensed for street operation, will appear in growing numbers. This form of travel offers a desirable alternative to the automobile in terms of cost and environmental protection. Bicycles and 3-wheeled pedal power vehicles will also be popular because of the flat terrain and recreation oriented population.

Consideration has been given to the development of a system of pathways for use by electric carts and bicycles. Although this idea has not been totally rejected, there are no current plans to incorporate such a system in Sun City West. At first glance, the perimeters of golf courses appear to be highly suited for a system of pathways because of their basic linear pattern. Closer consideration reveals two major problems, though; first, the active use of both golf course and pathway presents a serious safety hazard and second, the paths would result in a physical barrier between the numerous golf course lots and the courses themselves and heavy travel activity would result in a nuisance to the owners of these highly desirable home sites.

An off-street pathway system would require numerous street crossings if residential areas are to be linked with activity centers. These crossings would produce highly concentrated areas of modal conflict. Construction of grade separations with sufficient capacity to handle the significant pathway traffic would be quite costly and would introduce a disruptive visual element into the overall community design. Since carts and bicycles would occasionally use streets anyway, it would be better to develop a total coexistence of the modes from the very start. In this manner, cart drivers and bikers will not be prone to violate the "rules of the road" and auto drivers will be continually exposed to the slower modes of travel and will develop an instinctive tolerance and respect for them. This concept is working well in Sun City.

Intercity and metro area transportation services will be provided by bus and limousine/van operations. Like Sun City, opportunities will be provided in the new community for the establishment of a bus terminal.

The recreation-retirement community is unique in the types of trips generated. The work trip and school trip, which are the primary contributors to peak travel flows, will be almost negligible in Sun City West. The predominant trip purposes will be the shopping trip and the

social-recreation trip. Because these trips will relate to the primary sources of diversion and activity in Sun City West, they will be made with greater frequency and regularity than in a traditional community. These trips are typically made at variable times from mid-morning to late afternoon. It is therefore anticipated that traffic volumes will be moderate and evenly distributed over most of the daylight hours and generally light during the night time.

Essentially all traffic on Sun City West's streets will be internally generated. Persons working in Sun City West but living elsewhere and nonresidents patronizing local commercial areas are expected to account for a very small percentage of the total traffic volume.

2. STREET CIRCULATION PLAN

The proposed street plan is presented by map on Plate 5. The basic elements of the plan are an external perimeter roadway and an internal hierarchy of arterial, major collector, minor collector and residential streets in a curvilinear pattern.

Existing Roadways and Their Improvement

Primary access to the new community site from the Phoenix metropolitan area is via Grand Avenue (U. S. Route 60/89 and State Route 93) and Bell Road. Bell Road also directly links Grand Avenue and the new community with Interstate Highway 17.

Grand Avenue along the west side of the project is an all weather surface two lane roadway constructed of asphaltic concrete with a pavement width of approximately 40 feet. Since the roadway carries both State and U. S. Highway designations, all improvements and maintenance are performed by the Arizona Department of Transportation.

Bell Road along the south side of the project site is also an all weather surface, four lane roadway. It is constructed of asphaltic concrete with a pavement width of approximately 56 feet. This roadway is included in the Maricopa County Highway System and thus all improvements and maintenance are performed by the Maricopa County Highway Department.



D

STREET PLAN

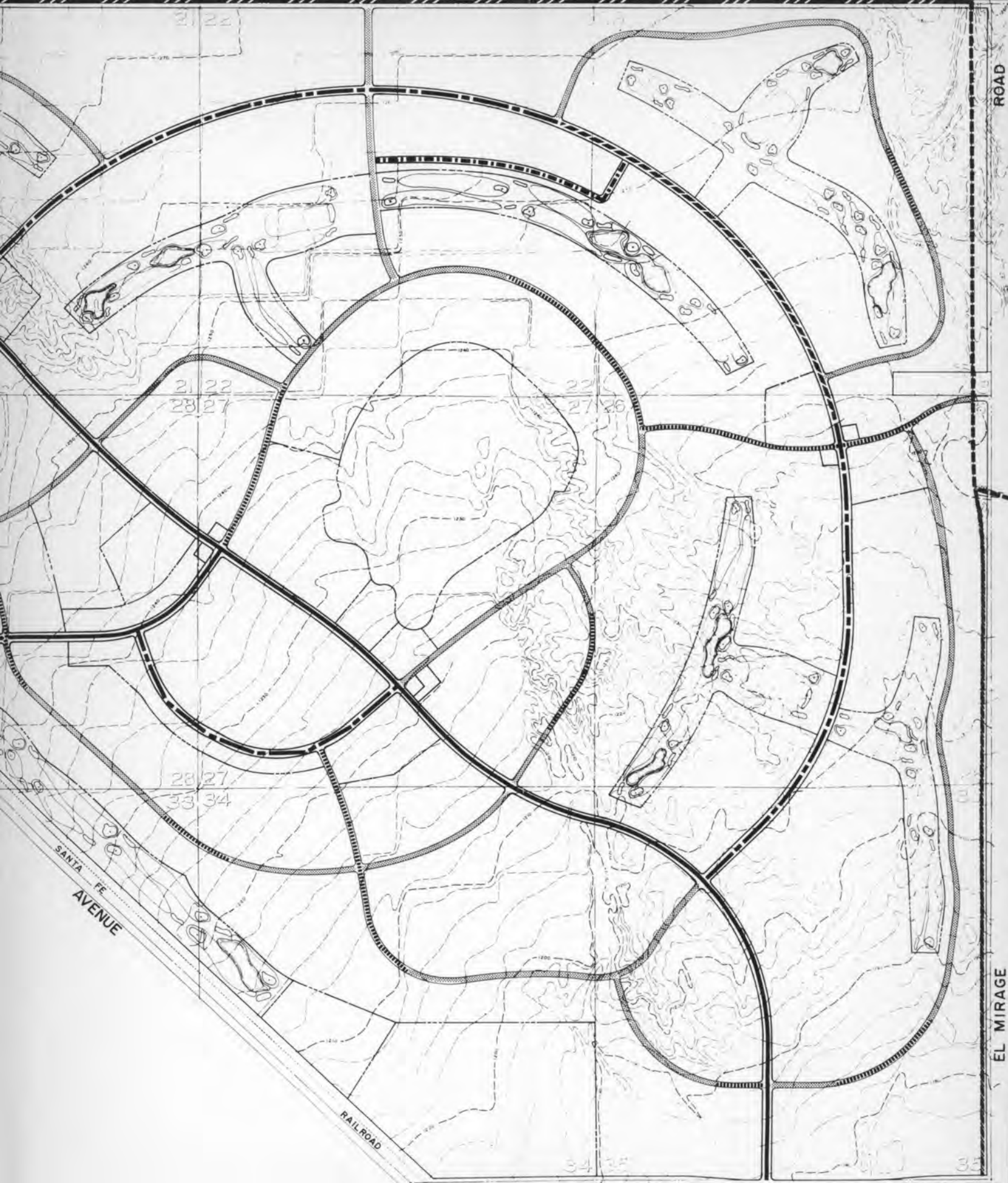
Sun City West

LEGEND

- COLLECTOR STREET SECTION B
- COLLECTOR STREET SECTION B-1
- ////// ARTERIAL STREET SECTION C
- ===== ARTERIAL STREET SECTION D
- ARTERIAL STREET SECTION D-1
- - - - - RESIDENTIAL STREET (SPECIAL) SECTION D-2
- ////// DEER VALLEY ROAD HALF-SECTION
- ////// EL MIRAGE ROAD HALF-SECTION
- EL MIRAGE ROAD HALF-SECTION (WITH CHANNEL)

ROAD

ROAD



EL MIRAGE

BELL

ROAD

Grand Avenue and Bell Road will comprise two links of an important perimeter roadway system which will be external to the community proper, i. e. outside the perimeter boundary wall. This perimeter system is essential because limited through traffic facilities will be provided within the new community. It will be especially important to provide access to property immediately north of the project site. The remaining links of the perimeter system will be provided by Deer Valley Road and El Mirage Road.

Deer Valley Road is currently a gravel roadway and El Mirage Road does not exist along most of the eastern boundary of the new community. The Developer will improve Deer Valley Road and construct an El Mirage Road extension to Maricopa County Highway Department minimum standards of double inverted penetration seal coats as shown by the typical roadway sections on Plate 6 and Plate 7.

Within the project site are numerous gravel surface roads for access to farm fields. These roads are considered private and are not generally maintained except for Litchfield Road between Grand Avenue and Deer Valley Road and Beardsley Road between Grand Avenue and Dysart Road. Both of these roads have 66 foot dedicated rights-of-way and are frequently bladed by Maricopa County Highway Department. The only hard surface roadway within the project site is Dysart Road which provides access to the Circle One Ranch Feed Lot and is constructed of inverted penetration seal coat.

Street System Within the Planned Community

A grid-like pattern of roads currently exists within the project site. This pattern is caused mainly by the land use and previous land ownership patterns of the area. It is usually County policy that all section line roads on a one mile square grid be designated as arterial roads. This grid road pattern will be maintained along the periphery of the site by the construction of Deer Valley Road and El Mirage Road as previously discussed. A major departure of the grid pattern is evident in the street system planned for the new community.

The planned street system within Sun City West will be comprised of a system of arterial streets and supporting hierarchy of major and minor collectors and residential streets. The arterial street shown on the Street Plan (Plate 5) as Section C (Plate 8) is the major traffic carrier and collector of the proposed development. This street provides major access to the central commercial/recreation core development and will serve to channel traffic into and out of the community at three points, one at Bell Road and the other two at Grand Avenue.

The major arterial street will be constructed of 2 inch asphaltic concrete pavement over a minimum of 9 inches of aggregate base depending on soil tests, and will have concrete curb and gutters. The road will be a four-lane divided street on a curvilinear alignment to provide a continuing change of vistas and be aesthetically and environmentally pleasing. Left turn bays will be made by indentation of median islands to facilitate traffic safety and efficient flows.

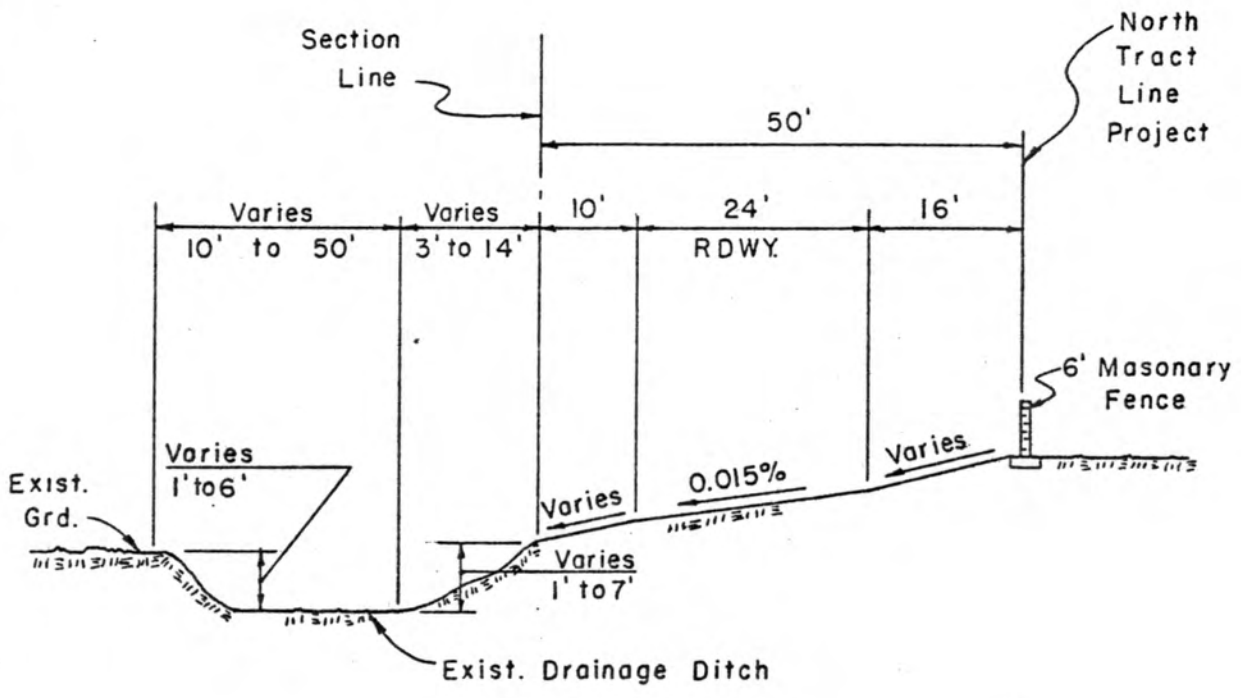
The other arterial streets are shown on Plate 5 as Section C and Section D-1 (Plate 8 and 9). Pavement design of these streets will be the same as the major arterial with curbs and drainage facilities as shown on Plates 8 and 9.

The design of the collector streets is indicated by Sections B and B-1 on the Street Plan and graphically depicted by Plate 10. These streets will serve as a connection between the arterial street and the net work of residential streets. The collectors will be designed primarily for internal traffic circulation and to provide direct access to the core area and neighborhood shopping and recreational facilities. The collector streets will be constructed with concrete vertical curb and gutter and will be of 2 inch asphaltic concrete pavement over a minimum of 6 inches aggregate base depending on soil tests. Parking will be permitted adjacent to the edge of the roadway.

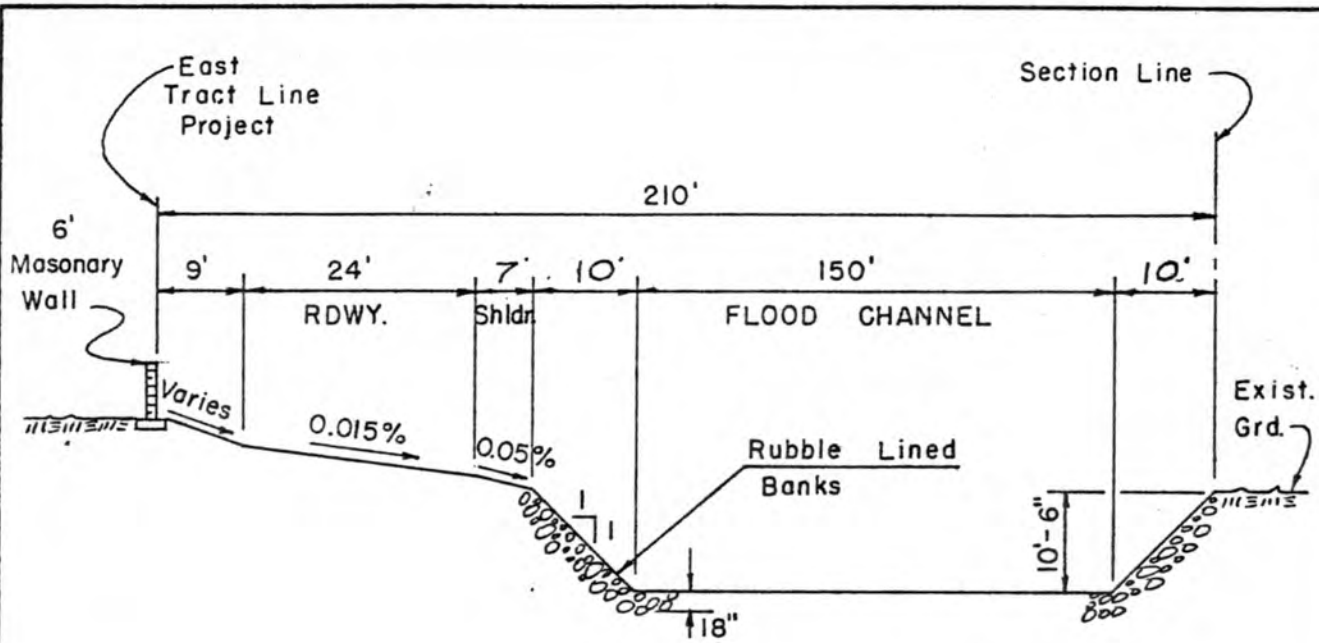
Basic residential streets will have 50 foot rights-of-way with 32 foot back of curb width street sections. Those residential streets located in high density areas or which partially serve as a collector will have 60 foot rights-of-way with 40 feet street widths and concrete roll curb and gutter. A special residential street section D-2 is depicted on Plate 9 and shown on the Street Plan. This street section was developed for routing of storm run-off to a channel in an area of flat street slopes. Sidewalks will be constructed on both sides of residential streets. Residential streets are intended to serve only limited abutting land uses and will generally be of looped or cul-de-sac design to discourage through traffic. These roadways will be constructed of 2 inch asphaltic concrete pavement over a 6 inch aggregate base depending on soil tests. Roll concrete curb and gutter will be provided and parking will be permitted on residential streets. The Street Plan indicates proposed locations of only the wider residential streets since layouts of basic residential streets are indeterminate at this time. A typical cross section of a residential street is depicted by Section A in Plate 11 but is not referenced on the Street Plan.

All streets in the new community will become a part of the County Street System and will be paved conforming to Maricopa County Highway Department Details and Specifications except as shown on Plates 6 through 11.

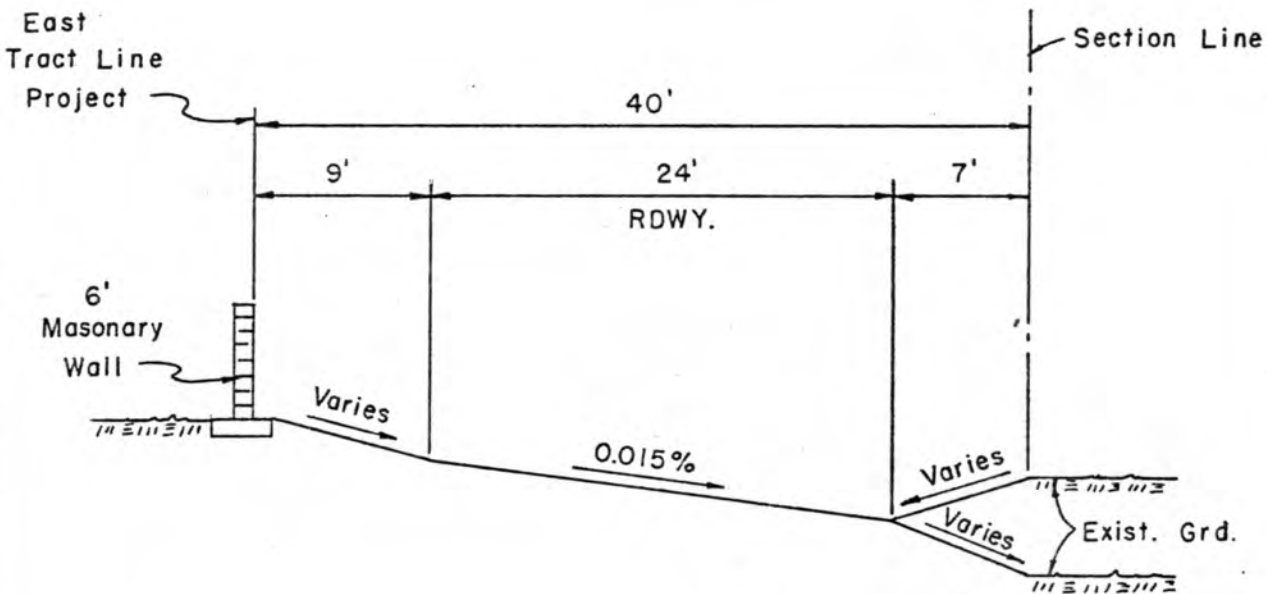
To accommodate bicycle traffic, sidewalks will be depressed at the curb returns on the arterial and collector streets and roll curbs will be used for curb returns on residential streets in lieu of 4" vertical curb returns.



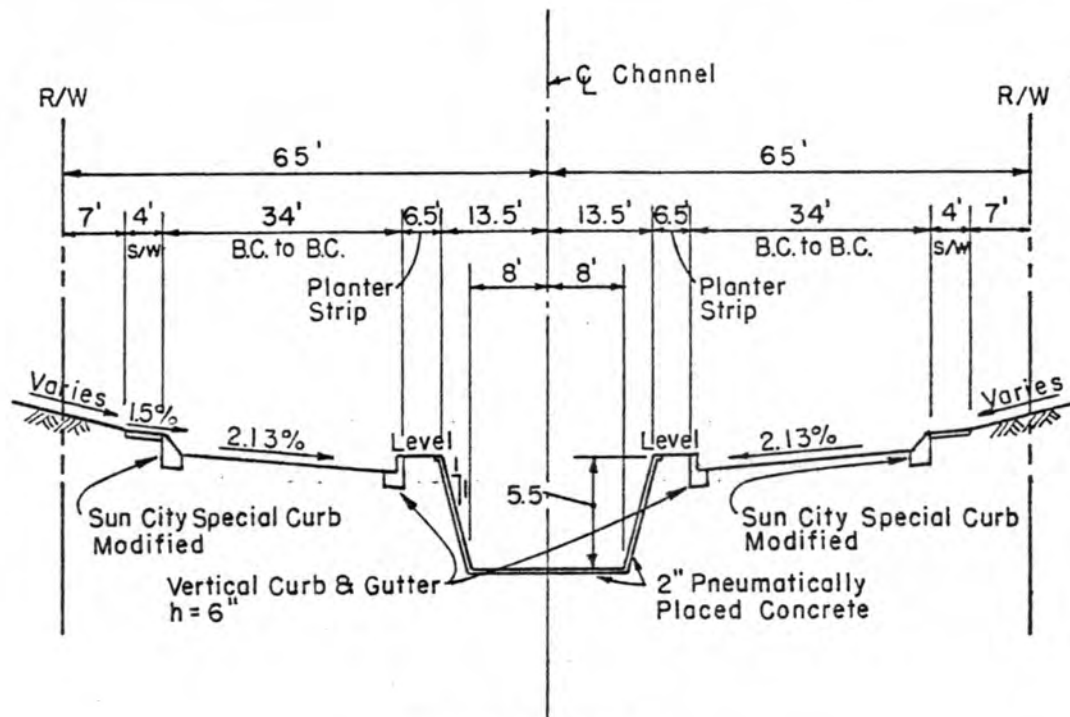
DEER VALLEY ROAD HALF SECTION
 GRAND AVE. TO EL MIRAGE



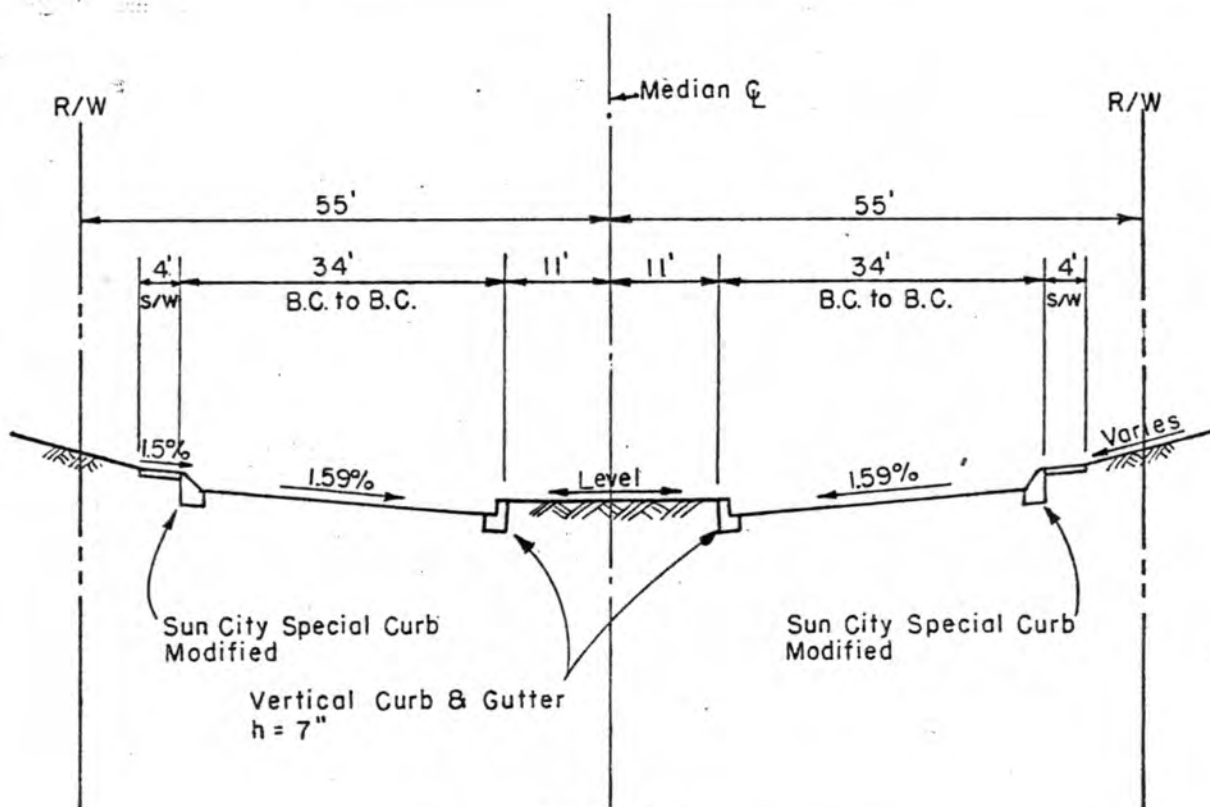
EL MIRAGE ROAD HALF SECTION
DEER VALLEY ROAD TO 16/8 CORNER SECTION 26



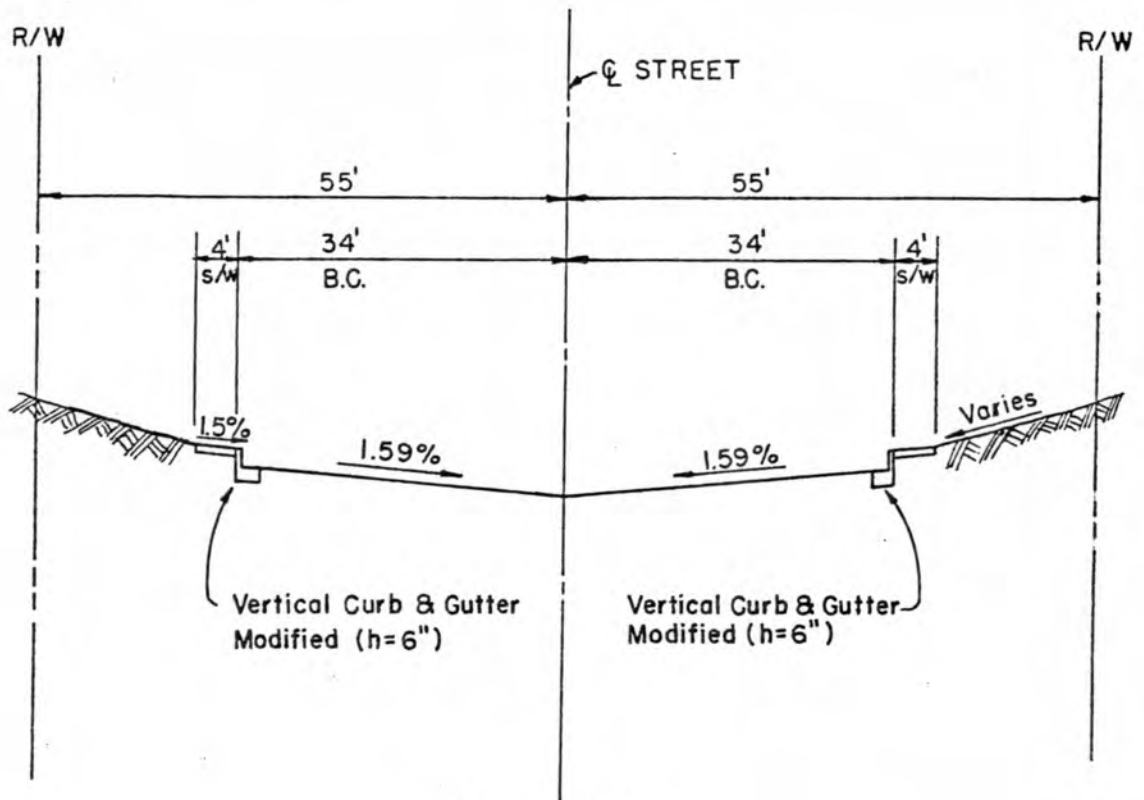
EL MIRAGE ROAD HALF SECTION
16/8 CORNER SECTION 26 TO BELL ROAD



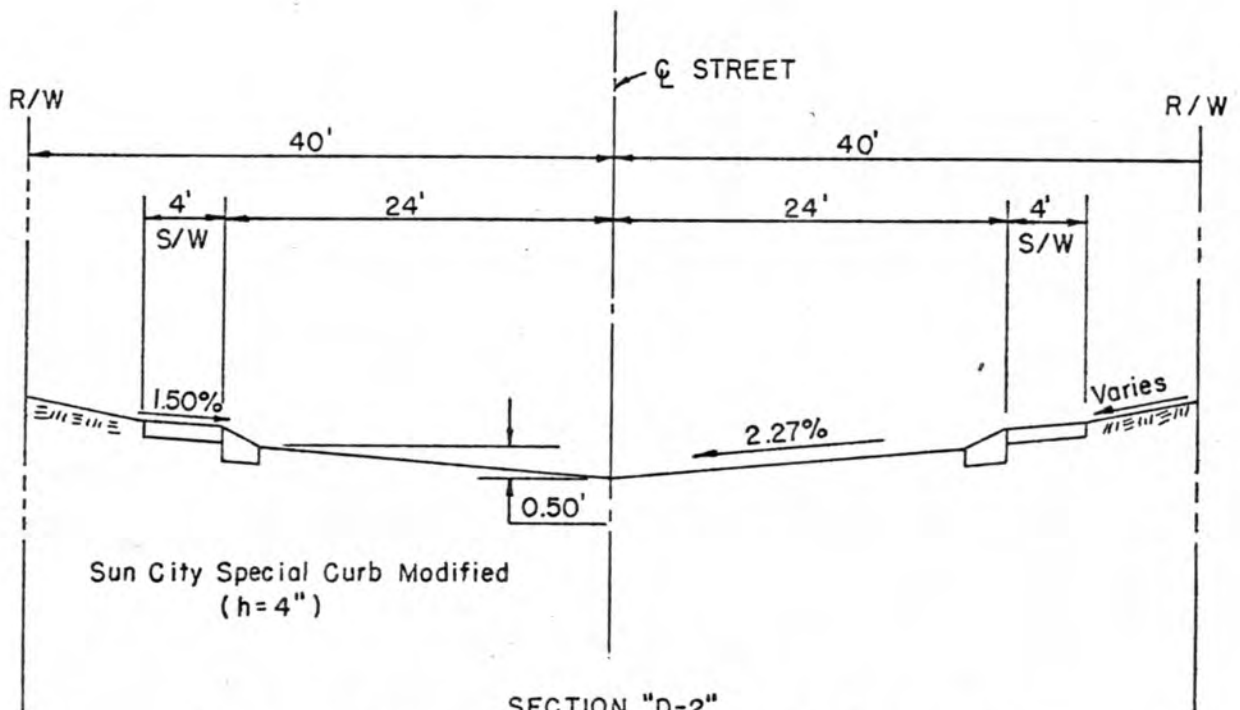
SECTION "C"
 ARTERIAL STREET WITH CENTER CHANNEL



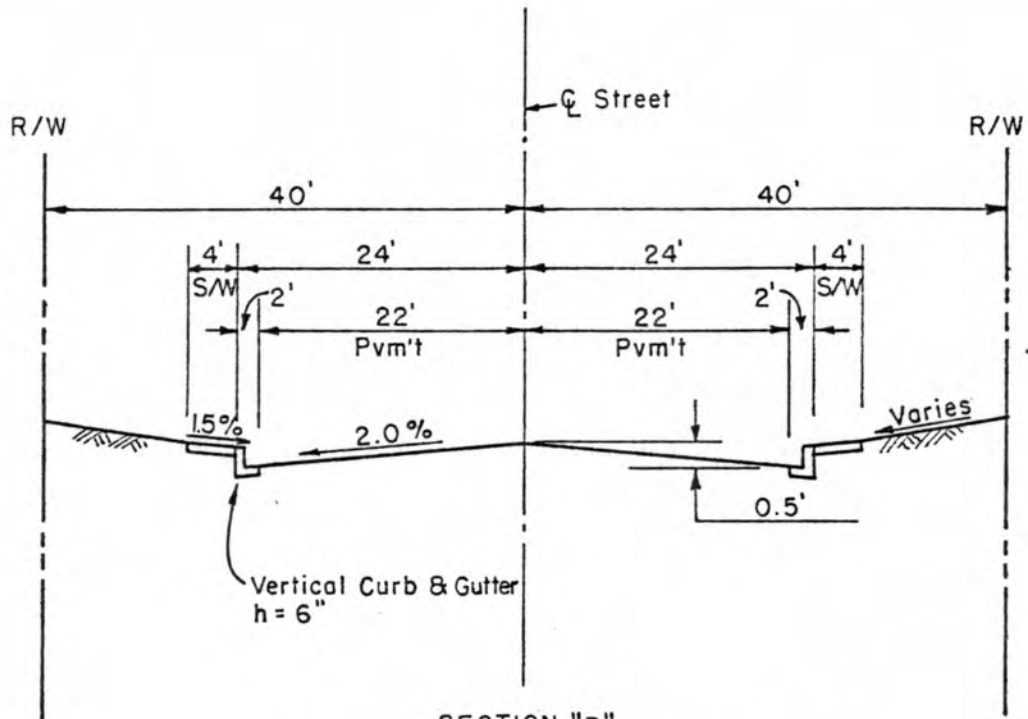
SECTION "D"
 MAJOR ARTERIAL WITH DIVIDED MEDIAN



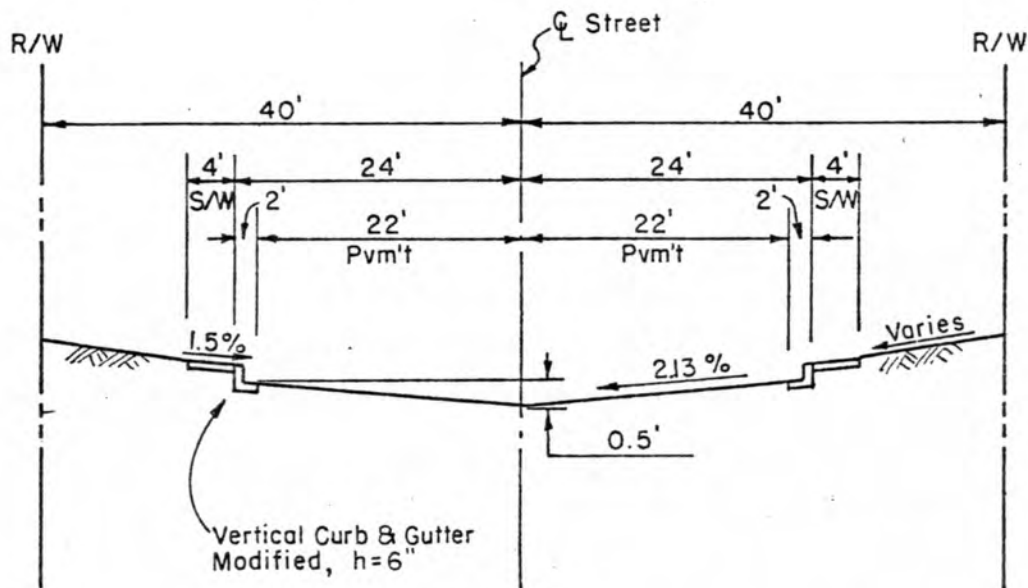
SECTION "D-1"
 MAJOR ARTERIAL



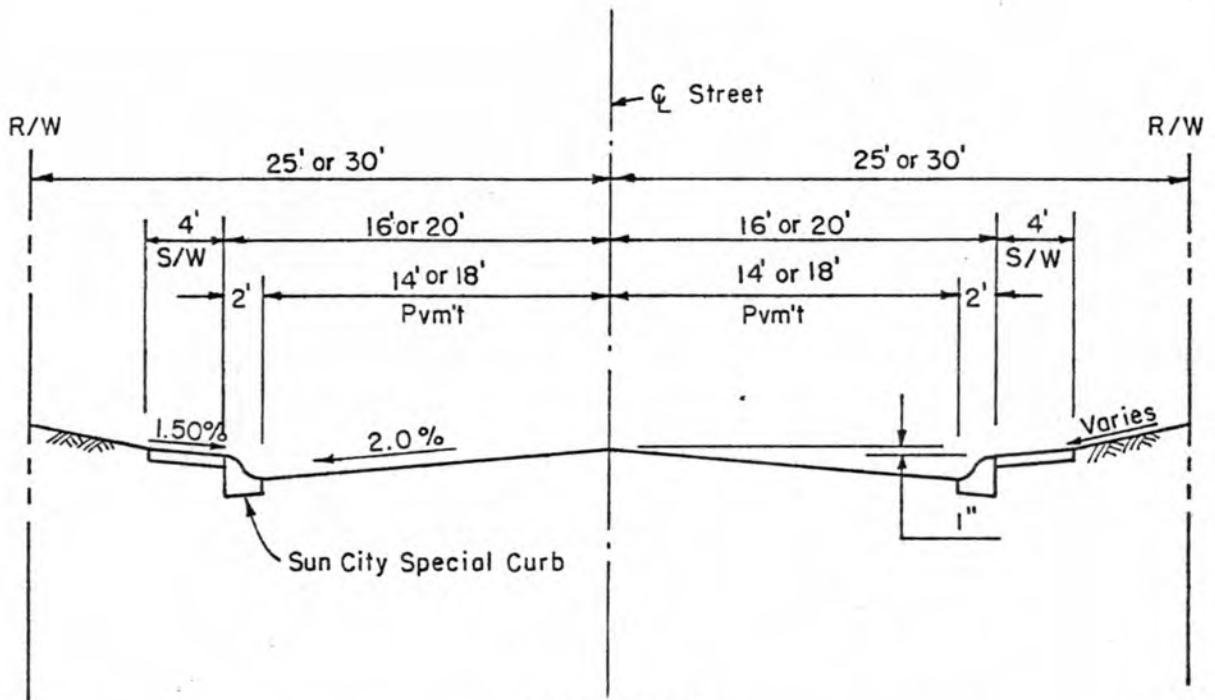
SECTION "D-2"
 SPECIAL RESIDENTIAL STREET WITH INVERTED CROWN



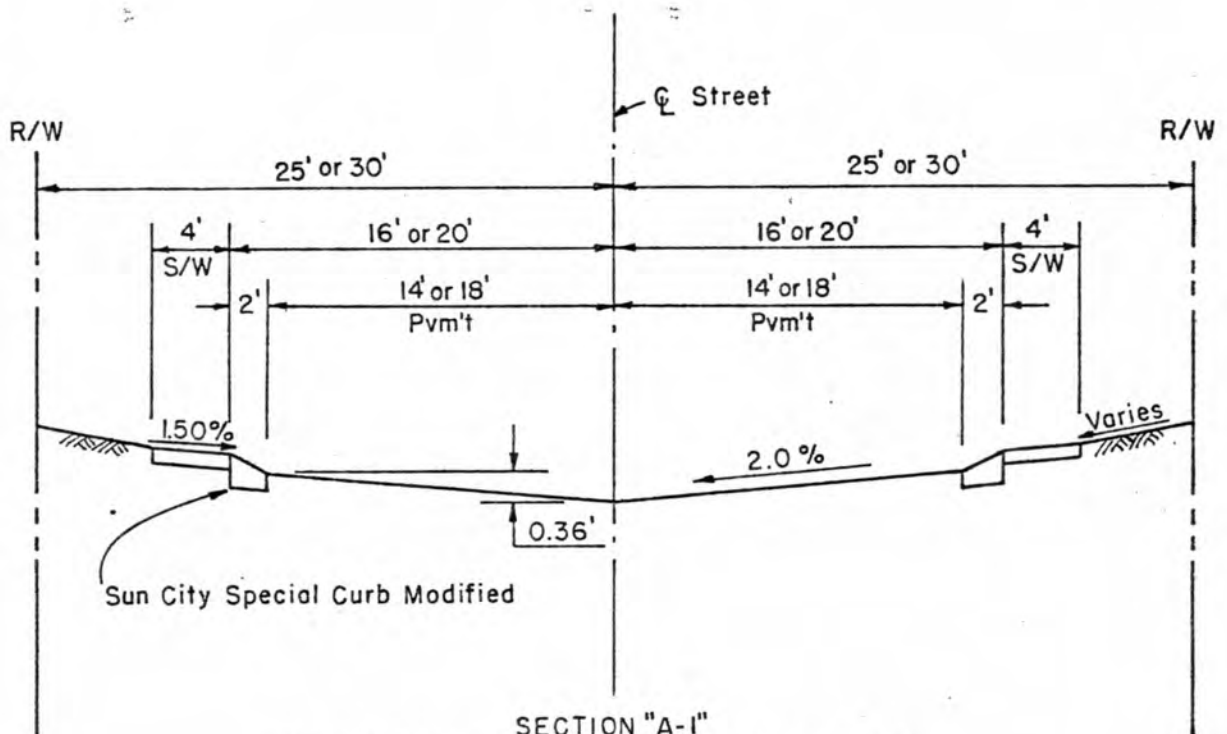
SECTION "B"
COLLECTOR STREET WITH NORMAL CROWN



SECTION "B-1"
COLLECTOR STREET WITH INVERTED CROWN



SECTION "A"
RESIDENTIAL STREET WITH NORMAL CROWN



SECTION "A-1"
RESIDENTIAL STREET WITH INVERTED CROWN

Section E
COMMUNITY SERVICES
& FACILITIES

Section E

COMMUNITY SERVICES & FACILITIES

The residents of Sun City West will require and desire the whole range of community services and facilities typically found in a small city. Once developed, the new community will actually have certain features found only in much larger cities. For example, considering the existing Sun City, few other cities of 40,000 population can boast of their own symphony orchestra or semi-professional soft ball team. Described below are the major community services and facilities which will exist in Sun City West.

1. RECREATION

The new community will cater to a leisure-recreation life style and therefore numerous opportunities of this nature will exist. As discussed in Section 3 of this report, the golf course is a dominant feature of the Land Use Plan. Six 18-hole golf courses will satisfy a high demand for this sport and will provide park-like open space for the enjoyment of the entire community.

The Developer will build one main and two neighborhood satellite recreation centers. These centers are quite extensive in terms of facilities offered and have proven to be very popular in the existing Sun City. Facilities which will be a part of Sun City West's recreation centers include: swimming pools; therapy pools; shuffle board courts; lawn bowling greens; bowling alley; billiard rooms; miniature golf courses; garden plots; areas for ballroom and square dancing; tennis courts; craftsman shops; and handball and squash courts. There will also be meeting rooms and rooms for such activities as card playing, knitting, stamp collecting and various arts and crafts.

2. CULTURE AND ENTERTAINMENT

An enclosed amphitheater, will be a part of the core area main recreation center. With an audience capacity of about 7,500 persons, the amphitheater will be host to a variety of musical and theatrical productions.

Space will be provided in the central recreation center for a library. It is anticipated that the new residents will assist the County in stocking the library with books. The recreation centers will also provide facilities for art, sculpture, ceramics and other activities of this nature.

An art museum has been recently established in Sun City with the assistance of the Phoenix Museum of Art and many of the residents have loaned their works for display. It is expected that the Developer will continue to sponsor its Lecture Series for the cultural enrichment of Sun City West's residents.

3. HEALTH AND MEDICAL

As stated in Section C of this report, opportunities will be made available in commercial areas for the establishment of doctor, dentist, and other medical and related offices. Additionally, land will be reserved in the core area commercial center for the development of a hospital. Until such time that a hospital will be constructed in Sun City West, the existing Boswell Memorial Hospital in Sun City will meet the needs of the new community. This hospital is already undergoing its first expansion to keep pace with the needs in the general region.

Boswell Memorial is a community hospital with a Board of Directors comprised of local people. The Boswell Hospital Foundation is a separate legal entity and serves as the financial master planning arm of the hospital. The Foundation's funds are used to finance both capital and operating projects.

4. RELIGION

The Church is an important element in the community. In addition to religious observance, the Church serves many social functions such as counseling and fellowship. At least 10 sites ranging in size from 3 to 5 acres will be reserved in Sun City West Phase I for houses of worship. The residents themselves will decide which denominations are represented. The Developer will sell land to the church at the cost of improvements and landscaping.

5. FIRE PROTECTION

Fire protection services will be provided by a Fire District set up under State law. This District will either be an expansion of the existing Fire District in Sun City or will be a new one.

The Sun City Fire District is governed by a Board of Directors who are elected by the voters residing in the District. The Board contracts annually with the Rural Metro Fire Department, a private corporation, to provide fire protection in Sun City. The Board owns two fire stations as well as most of the fire fighting equipment. Personnel and supplemental equipment funds are provided by a rebate of a portion of the motor vehicle fees from the District as well as a property tax mill levy.

6. POLICE PROTECTION

As an unincorporated area, Sun City West will receive police protection and service from the Maricopa County Sheriff's Department. As with Sun City, this will require the assignment of patrol cars within the new community. The Sheriff's Posse of Sun City has been organized to provide a variety of assistance to the Sheriff's Department. Although police protection has been excellent, some people desire the services of private security organizations and these services are available.

7. WATER AND SEWER

Citizens Utilities, a private corporation, has a franchise to provide water and sewer service in Sun City and Sun City West. The Del E. Webb Development Company will construct, at cost, the complete water and sewer systems for the new community under contract with Citizens Utilities. These systems will be owned, managed and maintained by Citizens Utilities.

8. SOLID WASTE COLLECTION

Garbage and trash collection services will be provided by private contractor. Solid waste disposal will be in the County landfill or by any other method as directed by the County.

9. OTHER GOVERNMENTAL SERVICES

Maricopa County has been instrumental and cooperative in extending certain basic services directly to Sun City such as local (periodic) offices for automobile registration and licensing. In the near future, the County will be constructing a permanent satellite facility on land deeded

to the County from the Developer. This site is on Bell Road, immediately south of the Sun City Phase I project area. Initial use of the facility is expected to be a Sheriff's substation. Future use is expected to include a court room and administrative offices. As in Sun City, the maintenance of all streets in the new community will be the responsibility of Maricopa County once the streets have become part of the County system.

Section F
COMMUNITY
ORGANIZATION

Section F

COMMUNITY ORGANIZATION

A basic reason for the existence of communities is that geographic concentration permits the organization of people to collectively provide facilities and services for themselves which otherwise would not be possible. During Sun City West's initial stages of development, it will be the Developer who actually provides and initiates community organization and assumes the responsibility of making policy decisions which influence the community environment. As the community takes shape, and internal initiative for organization takes hold, these responsibilities will shift to the residents.

f. THE ROLE OF THE DEVELOPER

As discussed in other sections of this report, the Developer will be directly responsible for the initial construction of essentially all basic municipal facilities such as water supply and distribution system, sewage collection and treatment system, streets, recreation centers, golf courses, and the like. The Developer will also be initially responsible for the management and maintenance of these facilities and for the provisions of various services.

Understandably, the first residents in the new community will lack the organization and will tend to be deficient in the resources necessary to shoulder these responsibilities. But as Sun City West grows, a whole range of professional, managerial and technical capability will appear among the population ranks, certain natural leaders and civic activists will surface, and the community will be ready to start managing its own affairs.

Some developers retain control over revenue producing recreational amenities as profit centers. The Del E. Webb Development Company has a policy of divesting itself of these facilities and turning control and responsibility over to the residents as quickly as possible. The firm recognizes that it would be neither healthy nor feasible to dominate or even directly influence the general affairs of the community for an indefinite period of time. The community needs to establish its own mechanism and organization for perpetuating itself.

Although responsibilities will be transferred to the residents as quickly as possible, it is significant to note that the vast resources of the

Developer will remain accessible for advice and counsel. The Developer will not disappear after all lots are sold. The Del E. Webb organization has a long history of respected, stable operations and will carry on the traditions of sincerity and compassion of Mr. Del E. Webb himself for years to come.

2. RESIDENT ASSOCIATIONS AND ORGANIZATIONS

The nature of the formal and informal organizations which will exist in Sun City West will be known only after the new community becomes substantially developed; and even then the precise picture may not be totally apparent. However, a review of the community organization structure in the existing Sun City provides a reasonable expectation for the new Community.

Community Affairs

Two broad based resident organizations which exist in Sun City and deal with overall community affairs are the Sun City Home Owners Association (SCHOA) and the Sun City Taxpayers Association, Inc. (SCTA).

SCHOA concerns itself with general conditions in the community and the protection of the health and well-being of the residents. In the area of security and safety, SCHOA sponsors the Sheriff's Posse of Sun City and the Emergency Services Organization as well as programs such as "Operation Identification" and "Neighborhood Watch". The organization assists in bringing certain County services to the community and lobbies for or against various legislative proposals which could impact on the residents. Active committees within SCHOA include the following: State Legislative; County Legislative; Local Affairs; Education; Pollution; Special Programs; Special Research and Public Relations and Publicity.

As its name implies, the Sun City Taxpayers Association is primarily concerned with problems and conditions affecting the taxes of the residents. Areas of vital concern to SCTA are as follows: Schools; real estate assessments; fire protection; and water, sewer and solid waste collection rates. The Association also continually researches the aspects of Home Rule. Primary committees are Police Protection, Laws and Legislation, and Public Utilities.

Broad based community organizations like SCHOA and SCTA generally require a membership fee of several dollars per year to cover basic

services and administrative expenses. Fund raising activities such as advertising sales for directories also help to defray costs. The Associations are typically governed by a board of directors elected by the membership. Paid staff may be necessary to supplement the volunteer actions of the membership.

Recreation Facilities

The recreation facilities constructed by the Developer and eventually taken over by the community represent a significant asset and a complex physical plant. Recreation Centers of Sun City, Inc. was formed by Sun City residents for the purposes of owning and operating these centers.

The primary functions of the organization, which is a nonprofit corporation, are to maintain a general social, cultural, recreational and amusement enterprise for the benefit of its members; to coordinate, implement and aid the various recreational and social clubs and to promote cooperation in all matters of interest to the residents. Community residents become members upon payment of an annual membership fee of \$40.00. The organization's facilities are under the supervision of a Board of Directors elected by the membership and a paid staff directed by a General Manager.

Apartment Maintenance

The owners of dwelling units in each multi-family apartment complex form associations for the primary purpose of maintaining their structure and grounds. These associations establish their own fees and functions based on the desires of the apartment residents and the particular requirements of the facility.

3. SERVICE ORGANIZATIONS AND CLUBS

A wide range of civic, service and professional organizations exist in Sun City for the betterment of the community and the civic fulfillment of their membership. A partial list of these organizations are: Toastmasters; Lions; Rotary; Kiwanis; Nights of Columbus; Masons; Salvation Army; Elks; Physicians Club; and the American Association of Retired Persons.

Numerous clubs also exist for a wide range of hobby and recreational interests. For example, there are over 20 card clubs; over 20 sport clubs. Additional social organization comes about through college alumni associations and home state clubs.

Numerous opportunities therefore exist for the residents to join in organization to solve community problems, ensure the provision of services, advance avocational interests and just plain provide companionship.

Section G
IMPLEMENTATION:
ZONING CHANGE
REQUEST

Section G

IMPLEMENTATION:

ZONING CHANGE REQUEST

As the Development Master Plan transitions into reality, the implementation process will proceed within two basic frameworks. One involves the Developer and his relationship to the market, financial community, engineer, planner, architect, and builder, i. e. the ability to produce "brick and mortar". The other concerns the legal and regulatory framework which enables the Developer to initiate the project and proceed logically to its successful planned conclusion.

The ability of the Del E. Webb Development Company to physically produce Sun City West is conveyed in other portions of this report, with particular reference to the existing Sun City, and will not be elaborated upon here. The implementation strategy discussed below concerns the basic regulatory framework consisting of the Master Plan itself, zoning and incrementally phased subdivision platting.

1. MASTER PLAN INTERPRETATION

The Development Master Plan is not a final blueprint specifying every last detail of the new community. The Plan is a general guide for development and a statement of the basic goals and objectives to be achieved for the new urban environment. The Plan enables the Developer to plot a basic course toward final implementation and enables Maricopa County planners to view the intent of each stage of actual development within the context of the overall scheme and its attendant regulatory controls.

The proposed strategy of implementation therefore recognizes that planning is a continuing process and that there will be a need to continually evaluate actual implementation within the framework of the Development Master Plan. Although the existing Sun City is a success, the learning process continues. As time progresses, the needs and desires of the market place are subject to change and new technologies and design innovations are likely to evolve.

The proposed implementation strategy incorporates a combination of long term stability -- projectwide zoning, and short range flexibility -- phased subarea platting, to ensure the high quality development desired by the Developer, the County, and the residents themselves.

2. COMMUNITYWIDE ZONING

The Developer requests approval of the entire proposed zoning package by the submittal of this Development Master Plan. The reasons for obtaining projectwide zoning at the outset are basic to the Master Plan implementation strategy and are summarized below:

- . Total community zoning will allow development to progress in an orderly and continuing manner -- determined by market factors and the insistence of maintaining a high quality, balanced development at all stages -- and unencumbered by administrative and technical delays associated with the processing of incremental zoning requests.
- . Communitywide zoning will afford a measure of implementation stability to the Developer thus enabling him to concentrate more fully on turning the Master Plan into reality.
- . Total zoning, especially the specification of all commercial sites, will convey to prospective residents that the Master Plan for the new community is a serious endeavor. These persons will be able to select their home sites with full knowledge of the relationships between commercial and residential areas and with the assurance that these relationships will not change.
- . Although the commercial zone request is large and ahead of development, the Developer will remain in complete control over the determination of how these sites will be used; that this development will be appropriate and high quality should be obvious from this Development Master Plan and the Developer's previous accomplishments in the existing Sun City.
- . The RUP zoning approach for all residential areas provides long term stability without the loss of short-term flexibility. Initial zoning of all residential areas into districts specifically relating to housing type would produce an unrealistic rigidity to the plan, totally opposite to the concepts of master planning. The same objective of ensuring that the County has control over Master Plan implementation can be better served through the established plat approval process and the Developer's proposed maximum density controls.

3. PLAT APPROVAL -- PHASED DEVELOPMENT

Sun City West will be developed incrementally in phases influenced by market adsorption and the maintenance of high quality development. Housing construction will not out-pace the provision of supporting services and amenities since each development module is planned as a balanced unit with commercial, recreational and other public/semi-public developments. In most cases, the supporting amenities will actually be constructed prior to the time that related residential areas are completed.

Within the development modules, separate plat approval submissions will be made for each housing type. This will provide assurance that the housing-type density controls are being met. Regulatory bodies will be able to review each plat submission in relation to the areas already developed or developing and in the context of the overall plan.

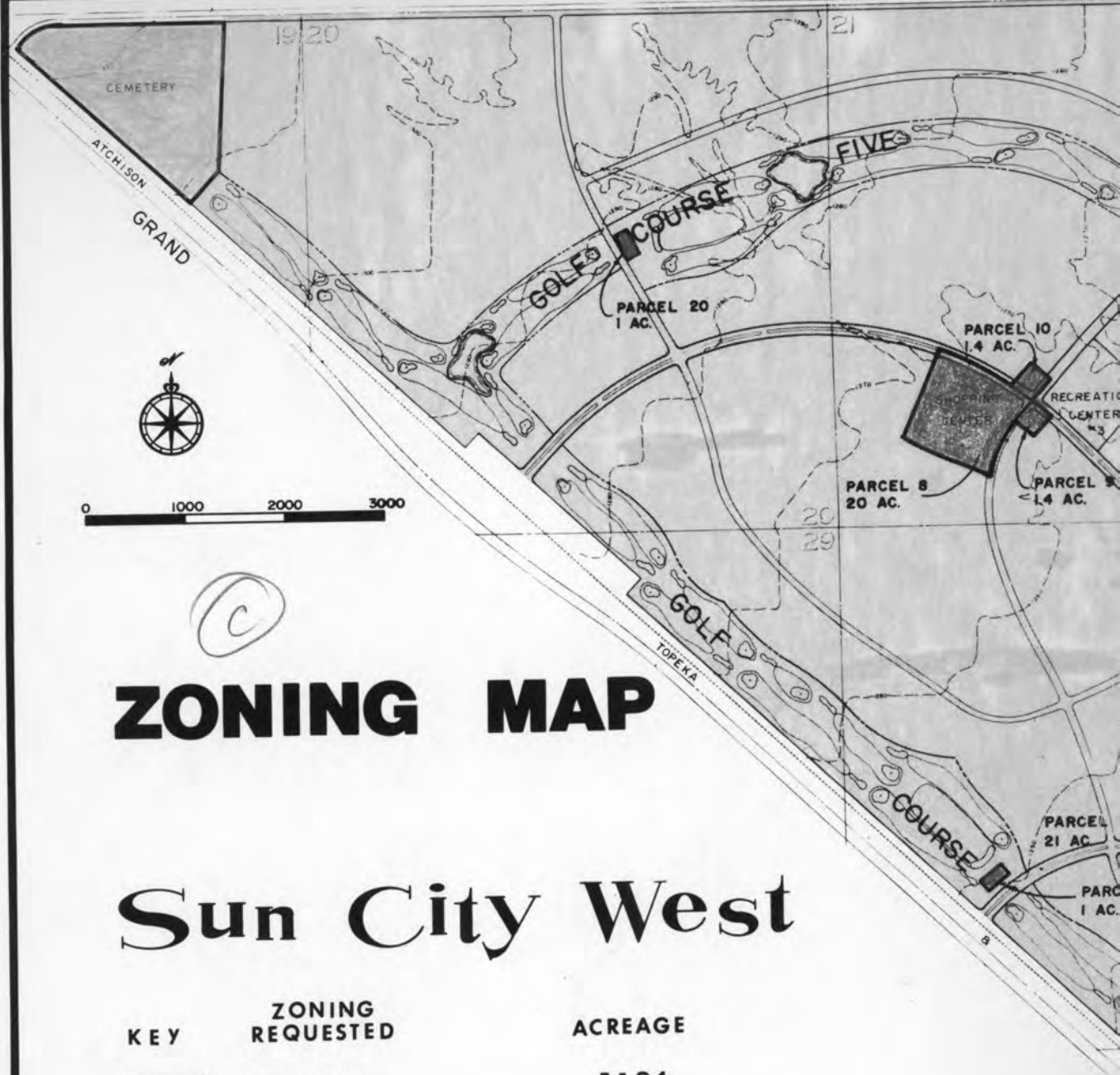
Since construction will occur at a high pace, the pieces to the "puzzle" will go together rapidly and the total "picture" will soon become evident. The plat approval process will be expedited by the fact that all zoning throughout the project site will already be established. If the pieces are not going together in a manner consistent with the general plan, the whole process can be slowed or stopped simply through refusal to approve preliminary plat submissions. Although the need for its application is not anticipated, this technique provides for strong controls over the development.

4. ZONING DISTRICT CHANGES

The entire portion of the tract of land planned for development as Sun City West Phase I is currently zoned R-43. It will therefore be necessary to obtain zoning district changes prior to the construction of any improvements and the actual subdividing of the land for development. The formal request for zoning district changes to permit the implementation of this development Master Plan is presented on the proposed Zoning Map Plate 12 and in the following narrative.






Industrial Zoning

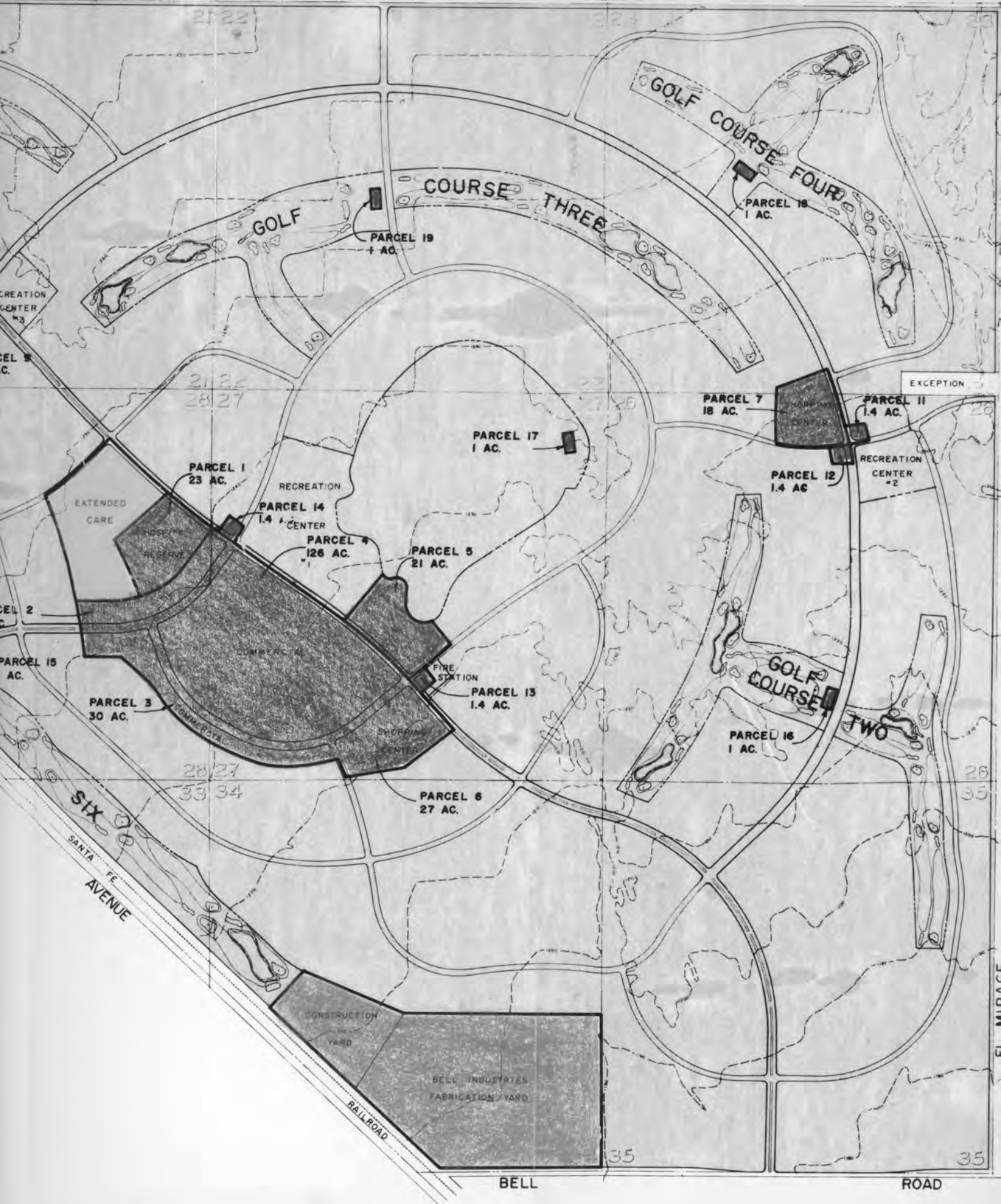
Industrial zoning (IND-2) is requested for one parcel of land comprising 172 acres (gross) in size and accounting for approximately 3% of the total Phase I project area. This site will be used by the Del E. Webb



ZONING MAP

Sun City West

KEY	ZONING REQUESTED	ACREAGE
	R3/RUP	5124
	R-5	46
	INDUSTRIAL	172
	C-2	300
	RURAL SPECIAL PERMIT FOR CEMETERY	55
TOTAL		5697



Development Company for the manufacture of housing components, storage of equipment and building supplies, subcontractor's yards, and other activities associated with the development of Sun City West.

Commercial Zoning

Commercial Zoning (C-2) is requested for 20 parcels of land comprising a total of 300 acres (gross) and accounting for 5.3% of the total Phase I project area. These parcels are shown on the Zoning Map, Plate 12. Following is a summary of the size and intended use of each parcel:

<u>PARCEL</u>	<u>ACREAGE</u>	<u>INTENDED USE</u>
Parcel No. 1	23 acres	Hospital
Parcel No. 2	21 acres	Medical Offices
Parcel No. 3	30 acres	Professional Offices, Misc. Comm. Uses
Parcel No. 4	126 acres	Regional Shopping Center
Parcel No. 5	21 acres	Two Restaurants
Parcel No. 6	27 acres	Neighborhood Shopping Center
Parcel No. 7	18 acres	Neighborhood Shopping Center
Parcel No. 8	20 acres	Neighborhood Shopping Center
Parcel No. 9 through 14	1.4 acres	Financial, Automotive Services
Parcel No. 15 through 20	1 acre	Golf Course Clubhouse

The size requirements of these commercial parcels are related to their basic function (i.e. neighborhood center, regional center) and are judged to be of sufficient area based on the Developer's extensive experience. The location of the sites are endemic to the Master Plan concept of clearly defined, multiple nuclei around which the residential areas will exist and are strongly related to the proposed street circulation system. Establishing these zones at the outset not only facilitates the orderly progression of development but also permits home buyers to select their homesites with the knowledge of commercial-residential area relationship and with the assurance that these relationships are stable.

Residential Zoning

R-5 zoning for a 46 acre tract near the Hospital Site is requested to permit construction of nursing home facilities. We request that the balance of the area in the planned Sun City West Phase I, a total of 5,124 acres

(gross) accounting for approximately 90% of the total Phase I project area, be zoned R-3/RUP.

The R-3/RUP zoning allows for all those housing types envisioned by the Master Plan -- single family, two family and multi-family.

The purpose of the Residential Unit Plan of Development (RUP) is to provide for variation of lot size, dwelling types and surrounding open space within large scale developments. This is consistent with the residential land use concept of the Sun City West Master Plan.

Sun City West is actually more than a large scale residential development, it is a total community with a projected population of approximately 32,500 persons. Because of the magnitude of ultimate development and the length of time required to achieve it, the precise residential development pattern in terms of type and numbers of units by subarea for the entire community cannot be specified at the outset.

Nevertheless, it is appropriate and essential that Maricopa County regulatory bodies have the tools to ensure that Sun City West develops properly, consistent with the Master Plan and in accordance with the approved zoning. The Developer proposes that this regulation be brought about through the established subdivision plat approval process in conjunction with density controls over maximum project density and maximum density by housing type.

Special Use Permit: Cemetery

In accordance with Article XXIV of the 1969 Amended Zoning Ordinance for the Unincorporated Area of Maricopa County, the Developer requests a Cemetery be permitted as a special use within the existing R-43 district. The site for this cemetery is shown on the Land Use Map (Plate 3) and the Zoning Map (Plate 12). A cemetery is another element in the Development Master Plan which contributes toward making Sun City West a total community. The cemetery has been located so as to minimize its visual presence in the community. The proposed cemetery site is 55 acres.

5. DENSITY CONTROLS

The R-3/RUP zoning requires that average lotsize per dwelling unit must not be less than 3,000 square feet. Theoretically this could produce a maximum density of about 14.5 units per acre (net of streets). However, the Developer has neither a desire nor a need to develop up to this level of intensity.

The Developer submits the following density controls as a part of the Development Master Plan and as a condition for the approval of the requested zoning district changes:

TABLE 5

PROPOSED DENSITY CONTROLS

Overall Project Density Control

3.0 units/acre: Maximum gross project area density at any and all stages of development

Housing Type Density Control

3.65 units/acre: Maximum single family development density*

4.65 units/acre: Maximum two-family development density*

7.0 units/acre: Maximum multi-family development density*

* Specific subareas devoted to each housing type will be clearly defined through preliminary subdivision plat submittals. The maximum density controls by housing type will be applied by calculating gross densities inclusive of streets and the commercial, public and semi-public land uses associated with each basic grouping of housing units but exclusive of golf courses.

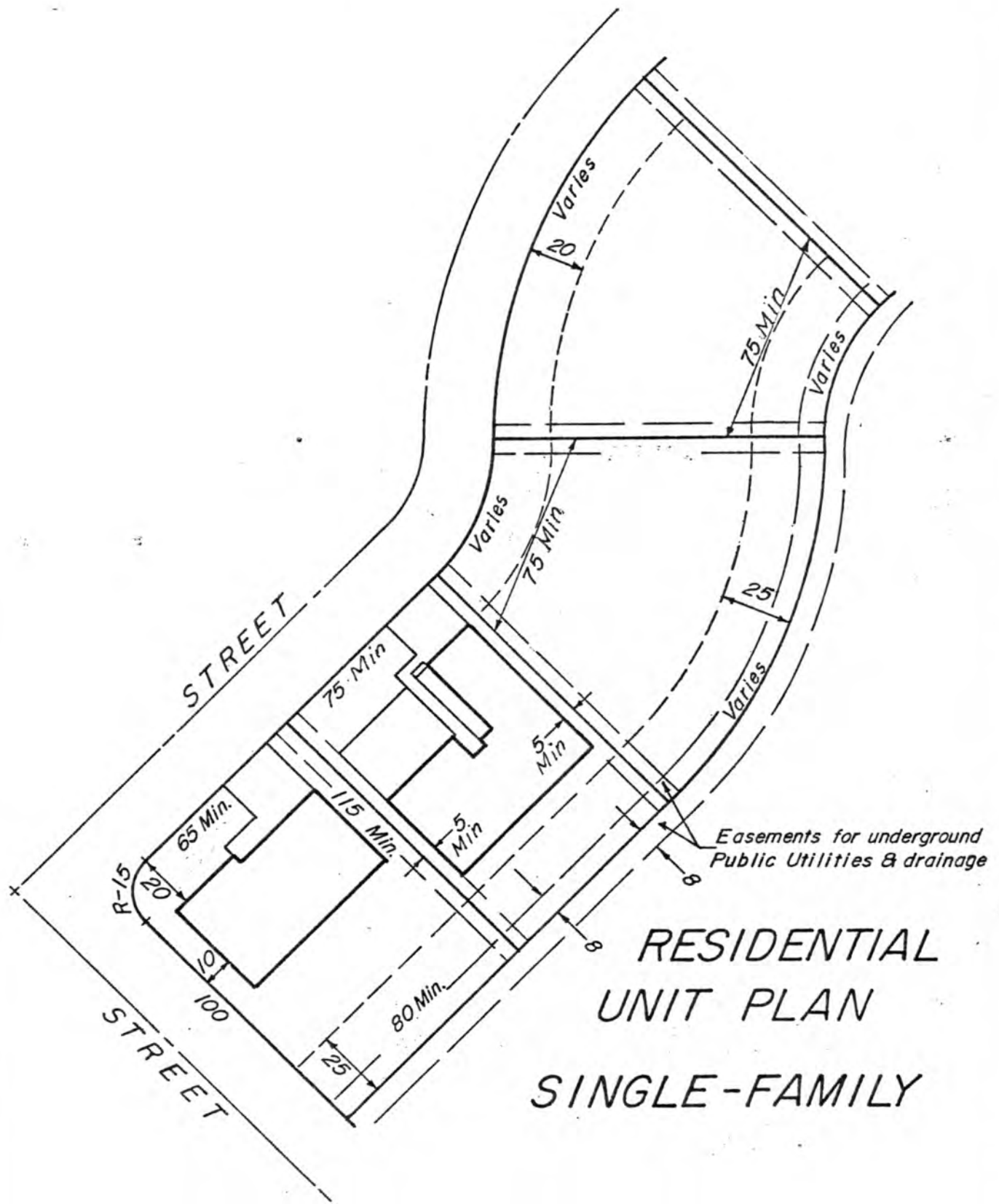
6. TYPICAL HOUSING LAYOUTS

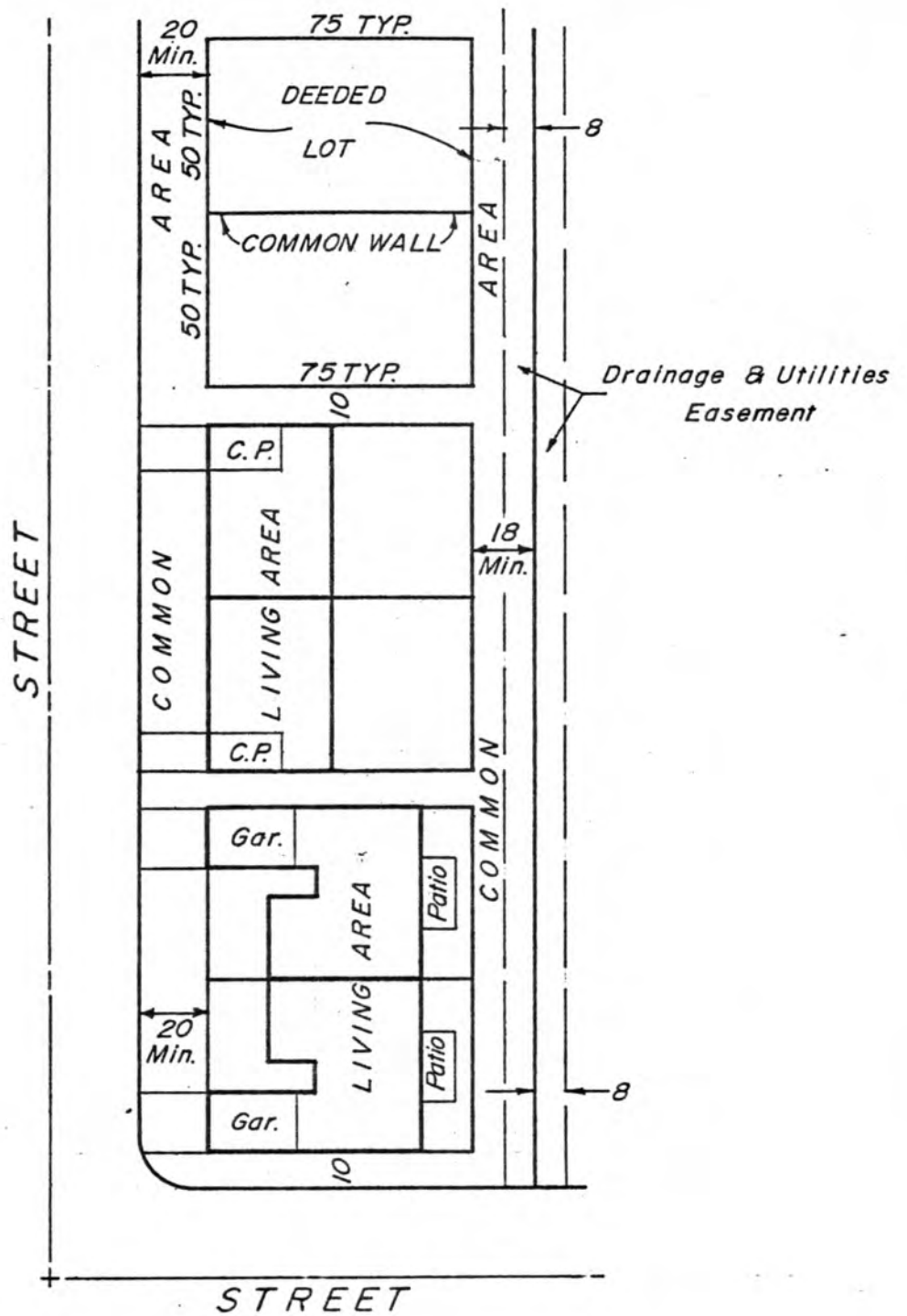
Plates 13, 14, 15 and 16 present the detailed Residential Unit Plan of Development for the four basic housing types which are proposed for Sun City West Phase I.

Plate 17, titled First Development Area, is a preliminary plan for the first 1500 units of production housing. Plate 17 shows, in detail, the relationship of the various housing types and street patterns for residential and collector streets. This preliminary plan is typical for the proposed Residential Unit Plan of Development.

Production multi-family dwelling units, Plate 15, will be single story structures typically containing from 4 to 8 units per building. The two story apartments detailed on Plate 16 will be constructed only in the community center, as shown, and will be utilized by the Developer as rental apartments for the Vacation program. Upon completion of development, they will be sold through subdivision of air space.

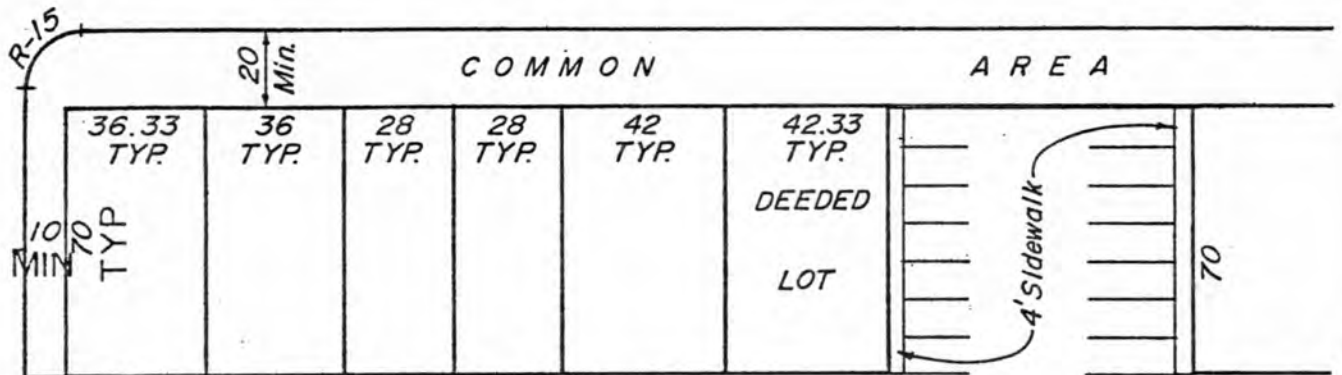
Duplex structures will have traditional layouts as indicated by Plate 14.





RESIDENTIAL UNIT PLAN
 DUPLEXES

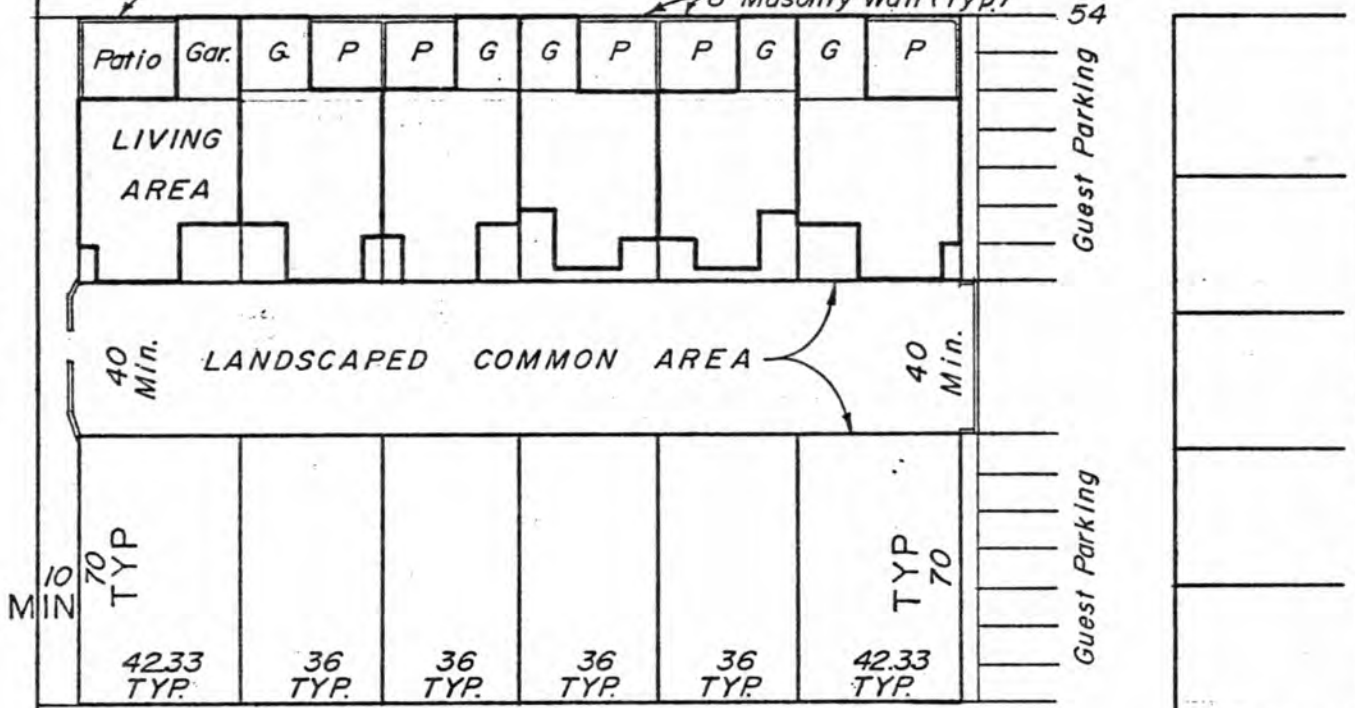
STREET



30' Easement for underground Public Utilities and private drive

6' Masonry Wall (Typ)

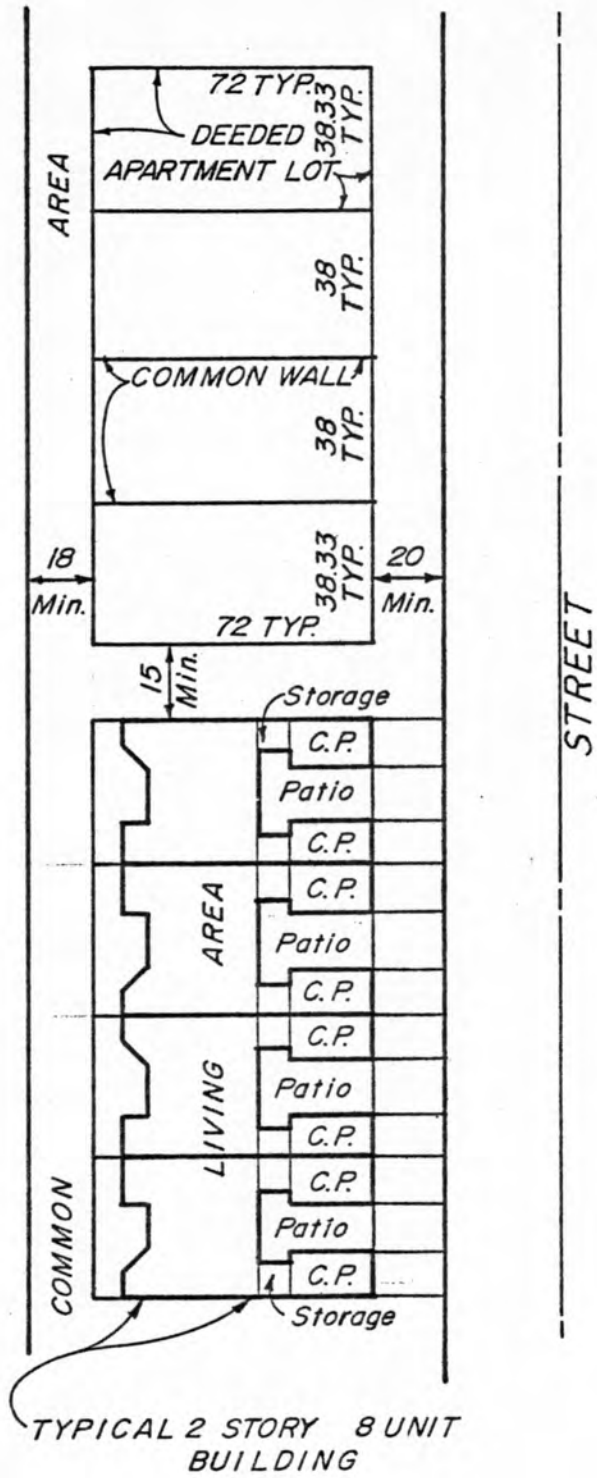
STREET



RESIDENTIAL UNIT PLAN

GARDEN APARTMENTS

GOLF COURSE



RESIDENTIAL UNIT PLAN
SPECIAL VIEW APARTMENTS

FIRST DEVELOPMENT ARE

Sun City West



7. FROM PLAN TO REALITY

The Developer will initiate construction of the central recreational-commercial core area and its supporting street and utility facilities during 1977 and housing construction will commence by the Summer of 1978. Within 10 years of publication, this Phase I Development Master Plan will actually be implemented in its entirety; to say such an accomplishment will be a massive and complex endeavor would be a gross understatement. Nevertheless, the real estate market and development resources necessary already exist.

Sun City West will therefore begin to take shape as soon as the zoning and other regulatory tools comprising the implementation framework are established, and the City will soon join the ranks of only a small number of successful, totally planned new communities in the United States. That the existing Sun City, Arizona, is on this list - is no small tribute to Maricopa County and to the capabilities and resources of the developer, the Del E. Webb Development Company.

Like the popular cliché, this Plan too will collect "dust" on the shelf -- not the dust of idle passing years but the cloud of activity created as a desert landscape is transformed into a totally new recreation-retirement community.

Part II
DRAINAGE

Section H
INTRODUCTION TO
DRAINAGE MASTER
PLAN

Section H

INTRODUCTION TO

DRAINAGE MASTER

PLAN

Drainage analysis has been conducted for the purposes of evaluating the existing conditions on and adjacent to the Sun City West Phase I site and the future conditions relating to the proposed development of the project site for the control of periodic flooding conditions which result from a 100 year Frequency Storm.

From this analysis a Master Drainage Plan has been developed consisting of roadways, roadways with center channels and lined drainage channels to carry the design Frequency Storm away from the proposed development. Once implemented, this Plan will insure that housing construction is above flood levels for design frequency storms.

The study area contains approximately 5,687 acres of land within Township 4 North, Range 1 West. This land is owned by the Del E. Webb Development Company and is currently being farmed by several different parties, primarily Boswell Farms, Inc. and a cattle feeding yard (Lizard Acres) operated as Circle One Ranch. The total acreage is not under cultivation but varies in useage from raw desert to fallow to agricultural with the latter being the primary useage.

1. NATURAL FEATURES

The study area lies within the portion of the state designated as the upper Sonoran Desert and has all of the general terrain features usually associated with a typical southwestern desert region. This consists of creosote bushes and Saguaro Cactus as the predominate plants on the flats, with Palo Verde and Ironwood trees lining the washes including Mesquite bushes which generally form very dense thickets at ends of washes.

The topography consists of flat desert plain sloping southeast with the White Tank Mountains to the west and the Wickenburg and Hieroglyphic Mountains to the north. The Beardsley Canal and proposed Central Arizona Project Canal

lie north of the project site. In 1956 the Army Corps of Engineers completed construction of a Detention Basin known as the McMicken Dam to protect Luke Air Force Base from flooding by Trilby Wash. The outlet for this basin is an earth lined channel (McMicken Dam Outlet Channel) varying in width from 20' to 50' along the north side of the project site.

The area is drained by many arroyos and washes which discharge into the Detention Basin or Outlet Channel and ultimately discharge into the Agua Fria River located along the east side of the project site. This river along with the other rivers in the Phoenix area are dry and have no permanent flow. In the vicinity of the project site the Agua Fria River banks are reasonably well defined as a water course and are capable of carrying sizeable flows resulting from high intensity summer storms prevalent to this area.

The climate of the area is typical of the arid Sonoran Desert. Temperatures vary from highs near 120° F in summer to lows below 20° F. in winter. Long range temperature approximates 70° F.

Rainfall in the area is usually concentrated in the months of December-March and July-September. Winter storms are normally the result of the easterly movement of storm fronts arising in the Northern Pacific. These fronts pass across the state in cycles during the winter months and usually exert their maximum influence in the higher elevations and along the Mogollon Rim Country; however, they are frequently of several days' duration and may result in significant precipitation within the watershed being studied.

Summer storms more often result from the movement of wet air masses northward from the Gulf of Mexico traveling generally from southwest to northeast across the state. These storms are frequently of high intensity and may produce cyclonic activity as well as large amounts of precipitation. Local thunderstorms are also frequently observed during the summer and fall. These generally do not cover large areas, but may result in severe localized flooding due to their high intensity. Floods may, of course, result from any of the types of storms discussed, depending on duration and location of high intensity rainfall.

2. HYDROLOGY

Storm runoff has been estimated by the Soil Conservation Service Method using precipitation maps prepared by the U. S. Weather Bureau for the Soil Conservation Service. Values of precipitation were selected from these maps for the study area for 6 hour and 24 hour duration storms of 100 year frequency. These values were then converted to 12, 3, 2 & 1 hour rainfalls by use of equations relating 6 hour and 24 hour durations. Storm runoff quantities were then computed by the TR-20

Hydrology Program in the study area for 100 year Frequency Storms of 24, 12, 6, 3, 2 & 1 hour duration, utilizing the appropriate curve numbers of the contributing drainage areas.

3. DESIGN CRITERIA

FROM: Arizona Highway Department - Bridge Division
 "Hydrologic Design for Highway Drainage in Arizona"

PRECIPITATION (Inches)

<u>DURATION</u> <u>(Hours)</u>	<u>10 yr. Freq.</u>	<u>25 yr. Freq.</u>	<u>50 yr. Freq.</u>	<u>100 yr. Freq.</u>
6	2.1	2.6	2.9	3.3
24	2.5	3.2	3.6	4.20
2*	1.79*	2.14*	2.36*	2.61
1	1.5	2.0	2.2	2.40

* Interpolated values equating 6 hour and 24 hour rainfalls
 (P hr. = 1.77 P₆ - 0.77 P₂₄)

Peak runoff estimate based on 100 Year Frequency Storm of 24 hour duration.

Runoff Quantities have been calculated using computer application of the TR-20 Hydrology Program based on Soil Conservation Unit hydrograph equation for estimating peak rate of runoff:

$$Q_p = \frac{484 AQ}{T_p}$$

WHERE:

Q_p = peak discharge is cfs

A = Drainage Area in square miles

Q = Runoff volume of the watershed in inches

T_p = Time to peak in hours

484 = is a constant for the units used

Time to peak is based on the following

$$T_p = \frac{D}{2} + 0.6T_c$$

Where:

T_p = time to peak in hours

D = Duration of storm in hours

T_c = time of concentration in hours

The Runoff volume Q is a function of the storm rainfall and a curve number (CN) which is based on a vegetative cover type and density and a hydrologic soil group. The hydrologic soil group within Sun City West and the surrounding area is constant as group C (slow infiltration rate). The cover type and density within Sun City West will vary considerably for each drainage area; thus the CN will be based on a weighted CN corresponding to the type of development using the following values:

CN	Type of Development
91	Commercial Areas
87	Single Family Housing Area
83	Apartment Complex Area
83	Duplex Areas
80	Undeveloped Desert Areas
74	Golf Course Areas

Section I
HYDROLOGICAL
ANALYSIS

Section I

HYDROLOGICAL

ANALYSIS

The Master Drainage Plan is based on the quantities and characteristics of runoff, both within the proposed developed new community and from the surrounding area. Presented below is a description of the onsite and offsite drainage areas and their associated runoff quantities and points of storm water discharge concentration.

1. OFFSITE DRAINAGE

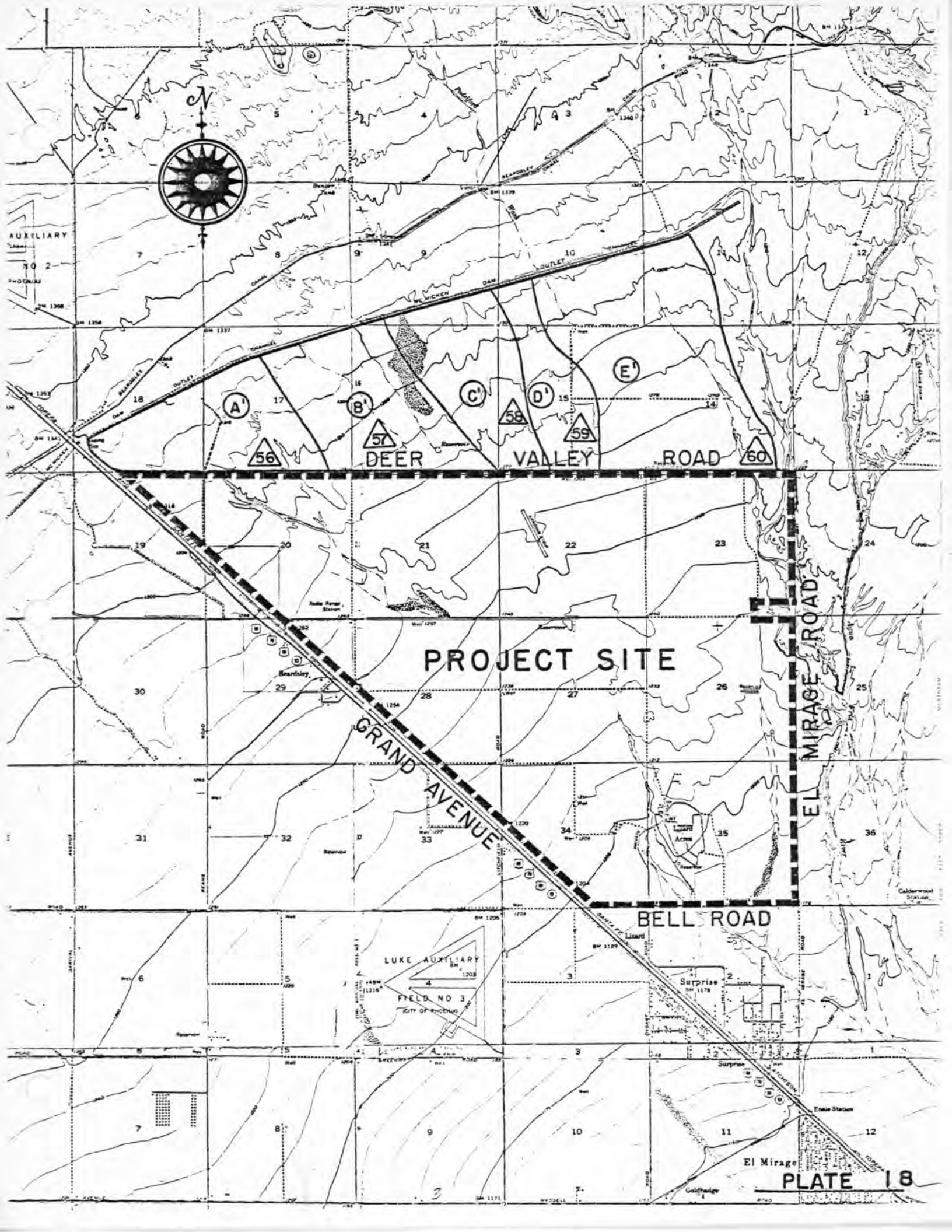
Offsite Drainage Area Description

As shown by Plate 18 the offsite drainage area of this study encompasses Sections 14, 15 and 16 and parts of Sections 9, 10, 11, 17 and 18 of Township 4 North, Range 1 West up to the outlet channel of McMicken Dam. This study area is mostly undeveloped desert land with a small mix of agricultural row crop useage by Bodine Produce Company in Sections 14 and 15. The type of cover in this area is considered to be Desert Brush with density rating of "poor" and a Hydrologic Soil Group C, all as described in Arizona Highway Department Hydrologic Design Manual.

In addition to the aforementioned sections, the offsite drainage includes overflow from McMicken Dam outlet channel ranging between 4450 cfs and 14,000 cfs, including side inflows from adjacent drainage areas. This flow comes down an existing wash along the east boundary of Sections 11, 14, 23 and 26 before being intercepted by Agua Fria River Channel.

There presently exists along the north side of Deer Valley Road an earth channel of varying depth and width between Reams Road and El Mirage Road. This ditch will divert storm water runoff from the north in an easterly direction to its intersection with El Mirage Road Channel Section for conveyance to the Agua Fria River. The existing ditch section increases in width and depth as it proceeds east.

The existing design capacity of this ditch is not known at this time as no field data was taken north of Deer Valley Road. This ditch will intercept runoff from two defined washes in the area with the remainder being interception of sheet flow off desert land and agricultural land.



PROJECT SITE

GRAND AVENUE

BELL ROAD

EL MIRAGE ROAD

DEER VALLEY ROAD

PLATE 18

Runoff Quantities and Concentration Points

Storm runoff contributions have been estimated for each Offsite Drainage Area (as shown on Plate 18) for a 100 year Frequency Storm of 24 hour duration. Runoff quantities for each Drainage Area are presented in Table 6. TR-20 Program routed storm runoff quantities, at indicated concentration points, are presented in Table 7.

Runoff calculations were based on the land within the drainage area remaining undeveloped or in agricultural useage. If offsite land use changes, it will be the responsibility of the owner(s) of said land to increase the channel size associated with the proposed Deer Valley Road improvement if runoff quantities are sufficiently increased or cause any flood of Sun City West.

2. ONSITE DRAINAGE

Onsite Drainage Area Description

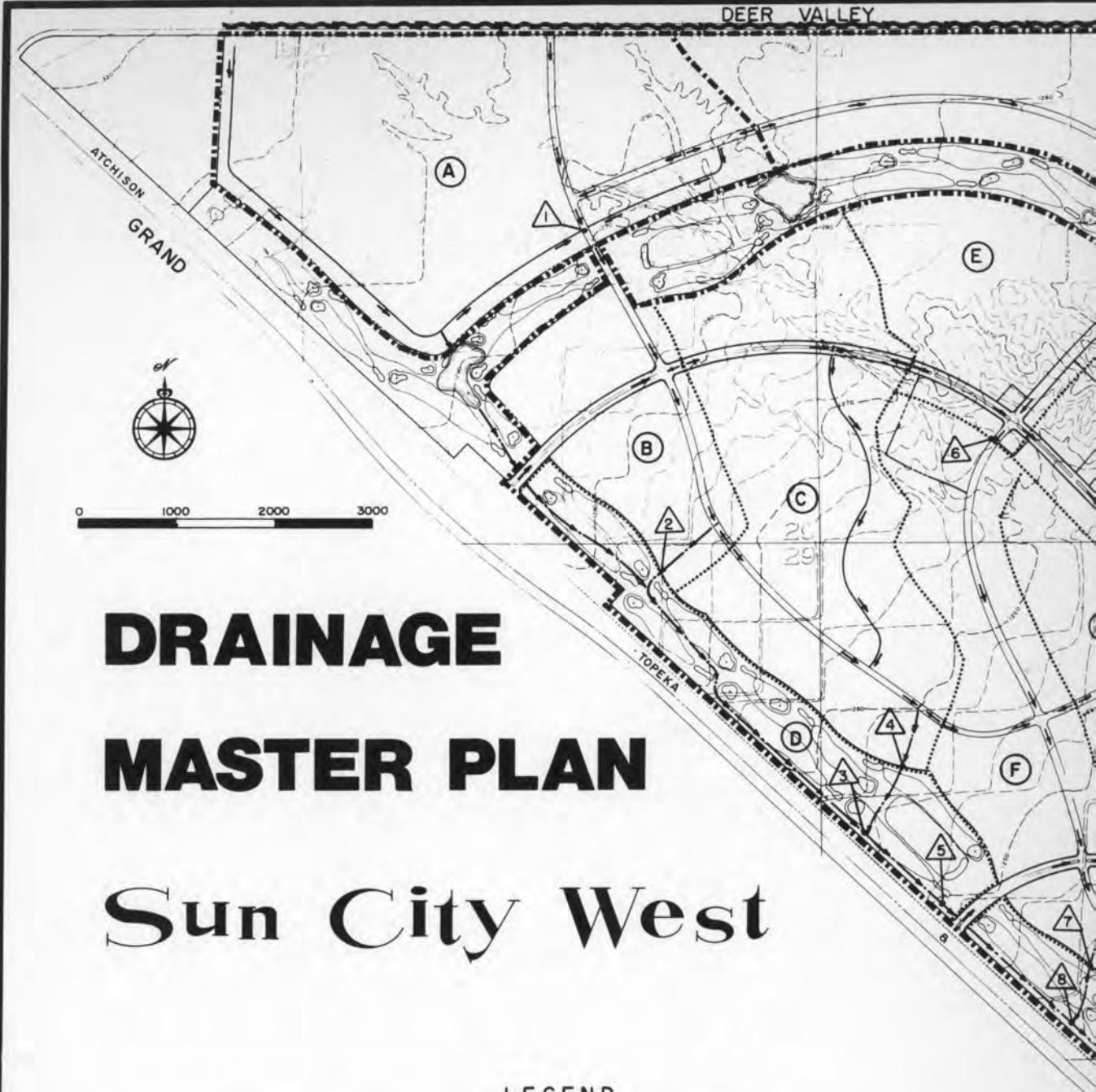
As shown by Plate 19, the drainage area of the project site extends from Bell Road to Deer Valley Road and from Grand Avenue to El Mirage Road, containing approximately 9 square miles of area. This land is currently in varying stages of useage ranging from Desert to fallow to agricultural. The surface runoff south of Deer Valley Road now is a combination of surface sheet flow and defined washes conveyed in a southeasterly direction. Upon reaching Bell Road, surface runoff is conveyed under the road in a system of pipe culverts and reinforced concrete box culverts.

The overall drainage pattern is in a southeasterly direction on an average slope of a 0.5' drop per 100 feet horizontal run. The elevations within the study area range from 1322 in the northwest corner to 1176 in the southeast corner, which gives a fall of 146 feet over the area.









The existing cover type varies from Desert Brush to agricultural crop with a density ranging from "poor" to "good" and having a hydrologic soil group in Category "C". Proposed development of the study area will include single family housing, apartments, golf courses, cemetery, shopping centers, recreation centers and other commercial uses resulting in varying curve numbers.

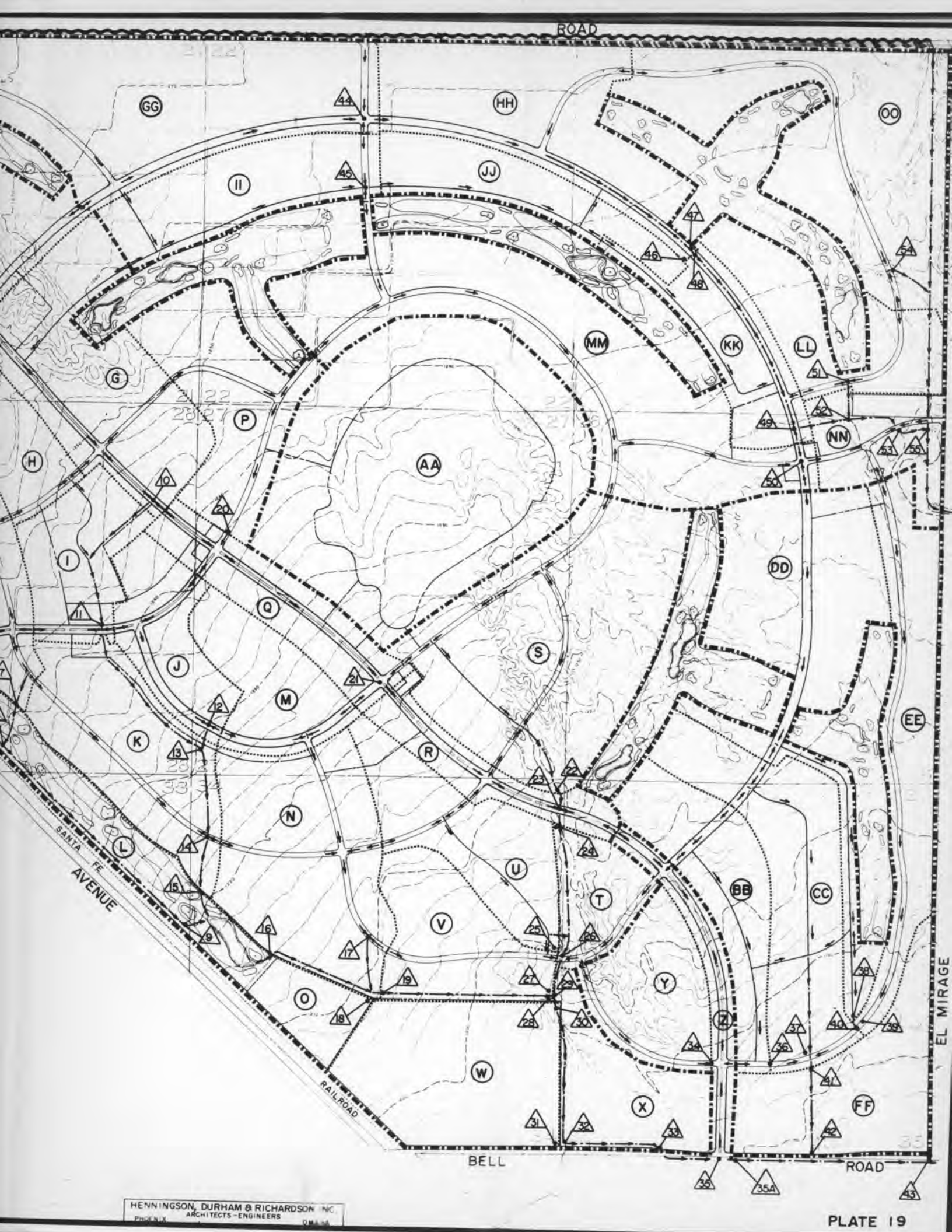
The central core designated by Drainage Area AA on Plate 19 contains model housing, apartments, a recreation center and a golf course. The unique feature of this core is that it will contribute no surface runoff as all the runoff will be stored on the golf course or it's lakes for use in irrigation of the golf course.

The surface runoff, with improvements, of the other drainage areas will be in the southeasterly direction. It is proposed that the drainage handling system for the project will use the roadway system network, grass or lined channels and a combination of roadways with median channels to transport the runoff to a discharge point. Once this runoff reaches Bell Road it will be conveyed under the roadway in box culverts and collected on the south side in a large channel to be conveyed east for discharge into the Agua Fria River channel.



LEGEND

-  DRAINAGE CHANNEL FLOW PATTERN
-  ARTERIAL or COLLECTOR STREET FLOW PATTERN
-  RESIDENTIAL STREET FLOW PATTERN
-  EXISTING DRAINAGE CHANNEL FLOW PATTERN
-  MAJOR DRAINAGE AREA BOUNDARY
-  DRAINAGE SUB-AREA BOUNDARY
-  (K)
-  (21)
- DRAINAGE SUB-AREA DESIGNATION
- CONCENTRATION POINT DESIGNATION



ROAD

GG

HH

OO

II

JJ

MM

KK

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G

21 22
28 27

P

NN

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RAILROAD

BELL

ROAD

EL MIRAGE

The entire project site is above the delineated Flood Plain of the Agua Fria River as shown on Flood Plain Maps prepared by the Maricopa County Flood Control District.

Runoff Quantities and Concentration Points

Storm runoff quantities have been estimated for each Onsite Drainage Area (as shown on Plate 19) for a 100 year Frequency Storm of 24 hour duration. Runoff quantities for each Drainage Area are presented in Table 8. The TR-20 Program routed storm runoff quantities, at indicated concentration points, are presented in Table 9.

TABLE 6

OFF-SITE STORM RUNOFF

SYMBOL	DRAINAGE AREA (Acres)	CURVE NUMBER	T _c (Min)	ESTIMATED PEAK (cfs)
A'	550	80	41.5	718
B'	595	80	58	637
C'	467	80	52.5	535
D'	301	80	54.5	338
E'	1101	80	78.5	958

TABLE 7

OFF-SITE ROUTED STORM RUNOFF

CONCENTRATION POINT	DRAINAGE AREA (Acres)	TIME TO PEAK (Hours)	ESTIMATED PEAK RUNOFF (cfs)	REMARKS
56	550	12.26	718	D.A. A'
57	1145	12.50	1315	D.A. A' & B'
58	1612	12.78	1583	D.A. A', B' & C'
59	1913	12.81	1794	D.A. A', B', C' & D'
60	3014	13.21	2381	D.A. A', B', C', D' & E'

TABLE 8

ON-SITE STORM RUNOFF

Symbol	Drainage Area (Acres)	Curve Number	Weighted Curve Number	T _c (Min)	Estimated Peak Runoff (cfs)
A	280.2	87.0	87.0	54	406
B	97.9	87.0	83.0	23	193
C	225.2	83.0 & 87.0	84.6	47	321
D	90.3	74.0	74.0	53	79
E	121.1	83.0	83.0	38	185
F	153.6	87.0 & 91.0	87.5	40.3	269
G	156.8	83.0, 87.0 & 91.0	85.8	37.5	271
H	50.0	87.0	87.0	23	112
I	69.9	83.0, 87.0 & 90.0	85.5	19	159
J	65.9	90.0	90.0	20.8	166
K	121.7	83.0, 87.0 & 90.0	85.8	26.5	249
L	87.1	74.0	74.0	57	73
M	69.8	91.0	91.0	16.7	192
N	159.1	83.0, 87.0 & 91.0	86.2	36.5	283
O	32.1	91.0	91.0	21	84
P	106.4	83.0 & 91.0	84.6	54	177
Q	72.1	91.0	91.0	27.8	168
R	47.8	83.0, 87.0 & 91.0	88.0	20.8	114
S	243.5	83.0 & 87.0	86.8	39	418
T	45.3	87.0	87.0	19.8	107
U	94.7	83.0, 87.0 & 91.0	86.6	41.7	194
V	85.3	87.0	87.0	28	177
W	137.1	91.0	91.0	25.5	331
X	75.8	87.0	87.0	19.5	181
Y	74.5	87.0	87.0	23	167
Z	36.4	91.0	91.0	35	239
AA	353.4			49.5	
BB	94.1	83.0 & 87.0	83.8	38	148
CC	138.4	83.0 & 87.0	83.8	47	192
DD	185.5	87.0 & 87.0	87.0	57.7	321
EE	119.2	87.0	87.0	57	168
FF	104.2	87.0	87.0	50	158
GG	299.9	87.0	87.0	78	338
HH	149.4	83.0	83.0	39	225
II	95.6	87.0	87.0	41	162
JJ	72.9	87.0	87.0	53	108
KK	71.8	87.0	87.0	31	141
LL	86.8	87.0	87.0	29	176
MM	252.5	83.0, 87.0 & 91.0	86.2	62	331
NN	40.9	87.0	87.0	10	111
OO	217.1	87.0	87.0	43	357

TABLE 9

ROUTED ON-SITE STORM RUNOFF

Concentration Point	Drainage Area (Acres)	Time to Peak (hours)	Estimated Peak Runoff (cfs)	Remarks
1	280.2	12.39	406	D.A. "A"
2	378.1	12.48	472	D.A. "A" & B
4	225.2	12.41	319	D.A. "C"
5	693.6	12.51	828	D.A. A,B,C & D
6	121.1	12.22	185	D.A. "E"
7	274.7	12.37	394	D.A. E & F
8	968.3	12.58	1162	D.A. A,B,C,D,E & F
9	1055.4	12.76	1192	D.A. A,B,C,D,E & F
10	156.8	12.21	271	D.A. G
11	276.2	12.16	478	D.A. G,H & I
12	65.9	12.05	166	D.A. J
14	121.7	12.10	249	D.A. K
15	464.3	12.19	835	D.A. G,H,I,J & K
16	1519.7	12.59	1639	D.A. "A" thru "L"
17	228.9	12.19	461	D.A. "M" and "N"
18	32.1	12.05	84	D.A. "O"
19	1780.7	12.43	1934	D.A. "A thru O"
20	106.4	12.20	177	D.A. "P"
21	178.5	12.25	280	D.A. P & Q
22	243.5	12.23	417	D.A. "S"
23		?	313	D.A. P,Q, & "R"
24	469.8	12.25	730	D.A. P,Q,R & S
25	94.7	12.11	194	D.A. U
26	609.8	12.23	952	D.A. P,Q,R,S,T, & U
27	85.3	12.12	177	D.A. "V"
29	695.1	12.22	1109	D.A. P thru V
30	2475.8	12.36	2919	D.A. "A" thru "V"
31	137.1	12.09	331	D.A. "W"
32	2612.9	12.37	3090	D.A. "A" thru "W"
33	2688.7	12.39	3149	D.A. "A" thru "X"
34	74.5	12.07	167	D.A. "Y"
35	110.9	12.12	239	D.A. "Y" and "Z"
35A	2799.6	12.35	3265	D.A. "A" thru "Z"
36	94.1	12.22	148	D.A. "BB"
37	138.4	12.31	192	D.A. "CC"
38	185.5	12.38	321	D.A. "DD"
39	119.2	12.42	168	D.A. "EE"
40	304.7	12.39	488	D.A. DD & EE
41	537.2	12.37	812	D.A. "BB" thru "EE"
42	641.4	12.40	963	D.A. "BB" thru "FF"

TABLE 9 (Cont'd)

ROUTED ON-SITE STORM RUNOFF

Concentration Point	Drainage Area (Acres)	Time to Peak (hours)	Estimated Peak Runoff (cfs)	Remarks
43	3441.0	12.40	4267	D.A. "A" thru "Z" & BB thru FF
44	299.8	12.67	338	D.A. "GG"
45	95.6	12.25	162	D.A. "II"
46	168.5	12.53	249	D.A. "II" & "JJ"
47	449.3	-	406	D.A. GG & HH
48	617.8	12.62	655	D.A. "GG" thru "JJ"
49	689.6	12.61	712	D.A. "GG" thru "KK"
50	252.6	12.44	331	D.A. "MM"
51	86.0	12.12	176	D.A. "LL"
52	775.6	12.45	812	D.A. "GG" thru "LL"
53	1069.0	12.53	1154	D.A. "GG" thru "NN"
54	217.1	12.27	357	D.A. "OO"

Section J
DRAINAGE MASTER
PLAN

Section J

DRAINAGE MASTER

PLAN

1. OFFSITE IMPROVEMENTS

Development north of Deer Valley Road is not likely to occur for quite a few years, therefore storm runoff design was based on this land remaining undeveloped. The project site is fairly well protected on the north from storm water runoff by the McMicken Dam outlet-channel which intercepts the runoff from the Hieroglyphic Mountains and Wickenburg Mountains. This outlet channel terminates in Section 11, Township 4 North, Range 1 West into a small branch wash which flows to the Agua Fria River. This small branch wash passes through the northeast corner of the project site, specifically the east quarter of the east half of Section 23.

The project site is further protected by an existing drainage channel of varying width (10' to 50') which also discharges into the above referenced small branch wash. This channel drains the existing land between McMicken Dam Outlet Channel and Deer Valley Road (see Plate 18). A visual inspection along Deer Valley Road presently indicates there has not been any recent over topping of the roadway and spilling onto the project site.

The proposed Drainage Master Plan includes using the existing drainage channel along the north side of the project site for continued conveyance of storm runoff to the east to El Mirage Road. This typical roadway/channel section is shown on Plate 6, Section D, "Deer Valley Road Section". The existing channel runoff will be turned south in the El Mirage Channel Section (Plate 7, Section D, "El Mirage Road Section") which terminates in an existing wash at approximately the northeast corner of Section 26. This existing wash will then transport the collected runoff southeast to the Agua Fria River Channel for disposal.

The flood outlets of McMicken Dam are mainly ungated, thus outflow from the detention reservoir will be uncontrolled. Under detention basin operation the outlet works consists of a spillway, one double 10' x 10' reinforced concrete box culvert (ungated outlet) and six 24" diameter reinforced concrete pipes and corrugated metal pipes (Gate Outlet). The gated pipe outlet works are for discharge directly into the Beardsley Canal.

2. ONSITE IMPROVEMENTS

As discussed above, all runoff north of the project site will be prevented from flowing onto the new community project site. This runoff will be captured in an existing drainage channel and taken east to the El Mirage Channel for conveyance south and east to the Agua Fria River. Therefore, rainfall falling on the project site will be handled

within the confines of the site by the planned roadway and drainage channels for ultimate discharge to the Agua Fria River.

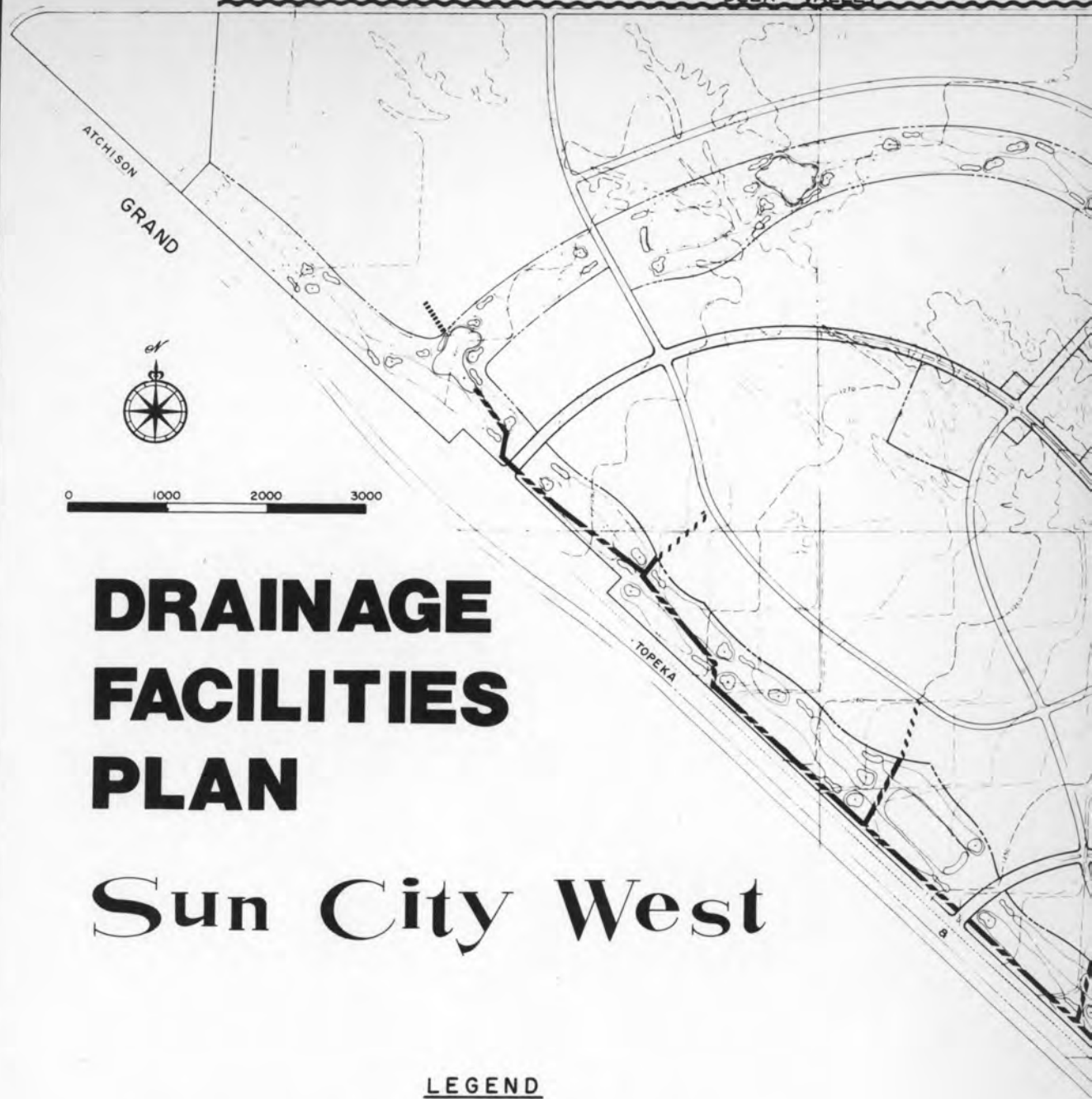
The overall new community project site has been planned with a road and channel network system, as shown on Plate 20, "Drainage Facilities Plan", designed to handle the 100 year Frequency Storm of 24 hour duration. The street system, with street sections as shown on Plates 8 through 11, will be used to convey the storm runoff until depth in the streets reaches 0 inches to 6 inches above top of curb, for residential streets. When the water gets to this depth, it will be routed to a drainage channel, as shown by typical channel sections on Plates 21 through 24, for conveyance to the Agua Fria River for discharge. The lining of the channel sections will vary depending upon quantity of flow conveyed, available right-of-way, velocity of flow and land use adjacent to the channel. Presently the linings intended are of four types as follows: bare earth, grass lined, soil cement or pneumatically placed concrete lining.

This Drainage Plan calls for the discharging of storm water from the project site at three locations as follows: into the El Mirage Channel at the northeast corner of Section 26 for conveyance to the Agua Fria; and through 2 existing reinforced concrete box culverts under Bell Road. The planned discharge at the northeast corner of Section 26 represents no major drainage problems as it is discharging directly into an existing branch wash which has a designated right-of-way for flood waters and is owned by Maricopa County Flood Control District.

The planned drainage discharges under Bell Road is a more complex situation. There currently exists a triple 10' x 5' RCB culvert approximately 1547 feet east of Dysart Road and a double 9' x 5' RCB culvert 2200 feet east of the previous box in Bell Road. These structures essentially drain most of the existing project site area into a small wash that passes through the north side of the Town of Surprise, Arizona and in turn discharges into the Agua Fria River. This wash is heavily choked with weeds, grass and trees and generally cannot accept a very large volume of drainage runoff without flooding the surrounding area due to lack of maintenance performed on the wash. Therefore, it is recommended that a drainage channel be constructed on the south side of Bell Road to handle the storm runoff discharged by these structures and convey it directly east into the Agua Fria River Channel south of the Bell Road Bridge.

This improvement serves a dual purpose for the protection of Surprise against flooding. It will eliminate the off-site storm runoff presently being conveyed through the community, thus minimizing the flooding potential to existing residences constructed adjacent to the wash. It will also reduce the amount of maintenance required for this wash and permit use of additional land along the wash for development of the community.

In order to handle the planned discharge under Bell Road, it is recommended that the triple 10' x 5' box culvert east of Dysart Road be expanded to a 6 barrel 10' x 5' RCB culvert by adding three more barrels to the structure, and that the double 9' x 5' box culvert be expanded to a 3 barrel 9' x 5' RCB culvert by adding one more barrel to the structure.

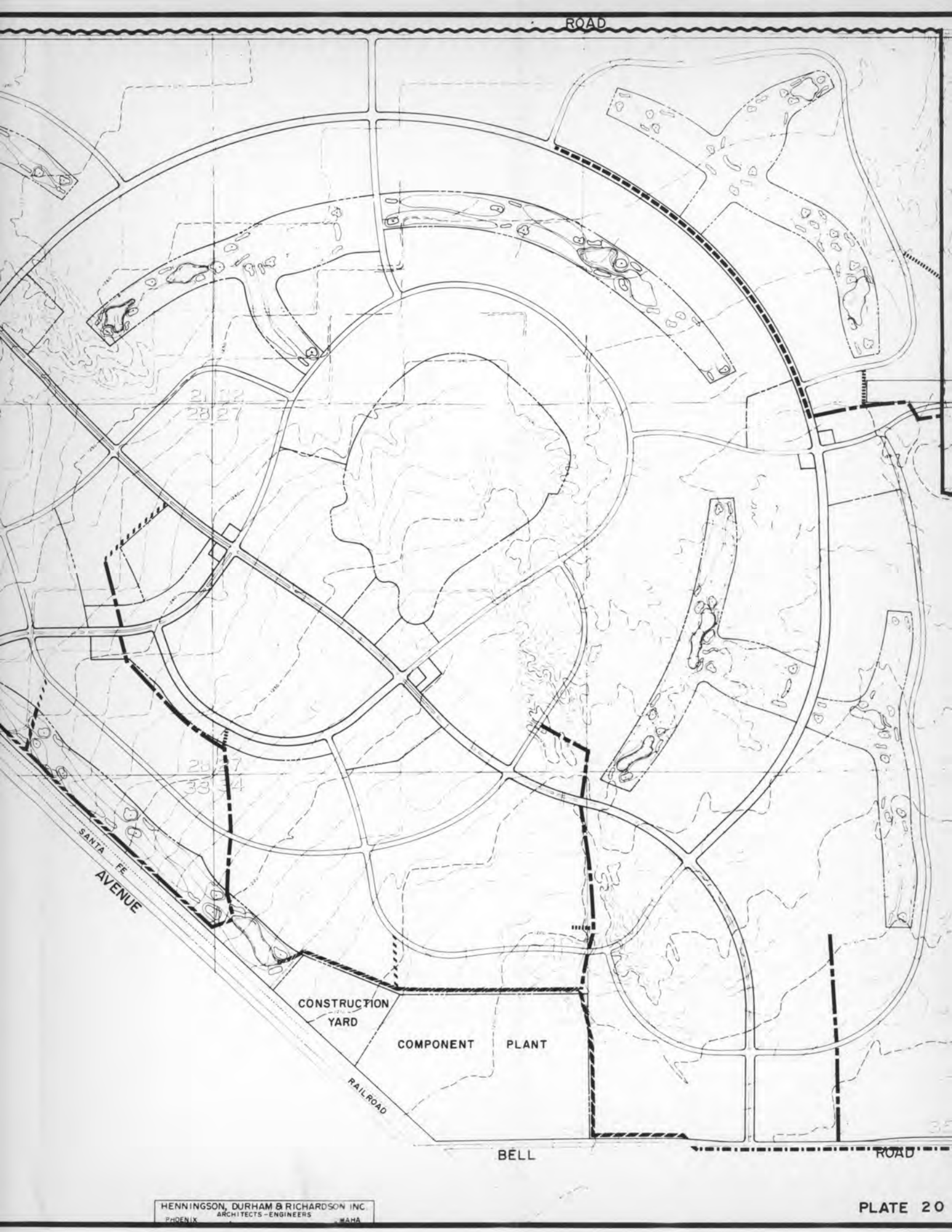


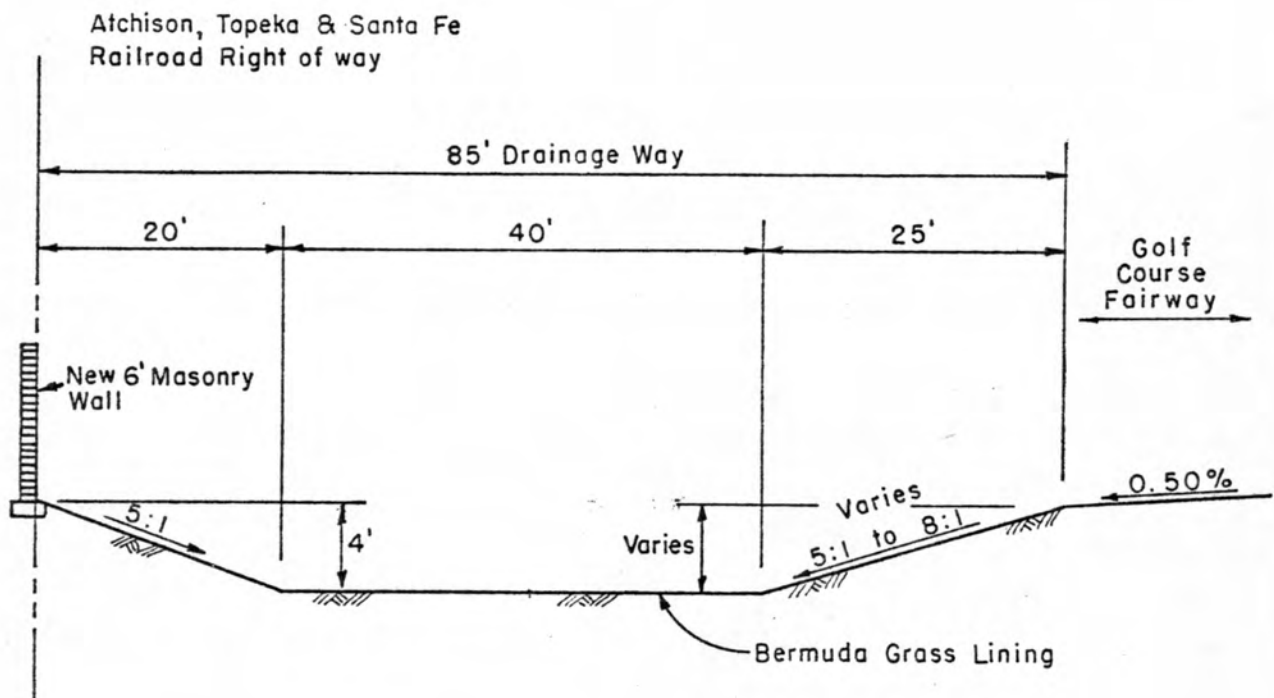
DRAINAGE FACILITIES PLAN

Sun City West

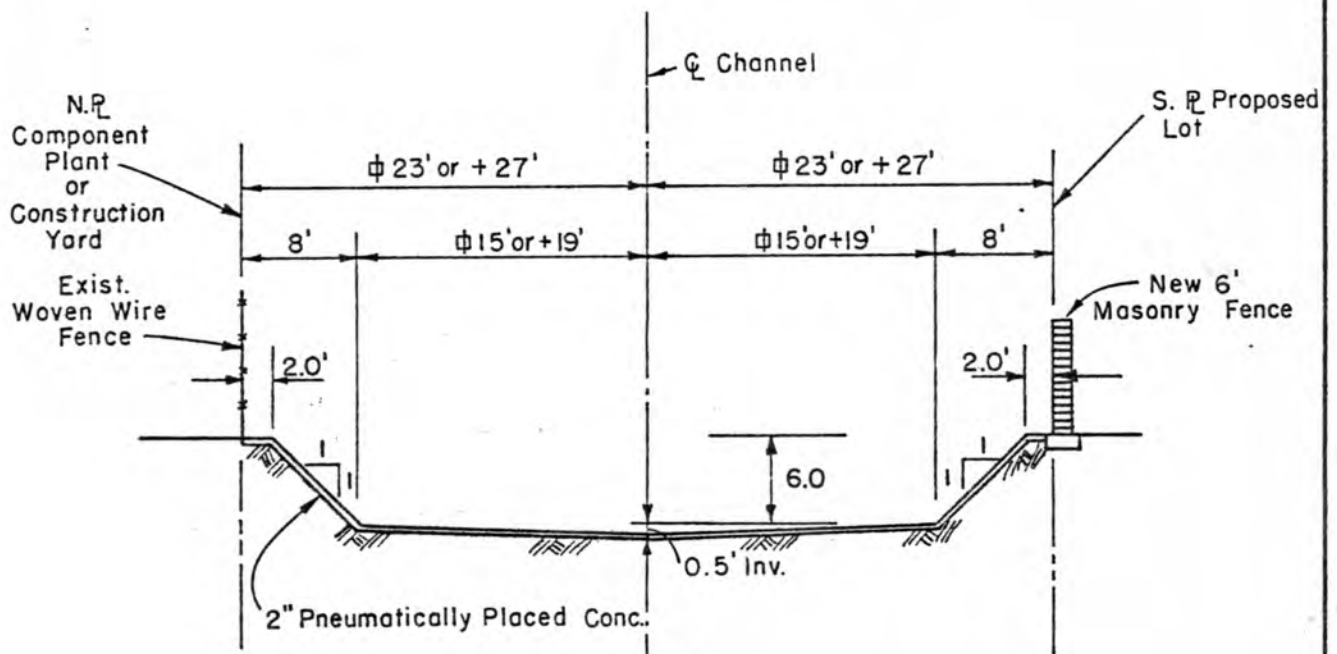
LEGEND

- ARTERIAL STREET SECTION G
- ====/==== DRAINAGE CHANNEL SECTION E
- ====\==== DRAINAGE CHANNEL SECTION F
- DRAINAGE CHANNEL SECTION G
- DRAINAGE CHANNEL SECTION H
- ====/==== DRAINAGE CHANNEL SECTION I
- DRAINAGE CHANNEL SECTION J
- ====\==== DRAINAGE CHANNEL SECTION K
- ===== EL MIRAGE ROAD CHANNEL SECTION
- ~~~~~ EXISTING DRAINAGE CHANNEL



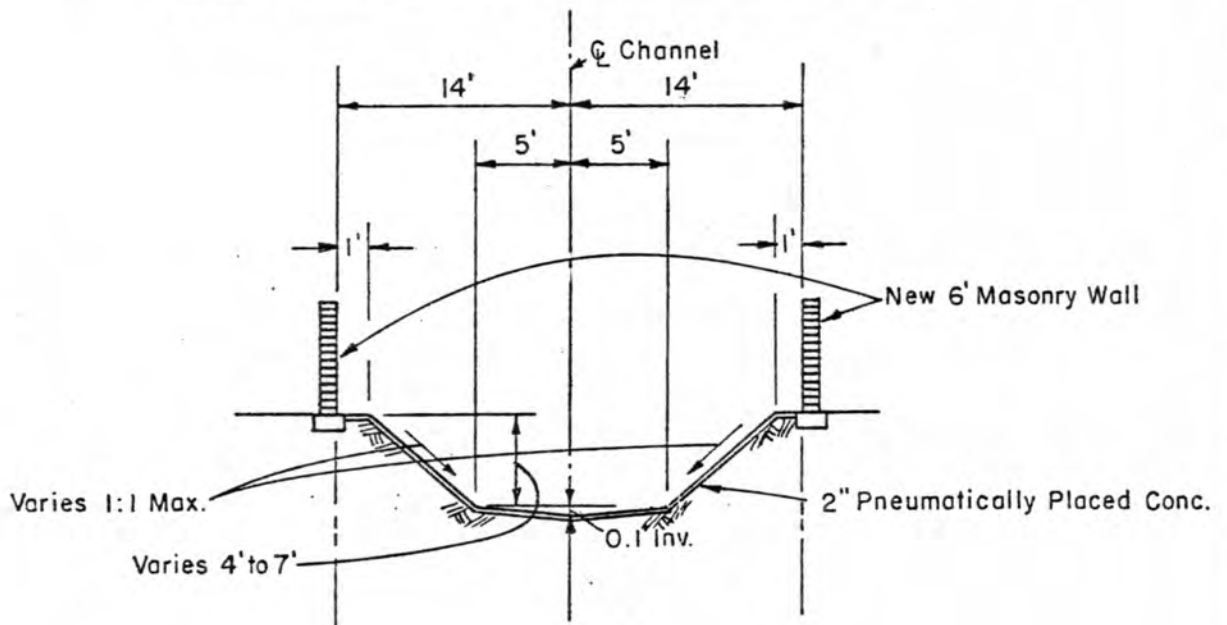


SECTION "E"
DRAINAGE CHANNEL THRU GOLF COURSE



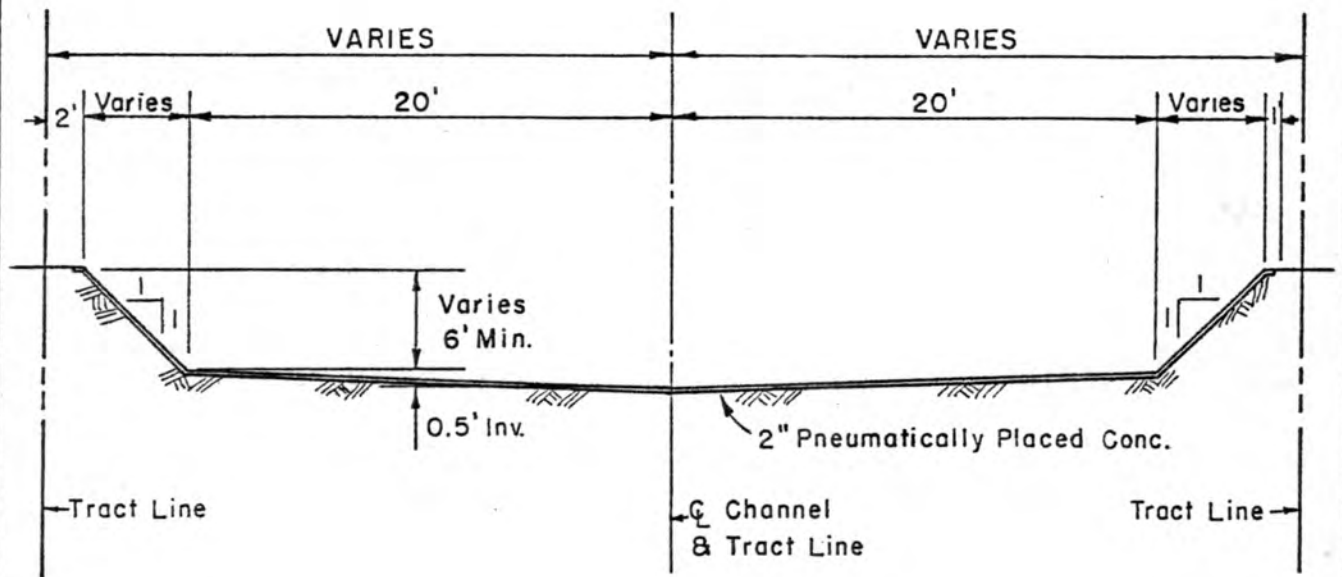
SECTION "F"

Φ DRAINAGE CHANNEL ALONG N. SIDE OF CONSTRUCTION YARD
+ DRAINAGE CHANNEL ALONG N. SIDE OF COMPONENT PLANT

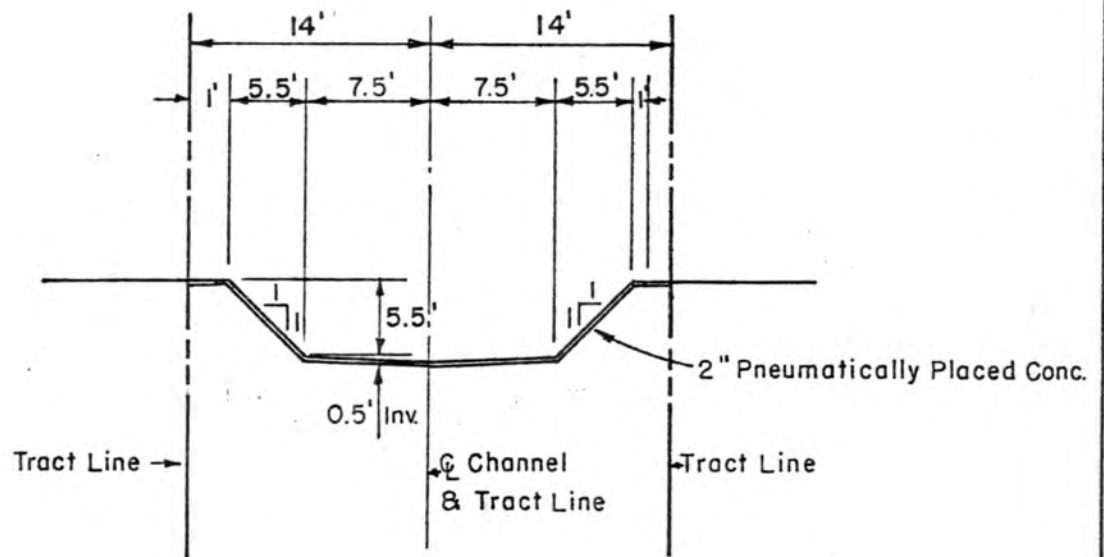


SECTION "G"

DRAINAGE CHANNEL WITH SCREEN WALLS



SECTION "J"
DRAINAGE CHANNEL ALONG BELL ROAD



SECTION "K"
TYPICAL DRAINAGE SECTION

This expansion will prevent the runoff from overtopping the culvert during a 100 year Frequency Storm, thus keeping Bell Road open to traffic in this section of roadway.

Discharge of storm water to the Agua Fria River in lieu of on-site detention was adopted for the following reasons:

1. The Agua Fria River is an adequate point of storm water discharge within reasonable proximity to the site.
2. The runoff from this project does not significantly increase the peak flow in the Agua Fria River.
3. Secondary discharge at the northeast corner of Section 26 is to the Mc Micken Dam Outlet Channel Floodway, a Maricopa County Flood Control District facility.
4. The proposed drainage channel along Bell Road to the Agua Fria River will alleviate a flood hazard in the town of Surprise.

3. STREET AND CHANNEL CAPACITIES

The Drainage Master Plan for Sun City West Phase I calls for storm water runoff to be conveyed to its outfall in the Agua Fria River by the roadway system, grass or lined channels, and a combination of roadway with a median channel.

Capacity of these storm water conveyance systems is based on Manning's Formula for open channel flow which is expressed as follows:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

$$Q = AV$$

V = Mean Velocity of Water in feet per second

n = Manning's coefficient of roughness

R = Hydraulic radius in feet (cross-sectional area ÷ wetted perimeter)

S = Slope of roadway or channel in feet per foot

Q = Conveyance quantity in cubic feet per second

A = Cross-sectional area of flowing water in square feet

Manning's roughness coefficient varies with the type of surface over which the water is flowing. Values used for "n" are as follows:

<u>"n"</u>	<u>surface type</u>
0.016	asphalt pavement
0.018	pneumatically placed concrete channel lining
0.018	soil cement channel lining
0.03	dirt median
0.03	flood channel, earth bottom, rubble sides
0.033-0.05	grass lined channels

Typical sections of roadways and channels are shown on Plates 6 through 8 and Plates 21 through 24. The anticipated capacity of these sections are dependent mainly upon the slope of the roadway or channel. Conveyance capacities have been estimated based on anticipated profiles. Final site development and layout will dictate the slope to which the roadway or channel will actually be constructed. During final site development, drainage will again be checked to insure that floors will be protected from 100 year Frequency Storm.

ROADWAYS (SEE PLATE 19)

1 to 2 - Assumed slope = 0.005'/ft. and roadway Section B-1

$$\begin{array}{l} Q \\ 100 \end{array} = 472 \text{ cfs} \\ \text{water depth 0.54' above T. C.} \quad \frac{V}{7.27} \text{ fps} \quad \frac{Q}{474} \text{ cfs}$$

4 - Assumed slope = 0.0046'/ft. and roadway Section B-1

$$\begin{array}{l} Q \\ 100 \end{array} = 319 \text{ cfs} \\ \text{water depth 0.32' above T. C.} \quad \frac{V}{6.07} \text{ fps} \quad \frac{Q}{321} \text{ cfs}$$

6 - Assumed slope = 0.0023'/ft. and roadway Section B-1

$$\begin{array}{l} Q \\ 100 \end{array} = 185 \text{ cfs} \\ \text{water depth 0.22' above T. C.} \quad \frac{V}{3.98} \text{ fps} \quad \frac{Q}{188} \text{ cfs}$$

7 - Assumed slope = 0.0043'/ft. and roadway Section B-1

$$\begin{array}{l} Q \\ 100 \end{array} = 394 \text{ cfs} \\ \text{water depth 0.46' above T. C.} \quad \frac{V}{6.43} \text{ fps} \quad \frac{Q}{391} \text{ cfs}$$

10 - Assumed slope = 0.0049'/ft and Roadway Section D

$$Q_{100} = 271 \text{ cfs}$$

water depth 0.16' above outside curb	$\frac{V}{4.95 \text{ fps (Pvmt.)}}$	$\frac{Q}{254 \text{ cfs}}$
	2.16 fps (Dirt)	$\frac{23 \text{ cfs}}{277 \text{ cfs}}$

12 - Assumed slope = 0.0045'/ft and Roadway Section D-1

$$Q_{100} = 166 \text{ cfs}$$

water depth at Top of Curb	$\frac{V}{4.34 \text{ fps}}$	$\frac{Q}{174 \text{ cfs}}$
----------------------------	------------------------------	-----------------------------

14 - Assumed roadway slope = 0.0057'/ft and Roadway Section B-1

$$Q_{100} = 249 \text{ cfs}$$

water depth 0.13' above T.C.	$\frac{V}{5.81 \text{ fps}}$	$\frac{Q}{246 \text{ cfs}}$
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17 - Assumed roadway slope = 0.0028'/ft and Roadway Section B-1

$$Q_{100} = 461 \text{ cfs}$$

water depth 0.73' above T.C.	$\frac{V}{6.02 \text{ fps}}$	$\frac{Q}{457 \text{ cfs}}$
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20 - Assumed roadway slope = 0.0025'/ft and Roadway Section B-1

$$Q_{100} = 177 \text{ cfs}$$

water depth 0.17' above T.C.	$\frac{V}{3.99 \text{ fps}}$	$\frac{Q}{177 \text{ cfs}}$
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21 - Assumed roadway slope = 0.0047'/ft and Roadway Section D

$$Q_{100} = 280 \text{ cfs}$$

water depth 0.18' above outside T.C.	$\frac{V}{4.94 \text{ fps (Pvmt.)}}$	$\frac{Q}{261 \text{ cfs}}$
	2.18 fps (Dirt)	$\frac{25 \text{ cfs}}{286 \text{ cfs}}$

22 - Assumed Roadway Slope = 0.0045'/ft and Roadway Section A-1

$$Q_{100} = 417 \text{ cfs}$$

$$\text{water depth } 0.83' \text{ above T.C.} \quad \frac{V}{7.12 \text{ fps}} \quad \frac{Q}{417 \text{ cfs}}$$

23 - Assumed Roadway Slope = 0.0039'/ft and Roadway Section D

$$Q_{100} = 313 \text{ cfs}$$

$$\text{water depth } 0.26' \text{ above T.C.} \quad \begin{array}{l} \frac{V}{4.85 \text{ fps (Pvmt.)}} \\ 2.18 \text{ fps (Dirt)} \end{array} \quad \begin{array}{l} \frac{Q}{285 \text{ cfs}} \\ 28 \text{ cfs} \\ \hline 313 \text{ cfs} \end{array}$$

25 - Assumed Roadway Slope = 0.0035'/ft and Roadway Section A-1

$$Q_{100} = 194 \text{ cfs}$$

$$\text{water depth } 0.45' \text{ above T.C.} \quad \frac{V}{4.90 \text{ fps}} \quad \frac{Q}{198 \text{ cfs}}$$

26 - Assumed Roadway Slope = 0.0025'/ft and Roadway Section A-1

$$Q_{100} = 167 \text{ cfs (Runoff D.A. T only)}$$

$$\text{water depth } 0.45' \text{ above T.C.} \quad \frac{V}{4.14 \text{ fps}} \quad \frac{Q}{167 \text{ cfs}}$$

27 - Assumed Roadway Slope = 0.0025'/ft and Roadway Section B

$$Q_{100} = 177 \text{ cfs}$$

$$\text{water depth } 0.60' \text{ above T.C.} \quad \frac{V}{4.02 \text{ fps}} \quad \frac{Q}{181 \text{ cfs}}$$

34 - Assumed Roadway Slope = 0.0033'/ft and Roadway Section B

$$Q_{100} = 167 \text{ cfs}$$

$$\text{water depth } 0.5' \text{ above T.C.} \quad \frac{V}{4.23 \text{ fps}} \quad \frac{Q}{167 \text{ cfs}}$$

This depth should consider inverted crown street or steepening roadway grade.

- 35 - Assumed Roadway Slope = 0.003'/ft and Roadway Section D
- | | | |
|--------------------------------------|-----------------------------|----------------------|
| $Q_{100} = 239$ cfs | | |
| water depth 0.20' above outside T.C. | $\frac{V}{4.02}$ fps (Pvmt) | $\frac{Q}{219}$ cfs |
| | 1.78 fps (Dirt) | $\frac{21}{240}$ cfs |
- 36 - Assumed Roadway Slope = 0.0044'/ft and Roadway Section A-1
- | | | |
|------------------------------|----------------------|---------------------|
| $Q_{100} = 148$ cfs | | |
| water depth 0.26' above T.C. | $\frac{V}{4.63}$ fps | $\frac{Q}{145}$ cfs |
- 37 - Assumed Roadway Slope = 0.0055'/ft and Roadway Section A-1
- | | | |
|------------------------------|----------------------|---------------------|
| $Q_{100} = 192$ cfs | | |
| water depth 0.33' above T.C. | $\frac{V}{5.54}$ fps | $\frac{Q}{192}$ cfs |
- 38 - Assumed Roadway Slope = 0.0043'/ft and Roadway Section A-1
- | | | |
|------------------------------|----------------------|---------------------|
| $Q_{100} = 321$ cfs | | |
| water depth 0.66' above T.C. | $\frac{V}{6.30}$ fps | $\frac{Q}{318}$ cfs |
- Too deep to be routed to Channel in Drainage Area CC
- 39 - Assumed Roadway Slope = 0.00265'/ft and Roadway Section B-1
- | | | |
|------------------------------|----------------------|---------------------|
| $Q_{100} = 168$ cfs | | |
| water depth 0.12' above T.C. | $\frac{V}{3.93}$ fps | $\frac{Q}{164}$ cfs |
- 40 - Assumed Roadway Slope = 0.00265'/ft and Roadway Section B-1
- | | | |
|------------------------------|----------------------|---------------------|
| $Q_{100} = 488$ cfs | | |
| water depth 0.81' above T.C. | $\frac{V}{6.08}$ fps | $\frac{Q}{489}$ cfs |
- Part is too deep to be routed to Drainage Channel in Area CC

- 44 - Assumed Roadway Slope = 0.00232'/ft and Roadway Section D-1
 $Q_{100} = 338$ cfs
water depth 0.47' about T.C. $\frac{V}{4.44}$ fps $\frac{Q}{338}$ cfs
- 45 - Assumed Roadway Slope = 0.00226'/ft and Roadway Section A-1
 $Q_{100} = 162$ cfs
water depth 0.46' above T.C. $\frac{V}{3.97}$ fps $\frac{Q}{162}$ cfs
- 46 - Assumed Roadway Slope = 0.003'/ft and Roadway Section D-2
 $Q_{100} = 249$ cfs
water depth 0.50' above T.C. $\frac{V}{4.8}$ fps $\frac{Q}{248}$ cfs
- 47 - Assumed Roadway Slope = 0.0025'/ft and Roadway Section C
 $Q_{100} = 406$ cfs
water depth 3.00' above channel bottom $\frac{V}{7.25}$ fps $\frac{Q}{413}$ cfs
water contained within channel banks
- 48 - Assumed Roadway Slope = 0.0040'/ft and Roadway Section C
 $Q_{100} = 655$ cfs
water depth 3.42' above channel bottom $\frac{V}{9.86}$ fps $\frac{Q}{655}$ cfs
- 49 - Assumed Roadway Slope = 0.0063'/ft and Roadway Section C
 $Q_{100} = 712$ cfs
water depth 3.15' above channel bottom $\frac{V}{11.80}$ fps $\frac{Q}{712}$ cfs

50 - Assumed Roadway Slope = 0.0027'/ft and Roadway Section B-1

$$Q_{100} = 331 \text{ cfs}$$

water depth 0.50' above T.C.

$$\frac{V}{5.22 \text{ fps}}$$

$$\frac{Q}{329 \text{ cfs}}$$

51 - Assumed Roadway Slope = 0.0029'/ft and Roadway Section B

$$Q_{100} = 176 \text{ cfs}$$

water depth 0.55' above T.C.

$$\frac{V}{4.15 \text{ fps}}$$

$$\frac{Q}{176 \text{ cfs}}$$

52 - Assumed Roadway Slope = 0.0032'/ft and Roadway Section B-1

$$Q_{100} = 357 \text{ cfs}$$

water depth 0.50' above T.C.

$$\frac{V}{5.68 \text{ fps}}$$

$$\frac{Q}{358 \text{ cfs}}$$

CHANNELS (SEE PLATE 20)

- 2 - Assumed Channel Slope = 0.0029'/ft and Channel Section K
 $Q_{100} = 472$ cfs
water depth 3.10' above channel hinge $\frac{V}{7.88}$ fps $\frac{Q}{472}$ cfs
- 2 to 3 - Assumed Channel Slope = 0.0055'/ft and Channel Section E
 $Q_{100} = 456$ cfs (Routed)
water depth 1.93 ft above channel bottom $\frac{V}{4.30}$ fps $\frac{Q}{456}$ cfs
- 4 - Assumed Channel Slope = 0.0035'/ft and Channel Section K
 $Q_{100} = 319$ cfs
water depth 2.30' above channel hinge $\frac{V}{7.31}$ fps $\frac{Q}{318}$ cfs
- 5 - Assumed Channel Slope = 0.0053'/ft and Channel Section E
 $Q_{100} = 828$ cfs
water depth 2.80' above channel bottom $\frac{V}{5.55}$ fps $\frac{Q}{840}$ cfs
- 7 - Assumed Channel Slope = 0.0032'/ft and Channel Section K
 $Q_{100} = 394$ cfs
water depth 2.70' above channel hinge $\frac{V}{7.66}$ fps $\frac{Q}{395}$ cfs
- 8 to 9 - Assumed Channel Slope = 0.0059'/ft and Channel Section E
 $Q_{100} = 1192$ cfs
water depth 3.25' above channel bottom $\frac{V}{6.37}$ fps $\frac{Q}{1165}$ cfs

This velocity erosive to grass lined channel, therefore consider reducing slope or reduce slope with wash checks.

- 10 - Assumed Channel Slope = 0.0025'/ft and Channel Section K
 $Q_{100} = 271 \text{ cfs}$
water depth 2.30' above channel hinge $\frac{V}{6.23} \text{ fps}$ $\frac{Q}{271} \text{ cfs}$
- 10 to 11 Assumed Channel Slope = 0.003'/ft and Channel Section H
 $Q_{100} = 478 \text{ cfs}$
water depth 2.80' above channel hinge $\frac{V}{7.59} \text{ fps}$ $\frac{Q}{476} \text{ cfs}$
- 12 to 13 Assumed Channel Slope = 0.003'/ft and Channel Section G
 $Q_{100} = 166 \text{ cfs}$
water depth 2.17' above channel hinge $\frac{V}{6.29} \text{ fps}$ $\frac{Q}{166} \text{ cfs}$
- 13 to 15 Assumed Channel Slope = 0.003'/ft and Channel Section H
 $Q_{100} = 835 \text{ cfs}$
water depth 3.55' above channel hinge $\frac{V}{9.03} \text{ fps}$ $\frac{Q}{834} \text{ cfs}$
- 16 to 19 Assumed Channel Slope = 0.0045'/ft and Channel Section F
 $Q_{100} = 1639 \text{ cfs}$
water depth 3.82' above channel hinge $\frac{V}{11.96} \text{ fps}$ $\frac{Q}{1635} \text{ cfs}$
- 19 to 28 Assumed Channel Slope = 0.00355'/ft and Channel Section F
 $Q_{100} = 1934 \text{ cfs}$
water depth 3.94' above channel hinge $\frac{V}{11.06} \text{ fps}$ $\frac{Q}{1933} \text{ cfs}$

17 to 19 Assumed Channel Slope = 0.0056'/ft and Channel Section K

$$Q_{100} = 461 \text{ cfs}$$

$$\text{water depth } 2.49' \text{ above channel hinge} \quad \frac{V}{9.71 \text{ fps}} \quad \frac{Q}{459 \text{ cfs}}$$

24 to 26 Assumed Channel Slope = 0.0025'/ft and Channel Section H

$$Q_{100} = 952 \text{ cfs}$$

$$\text{water depth } 4.08' \text{ above channel hinge} \quad \frac{V}{8.84 \text{ fps}} \quad \frac{Q}{951 \text{ cfs}}$$

25 - Assumed Channel Slope = 0.0035'/ft and Channel Section G

$$Q_{100} = 194 \text{ cfs}$$

$$\text{water depth } 2.27' \text{ above channel bottom} \quad \frac{V}{6.97 \text{ fps}} \quad \frac{Q}{194 \text{ cfs}}$$

26 to 29 Assumed Channel Slope = 0.0025'/ft and Channel Section H

$$Q_{100} = 1109 \text{ cfs}$$

$$\text{water depth } 4.47' \text{ above channel hinge} \quad \frac{V}{9.30 \text{ fps}} \quad \frac{Q}{1112 \text{ cfs}}$$

30 to 32 Assumed Channel Slope = 0.0035'/ft and Channel Section I

$$Q_{100} = 2919 \text{ cfs}$$

$$\text{water depth } 4.54' \text{ above channel hinge} \quad \frac{V}{12.11 \text{ fps}} \quad \frac{Q}{2918 \text{ cfs}}$$

32 to 33 Assumed Channel Slope = 0.0035'/ft and Channel Section I

$$Q_{100} = 3149 \text{ cfs}$$

$$\text{water depth } 4.75' \text{ above channel hinge} \quad \frac{V}{12.45 \text{ fps}} \quad \frac{Q}{3144 \text{ cfs}}$$

33 to 42 Assumed Channel Slope = 0.0035'/ft and Channel Section J

$$Q_{100} = 3265 \text{ cfs}$$
$$\text{water depth } 5.30' \text{ above channel hinge} \quad \frac{V}{10.57} \text{ fps} \quad \frac{Q}{3263} \text{ cfs}$$

41 to 42 Assumed Channel Slope = 0.0026'/ft and Channel Section H

$$Q_{100} = 963 \text{ cfs}$$
$$\text{water depth } 4.05' \text{ above channel hinge} \quad \frac{V}{9.27} \text{ fps} \quad \frac{Q}{963} \text{ cfs}$$

42 to 43 Assumed Channel Slope = 0.0035'/ft and Channel Section J

$$Q_{100} = 4267 \text{ cfs}$$
$$\text{water depth } 6.24' \text{ above channel hinge} \quad \frac{V}{14.29} \text{ fps} \quad \frac{Q}{4266} \text{ cfs}$$

49 to 52 Assumed Channel Slope = 0.0046'/ft and Channel Section H

$$Q_{100} = 712 \text{ cfs}$$
$$\text{water depth } 3.10' \text{ above channel hinge} \quad \frac{V}{10.18} \text{ fps} \quad \frac{Q}{712} \text{ cfs}$$

51 to 52 Assumed Channel Slope = 0.016'/ft and Channel Section G

$$Q_{100} = 176 \text{ cfs}$$
$$\text{water depth } 1.37' \text{ above channel bottom} \quad \frac{V}{11.30} \text{ fps} \quad \frac{Q}{176} \text{ cfs}$$

52 to 53 Assumed Channel Slope = 0.0025'/ft and Channel Section H

$$Q_{100} = 812 \text{ cfs}$$
$$\text{water depth } 4.05' \text{ above channel hinge} \quad \frac{V}{8.66} \text{ fps} \quad \frac{Q}{812} \text{ cfs}$$

53 to 54 Assumed Channel Slope = 0.0025'/ft and Channel Section H

$$Q_{100} = 1154 \text{ cfs}$$

$$\text{water depth } 4.58' \text{ above channel hinge} \quad \frac{V}{9.42 \text{ fps}} \quad \frac{Q}{1153 \text{ cfs}}$$

54 Assumed Channel Slope = 0.003'/ft and Channel Section G

$$Q_{100} = 357 \text{ cfs}$$

$$\text{water depth } 3.32' \text{ above channel bottom} \quad \frac{V}{8.07 \text{ fps}} \quad \frac{Q}{357 \text{ cfs}}$$

55 Assumed Channel Slope = 0.002'/ft and El Mirage Channel Section

$$Q_{100} = \begin{array}{l} 11,644 \text{ cfs (Offsite Runoff)} \\ \underline{4,450 \text{ cfs (Overflow spillway McMicken Dam Spillway)}} \\ 16,094 \text{ cfs Total Runoff in Channel} \end{array}$$

$$\text{water depth } 10.31' \text{ above channel bottom} \quad \frac{V}{9.73 \text{ fps}} \quad \frac{Q}{16,094 \text{ cfs}}$$

Part III
WATER & SEWER

Section K
INTRODUCTION TO THE
WATER & SEWER PLAN

Section K

INTRODUCTION TO THE WATER & SEWER PLAN

A complete water and sewer system will be developed and installed to serve the specified area. Development will proceed in a manner similar to that employed in the original Sun City development. Construction of both water and sewer facilities will be accomplished by the Del Webb Development Company under contract with Citizens Utilities Company.

After construction, both water and sewer systems will be owned, operated and maintained by the Citizens Utilities Company. Proper franchises for both services are held or are being obtained by that company.

The sewer system will be designed and constructed to be a completely self contained service system, not dependent upon other systems for disposal. The master plans for water and sewer anticipate the complete development and provide adequate facilities for the total expected population.

The overall design of both water and sewer systems is based on the experience gained in development of the existing Sun City facilities, and the operating data obtained over the years of operation.

The development criteria are based in general on the following design data:

SUN CITY, WEST WATER AND SEWER DESIGN CRITERIA

1. Gross Project Area Density	3.0 units/acre
2. Average Occupants per Unit	1.9
3. Total Land Area	5,697 acres
4. Golf Course Area	905 acres
5. Total Area Served by Utilities	4,792 acres
6. Utility Service Area Density	3.57 units/acre
7. Average Sewage Flow	165 gpd/dwelling unit
8. Peak Sewage Flow	289 gpd/D. U.
9. Average Water Demand	450 gpd/D. U.
10. Peak Hour Water Demand	2,370 gpd/D. U.
11. Peak Day Water Demand	866 gpd/D. U.

Section L
WATER SYSTEM
MASTER PLAN

Section L

WATER SYSTEM

MASTER PLAN

1. SUPPLY

Approximately 70% of the area included in the Sun City West Phase I development has previously been farmed by irrigation. The irrigation operations have come under the jurisdiction of the Maricopa County Municipal Water Conservation District No. 1. The source of supply of the surface water distributed by this district is from storage of Agua Fria River water in Lake Pleasant behind Waddell Dam. Water is delivered to the area through a network of canal structures. In addition to the surface water from Lake Pleasant, the system has been supplemented by substantial pumpage from groundwater supplies. An average annual use of 5.5 feet of water per acre has been reported for this area. Approximately 15% of the water use has been from Lake Pleasant water. The remainder has been from the groundwater supplies.

The estimated Dwelling Units for Phase I of Sun City West have been established at 17,100. At an estimated consumption of 450 gallons of water per Dwelling Unit per day, average annual requirement would be about 8700 acre feet per year. Golf course irrigation will require 5,150 acre feet.

It is anticipated that reclaimed wastewater will provide 3,750 acre feet per year for golf course irrigation, with a deficiency of 1,400 acre feet to be supplied from groundwater sources. Total groundwater pumped will be 10,000 acre feet per year. Since previous irrigation use has been about 22,000 acre feet per year for the same area, the Development will use much less groundwater than required for farming operations.

Wells in the area are capable of producing all of the water required by Phase I development. There are ten wells within the development area formerly operated by the District with a total pumping capability of about 15,700 gpm. In addition, there are five more wells which were privately owned, with an estimated capability of 4,000 to 5,000 gpm. This totals to a capability of about 20,000 gpm. Wells with this capability would be able to produce up to 32,000 acre feet of water per year, if required. Estimates established in previous investigations indicate that a full development of population would result in an effective draw-down of no more than 7 feet per year. Well log data indicates that water can be effectively produced to a depth of at least 1,500 feet. This would indicate an assured supply for many years at projected rates.

In addition to the groundwater supply, water from Lake Pleasant could be used. Without further legal clearances, water would be available for irrigation of the golf courses to supplement the water available from reclaimed wastewater. This would free an additional amount of water for potable use.

Citizens Utilities Company has applied for Central Arizona Project water. It is possible that 4,800 acre feet of CAP water will be available by 1985. It is anticipated that the CAP allocation will increase to 26,900 acre feet by 2034. The CAP water may be used to supplement groundwater sources.

2. HYDROLOGIC STUDIES

A complete and comprehensive study of the groundwater capabilities in the Sun City West area was completed in January, 1975, by the Water Development Corporation, consultants in Water Resources with offices in Tucson, Arizona. This study entitled "Review of Water Supply, Sun City West, Arizona" is submitted herewith and by reference is made a part of this report. The study has been submitted to the Arizona Water Commission.

This report addresses in depth the elements of demand, the elements of supply, and the elements of adequacy, and certifies that the area warrants being designated as a service area where an adequate supply of water exists. In addition to considerations for the use of potable water, the report documents the requirements and supplies of water for use in irrigation of the golf courses.

The overall recommendations of the report generally are for the use of surface water supplies for irrigation required in maintaining the golf courses, and any other similar green belt area.

In support of the recommendations in the report, the Consultants have carefully analyzed the basic hydrological data available, and considerable such supportive information is included in the body of the report. Such factual data as water quality analyses, driller logs, well discharge data, hydrographs and other records are documented and included in detail.

3. WATER TREATMENT

Both water from Lake Pleasant and from the CAP would require treatment before use as potable supplies; however, neither would require treatment for irrigation of golf courses, or other normal irrigation purposes. The quality of water from both sources is relatively good and it is anticipated that normal lime-alum clarification followed by chlorination would be adequate to meet existing drinking water standards.

Most of the wells situated in Sun City West Phase I area produce acceptable water without further treatment. The only exceptions are two wells which have flouride contents slightly above allowable limits and two which exceed the nitrate limits. By proper blending of these with water in the reservoirs, it is possible that acceptable levels can

TABLE 10
 CHEMICAL ANALYSES FOR TYPICAL WELLS WITHIN
 AREA OCCUPIED BY SUN CITY WEST

WELL NO. : DATE OF COLLECT. : COLLECTED BY : ANALYZED BY :	4-6 2/18/72 MC HARRIS	4-2 2/18/72 MC HARRIS	B-20 2/16/72 MC HARRIS	A-21 2/22/72 MC ASHL	I-19 5/20/71 MC HARRIS	A-21-E 9/20/71 DM ETL	2-30-S 2/22/72 MC HARRIS	2-25 9/20/71 DM ETL	B-28 2/16/72 MC HARRIS	3-26 2/16/72 MC HARRIS	4-34 2/22/72 MC HARRIS	B-29 9/20/71 DM ETL
CALCIUM, ppm	21	25	25	31	19	32	23	12	25	37	24	22
MAGNESIUM, ppm	9	11	8	10	12	8	9	5	9	16	10	6
SODIUM PLUS POTASSIUM, ppm	58	41	96	68	46	70	70	53	81	26	40	90
CARBONATE, ppm	0	0	4	0	--	0	0	0	4	0	0	0
BICARBONATE, ppm	139	141	144	193	170	205	152	134	182	148	151	173
SULFATE, ppm	40	21	102	45	30	27	48	14	63	27	30	43
CHLORIDE, ppm	40	42	53	44	20	36	52	20	38	44	24	42
FLOURIDE, ppm	0.5	0.6	1.5	0.8	0.8	0.9	0.7	0.8	1.0	0.5	0.6	1.7
NITRATE, ppm	--	--	--	--	--	32	--	28	--	--	--	44
IRON, ppm	--	--	--	--	--	Tr.	--	Tr.	--	--	--	Tr.
Total Dissolved Solids, ppm	308	282	434	392	298	411	355	267	403	298	280	422
pH	8.2	8.1	8.0	7.6	7.0	8.1	7.9	8.5	7.95	7.9	7.7	8.5

NOTE:

- MC = Maricopa County Municipal Water Conservation District No. 1
- ASHL = Arizona State Health Laboratory
- HARRIS = Harris Laboratories
- ETL = Engineers Testing Laboratories
- DM = Del Webb Development Company

be achieved without sophisticated treatment measures. Water Quality analyses are shown in Table 10.

4. STORAGE

Citizens Utilities Company has consistently developed the existing Sun City Water system with an adequate storage system to insure a reliable supply under all conditions of demand. The existing Sun City Water Company storage system includes approximately 6.5 million gallons total in nine separate tanks located strategically throughout the community.

The criteria for determining the required amounts of storage were developed by careful attention to area water demands, determination of well pump capabilities and fire flow demands. Each storage location was analysed with these factors considered on a demand area basis. As the various facilities were constructed, their effectiveness was monitored by flow testing and by "Hardy-Cross" analysis of the resulting system.

It is the intention of the Developer to continue to pursue this rational method of determining storage needs. To accomplish this, the development area has been divided into service areas, and the requirements have been projected to supply the needs of the anticipated population for each. The results are shown in Table 11.

On the basis of these projections, it appears that it will be necessary to provide approximately 4.0 million gallons of total storage in four locations throughout the development.

5. DISTRIBUTION

It has been the policy of the Citizens Utilities Company to require pipe sizing in conformance with good engineering practice and based on Hardy-Cross analysis of the proposed systems. An overall master plan has been developed for placement and sizing of major distribution lines in conformance with this policy. Data from records provided from Citizens Utilities indicate that the anticipated peak day water demand per dwelling unit will be 866 g/DU.

Storage and booster pump requirements have been estimated and their locations are shown on Plate 25 entitled "Water System Master Plan". Calculations are shown in Table 12.

The master plan has been developed with the express purpose of providing a well engineered looped system adequate to supply the needs of the fully developed community at the maximum flow rates without reduced pressures or excessive velocities. Storage and booster pump locations have been selected to make the most effective use of the existing wells and to keep the necessary facilities properly distributed consistent with the anticipated needs. This concept has worked exceptionally well in the development of Sun City and should be equally effective in providing proper service to Sun City West.

Sizes of the looped water mains are shown on Plate No. 25 referred to above.

TABLE 11

PHASE I - STORAGE CALCULATIONS

Peak Day Water Demand: 866 gpd/D.U.

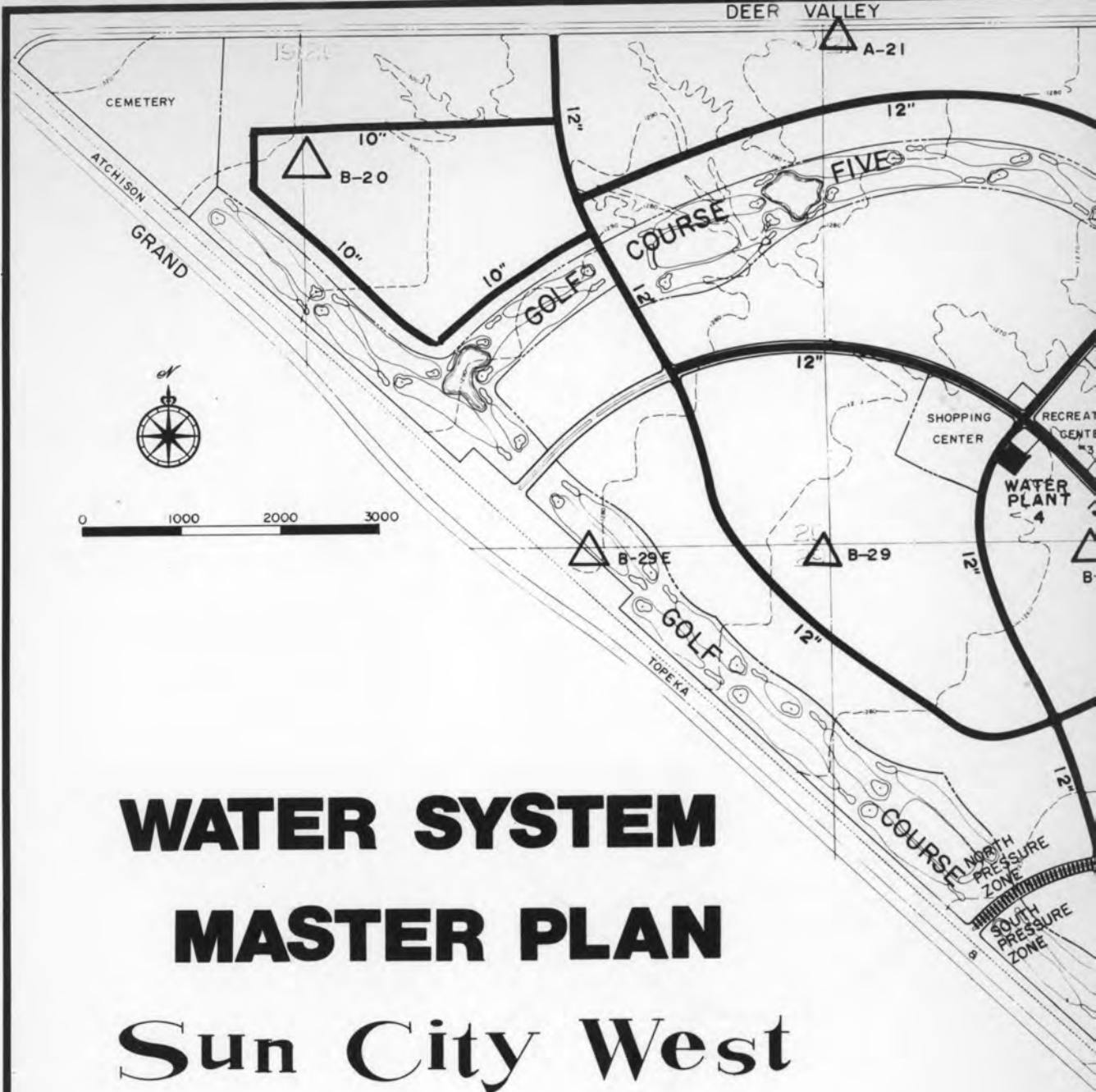
Well Supply - (866 gpd/DU) (17,100 DU) = 14,808,600 GPD
 = 617,000 G/Hr.
 = 10,290 GPM

TIME	PEAK DAY HOURLY DEMAND (%)	SYSTEM DEMAND (1000 G/Hr.)	SUPPLY (1000 G/Hr.)	FLOW TO/FROM STORAGE (1000 Gal.)	NET STOR- AGE REQ. (1000 Gal.)
6-7 AM	5.3	785	617	(168)	168
7-8 AM	9.4	1392	617	(775)	943
8-9 AM	11.4	1688*	617	(1071)	2014
9-10 AM	8.6	1274	617	(657)	2671
10-11 AM	6.1	903	617	(286)	2957
11-12N	4.6	681	617	(64)	3021
12N-1 PM	4.0	592	617	25	2996
1-2 PM	3.2	474	617	143	2853
2-3 PM	2.9	430	617	187	2666
3-4 PM	3.6	533	617	84	2582
4-5 PM	4.1	607	617	10	2572
5-6 PM	4.2	622	617	(5)	2577
6-7 PM	6.0	889	617	(272)	2849
7-8 PM	6.7	992	617	(375)	3224
8-9 PM	5.3	785	617	(168)	3392*
9-10 PM	3.3	489	617	128	3264
10-11 PM	2.2	326	617	291	2973
11-12 M	1.4	207	617	410	2563
12M-1 AM	0.9	133	617	484	2079
1-2 AM	0.9	133	617	484	1595
2-3 AM	0.9	133	617	484	1111
3-4 AM	0.9	133	617	484	627
4-5 AM	1.4	207	617	410	217
5-6 AM	2.7	400	617	217	0
	<u>100.0</u>	<u>14,808</u>	<u>14,808</u>		

NET STORAGE REQUIRED: = 3,392,000 gal.

TOTAL STORAGE REQUIRED: = 3,392,000 x 1.20
 = 4,100,000 Gal.

BOOSTER PUMP CAPACITY = $\frac{1,688,000}{60}$
 = 28,133 GPM



WATER SYSTEM MASTER PLAN Sun City West

- | | |
|-----|-----------------------|
| ■ | WATER PLANT |
| △ | EXISTING WELL |
| 12" | WATER MAIN |
| | SERVICE AREA BOUNDARY |

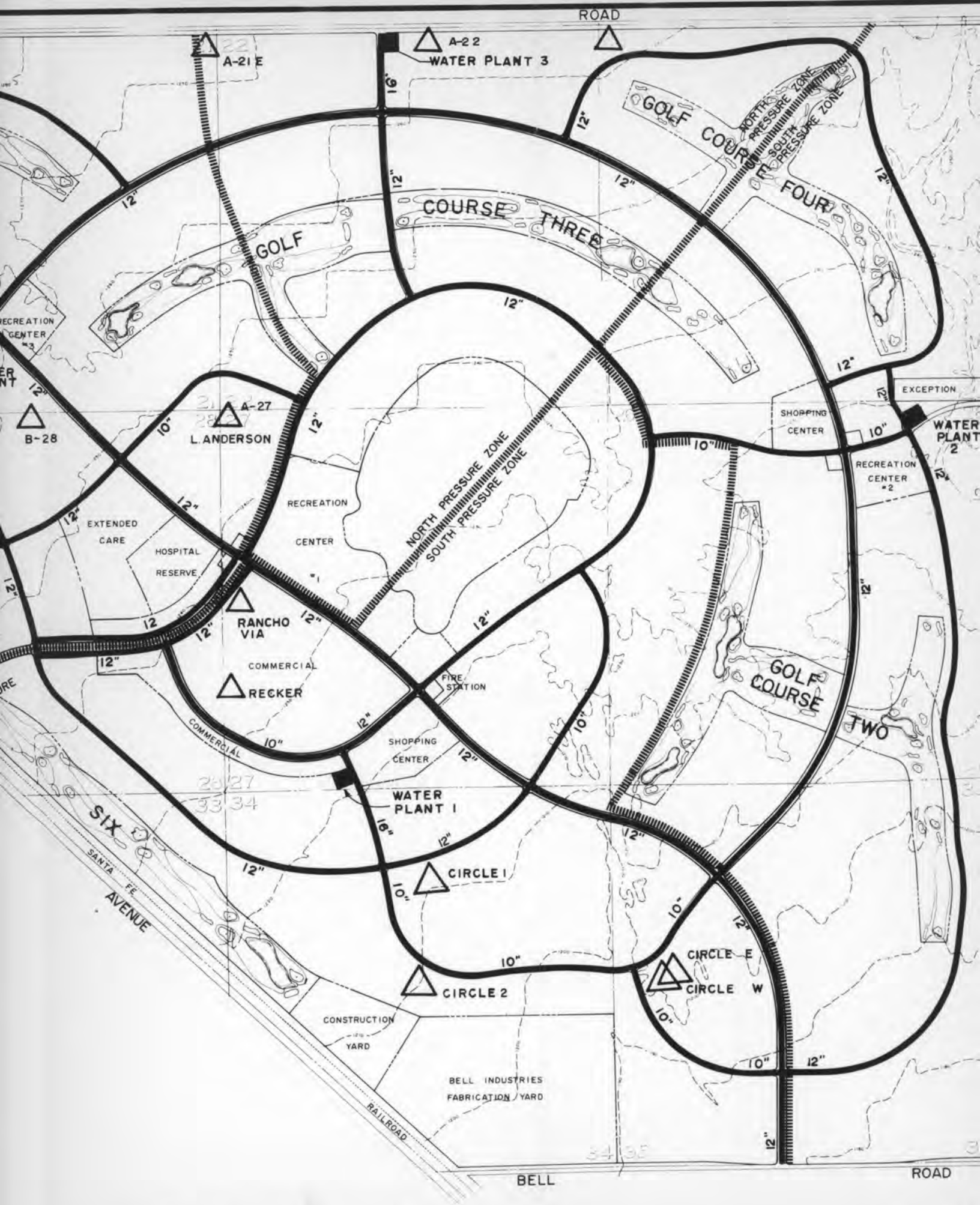


TABLE 12

PHASE I

WATER PLANT REQUIREMENTS

WATER PLANT NO. 1

Service Area - 1,430 acres
% of Phase I Area - 29.8%
Total Dwelling Units - (0.298) (17,100) = 5,100 D. U.
Yearly Avg. Demand - (5100) (450 gpd/D.U.) = 2.30 MGD
Well Capacity - (0.298) (10,290) = 3,070 GPM
Booster Pump Capacity - (0.298) (28,133) = 8,385 GPM
Total Storage Required - (0.298) (4,100,000) = 1,200,000 Gal.

WATER PLANT NO. 2

Service Area - 1,135 acres
% of Phase I Area - 23.7%
Total Dwelling Units - 4,050 D. U.
Yearly Avg. Demand - 1.82 MGD
Well Capacity - 2,440 GPM
Booster Pump Capacity - 6,670 GPM
Total Storage Required - 1,000,000 Gal.

WATER PLANT NO. 3

Service Area - 710 acres
% of Phase I Area - 14.8%
Total Dwelling Units - 2,530 D. U.
Yearly Avg. Demand - 1.14 MGD
Well Capacity - 1,520 GPM
Booster Pump Capacity - 4,160 GPM
Total Storage Required - 600,000 Gal.

WATER PLANT NO. 4

Service Area - 1,520 acres
% of Phase I Area - 31.7%
Total Dwelling Units - 5,420 D. U.
Yearly Avg. Demand - 2.44 MGD
Well Capacity - 3,260 GPM
Booster Pump Capacity - 8,920 GPM
Total Storage Required - 1,300,000 Gal.

Section M
SEWER SYSTEM
MASTER PLAN

Section M

SEWER SYSTEM

MASTER PLAN

1. SEWAGE COLLECTION SYSTEM

The Sun City West master sewer plan has been developed using the design criteria outlined in Section K of this report. All pipes are sized and shown on slopes adequate to provide a minimum velocity of 2.0 feet per second when flowing full, based on Mannings formula using an "n" factor of 0.13. A layout of the trunk sewers showing sizes and slopes is presented on Plate 26, entitled "Sun City West Sewer System Master Plan".

The general drainage pattern of the Sun City West Phase I area is from northwest to southeast. The development area has been divided into drainage areas and potential discharge has been calculated for each one. Collected flows have been calculated as they accumulate at major manhole junctions. These calculations are shown in Table 13 entitled "Design Computations - Proposed Trunk Sewers".

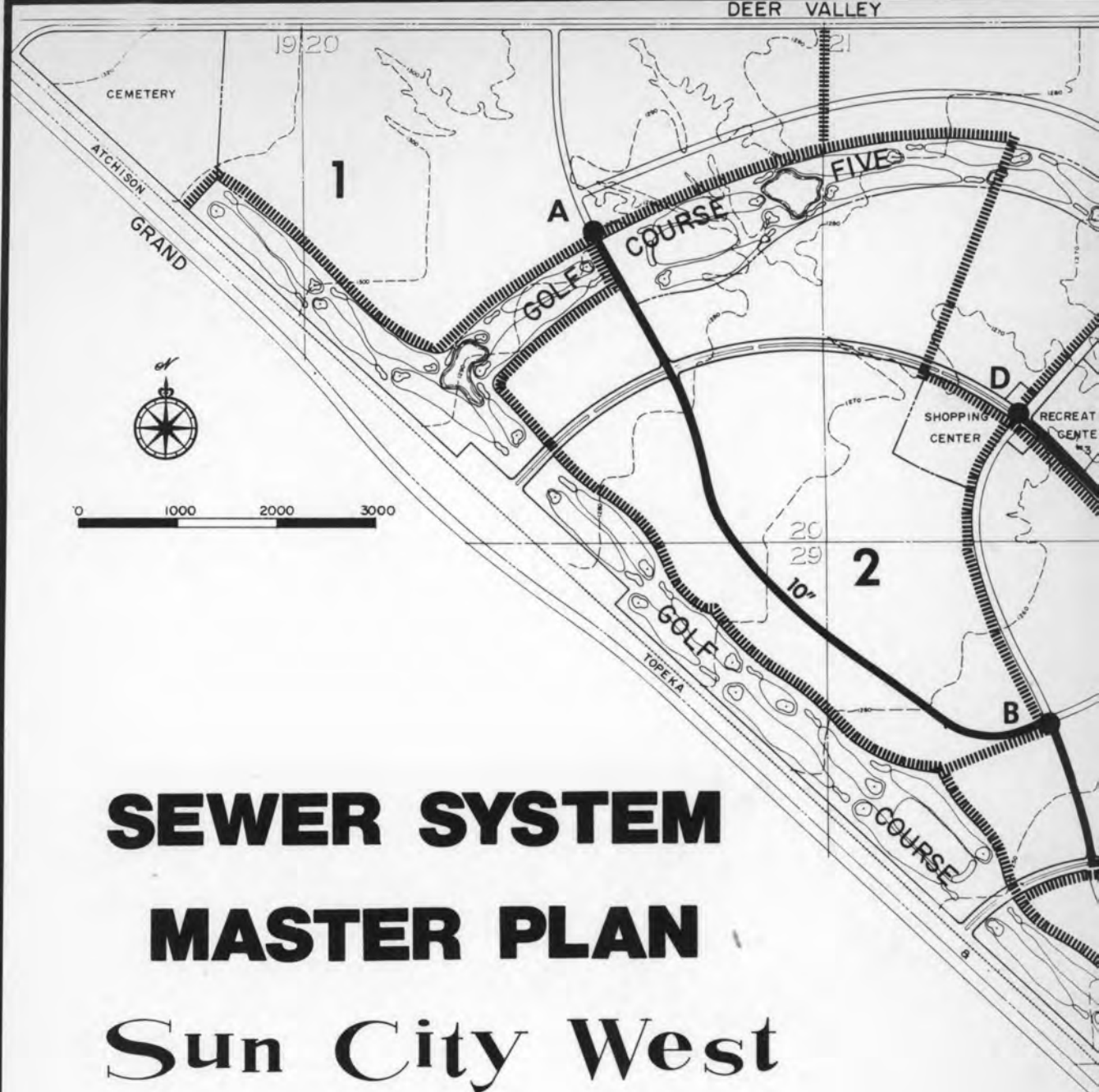
2. SEWAGE TREATMENT FACILITIES

Facilities to serve the Phase I development of Sun City West have been designed using the following parameters:

Average Daily Flow	165 gal/DU
Peak Hour Flow	289 gal/DU
Average BOD ₅	139 mg/l
Average Suspended Solids	253 mg/l

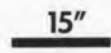

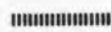


Flows will be collected at a lift station located at the southeast corner of the development. All flows to that point will be by gravity mains. The collected waste will be pumped through a force main to a treatment plant located north of the developed area. Plate 27 shows hourly flow variations as measured in the existing Sun City Sewer System.

Treatment for the Sun City West wastewater will be provided in three stages of construction. The first stage of the facilities will consist of an aerated lagoon system sized for 0.71 mgd flow. Effluent will be returned for irrigation of golf courses. There will be no discharge offsite.



SEWER SYSTEM MASTER PLAN

Sun City West

-  TRUNK SEWER & SIZE
-  COLLECTION POINT
-  DRAINAGE AREA BOUNDARY
- 12** DRAINAGE AREA NUMBER
-  FORCE MAIN ROUTE
-  PUMP STATION

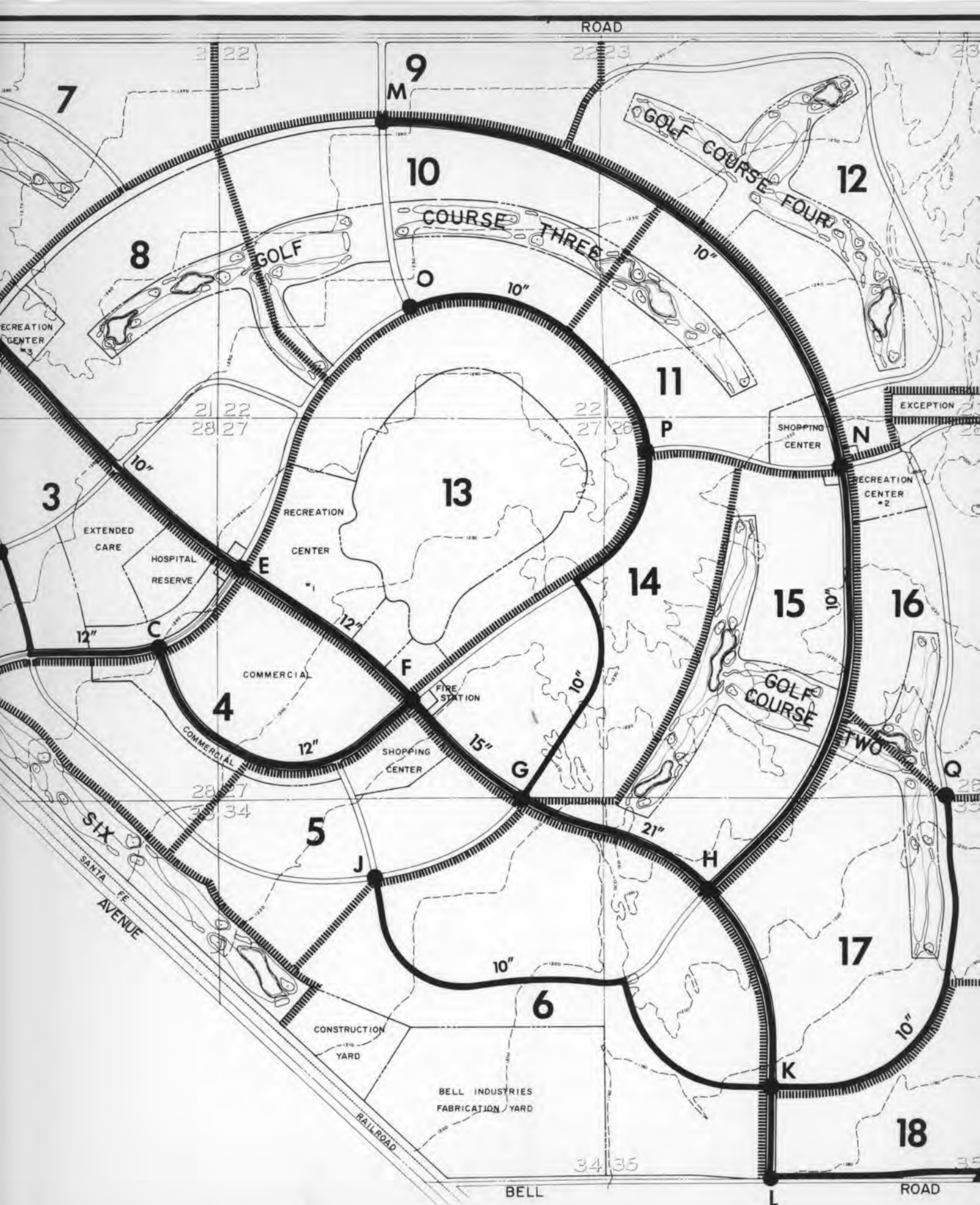


TABLE 13
DESIGN COMPUTATIONS
PROPOSED TRUNK SEWERS

SUN CITY WEST - PHASE ONE

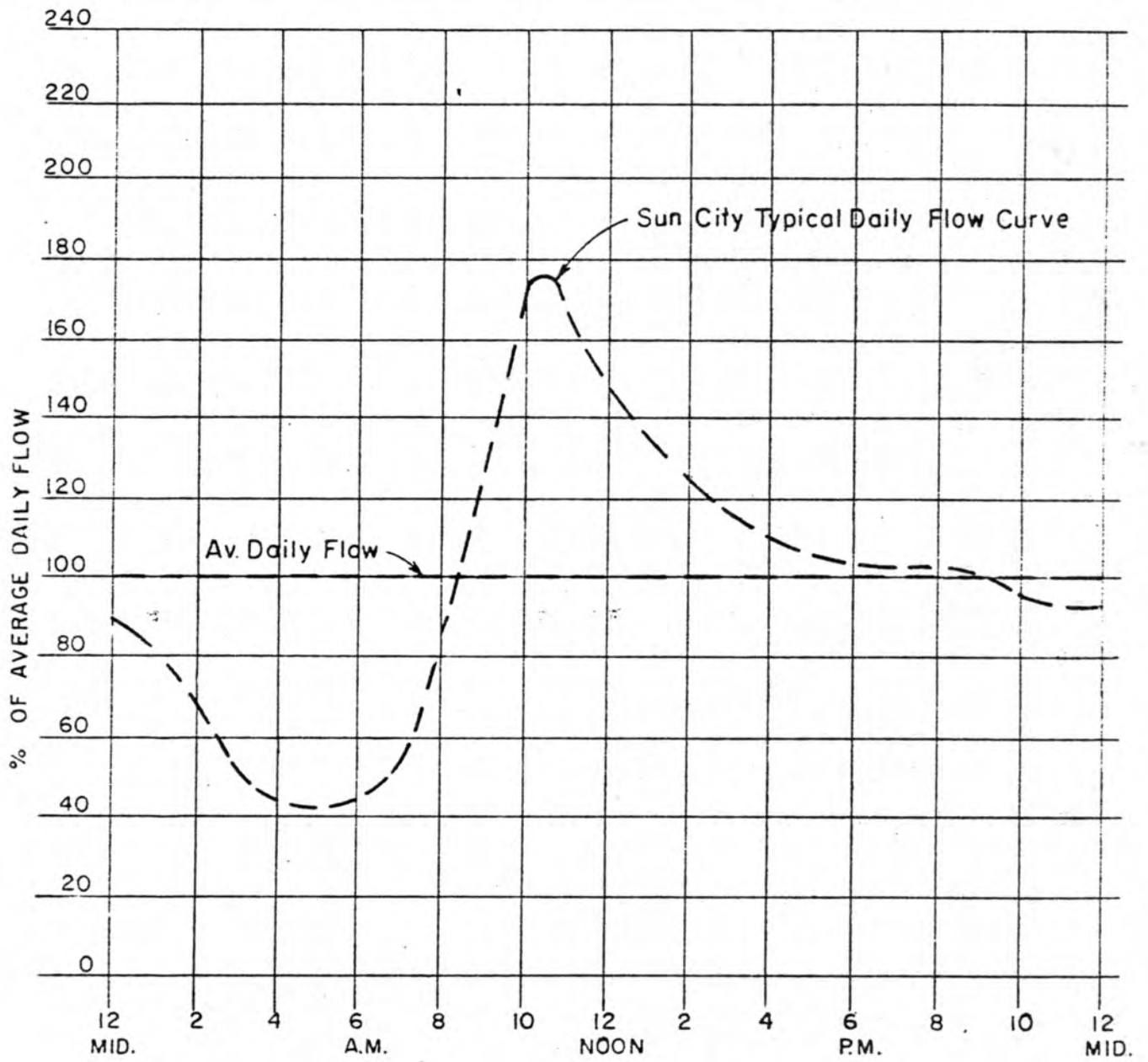
Line	Point of Conc.	Area # Added	Size of Area (Ac)	Total Dwelling Units	Daily Aver. Flow (DPM)	Time of Conc. for Area (HR)	Time of Conc. along Pipe (NR)	Pipe Time	Time After Peak Hr.	% of Daily Aver. Flow	Peak Sewage Flow (GPM)	Total Flow in Line (GPM)
A-B	A	1	365	1299	149	.61				175	251	251
B-C	B	2	419	1492	171	.39	1.24	.63	.85	165	282	533
C-F	C	3	202	719	82	.69	1.55	.43	.86	165	135	668
	F	4	252	897	103	.42	1.98		1.56	153	158	826
D-E	D	7	263	936	107	.72		.46		175	187	
E-F	E	8	281	1000	115	.78	1.18	.28	.40	170	196	
F-G	F	13	280	997	114	.72	1.46		.74	175	200	(826)
	F	7-8		222	222	1.46	1.98	.20	.52	169	1401	(200)
	G	14	252	897	103	.72	2.18		1.46	156	161	(375)
O-P	O	10	231	822	94	.50				175	165	
P-G	P	11	152	541	62	.39	1.10	.60	.71	167	104	(265)
G-H	H	15	218	776	89	.61	2.51	.33	.45	170	265	
M-N	M	9	152	541	62	.28			1.90	145	129	1956
N-H	N	12	378	1346	154	.83	1.25	.90	.42	170	262	
H-K	H				216	2.15	2.51	.15	.36	172		(371)
	K	17	257	915	105	.61	2.66		2.05	143	150	2327
												2477

TABLE 13 CONT'D.
DESIGN COMPUTATIONS
PROPOSED TRUNK SEWERS

SUN CITY WEST- PHASE ONE

Line	Point of Conc.	Area # Added	Size of Area (Ac)	Total Dwelling Units	Daily Aver. Flow (GPM)	Time of Conc. for Area (HR)	Time of Conc. along Pipe (NR)	Pipe Time After Peak Hr.	% of Daily Aver. Flow	Peak Sewage Flow (GPM)	Total Flow In Line (GPM)
J	5	191	680	78	.33				175	137	2598
J-K	6	605	2154	247	1.15	2.66	.82	1.51	155	(121)	
QK					.89		.70	1.77	148	(366)	2964
Q	16	210	748	86	1.42	2.66		1.24	160	137	3101
K-L	18	117	417	48	.56	2.72	.06	2.16	141	68	3169
NET TOTAL				4,825	17,177	1,969					

Max Flow = 4.56 MGI



HOURLY FLOW VARIATION

Stage Two will consist of a complete secondary treatment plant utilizing high rate trickling filters, with a capacity to treat 1.42 mgd. This stage will be completed within two years from initial start-up of the aerated lagoon system.

The third stage will consist of expansion of the trickling filter plant to 2.83 mgd capacity. This will be accomplished as the demand indicates. The aerated lagoons will be retained in service as polishing and retention ponds after stages two and three are complete. A summary of the design analysis for these facilities is outlined herewith. The complete design analysis is included at the end of this section.

LIFT STATION

The lift station will ultimately consist of a wet-well and dry well type of installation using three pumps, one of variable speed and two of constant speed, and each of 2,000 gallons per minute capacity at the required TDH. The initial phase will be served by the package lift station presently serving Sun City, which will match the capacity of the aerated lagoon. The permanent lift station will be constructed along with the first phase of the trickling filter plant.

FORCE MAIN

As indicated on the plans, the lift station will deliver the collected wastewater to a central treatment site north of the project. It is planned to accomplish this by using two force mains. The first force main will be installed in phase one construction. The second will be installed when flows reach 2000 gpm.

Design of both lines is based on the following parameters:

Total length of force main=	23,800 L. F.
Total static head=	140'
Peak Flow Rate=	3169 gpm
Average daily flow (2.83 mg)=	1968 gpm

Using a "C" of 140, calculations indicate that 12" lines will be required.

STAGE ONE AERATED LAGOON

As previously discussed, the initial installation will consist of an aerated lagoon. Design of the lagoon is described as follows:

Detention Time: Detention is based on removal of 90% of the applied BOD₅ in accordance with the following formula:

$$t = \frac{S_o - S_e}{1.05 (S_e) (K)}$$

Detention calculates to be 12.25 days. Total required volume is then 12.25 x 0.71 mgd, which is 8.7 mg. Assuming a 10' depth, 2.67 acres of surface will be required.

Oxygenation requirements: From standard tables it can be determined that about 1.3 pounds of oxygen will be required for each pound of BOD₅ entering the lagoon. The total oxygen required is then:

$$8160 \times .20 \text{ (lbs/cap/day BOD)} \times 1.3 = 2122 \text{ pounds oxygen per day.}$$

To determine the equipment necessary to provide the required oxygen, various manufacturers provide tables indicating the efficiency of oxygen transfer under various temperature conditions. In this instance, it has been determined that five 10 HP floating aerators of standard manufacture will provide adequate mixing and aeration.

Chlorination Requirement: The lagoon system will be followed by a chlorine contact tank with chlorine injection equipment of sufficient capacity to provide 2.0 mg/L of residual after fifteen minutes detention time at the peak hour rate.

STAGE TWO - TREATMENT PLANT DESIGN

This plant will be designed using essentially the same criteria as that used for Stage One, except that the Dwelling Units will be assumed to be 8550.

Headworks: The headworks will consist of flow diversion valves and structures, flow measurement and recording, and grit removal. The grit removal system will consist of an airlift type grit washer and a screw conveyor dewatering unit. The degritter will be sized to accommodate a 1.75 mgd average flow.

Primary Treatment: Primary treatment will be accomplished by a flocculator followed by a circular clarifier. The flocculator air supply will be designed at 4 cfm per lineal foot of basin.

The primary clarifier will be a centerflow type, designed to provide 2.5 hours detention at 150% of design flow, with weir overflow rates not to exceed 6,650 gallons per lineal foot, and a surface settling rate of not more than 650 gallons per square foot.

It is estimated that 45% of the influent BOD₅ and 65% of the influent suspended solids will be removed.

Secondary Treatment: Secondary treatment will be accomplished by a high rate trickling filter system. The filter will be designed to operate at a 2:1 recirculation rate. The filter will be loaded not to exceed 30 mgd per surface acre hydraulically, and not more than 90 pounds per 1000 cubic feet for BOD₅.

Final Clarifier: Effluent from the trickling filter will be directed to a final clarifier, designed to have a two hour detention time at peak hour flow rate. Weir loading will not exceed 15,000 gallons per lineal foot, and the upflow rate will not exceed 800 gallons per square foot. Settled sludge will be returned to the inlet structure of the primary clarifier.

Chlorination: The chlorine contact basin provided in the Stage One construction will be increased to accommodate the additional flow by doubling its original capacity.

Digesters: Settled sludge from the primary clarifier (includes the sludge from the secondary clarifier) will be pumped to a primary digester. The digester will be sized for 45 days retention and will be equipped with a floating cover, a gas recirculation mixing system, and a waste gas burner. Provisions will be made for heating the digester contents with the digester gas. The treated sludge will be disposed of by injection into the soil.

STAGE THREE - TREATMENT PLANT DESIGN

When measured wastewater flows indicate that the capacity of the Stage Two installation is being reached, a complete duplicate of the Stage Two plant just described will be constructed and put into service. It is anticipated that this will not occur before four years after initial start-up. However, treatment needs will be the governing factor for scheduling Stage Three construction.

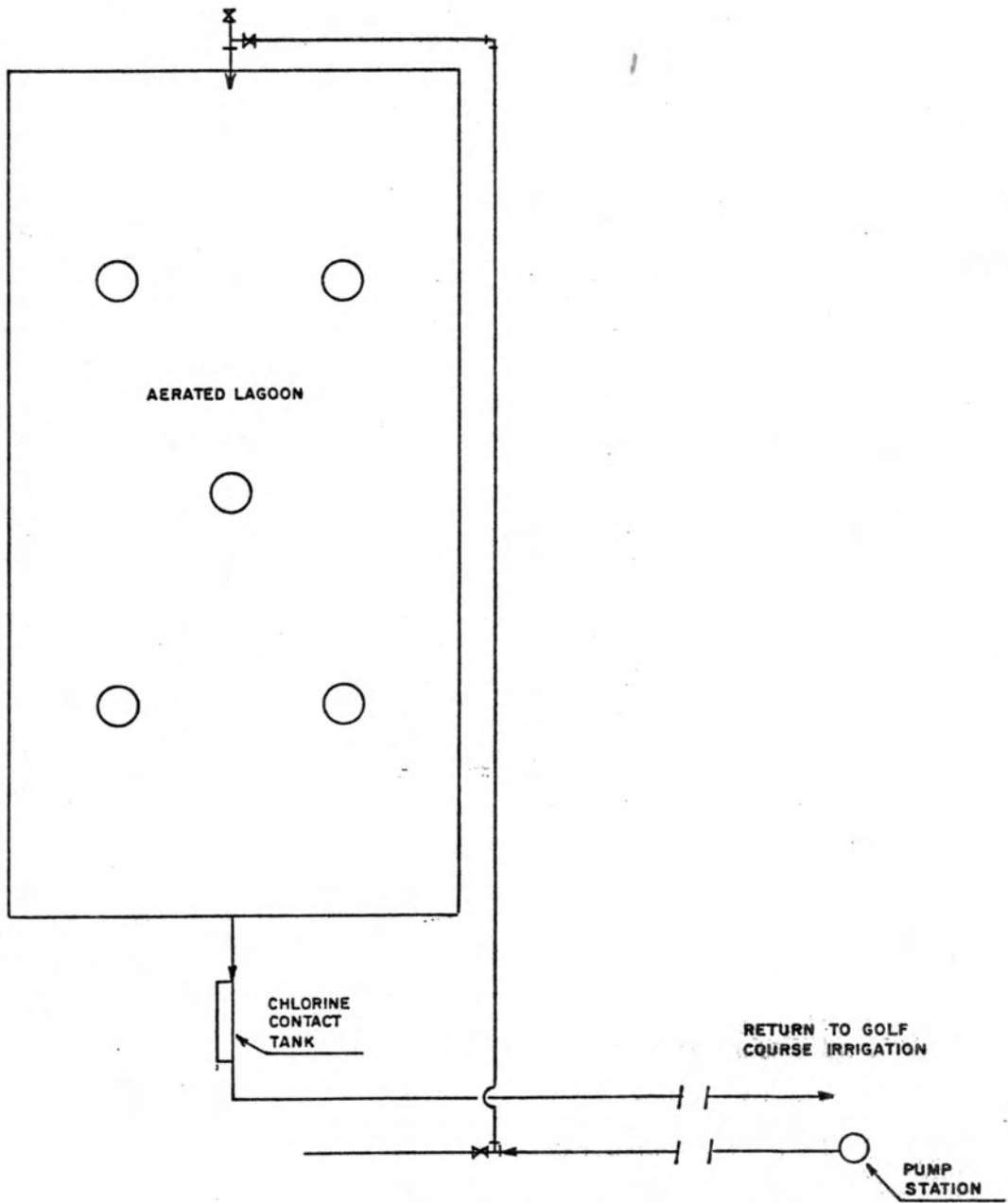
Schematic details showing each of the three stages of construction are shown on Plates 28, 29 and 30.

WASTEWATER REUSE

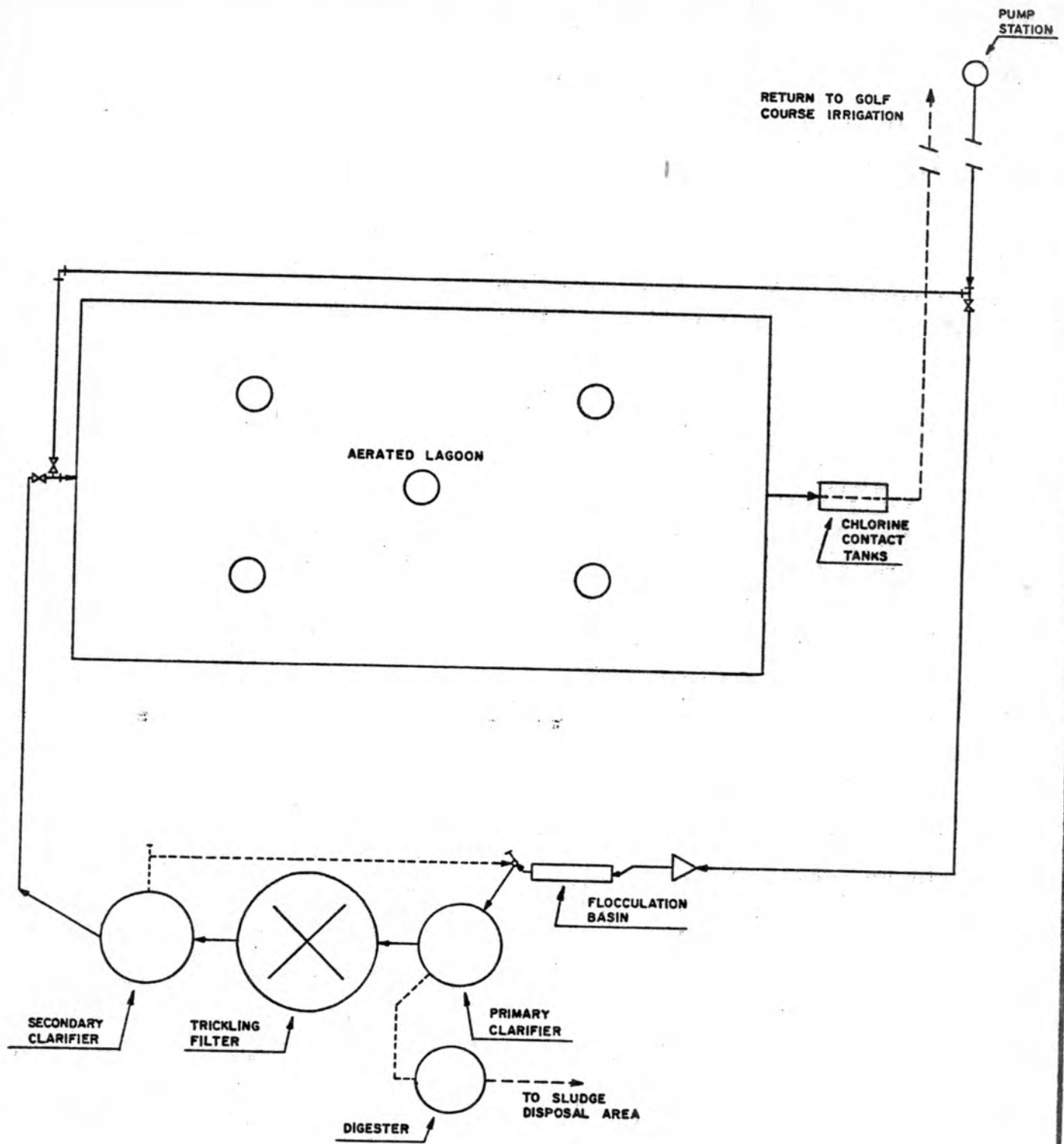
In conjunction with plans for re-use of treated wastewater on the golf courses, provisions will also be made for other alternative beneficial uses. Any excess quantities not needed for the golf courses can be diverted to irrigation of alfalfa or other non-edible productive crops which may be cultivated on land presently owned by the Del E. Webb Development Company. Further, as techniques are improved and basic standards are established, treated effluent may be utilized for groundwater recharge.

No unusual sewage handling problems are anticipated and since it is planned by the developer to provide adequate treatment to the collected wastes to permit re-use of the effluent in any one of several ways, no disposal problems should result from the construction of this project.

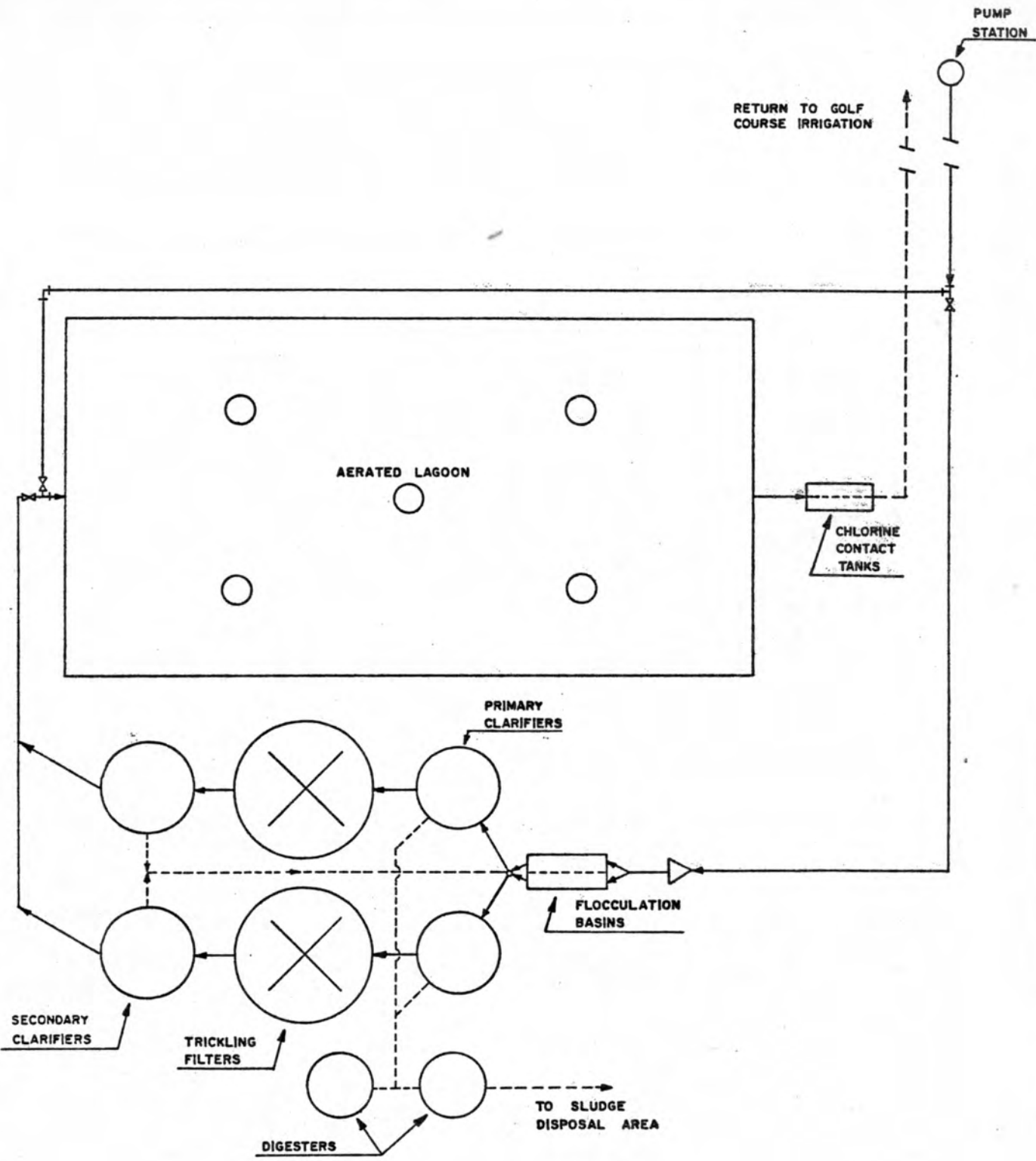
By making use of available modern treatment techniques and providing the necessary facilities for efficient operation and maintenance, the Developer is prepared to provide a completely modern and sanitary disposal system in keeping with the overall high quality of the development.



PROPOSED WASTE WATER TREATMENT FACILITIES
SUN CITY WEST, ARIZONA
STAGE I



PROPOSED WASTE WATER TREATMENT FACILITIES
 SUN CITY WEST, ARIZONA
 STAGE 2



PROPOSED WASTE WATER TREATMENT FACILITIES
 SUN CITY WEST, ARIZONA
 STAGE 3

3. DESIGN ANALYSIS

Wastewater facilities to serve the Phase I development of Sun City West have been designed on the following basis:

Ultimate Population	17,100 D. U.
Linear increase - 8 years @	2,140 D. U. /Year
Average Daily flow	165 gal/D.U.
Peak Hour Flow	175% of Average
Average BOD ₅	139 mg/L
Average Suspended Solids	253 mg/L

Flows will be collected at a lift station located at the southeast corner of the development. All flows to that point will be by gravity mains. The collected waste will be pumped through a force main to a treatment plant located north of the developed area.

Treatment for the Sun City West wastewater will be provided in three phases of construction. The first phase of the facilities will consist of an aerated lagoon system sized for 0.71 mgd flow. Effluent will be returned for irrigation of golf courses. There will be no discharge.

Phase II will consist of a complete secondary treatment plant utilizing high rate trickling filters, with a capacity to treat 1.42 mgd. This phase will be completed within two years from initial start-up of the aerated lagoon system.

The third phase will consist of expansion of the trickling filter plant to 2.83 mgd capacity. This will be accomplished as the demand indicates. The aerated lagoons will be retained in service after phase one is complete as polishing and retention ponds. A full design analysis for these facilities is included as follows:

LIFT STATION

The lift station will consist of a wet-well and dry-well installation using three pumps, one variable speed and two constant speed pumps, each of 2000 gpm capacity at the required TDH.

FORCE MAIN

The force main will be constructed in two stages. In the first stage, one 12" diameter main will be constructed. When a peak flow of 2,000 gpm is reached, a second 12" force main will be installed.

Total Length of Force Main	23,800 L. F.
Total Static Head	140 ft.
Peak Flow Rate (at design max.)	3,169 gpm
Average Daily Flow	
17,177 x 165=2.83 mgd=	1,968 gpm

FOR DUAL FORCE MAINS

Friction loss for 12" pipe @ 2000 gpm=	.770
Total HF= 238.0 x .770	183.3'
Static Head=	140.0'
TDH=	<u>323.3'</u> = 139.96 psi

Use Class 150 pipe

PHASE ONE - AERATED LAGOON

Assume 8 years - Straight line growth curve to ultimate population

Provide for 2 years growth.

$\frac{17,100}{8}$ DU x 2 x 165 = 705,400 gpd flow

DETENTION TIME CALCULATIONS

Assume desired removal of 90% BOD₅

$t = \frac{S_o - S_e}{(1.05)^t (S_e) (K)}$ where:
t = time in days
S_o = BOD₅ influent
S_e = BOD₅ effluent
K = BOD₅ removal rate @ design temp. = 0.7 @ 20° C
1.05 = Temperature coefficient

then:

S_o = 1632 lbs/ /days
S_e = 1632 x .10 = 163.2 lbs.

$t = \frac{1632 - 163.2}{1.05 (163.2) (0.7)} = 12.25$ days

then:

V = 705,400 x 12.25 = 8.64 mg = 1.16 million cu. ft.
at 10' total depth, surface area = $\frac{116,000}{43,560} = 2.66A$

Oxygen required = $\frac{(1.3 \text{ lbs } O_2)}{(1 \text{ lb. BOD}_5)} \times 1632 = 2,122 \text{ lbs. } O_2 / \text{ day}$

For summer operation assume 2.10 lbs. O₂ 1 HP 1 hr.
(per Tables for Mechanical Aerators)

then HP required is:

$$\frac{2122 \text{ \# BOD}_5}{2.10 \times 24} = 42.10 \text{ HP Total}$$

Mixing HP required (from Tables) = 40 HP
Use 5-10HP Aerators

Use basin dimensions:
250' x 465'

Install One Chlorine Contact Basin with Phase 1 -use "V" Notch Weir for flow measurements.

PHASE II AND III

TRICKLING FILTER PLANT- Design Parameters

Total Average Daily Flow	-	17,177 x 165	=	2.83 mgd.
Peak Flow	-	3,169 gpm	=	4.56 mgd.
*5 day BOD	-	139 mg/l		
*Suspended Solids	-	253 mg/l		
*Total Dissolved Solids	-	590 mg/l		
*pH	-	7.4		

* Values established by average of 2-24 composite samples from Sun City taken May 25 and June 1, 1977.

Headworks

Flow Measurement- Magnetic Flow meter with recorder.
Grit Removal- 2-1.5 mgd airlift type grit
(construct 1- Phase II) washers with screw conveyor dewatering units.

Primary Treatment

- A. Flocculators- design for 60 min. @ 2.85 mgd
use 2-45' x 12' x 15' SWD Tanks- (Construct one (1)
Phase II) Air Supply = 4 cfm/ lin. ft.
- B. Primary Clarifiers- use 2 units.
Circular Center Flow type- 75' dia- 7'
Sidewater Depth and 1:12 bottom slope ratio.
(Construct (1) one unit, Phase II)
Clarifier Mechanism to be- dual skimming arms,
center inlet, mechanical sludge collectors.

-Design Data

- Surface Area- 4418 ft.² each
- Volume - 231,320 gal. each
- Weir length= 345' each
- Surface settling Rate @ 150% average = 484 gal/ ft.²
- Detention 2.6 hrs. @ 4.3 mgd (150% Average)
- Weir Overflow rate= 6,200 gal/ lin ft. @ 150% average flow.
- Estimated BOD₅ removal with flocculator = 45%
.45 x 139 x 2.85 x 8.34 = 1487 lbs / day @ 2.85 mgd.
- Estimated Solids Removal with flocculation = 65%
.65 x 253 x 2.85 x 8.34 = 3909 lbs/ day @ 2.85 mgd
- Raw Sludge Volume @ 4% = 11,700 gpd
- Pumps Required - 2 @ 20 gpm- (plunger type)

Trickling Filters

-Construct 2 High Rate Trickling Filters to operate at 2:1 recirculation ratio. Effective hydraulic loading not to exceed 30 mgd/ surface acre and BOD₅ loading not to exceed 90 lbs./1000 cu. ft. Depth of bed to be 5'- Diameter to be 80'

Provide 4- 1500 gpm pumps- 2 constant speed and 2 variable speed.
(Install (1) one constant speed and (1) one variable speed- Phase II)

Final Clarifiers

Construct two final clarifiers each of 1.45 mgd Capacity- Size for 2 hour detention, weir loading not to exceed 15,000 gal/ lin ft. and surface upflow rate not to exceed 800 gal. / ft.² Each clarifier to be 9' SWD and 55' diameter. The clarifiers will be center flow type with sludge suction construction. Sludge from final clarifiers will be returned to the inlet of the primary clarifiers. Removals are assumed @ 20%.

Sludge Volume = $139 \times .2 \times 2.85 \times 8.34 = 660$ lbs.
@ 4% = 1980 gpd.

Chlorination

Construct two chlorine contact basins, capable of detention for 15 minutes at peak hour flow, and provide chlorination equipment capable of maintaining 2.0 ppm cl₂ in the treated effluent. Use two rectangular basins each 10' x 35' x 9' SWD.

Construct one basin- Phase I and one basin with Phase II.

Digesters

Construct two heated digesters, one to be primary, one to be secondary. Each will be supplied with floating covers and gas recirculation type mixing. Digester gas will be used for heating. Primary digester only will be constructed - Phase II.

Required Volume

Primary Sludge	-	3907 lbs.	
Secondary Sludge	-	660 lbs.	
Total Sludge		4569 lbs.	
% Volatile- assume 80%	=	$4569 \times .8 =$	3655 lbs.
Assume 45 day detention for 50% reduction-			
1st day Volatile Solids	=	3655	
45th day Volatile Solids	=	1828	
Average Volatile Solids	=	2742	
Non Volatile Solids	=	914	
Average daily Solids	=	3656 lbs.	

Volume required @ 5% Solids, 95% Supernatant

$$\frac{3656 \times 45}{62.4 \times .05} = 57,730 \text{ cu. ft.}$$

Construct two (2) digesters, each 30,000 cubic feet - use 44' diameter by 20' depth - Primary Digester only to be constructed - Phase II.

SLUDGE DISPOSAL

Sludge disposal by injection into the soil.