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SUN LAKES

MASTER PLAN 1978

(REVISED)

September 15, 1978

Prepared by:

Sun Lakes Properties, Inc.
General Partner for Sun Lakes
Marketing, a Limited Partnership, Developers and Owners
of Sun Lakes

With the Assistance of:

Henningson, Durham & Richardson,
Consulting Engineers

Robert Bowlsby, Planner

SUN LAKES PROPERTIES, INC.
25601 Sun Lakes Boulevard • Sun Lakes, Arizona 85224 • Telephone 963-6335

October 27, 1978

Mr. Don E. McDaniel, Jr.
Planning Director
Maricopa County Planning Department
111 South Third Avenue
Phoenix, Arizona 85003

Dear Mr. McDaniel:

You will find enclosed a revised edition of the Master Plan which was submitted on October 19, 1973, and approved by the Maricopa County Planning and Zoning. We are submitting the enclosed for a formal review by the Technical Advisory Committee and the Maricopa County Planning and Zoning Commission.

Overall, the Master Plan is very similar to the original with regard to the layout of lots, golf course, club facilities, etc. The major changes are as follows:

1. The proposed commercially zoned property has been reduced from 25 acres to 12.5 acres.

2. We are requesting that the single family housing be onsite built homes rather than doublewide mobiles.

3. We are requesting zoning for multi-family housing.

The 1973 Master Plan contained 2,174 units. That number has been revised in the 1978 Master Plan to approximately 1,480 units of detached houses and approximately 890 multi-family units for a total of 2,370± dwellings.

Sincerely,

SUN LAKES PROPERTIES, INC.,
GENERAL PARTNER FOR SUN LAKES
MARKETING, A LIMITED PARTNERSHIP

E. J. Robson

E. J. Robson
President

EJR:bs
Enclosure

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SUMMARY OF MASTER PLAN 1978 FOR SECTION 32

SUN LAKES Master Plan 1978 is the first comprehensive update of the original Master Plan approved by the Maricopa County Board of Supervisors in 1973. While the development of Section 31 proceeded in accordance with the original plan, drastic changes in the housing market became evident:

1. The cost of highend doublewide mobile homes (the original concept for SUN LAKES) increased considerably.
2. The cost of transporting the mobile homes (the majority of which come from California) more than tripled.
3. Bank financing was extremely difficult to obtain, as was financing for offsite improvements in an area being readied for mobile homes.
4. There was a decline in demand for the highend double-wide for the above-mentioned reasons.
5. All these factors together made it possible to build a quality home onsite for less than the cost of bringing in a mobile home and installing it according to the restrictions.

Zoning was amended in the last five units in Section 31 to permit onsite building of homes. These homes provided SUN LAKES with a mixed product and a chance to test the scale of mobile homes against the onsite built homes.

The new Master plan for Sections 29, 30 and 32 provide for the same onsite single family home plans which have been so successful in Section 31. In addition, the developer would like to offer another type of living, multiple housing (currently in the form of fourplexes). This fulfills the need of another type of market, the adult to whom the exterior

maintenance and safety provided by townhouse living is of utmost importance.

Based on this proposal, with the full implementation of the plan, the following numbers of dwelling units and population figures can be anticipated for Sections 29, 30, 31 and 32:

	Dwelling Type	Number of Units	Population Per Unit	Population Total
Section 29	Single Family	1800-2250	2	3600-4500
	Multi-Family			
	Low Density	210-315	2	420-630
	Med. Density	225-375	2	450-750
Section 30	Single Family	1400-1750	2	2800-3500
	Multi-Family			
	Low Density	300-450	2	600-900
	Med. Density	290-480	2	580-960
Section 31	Single Family	2014	2	4028
	Multi-Family			
	Low Density	26	2	52
Section 32	Single Family	1480-1850	2	2960-3700
	Multi-Family			
	Low Density	690-1035	2	1380-2070
	Med. Density	220-370	2	440-740
TOTAL	Single Family	6694-7864	2	13388-15728
	Multi-Family			
	Low Density	1227-1826	2	2452-3652
	Med. Density	735-1225	2	1470-2450

The subsequent sections of this report discuss the following aspects of the proposal:

A. Physical Setting
B. Residential Land Use
C. Commercial and Community Facilities
D. Circulation System
E. Summary of Engineering and Utility Information
F. Summary of Changes

A: PHYSICAL SETTING

SUN LAKES is located approximately 19 miles south of the 24th Street/Interstate 10 interchange and approximately six miles southwest of Chandler, Arizona. There is easy access from SUN LAKES to the Interstate Highway 10 on Riggs Road, and the distance is approximately two miles. The total master plan area includes the following:

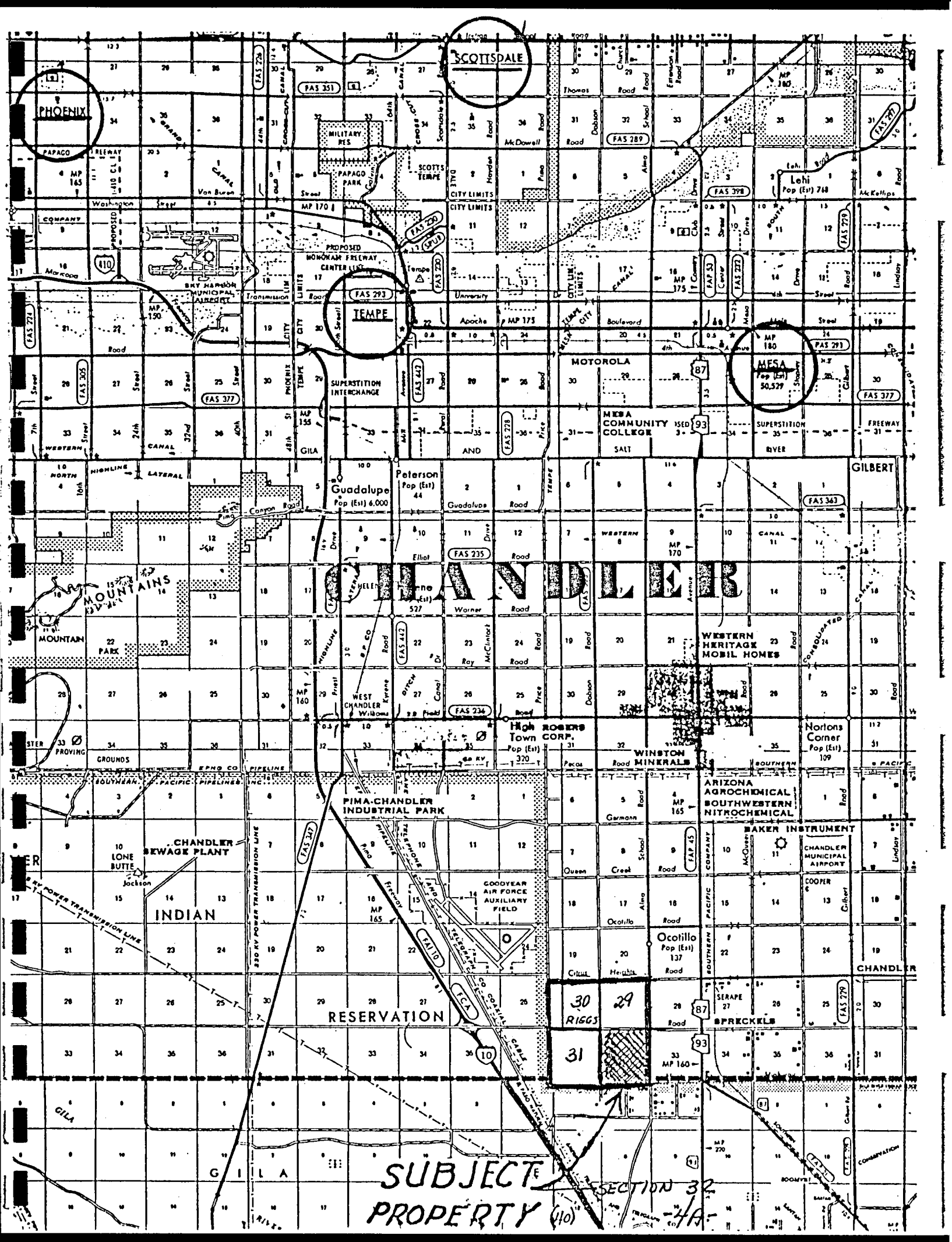
> Sections 29, 30, 31 and 32, Township 2 South, Range 5 East, G&SRB&M, Maricopa County, Arizona.

Section 31 is nearing completion at the present time. The information contained herein is a revision of the Master Plan submitted to the Board of Superviors in 1973 and pertains to the next phase of development, Section 32. This site is bordered by Riggs Road on the north, Hunt Highway on the south, Dobson Road on the west and Alma School Road on the east. The Gila Indian Reservation borders SUN LAKES Sections 31 and 32 on the south and continues north along the western boundary of Section 31. Because of this situation, foreign traffic through the development will be minimal. This report also contains some general information on Sections 29 and 30 so that the relationship of all four sections can be viewed.

The total acreage included in the SUN LAKES project is 2,560 acres (including all four sections). The land is generally

level, and there are no major water courses on the site. Approximately 624 acres in Section 31, adjacent to the subject Section 32, are presently developed or are under construction. The land in Sections 29, 30 and 32 is currently being used for agricultural purposes and will be used for such purpose until development begins.

A general map showing SUN LAKES and the area surrounding it is included on the following page.


SCOTTSDALE
PHOENIX
TEMPE
MESA
CHANDLER
GILBERT
Lehi
Guadalupe
Peterson
MOTOROLA
MESA COMMUNITY COLLEGE
SUPERSTITION INTERCHANGE
WESTERN HERITAGE MOBIL HOMES
WINSTON MINERALS
ARIZONA AGROCHEMICAL
SOUTHWESTERN NITROCHEMICAL
BAKER INSTRUMENT
PIMA-CHANDLER INDUSTRIAL PARK
CHANDLER SEWAGE PLANT
GOODYEAR AIR FORCE AUXILIARY FIELD
CHANDLER MUNICIPAL AIRPORT
Ocotillo
SPRECKELS
INDIAN
RESERVATION
GILA
MOUNTAINS
SUBJECT PROPERTY
SECTION 32
-4A-

B: RESIDENTIAL LAND USE

Residential land use in the SUN LAKES Master Plan 1978 for Section 32 includes a proposed zoning as follows:

1. Residential Single Family - 369.8 acres;
2. Residential Multi-Family - 140.2 acres;
3. Commercial - 12.5 acres.

Prelimary planning has also been done for Sections 29 and 30. The tentative breakdown for these Sections is as follows:

Section 29

1. Residential Single Family - 448.4 acres;
2. Residential Multi-Family - 59.6 acres;
3. Commercial - 32 acres.

Section 30

1. Residential Single Family - 350.2 acres;
2. Residential Multi-Family - 82 acres;
3. Commercial - 28.6 acres.

With Section 31 now nearing completion, immediate planning for Section 32 is necessary. The above plans were based on the following assumptions:

1. The major portion of housing should continue to be single family. Due to the popularity of the onsite built homes shown in Section 31, these plans will continue to be offered.

2. There is a definite demand for multiple housing in order to offer a mixed product and cover the needs of prospective buyers more adequately.

There are four basic housing forms presently planned for the three remaining sections: detached single units and three types of multiple dwellings.

The detached dwellings will be situated on lots ranging from 6,000 to 9,000 square feet. The homes are placed with a solid wall on the 5-foot setback line so that a good-sized yard may be realized on one side of the home rather than a narrow side yard on each side. Minimum setbacks are 20 feet in front and 25 feet in the rear. These single family homes are currently being constructed in Section 31. Square footage ranges from 1,100 to 1,800 with two-bedroom, two-bath plans as well as three-bedroom, two- and three-bath plans.

Among the adult population today, the provision of exterior maintenance services is also an important benefit and one which cannot be found in the ownership of conventional single family homes. Master Plan 1978 provides for multi-family housing. Plans are currently being drawn for townhouses, duplexes and fourplexes. The townhouses are two- and three-bedroom, two-bath plans and range in size from 1,200 to 1,600 square feet.

Floorplans and elevations for both the detached homes and townhouses are included in the Appendix to this report.

The densities included in the subdivision plan are classified in three categories:

1. Single family dwellings - Low density (4 per acre);
2. Multi-family dwellings - Low density (6-9 per acre);
3. Multi-family dwellings - Medium density (9-15 per acre).

It should be noted that the first unit offered for sale in Section 32 is planned to yield 3.5 single family dwellings per gross acre; the first unit offering multi-family dwellings for sale is planned to yield 5.1 dwellings per gross acre. The 17.7% of land in the section allocated for recreational facilities, parks and greenbelts reduces the overall density to a comfortable 3.7 dwellings per acre.

SUN LAKES is a planned adult community offering a "way-of-life" style. It is designed for an adult population with a minimum age requirement for one of the buyers being 40 years of age or more. No person under the age of 19 years will be allowed as a permanent resident.

SUN LAKES Section 32 will be a planned phase development with different phases planned from 1978 through 1982. The rate of development, of course, will depend largely upon economic factors and the market.

There are presently 2,066 residential lots of record in SUN Lakes Section 31. The progress of engineering design

has been as follows:

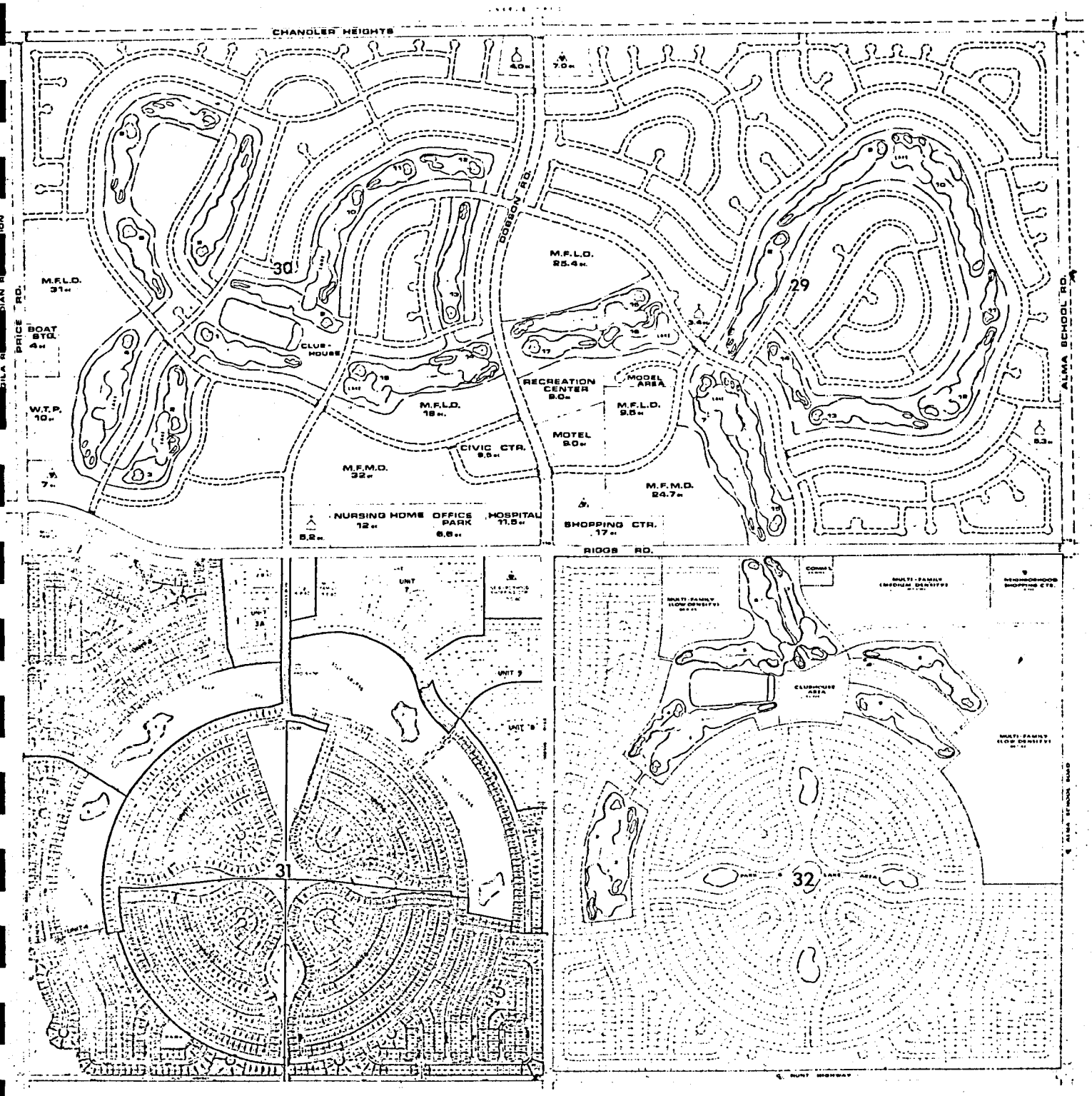
Year	1972	1973	1974	1975	1976	1977	1978
Recorded lots	469	1030	-	-	282	52	233

Site development and improvements are continuing on the above lots, and completion is expected by mid-1979.

Page 9 of this report contains the development plan for Section 31 (current site of development) and Section 32, the next phase of development. It also includes the preliminary plans for Sections 29 and 30. These plans are tentative and subject to some change; however, the overall plan of the four sections provides the opportunity to veiw The total SUN LAKES concept.

The development plan and phasing schedule for Section 32 are on pages 10 and 11.

The tables on pages 12-16 provide a breakdown of land use for the four sections (individually and collectively).



LAND USE DATA

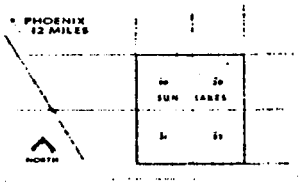
	LAND USE	ACRES	%	YIELD	DWELLING UNITS
	SINGLE FAMILY	1668.9	65.3	4.2 ac	6930
	MULTI-FAMILY				
M.F.L.D.	a. low density	205.1	8.0	6.4 ac	1310
M.F.M.D.	b. medium density	81.2	3.2	10.9 ac	880
	SHOPPING CENTER	50.0	2.0		
	COMMERCIAL	37.1	1.5		
	PUBLIC-QUASI-PUB.				
	a. golf course	391.5	15.3		
	b. recreation ctrs.	29.0	1.2		
	c. parks & lakes	39.3	1.5		
	d. other	53.3	2.0		
	TOTAL	2555.0	100.0	3.5 ac	9120

OWNER - SUN LAKES PROPERTIES INC.
25601 SUN LAKES BLVD.
SUN LAKES, ARIZONA
PHONE (602) 963 6335

PLANNER - ROBERT M. BOWLSBY ASSOC., INC.

ENGINEER - HENNINGSON, DURHAM & RICHARDSON, INC.

GOLF COURSE ARCHITECT - JEFF HARDIN, INC.



VICINITY MAP

NORTH

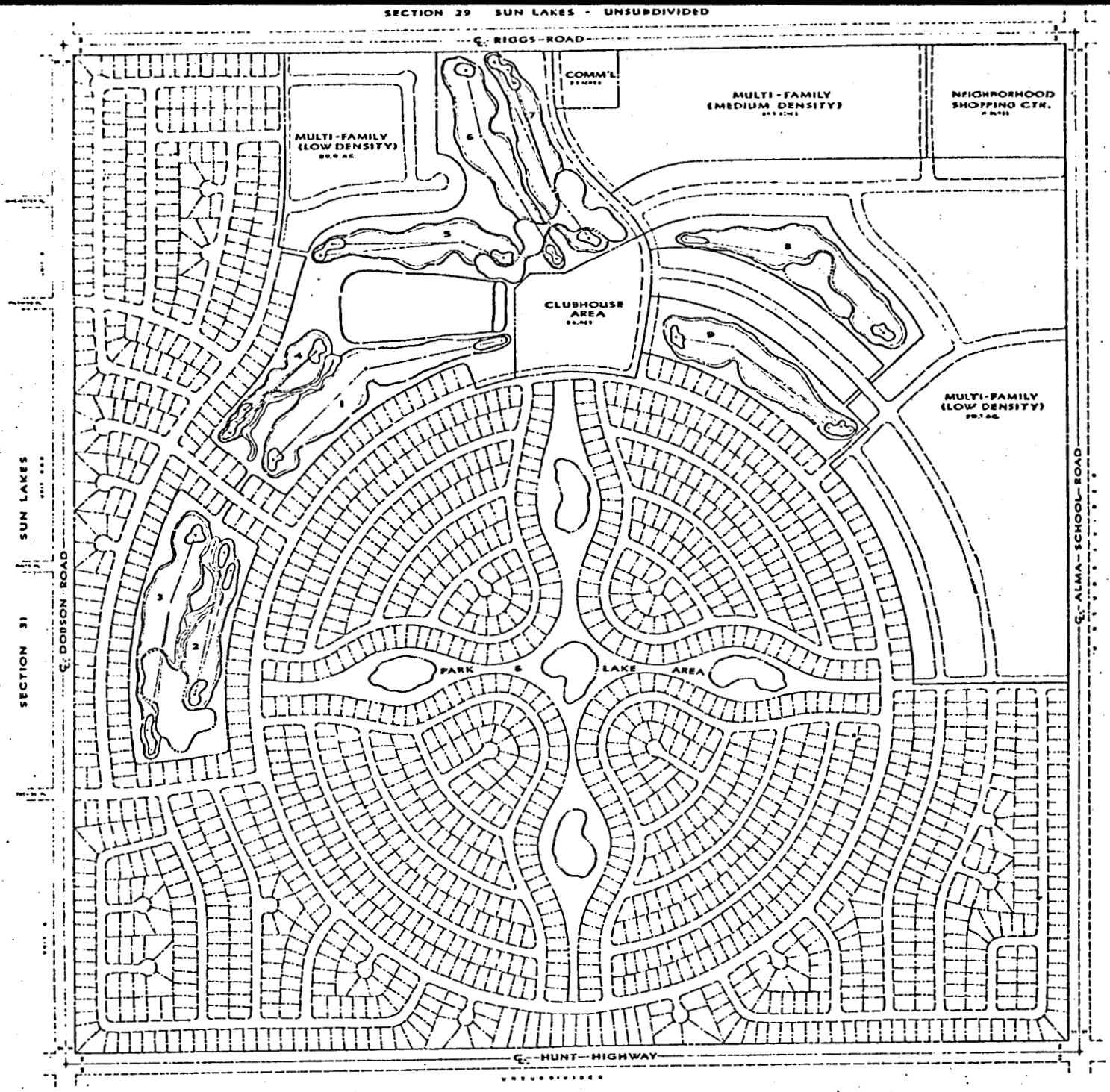
SUN LAKES DEVELOPMENT PLAN

MARICOPA COUNTY, ARIZONA

NOTE

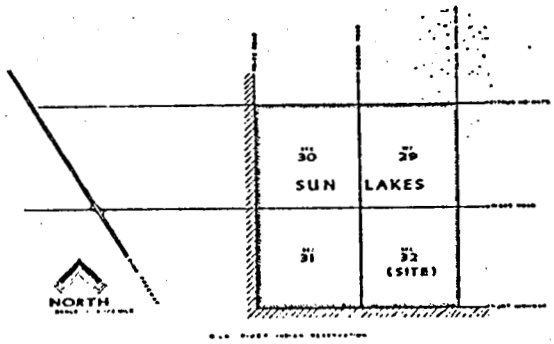
OCTOBER, 1970

SECTION 29 SUN LAKES - UNSUBDIVIDED



LAND USE DATA

LAND USE	ACRES	%	YIELD	DWELLING UNITS
SINGLE FAMILY	369.8	58.3	4.0	1480
MULTI-FAMILY				
a. low density	115.7	18.2	6.0	694
b. medium density	24.5	3.5	8.0	196
SHOPPING CENTER	10.0	1.5		
COMMERCIAL	2.5	0.7		
RECREATION				
a. golf course	81.0	12.7		
b. club house	8.0	1.3		
c. parks & lakes	23.8	3.7		
TOTAL	635.3	100.0	3.7	2370



VICINITY MAP

NORTH

SUN LAKES DEVELOPMENT PLAN

SEC. 32

NOTE

PHASING SCHEDULE

SUN LAKES, SEC. 32, MARICOPA COUNTY, ARIZONA

PHASE	LAND USE	GROSS AC.	NO./D.U.
I 1978-79	SINGLE FAMILY	93.0	276
	MULTI-FAMILY	20.2	114
	GOLF COURSE/CLUBHOUSE	89.0	-
	SUBTOTAL	202.2	390
II 1979-82	SINGLE FAMILY (INC. LAKES)	114.0	390
	MULTI-FAMILY (LOW DENSITY)	95.1	694
	SUBTOTAL	209.1	1084
III 1970-81	SINGLE FAMILY (INC. LAKES)	187.0	700
	SUBTOTAL	187.0	700
IV 1981-83	MULTI-FAMILY (MED. DENSITY)	24.5	196
	COMMERCIAL	12.5	-
	SUBTOTAL	37.0	196
	TOTAL:	635.3	2370

*NOTE: Section 29 will follow Section 32 in development, and Section 30 will be the last of the four sections. However, the rate of development for all three remaining sections depends largely upon economic factors and the market. The number of years and rate of development shown above will be repeated, if possible, in Section 29, then 30.

SUN LAKES SEC. 29, MARICOPA COUNTY, ARIZONA

LAND USE DATA

LAND USE	ACRES	%	YIELD	DWELLING UNITS
SINGLE FAMILY	448.4		4.0-5.0	1794-2242
MULTI-FAMILY				
A. LOW DENSITY	34.9		6.0-9.0	210-314
B. MEDIUM DENSITY	24.7		9.0-15.0	222-370
SUB-TOTAL:	508.0	76.9	4.4-5.8	2226-2926
SHOPPING CENTER	23.0			
COMMERCIAL* MOTEL/RESTAURANT SERVICE STATION	9.0			
SUB-TOTAL:	32.0	4.9		
PUBLIC & SEMI-PUBLIC				
A. GOLF COURSE	100.0			
B. RECREATION CENTER	9.0			
C. CHURCH SITES	8.7			
D. OTHER	2.3			
SUB-TOTAL:	120.0	18.2		
TOTAL:	660.0	100.0	3.4-4.4	2226-2926

*ESTIMATED POPULATION: 4940

SUN LAKES, SEC. 30, MARICOPA COUNTY, ARIZONA

LAND USE DATA

LAND USE	ACRES	%	YIELD	DWELLING UNITS
SINGLE FAMILY	350.0		4.0-5.0	1400-1750
MULTI-FAMILY				
A. LOW DENSITY	50.0		6.0-9.0	300-450
B. MEDIUM DENSITY	32.0		9.0-15.0	290-480
SUB-TOTAL:	432.2	71.1	4.6-6.2	1990-2680
COMMERCIAL*				
BOAT & TRAILER	4.0			
MEDICAL OFFICES	6.6			
NURSING HOME	11.0			
CONVENIENCE CENTER	7.0			
SUB-TOTAL:	28.6	4.4		
PUBLIC & SEMI-PUBLIC				
CIVIC CENTER	9.5			
HOSPITAL	11.5			
CHURCHES	9.2			
WASTE TREATMENT	10.0			
GOLF COURSE	110.0			
OTHER	2.0			
SUB-TOTAL:	152.2	24.5		
TOTAL:	613.0	100.0	3.3-4.4	1990-2680

*ESTIMATED POPULATION: 4480

SUN LAKES, SEC. 31, MARICOPA COUNTY, ARIZONA

LAND USE DATA

LAND USE	ACRES	%	YIELD	DWELLING UNITS
SINGLE FAMILY	500.5		4.1	2014
MULTI-FAMILY A. LOW DENSITY	4.5		7.0	26
SUB-TOTAL:	505.0	78.0	4.1	2040
COMMERCIAL	4.0			
SHOPPING CENTER	10.0			
SUB-TOTAL:	14.0	2.0		
PUBLIC				
GOLF COURSE	100.5			
CLUBHOUSE	12.0			
LAKES	15.5			
SUB-TOTAL:	128.0	20.0		
TOTAL:	647.0	100.0	3.1	2040

SUN LAKES, SEC. 32, MARICOPA COUNTY, ARIZONA

PROPOSED LAND USE

LAND USE	ACRES	%	YIELD	DWELLING UNITS
SINGLE FAMILY	369.8	58.3	4.0-5.0	1480-1850
MULTI-FAMILY				
A. LOW DENSITY	115.7	18.2	6.0-9.0	690-1035
B. MEDIUM DENSITY	24.5	3.5	9.0-15.0	220-370
SHOPPING CENTER	10.0	1.5		
COMMERCIAL	2.5	0.7		
RECREATION				
A. GOLF COURSE	81.0	12.7		
B. CLUBHOUSE	8.0	1.3		
C. PARKS & LAKES	23.8	3.7		
TOTAL	635.3	100.0	3.7-5.1	2390-3255

PROJECTED POPULATION

TYPE UNIT	DWELLING UNITS	PERSONS/UNIT	POPULATION
SINGLE FAMILY	1480-1850	2	2960-3700
MULTI-FAMILY			
A. LOW DENSITY	690-1035	2	1380-2070
B. MEDIUM DENSITY	220-370	2	440- 740
TOTAL			1820-9810

NOTE: NO SCHOOL AGE CHILDREN ANTICIPATED UNDER AGE 19.

SUN LAKES, SEC. 29, 30, 31 & 32, MARICOPA COUNTY, ARIZONA

LAND USE DATA

LAND USE	ACRES	%	YIELD D.U./AC.	DWELLING UNITS
SINGLE FAMILY	1668.9		4.0-5.0	6770-8350
MULTI-FAMILY				
A. LOW DENSITY	205.1		6.0-9.0	1230-1845
B. MEDIUM DENSITY	81.2		9.0-15.0	730-1215
SUB-TOTAL:	1955.2	76.5	4.4-5.8	8630-11410
SHOPPING CENTER	50.0			
COMMERCIAL	37.1			
SUB-TOTAL:	87.1	3.5		
PUBLIC & QUASI-PUBLIC				
A. GOLF COURSE	391.5			
B. CLUBHOUSE & REC. CENTER	29.0			
C. LAKES (SEC. 31)	39.3			
D. CIVIC CENTER	9.5			
E. HOSPITAL	11.5			
F. CHURCH SITES	17.9			
G. WASTE TREATMENT	10.0			
H. OTHER	4.3			
SUB-TOTAL:	513.0	20.0		
TOTAL:	2555.0	100.0	3.4-4.5	8630-11410

C: COMMERCIAL AND COMMUNITY FACILITIES

A set of recreation facilities commensurate with or better than those found in Section 31 will be constructed. These facilities will include a 9-hole championship golf course (with the second 9 holes to be built in Section 29) with pro shop and lounge, tennis courts, shuffleboard courts, complete health center with jacuzzi, swimming pools and a club which will feature lounges, large meeting hall, billiard room, card rooms and an arts and crafts center which will include work area and exhibition space. In addition, there will be picnic areas, greenbelt and a separate swimming area for owners with visiting children.

A shopping center exists on the entrance road to Section 31 with a bank, grocery market and soon-to-be-opened space with beauty/barber shop, travel agency and medical clinic. There are 10 additional commercial acres in Section 31, and 12.5 acres planned for commercial use in Section 32.

According to the plan, 112.8 acres (17.7% of total land area) are set aside for community facilities, and 12.5 (2.2% of land) are proposed for commercial use. The breakdown in acres for the community facilities is as follows:

1. Golf Course - 81.0 acres (12.7% of total land area)
2. Clubhouse - 8.0 acres (1.3% of total land area)
3. Parks and lakes - 23.8 acres (3.7% of total land area)

The original Master Plan for Section 32 set aside 25 acres for commercial use. Access to the Interstate Highway and easy access to the nearby cities of Chandler, Tempe and Mesa are a definite asset to residents of SUN LAKES. Yet, there is also a need for commercial land within the subdivision to complete the concept of the perfect adult recreational community. The amount of commercial land allocated in the revised Master Plan, however, calls for 12.5 acres, or a reduction of 12.5 acres in commercial land use.

Preliminary plans have begun on commercial layouts in Sections 29 and 30. The development of Section 29 will follow Section 32, and approximately 32 acres of commercial acreage will be requested in zoning. Twenty-three of these acres will be set aside for a shopping center and nine acres for a motel/restaurant and service station. Additional commercial acreage is planned in Section 30, the last of the four sections to be developed. Preliminary plans call for a total of 28.6 acres to be used for boat and trailer storage, medical offices, nursing home and convenience center.

The general layout of the commercial area can be viewed on the map on page 9. A breakdown of the commercial is also included in the tables on pages 12-16.

D: CIRCULATION SYSTEM

Access to the metropolitan area is provided by the interchange at Interstate Highway 10 and Riggs Road. Riggs Road borders the subject section on the north, and Section 32 is located approximately two miles east of Interstate Highway 10. The intersection of Interstate Highway 10 and 24th Street in Phoenix is approximately 19 miles from Riggs Road. Access to the nearest city of Chandler (approximately six miles from SUN LAKES) is provided by Arizona Highway 87 which intersects with Riggs Road approximately two miles east of Section 32.

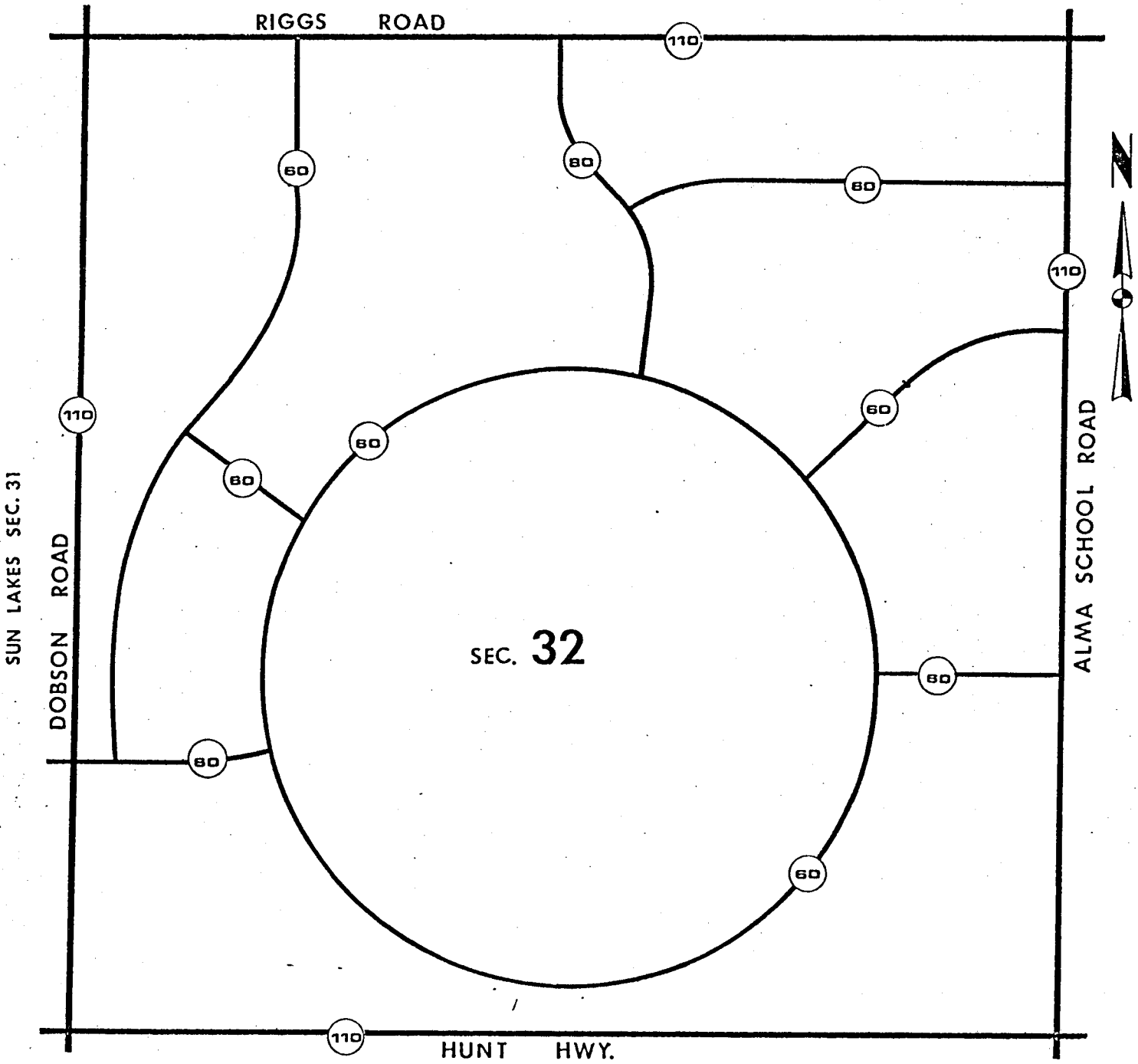
Extensive use has been made in Section 31 for curvilinear street patterns in order to heighten the aesthetic beauty of the subdivision and to control traffic speeds. This pattern will be continued in Section 32. Sections 29 and 30, however, will not make use of curvilinear streets, but plan instead for single fairways throughout most of the area. In addition, preliminary plans show Dobson Road as being curved slightly. This, again, is to aid in traffic control and to add to the aesthetics of the design. (At the present time, Dobson Road between Sections 29 and 30 consists of a dirt, single lane road; it is not a through street.)

The circulation pattern for Section 32 essentially follows the original Master Plan submitted in 1973. All streets on the map will paved and will conform to Maricopa County Highway Department Details and Specifications. All roadways will dedicated to the public.

A map showing circulation pattern width of public rights-of-way and street sections are included in this report on page 21.

SUN LAKES

MAJOR STREET PLAN



Gila River Indian Reservation

E: SUMMARY OF ENGINEERING AND UTILITY INFORMATION

Engineering

A boundary and topographical survey of the site locating all monuments and showing ground elevation at one-foot intervals has been completed. The master plan has been reviewed, and all acreage and lot estimates are within reasonable tolerances. The survey shows all existing easements and rights-of-way for roadways, drainage and utilities.

Site Drainage

Present drainage is to the southwest, showing an average slope of 0.2 foot drop per horizontal 100 feet. From the southeast corner to the southwest corner, there is approximately 100 feet difference in elevation in both Sections 31 and 32. The average level slope of 0.2% is uniform throughout the site with no thanges; therefore, no major problem to grade and drain streets, parking and lot areas is anticipated. Drainage can be accomplished within the roadway network with a mimimum of storm drainage construction. Sections 29 and 30 are of the same nature as Sections 31 and 32, and the handling of storm drainage will be the same in all four sections. The storm runoff will be taken care of by a system of planned roadways, channels, lakes, golf course detention basins, storm drain pumps and force mains.

The roadways and channels convey the runoff on the surface to a system of lakes where it is temporarily stored and then routed through the lake network by storm drains, pumps and force mains. Pumps and force mains will be constructed in low lakes for positive discharge. The pumps will operate depending on storm lake level with ultimate point of discharge to, most probably, Riggs Road and Price Road intersection.

A preliminary master drainage report for Section 32 begins on page 27. This report is followed by a letter from Jason Burgess, engineer, regarding the drainage plan for Sections 29 and 30.

Sewers

Sewage treatment facilities will be located on the property to serve the sanitary sewage collection system by gravity flow. These facilities are discussed in entirety in the master sewer and water report for Section 32, which begins on page 63. The wastewaters in Sections 29 and 30 will be handled similarly to the flows for Sections 31 and 32. Collected flows are delivered to a centrally located lift station and the flow will be pumped to the existing wastewater treatment location. As flows are generated, the existing wastewater treatment plant will be re-constructed to treat the anticipated flows. All sewers are designed

and constructed in accordance with specifications of the Arizona State Department of Health and the Maricopa County Department of Health.

A master water and sewer plan for Section 32 follows the Master Drainage Report. Also included is a letter from Karl Hirlinger, engineer, regarding the water and sewer plan for Sections 29 and 30.

Domestic Water

Domestic water supply to the development will be from a well source located within the boundary. The water distribution system will be capable of providing minimum flows required for fire protection. The system will utilize ground storage for supply to booster pumps. The booster pumps will be sustained by a pressure tank to handle system pressures on the smaller demands.

The water distribution system will be interconnected to the previous development. For supplementary data, please refer to the master sewer and water plan report.

Electrical Power

Electrical power to the subdivision will be provided by Salt River Project.

Telephone Service

Telephone service to the subdivision will be provided from the area service company, Mountain States Telephone Company. Main lines leading from Chandler to the Sun Lakes area are being installed simultaneously with lines within the subdivision so that no delays in new hookups are anticipated.

Gas Service

There will be no natural gas service to the subdivision. All homes will be total electric.

Fire and Security Protection

SUN LAKES is under the jurisdiction of the Maricopa County Sheriff's Department. In addition, SUN LAKES has its own fire and security service which operates on a 24-hour per day, seven days per week basis, and a Volunteer Fire Company has been formed. A fire hydrant system is also in existence, and SUN LAKES currently has a fire rating of "eight." This service will be continued in all of the other sections.

Refuse Removal

Sanitary Disposal Service has agreed to handle refuse removal in Sections 29, 30 and 32 on the same basis as it is now operating in Section 31.

Water Availability for Golf Courses and Lakes

For water supply information, reference should be make to the

master water and sewer report. It is planned to use existing irrigation wells owned by the developer to supply the golf courses and lake areas as outlined in the report. The lakes will serve primarily as storage facilities for irrigation water requirements of the subdivision. In addition, the lakes will collect drainage from storm run-off and will serve as reservoirs for storage of wastewater treatment plant effluent. Use of the lakes for run-off and treated wastewater storage will permit salvage of these waters for use in the golf course irrigation program.

MASTER DRAINAGE REPORT

FOR

SUN LAKES SECTION 32

THIS IS NOT THE FINAL
REVISED MASTER REPORT

AUGUST 1978

Henningson, Durham & Richardson
100 West Clarendon, Suite 1222
Phoenix, Arizona 85013

PRELIMINARY

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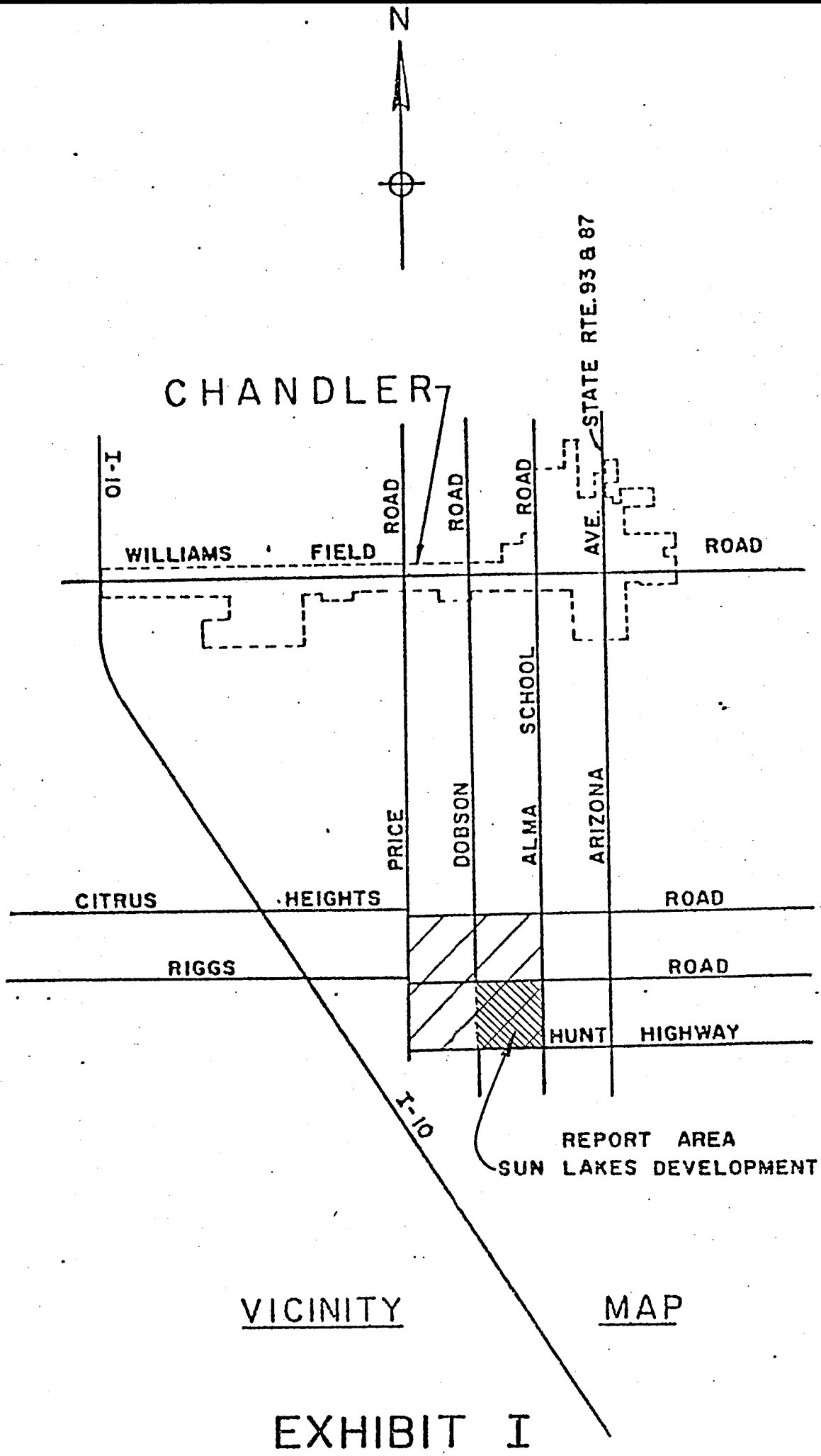


VICINITY MAP

EXHIBIT I

INTRODUCTION

Drainage analysis has been conducted for the purposes of evaluating the existing conditions on and adjacent to Sun Lakes Development Plan of Section 32 site and the future conditons 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, storm drains, retention areas, lakes, pumping facilities and 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 storm.

The study area contains approximately 635 acres of land within Township 2 South, Range 5 East. This land is owned by the Sun Lakes Development Company and is currently being farmed.

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 and irrigated farm land sloping west from the San Tan Mountains to the east. The Consolidated Canal (East Branch), Eastern Canal, and Roosevelt Conservation District Floodway, lie to the east and the Gila River south of project site. These canals and floodway are protected by levees which divert westerly sheet flow storm water south to the Gila River.

The area is drained mainly by sheet flow which ultimately discharge into the Gila River located south of the Project Site. This river along with the other rivers in the Phoenix area are dry and have no permanent flow. The Gila 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 area immediately south of Hunt Highway (Southern Project Site Border) and north of Gila River has heavy bush growth presumably resulting from frequent storm flows through the area from Canal levee diversions east of the project site.

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.

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. Other values were obtained by converting various hourly rainfalls by use of an equation 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 Storm of twenty-four (24) hour duration, utilizing the appropriate curve numbers of the contributing drainage areas.

DESIGN CRITERIA

Table 1

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

Precipitation (Inches)

Duration (Hours)	2 yr. Freq.	5 yr. Freq.	10 yr. Freq.	25 yr. Freq.	50 yr. Freq.	100 yr. Freq.
6	1.10	1.60	1.90	2.30	2.60	3.00
24	1.30	1.85	2.20	2.75	3.20	3.60
2*	0.95*	1.41*	1.67*	1.95*	2.14*	2.54*
1*	0.9 *	1.35*	1.60*	1.85*	2.00*	2.40*

*Interpolated values equating 6 hour and 24 hour rainfalls
(P_2 hr. = 1.77 P_6 - 0.77 P_{24}) P_1 hr = 2P_6 - P_{24}

Peak runoff estimate based on 100 Year Frequency Storm of 24 hour duration. (See Tables 2, 3)

Runoff Quantities have been calculated using computer application of the TR-20 Hydrology Program which can be approximated by the following equation:

$$Q_P = \frac{484\ AQ}{T_P}$$

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 can be approximated by 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 curve number (CN) which is based on a vegetative cover type and density and a hydrologic soil group. The hydrologic soil group within Sun Lakes Development and the surrounding area is constant as group C (slow infiltration rate). The cover type and density within Sun Lakes Development does not vary considerably for each drainage area; thus the CN will be based on the type of development anticipated using the following values:

CN	Type of Development
91	Commercial Areas
87	Single Family Housing Area
83	Apartment Complex Area
74	Golf Course Areas
100	Lake Water Surface

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.

Offsite Drainage Area

This study area is mostly agricultural land with a small mix of commericial land, therefore the roads in the area are built up to contain the irrigation waters. The type of cover in this area is considered to be Desert Brush with density rating of "poor" although areas south of Hunt Highway have quite good cover densities and a Hydrologic Soil Group C, all as described in Arizona Highway Department Hydrologic Design Manual.

As seen by Exhibit II, the offsite drainage area is rather small namely only Section 33 Township 2 South, Range 5 East because Riggs Road is built up and acts as a ridge and Arizona Avenue (Highway 87 and 93) is also built up and diverts westerly flowing runoff south of project site.

The offsite drainage area is limited to the aforementioned section since the Consolidated Canal (East Branch) levee diverts the storm runoff south from the San Tan Mountains to the east.

This diverted runoff passes under Highway 87 and flows south along the east side of Arizona Avenue (Highway 93) to approximately the NE corner of SE 1/4 of the SE 1/4 of Section 4 where it flows under Arizona Avenue. This flow then continues west and under I-10 until it reaches the Gila River. Flow in this area is mainly sheet flow as there are no major defined washes.

Presently there exists a drainage ditch along the east side of Alma School Road (East border of Section 32) which conveys drainage south to Hunt Highway. This ditch passes under a mid-section farm road of Section 33 in a 24" diameter pipe culvert. Drainage then passes under Alma School Road in a 24" culvert and is conveyed west along the north side of Hunt Highway. Generally the drainage in Section 33 is field contained because of irrigation.

Runoff quantity has been estimated for the offsite Drainage area (see Exhibit II) for 100 year frequency storm and is 115 cfs. This runoff will concentrate in the southwest corner of Section 33 and be transmitted west by Hunt Highway.

Runoff calculations were based on the land within Section 33 area remaining undeveloped or in agricultural useage. If offsite land use changes of this Section, it will be the responsibility of the owner(s) of said land to increase the conveyance capacity associated with the proposed Alma School Road and Hunt Highway improvement

if runoff quantity of this section is sufficiently increased or provide retention with Section 33 to prevent any flooding of Sun Lakes Development.

Onsite Drainage Area

As seen by Exhibit IV, the drainage of the project site is bordered by Riggs Road on the north, Dobson Road on the west, Hunt Highway on the south, and Alma School Road on the east, which contains approximately 635 acres of area. This land is currently under cultivation and agricultural use. The surface runoff now is a combination of sheet flow and roadway drainage ditches conveyed in a general westerly direction. Upon reaching Section 31 (presently being developed), surface runoff is divided, part of which flows south to Hunt Highway for conveyance west to a Detention Reservoir and part of which flows on the street system to a series of lakes within Section 31.

The overall drainage pattern of Section 32 is in a westerly direction on an average slope of a 0.23' drop per 100 feet horizontal run. The elevations within the study area range from 1201 in the northeast corner to 1189 in the northwest corner, which gives a fall of 12 feet over the Section.

The existing cover type varies as to the agricultural crop with a general density range of "good" and having a hydrologic soil group in Category "C". Proposed development of the study

area will include single family housing, apartments, golf courses, shopping centers, recreation centers and other commercial uses resulting in varying curve numbers. The unique feature of this Section is that it will contribute little surface runoff as all the runoff will be stored on the golf course or proposed lakes for use as irrigation of the golf course or water replenishment of interior lakes. This design greatly reduces the volume of runoff generated from section development and meters the water out through a pump system at a slower rate which can be handled by Hunt Highway Section.

The surface runoff, with improvements, will be in the westerly direction. It is proposed that the drainage handling system for the project will use the roadway system network, grass or lined channels. Once the runoff reaches a discharge point it will be stored on the golf course in lakes or grassed fairway retention areas, or within the series of lakes in the development. The lakes in the developed area will be interconnected by a gravity storm drain system with the golf course lakes being connected by a pump system to allow for draw down of its water surface after or during a storm.

Storm runoff quantities have been estimated for each Onsite Drainage Area (as shown on Exhibit IV) for a 100 year Frequency Storm of 24 hour duration. Runoff quantities for each Drainage Area are presented in Table 2. The TR-20 Program routed storm runoff quantities, through indicated concentration points and are presented in Table 3.

TABLE 2

On-Site Storm Runoff

Symbol	Drainage Area (Acres)	Curve No.	Weighted Curve No.	Tc (Min)	Est. Peak Runoff (cfs)	Computer Ref. No.
A	19.14	87	--	23	33	49
B	18.47	87	--	25	31	17
BB	5.74	87	--	16	12	19
C	37.36	87	--	32	57	42
D	24.84	87	--	28	40	39
E	30.21	87	--	31	46	50
F	16.25	87	--	22	29	21
G	83.43	87	--	37	121	46
H	8.95	87	--	23	16	36
I	12.76	87	--	20	24	31
J	51.68	87	--	51	63	33
K	22.80	87	--	20	42	27
L	25.99	87	--	27	42	24
M	31.52	87	--	30	49	7
N	12.33	87	--	24	21	11
O	20.82	87	--	17	41	3
P	9.81	91	--	15	23	1
Q	28.47	88	--	30	46	14
R	11.71	74	--	48.5	8	43

TABLE 2

On-Site Storm Runoff

Symbol	Drainage Area (Acres)	Curve No.	Weighted Curve No.	Tc (Min)	Est. Peak Runoff (cfs)	Computer Ref. No.
Lake 1	20.01	74 & 100	76.2	45	16	S1
Lake 2	60.38	74 & 100	77.1	42	43	S2
Lake 3	14.07	74 & 100	75.8	48	10	S3
Retention 4 & 11	11.29	74	--	47	8	S4
Lake 5	5.22	74 & 100	84	15	10	S5
Lake 6	6.80	74 & 100	80.5	15	11	S6
Lake 7	8.67	74 & 100	81.5	15	14	S7
Lake 8	7.58	74 & 100	80.9	15	12	S8
Lake 9	7.99	74 & 100	80.5	15	13	S9
Lake 10	7.17	74 & 100	81.3	15	12	S10

TABLE 3

Routed Onsite Runoff

Concentration Point	Drainage Area (Acres)	Time to Peak (Hours)	Estimated Peak (cfs)	Est. Storm Drain Discharge (cfs)	Remarks
2	9.81	12.00	21		D.A., P.
3	20.82	11.99	41		D.A., O.
4	30.63	12.00	62		D.A., O & P
5	30.63	12.00	61		D.A., O & P
6	44.70	24.00	--	1.17	D.A., O, P & Lake 3 flow metered out by pipe size
7	31.52	12.15	49		D.A., M.
8	31.52	12.18	48		D.A., M.
9	11.29	12.36	8		D.A., Retention Area 4 and 11
53	42.81	12.31	61		D.A.M., Retention Area 4 & 11
10	42.81	12.53	64		Overflow from Ret. Area 4 & 11
11	12.33	12.07	21		D.A.N.
12	55.14	12.52	72		D.A., M & N, overflow from Ret. Areas 4 & 11
13	55.14	12.52	69		Same as above
15	28.47	12.16	46		D.A., Q
16	83.61	12.48	95		D.A., M, N, & Q; overflow from Ret. Areas 4 & 11
18	18.47	12.15	28		D.A., B

TABLE 3

Routed Onsite Runoff

Concentration Point	Drainage Area (Acres)	Time to Peak (Hours)	Estimated Peak (cfs)	Est. Storm Drain Discharge (cfs)	Remarks
20	5.74	12.00	11		D.A., BB
51	30.21	12.19	45		D.A., E
52	243.11	25.25	--	2.42	D.A, B, BB, E, M, N & Q and Lake 2 overflow from Ret. Area 4 & 11, pipe flow from Lake 3, flow metered out by pumping
22	16.25	12.05	28		D.A. F.
23	273.43	24.50	--	2.62	D.A. F and Lake 9; pumping from Lake 2 flow metered out by pipe size
25	25.99	12.11	42		D.A. L.
26	31.21	12.08	--	1.00	D.A. L and Lake 5 flow metered out by pipe size
28	22.80	12.05	40		D.A.K.
30	60.81	24.00	--	1.69	D.A.K & Lk 6; pipe flow from Lk. 5; flow metered out by pipe sz.
32	12.76	12.03	23		D.A. I
34	51.68	12.40	60		D.A.J
35	60.35	15.25	--	4.90	D.A., J & Lake 7; flow metered out by pipe size

TABLE 3

Routed Onsite Runoff

Concentration Point	Drainage Area (Acres)	Time to Peak (Hours)	Estimated Peak (cfs)	Est. Storm Drain Discharge (cfs)	Remarks
37	8.95	12.07	15		D.A.H.
38	423.88	25.00	--	9.43	D.A. I & J & Lk 8; pipe flow from Lks 6, 7 & 9; flow metered out by pipe size
40	24.84	12.16	38		D.A. D.
41	455.89	24.00	--	10.29	DA, D & Lk 10; pipe flow from Lake 8; flow metered out by pipe size
42	37.36	12.18	57		D.A. C
43	11.71	12.39	8		D.A. R
44	49.07	12.20	64		D.A.C. & R
45	69.08	12.27	60		D.A.C., R & lake 1
47	83.43	12.24	119		D.A. G
48	608.40	24.75	--	11.52	D.A. C, G, R & Lake 1; pipe flow from Lake 10; flow meteredout by pumping

DRAINAGE MASTER PLAN

Offsite Improvements

Development east of Alma School road is not anticipated to occur for quite a few years, therefore storm runoff design was based on land remaining undeveloped. The improvement of Alma School Road will only be a half street improvement as required by Maricopa County Highway Department Subdivision Regulations. The first 3/4 miles of this street south of Riggs Road will be built above existing ground thus the existing drainage ditch on the west side will remain in use for conveyance of storm runoff from Section 33 south. The last 1/4 mile of Alma School Road north of Hunt Highway will be cut into the existing ground thus the roadway section will be used for continued conveyance of storm runoff from Section 33 south.

The project site is protected by three existing features which divert water south of the project site. These features are the Arizona Avenue which is constructed above the existing ground and the leeves of Eastern Canal and Consolidated Canal.

The proposed Drainage Master Plan includes reconstructing Alma School Road and Hunt Highway (See Plate III) for conveyance of offsite runoff south and west respectively past the project site.

Onsite Improvements

Runoff east of the project site will be prevented from flowing onto the new community project site. This runoff will be captured by either an existing drainage ditch adjacent to Alma School Road

or by the Alma School Roadway Section for conveyance south to Hunt Highway. Thence, Hunt Highway Roadway section will convey the runoff west past the project site. Therefore, rainfall falling on the project site will be handled within the confines of the site by planned roadways, channels, lakes, golf course detention basins, storm drains, storm drain pumps and force mains.

The overall new community project site has been planned with a road, channel, storm drain, lake network system, as shown on Exhibit V, designed to handle the 100 year Frequency Storm of 24 hour duration. The street system, with street sections as shown on Plates I thru III will be used to convey the storm runoff to channels. The channels shown by Plate IV will route the runoff to the lakes or retention areas for storage. The lining of these channel sections will either be grass lined or pneumatically placed concrete lining depending on the quantity of flow conveyed, available right of way, velocity of flow and land use adjacent to the channel. Once the flow reaches the lake system, it will be temporarily stored then routed through the lake network by storm drains, pumps and force mains. Pumps and force mains are constructed in the low lakes to provide for a method of positive discharge. Lake 2 will be served by one 1000 gpm pump which discharges into Lake 9 through a 10" diameter force main. Lake 1 will be served by 2 2500 gpm pumps which discharge through a 20" diameter force main offsite. These pumps will operate in stages depending on storm lake level.

This drainage plan serves a dual purpose of providing retention of storm runoff for use in golf course irrigation and reducing the amount of runoff from the development of Section 32 which affords protection to the existing development in Section 31.

Lake Capacities

The drainage Master Plan for Sun Lakes Section 32 calls for storm water runoff to be temporarily stored in a system of 9 lakes. These lakes are interconnected by a system of storm drains to allow passage of water by gravity throug the lake network by metered flow, except Lake 1 and 2 which discharge via pumps through a force main.

Capacity of this lake network is based on results of the TR-20 program of routed storm flow as follows:

Table 4
Proposed Lakes

Lake No.	Water Surface Area (Acres)	Water Surface Elevation	100 yr. Peak Inflow (cfs)	Water Surf. Elev. @ Peak Flow	Depth Peak Storage (ft)	Max. Storage Volume (acre-ft)	Est. Min. Finished Floor Adjacent
1	1.70	1182.5	205	1187.62	5.12	25.36	1189.5
2	3.00	1187.5	186	1190.35	2.85	28.64	1192.7
3	1.00	1190.5	67	1193.29	2.79	6.47	1194.7
Det. 4	---	---	55	1195.06	1.56	1.40	1195.7
5	2.00	1191.0	51	1191.61	0.61	1.22	1195.7
6	1.70	1190.5	51	1192.28	1.78	4.63	1194.6
7	2.50	1190.0	65	1192.17	2.17	7.11	1193.7
8	2.00	1187.5	60	1189.22	1.72	5.06	1192.9
9	2.00	1188.0	43	1189.56	1.56	4.08	1193.3
10	2.00	1187.0	58	1188.74	1.74	4.95	1191.7
Det.11	---	---	68	1193.08	1.58	1.07	1193.7

The above refernce table is tentative elevations and storage volumes which could change at time of final site development.

Street and Channel Capacities

The Drainage Master Plan for Sun Lakes Section 32 calls for storm water runoff to be conveyed to its outfalls in the system of lakes,by the roadway system, grass, or lined channels.

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:

"n"	surface type
0.016	asphalt pavement
0.018	pneumatically placed concrete channel lining
0.031-0.05	grass lined channels

Typical sections of roadways and channels are shown on Plates I, II, III and IV. 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.

ROADWAYS (See Exhibit IV)

2 - Assumed slope = 0.005'/ft. and roadway Section A (40')

Q_{100} = 21 cfs
water depth 0.01' above T.C.

V	Q
2.35 fps	21 cfs

3 - Assumed slope = 0.003'/ft. and roadway Section A-1 (40')

Q_{100} = 41 cfs
water depth 0.10' below T.C.

V	Q
2.72 fps	41 cfs

7 - Assumed slope = 0.0014'/ft. and roadway Section A (40')

Q_{100} = 49 cfs
water depth 0.33' and above T.C.

V	Q
2.26 fps	49 cfs

10 - Assumed slope = 0.0024'/ft. and roadway Section B-1

Q_{100} = 64 cfs
water depth 0.26' below T.C.

V	Q
2.81 fps	65 cfs

11 - Assumed Roadway slope = 0.0028'/ft. and Section A (32')

Q_{100} = 21 cfs
water depth 0.11' above T.C.

V	Q
2.23 fps	22 cfs

16 - Assumed Roadway slope = 0.0024'/ft. and Section B-1

Q_{100} = 95 cfs
water depth 0.12' below T. C.

V	Q
3.31 fps	98 cfs

17 - Assumed Roadway slope = 0.0015'/ft. and Section A (32')

Q_{100} = 31 cfs
water depth 0.25' above T. C.

V	Q
2.09 fps	30 cfs

21 - Assumed Roadway slope = 0.0021'/ft. and Section A (32')

Q_{100} = 29 cfs
water depth 0.20' above T. C.

V	Q
2.28 fps	29 cfs

24 & 27 - Assumed Roadway slope = 0.0057'/ft. and Section A-1 (40')

Q_{100} = 42 cfs
water depth 0.16' below T. C.

V	Q
3.29 fps	43 cfs

31 - Assumed Roadway slope = 0.0025'/ft. and Section A (32')

Q_{100} = 24 cfs
water depth 0.14' above T. C.

V	Q
2.24 fps	24 cfs

33 - Assumed Roadway slope = 0.0017'/ft. and Section A-1 (40')

Q_{100} = 63 cfs
water depth 0.12' above T. C.

V	Q
2.70 fps	64 cfs

36 - Assumed Roadway slope = 0.0015'/ft. and Section A (32')

Q_{100} = 16 cfs
water depth 0.11' above T. C.

V	Q
1.64 fps	16 cfs

39 - Assumed Roadway slope = 0.0018'/ft. and Section A (32')

Q_{100} = 40 cfs
water depth 0.24' above T.C.

V	Q
2.26 fps	41 cfs

42 - Assumed Roadway slope = 0.0015'/ft. and Section A-1 (40')

Q_{100} = 57 cfs
water depth 0.10' above T.C.

V	Q
2.48 fps	57 cfs

46 - Assumed Roadway slope = 0.0018'/ft. and Section A-1 (40')

Q_{100} = 121 cfs
water depth 0.38' above T.C.

V	Q
3.51 fps	120 cfs

49 - Assumed Roadway slope = 0.0026'/ft. and Section A (32')

Q_{100} = 33 cfs
water depth 0.21' above T.C.

V	Q
2.59 fps	34 cfs

50 - Assumed Roadway slope = 0.0022'/ft. and Section A-1 (40')

Q_{100} = 46 cfs
water depth at T.C.

V	Q
2.65 fps	50 cfs

CHANNELS (See Exhibit IV)

4 to 5 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.018)

Q_{100} = 62 cfs
water depth 1.24' above channel bottom

V	Q
4.27 fps	62 cfs

7 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.018)

Q_{100} = 49 cfs
water depth 1.09' above channel bottom

V	Q
3.98 fps	49 cfs

16 - Assumed Channel slope = 0.003'/ft. and Channel Section B (n = 0.018)

Q_{100} = 95 cfs
water depth 1.17' above channel bottom

V	Q
4.42 fps	96 cfs

17 - Assumed Channel slope = 0.0036'/ft. and Channel Section A (n = 0.018)

Q_{100} = 31 cfs
water depth 0.81' above channel bottom

V	Q
3.69 fps	31 cfs

17 to 18 - Assumed Channel slope = 0.0036'/ft. and Channel Section A (n = 0.033)

Q_{100} = 28 cfs
water depth 1.07' above channel bottom

V	Q
2.35 fps	28 cfs

19 to 20 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.033)

Q_{100} = 12 cfs
water depth 0.70' above channel bottom

V	Q
1.69 fps	12 cfs

21 to 22 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.018)

Q_{100} = 29 cfs
water depth 0.82' above channel bottom

V	Q
3.39 fps	29 cfs

24 to 25 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.018)

Q_{100} = 42 cfs
water depth 1.00' above channel bottom

V	Q
3.79 fps	42 cfs

27 to 28 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.033)

Q_{100} = 42 cfs
water depth 1.39' above channel bottom

V	Q
2.48 fps	42 cfs

31 to 32 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.018)

Q_{100} = 24 cfs
water depth 0.74' above channel bottom

V	Q
3.20 fps	24 cfs

33 to 34 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.033)

Q_{100} = 63 cfs
water depth 1.72' above channel bottom

V	Q
2.78 fps	63 cfs

36 to 37 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.033)

Q_{100} = 16 cfs
water depth 0.82' above channel bottom

V	Q
1.85 fps	16 cfs

39 to 40 - Assumed Channel slope = 0.003'/ft. and Channel Section A (n = 0.033)

Q_{100} = 40 cfs
water depth 1.36' above channel bottom

V	Q
2.45 fps	40 cfs

43 - Assumed Channel slope = 0.0025'/ft. and Channel Section A (n = 0.033)

Q_{100} = 8 cfs
water depth 0.60' above channel bottom

V	Q
1.40 fps	8 cfs

43 to 44 - Assumed Channel slope = 0.006'/ft. and Channel Section B (n = 0.033)

Q_{100} = 64 cfs
water depth 1.08' above channel bottom

V	Q
3.26 fps	64 cfs

44 to 45 - Assumed Channel slope = 0.006'/ft. and Channel Section B (n = 0.033)

Q_{100} = 64 cfs
water depth 1.08' above channel bottom

V	Q
3.26 fps	64 cfs

46 to 47 - Assumed Channel slope = 0.003'/ft. and Channel Section B (n = 0.018)

Q_{100} = 121 cfs
water depth 1.33' above channel bottom

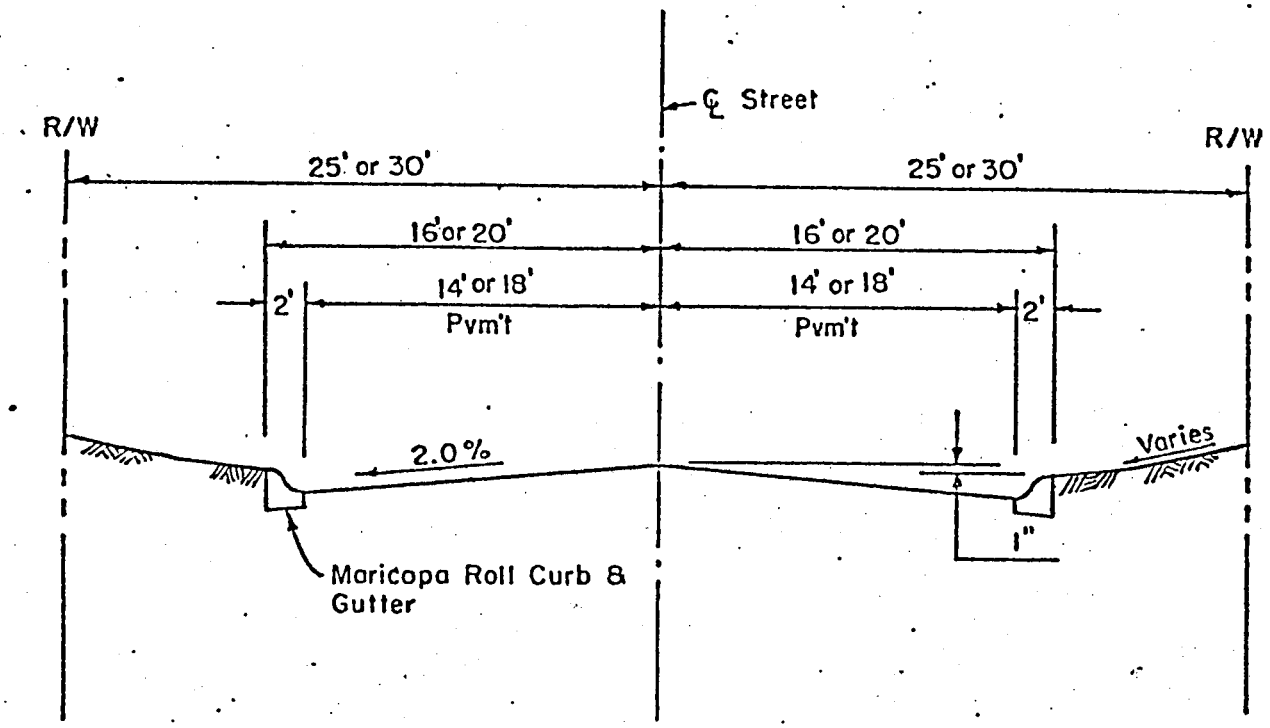
V	Q
4.76 fps	120 cfs

50 to 51 - Assumed Channel slope = 0.0025'/ft. and Channel Section A (n = 0.018)

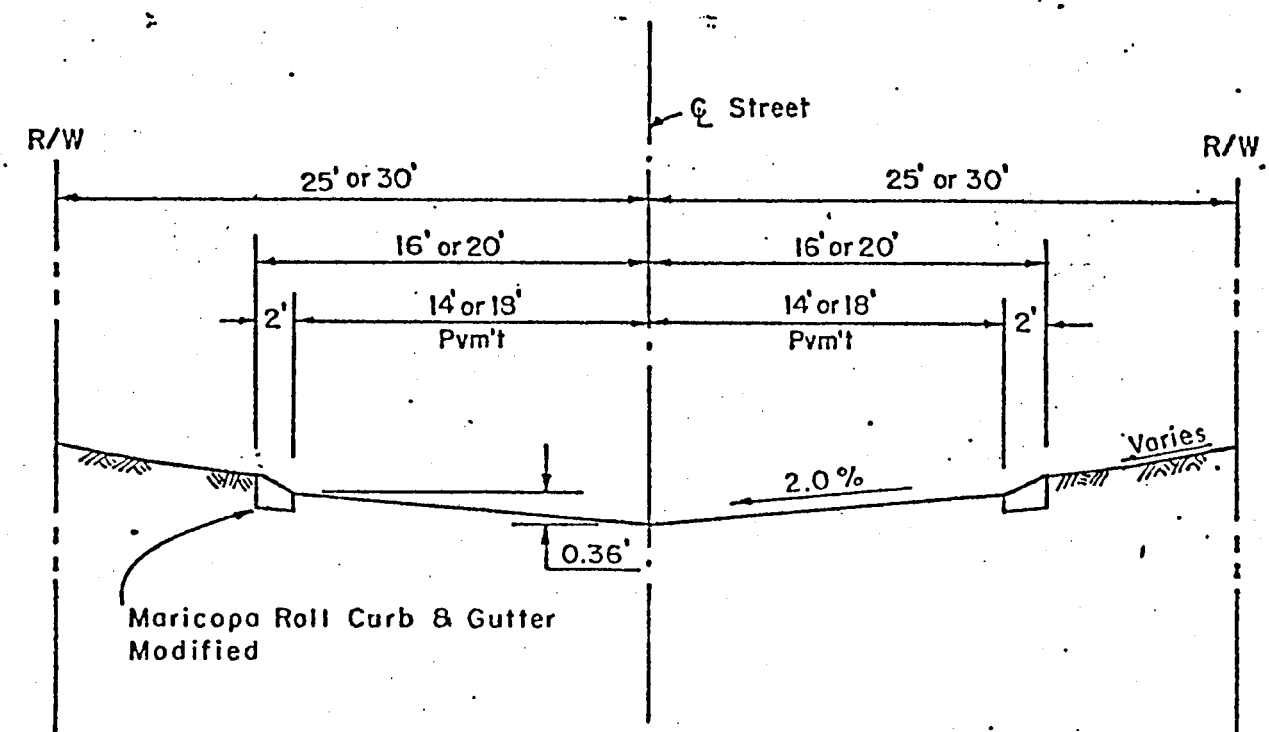
Q_{100} = 46 cfs
water depth 1.11' above channel bottom

V	Q
3.67 fps	46 cfs

In grading Section 32 housing finished floors will be constructed above the depths indicated above for flood protection against 100 year frequency storm.

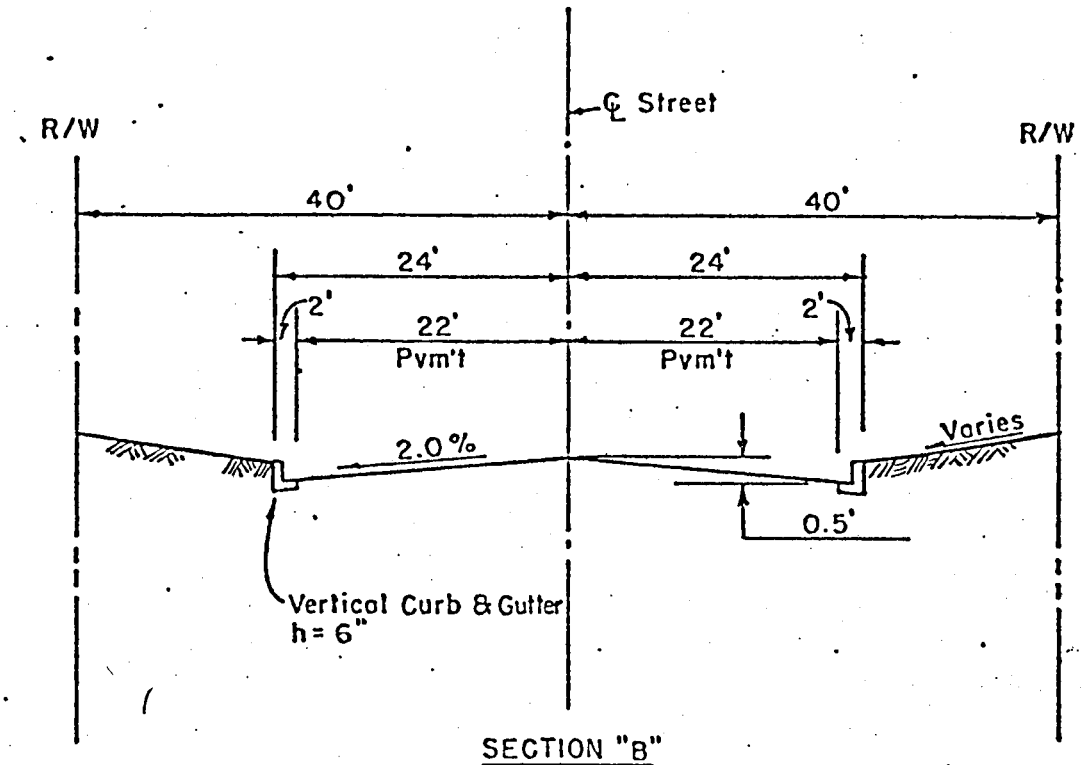


SECTION "A"
RESIDENTIAL STREET WITH NORMAL CROWN

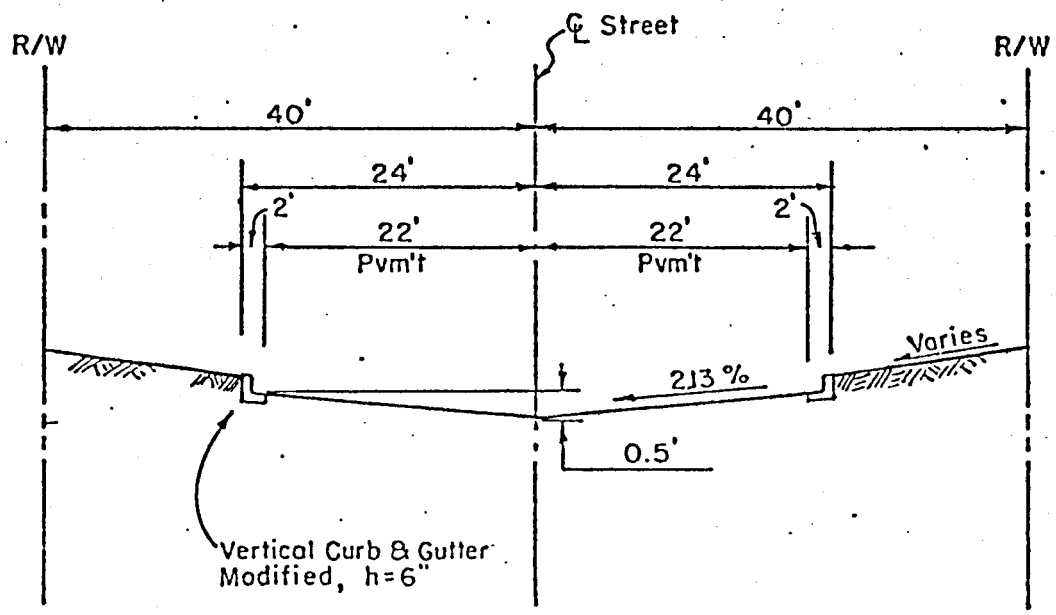


SECTION "A-1"
RESIDENTIAL STREET WITH INVERTED CROWN

PLATE I

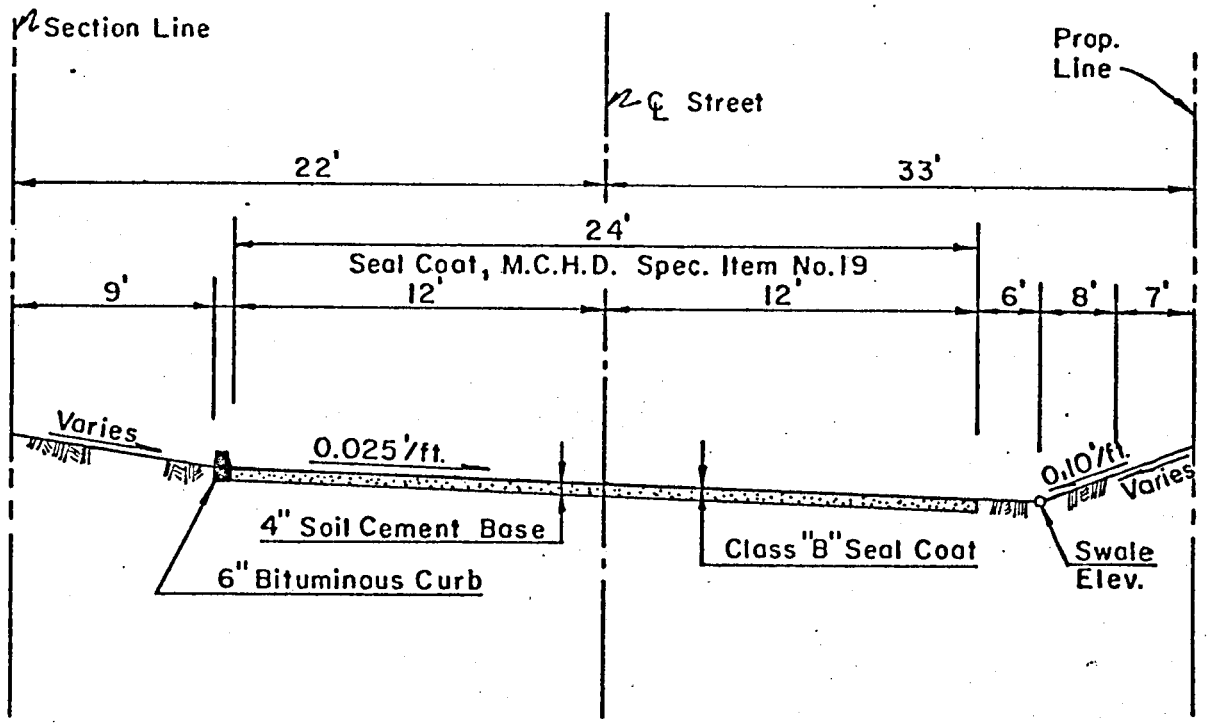


SECTION "B"
COLLECTOR STREET WITH NORMAL CROWN

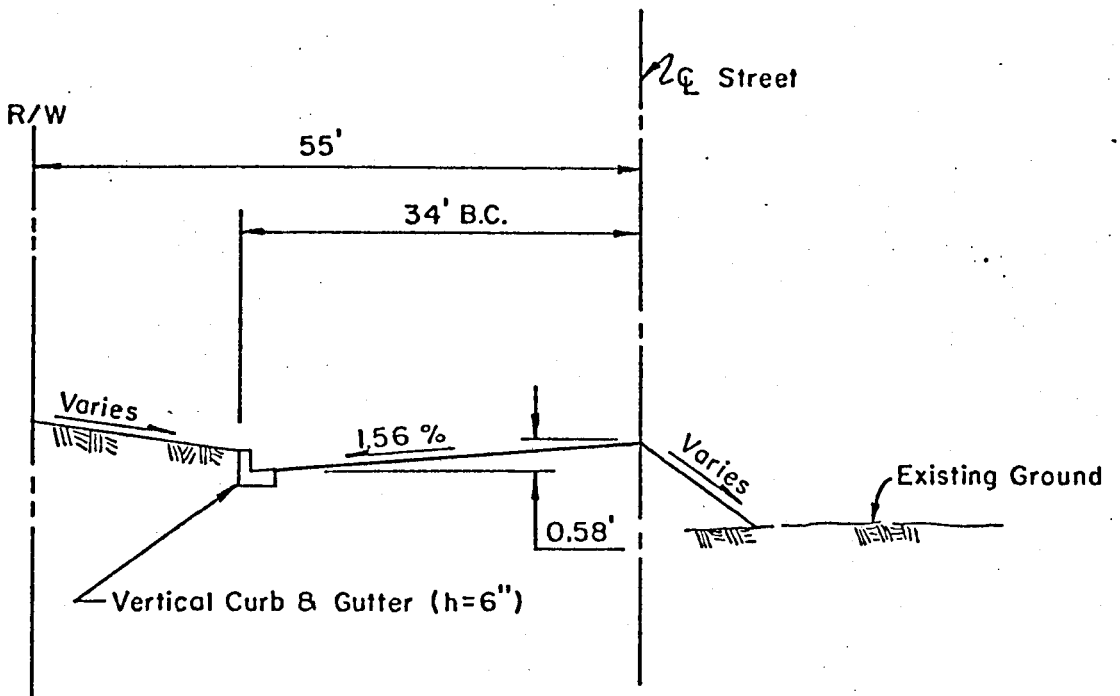


SECTION "B-1"
COLLECTOR STREET WITH INVERTED CROWN

PLATE II

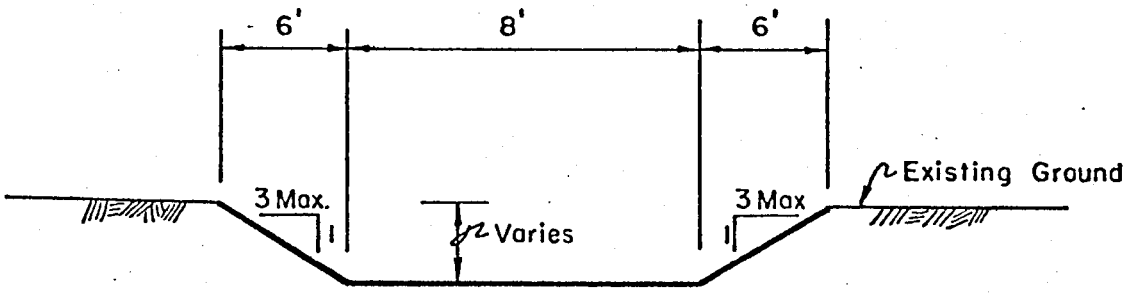


SECTION "C"
HUNT HIGHWAY

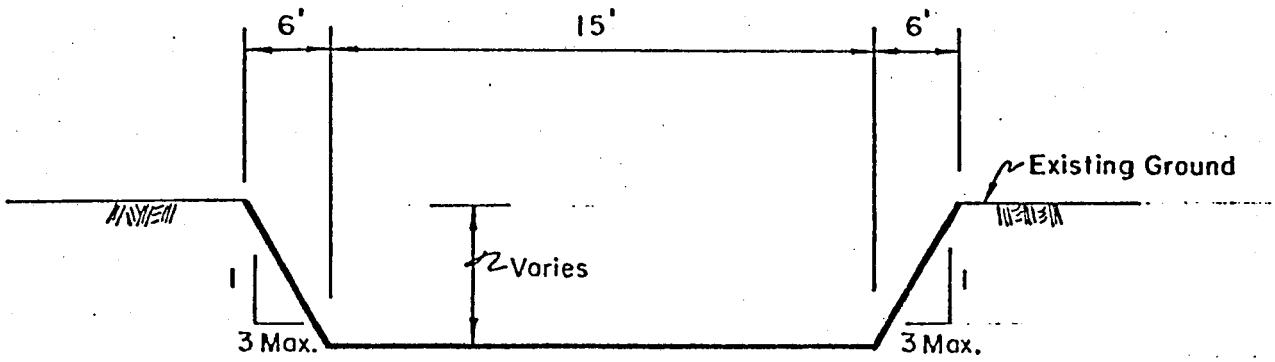


SECTION "D"

PLATE III

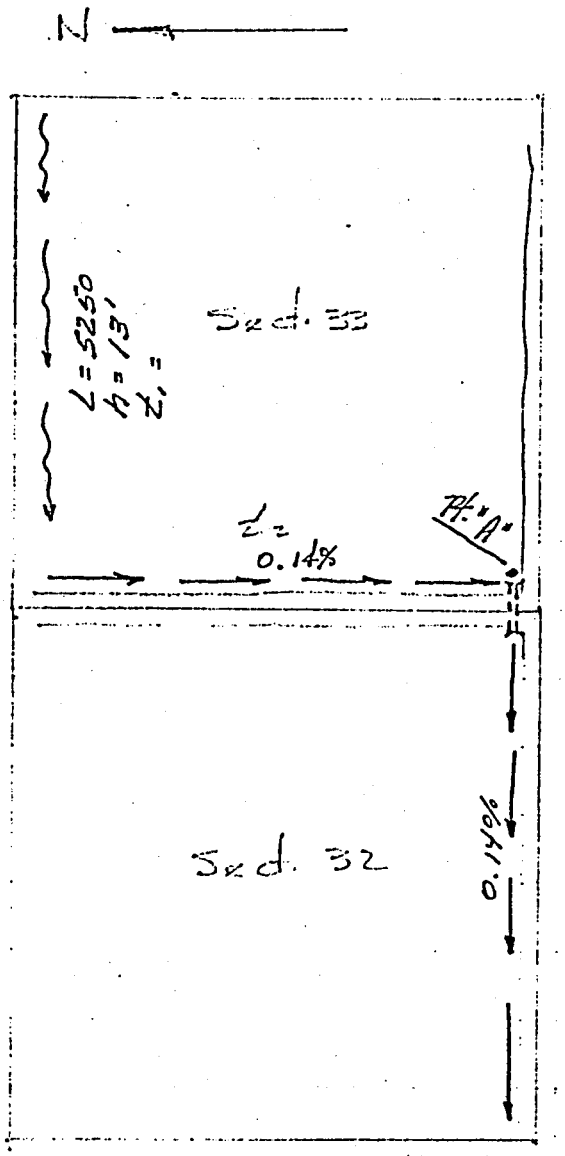


TYPICAL CHANNEL SECTION "A"



TYPICAL CHANNEL SECTION "B"

PLATE IV



$$t_1 = \frac{L^{1.15}}{7700\,H^{0.38}}$$

$$= \frac{5250^{1.15}}{7700\,(13)^{0.38}} = 0.93 \text{ hr.}$$

$$t_2 = \frac{5250}{1.62 \text{ fps} \times 60} = 53.6 \text{ m} = 0.89 \text{ min}$$

$t_c = t_1 + t_2 = 1.82$ hr.

$T_p = D/2 + 0.6\,t_c$ where $D = 1$ hr.

$= 0.5 + 1.09$

$T_p = 1.59$

For 100 yr. Storm

$I_{24} = 3.6"$ $I_6 = 3.0"$, $I_1 = 2.4"$

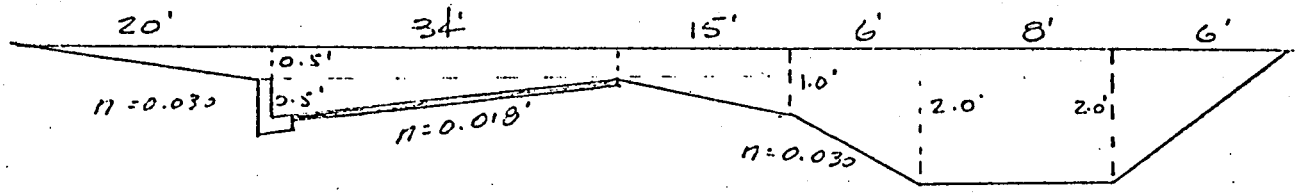
$I = 1.7"/\text{hr}$ for $t_c = 1.82$ hr. (Fig 3-2

$Q = 0.39"$ [$I = 1.7"$, $CN = 80$] (Fig 2-4)

$$Q_p = \frac{484\,A\,Q}{T_p} = \frac{484\,(1.0)(0.39)}{1.59}$$

$Q_p = 115$ cfs.

Alma School Rd.



$n = 0.030$

$A = \frac{1}{2}(20 \times 0.5) + \frac{1}{2}(15 \times 1.0) + (1.5)(6) + 2.0(8) + \frac{1}{2}(2 \times 6) = 43.50$

$P = 20 + 15 + 6 + 8 + 6.3 = 55.3$

$R_1 = 0.787$

$R_1^{2/3} = 0.852$

$V_1 = \frac{1.486}{0.03}(0.852)(0.0014^{1/2}) = 1.53$

$Q = 1.53(43.50) = 65$ cfs

$n = 0.018$

$A_2 = 0.75(34) = 25.5$

$P_2 = 34$

$R_2 = 0.75$

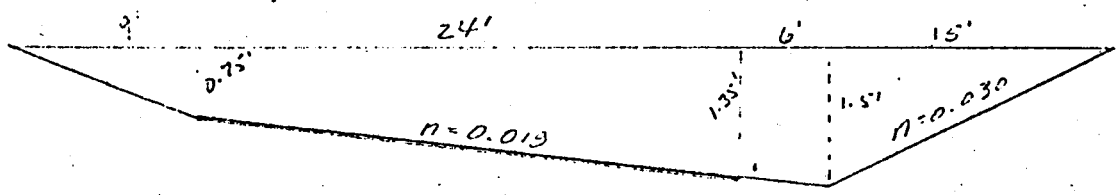
$R_2^{2/3} = 0.825$

$V_2 = \frac{1.486}{0.018}(0.825)(0.0014)^{1/2} = 2.55$

$Q_2 = 2.55(25.5) = 65$

$Q_1 + Q_2 = 130$ cfs.

Hunt Hwy.



$n = 0.030$

$A_1 = \frac{1}{2}(9 \times 0.75) + (6 \times 1.425) + \frac{1}{2}(15 \times 1.5) = 23.19$

$P_1 = 9 + 6 + 15 = 30$

$R_1 = 0.773$

$R_1^{2/3} = 0.842$

$V_1 = \frac{1.486}{0.030}(0.842)(0.0014)^{1/2}$

$= 1.56$ fps

$Q_1 = (1.56)(23.18)$

$= 36.17$ cfs

$n = 0.018$

$A_2 = \frac{1}{2}(0.75 + 1.35)(24) = 25.20$

$P_2 = 24$

$R_2 = 1.05$

$R_2^{2/3} = 1.033$

$V_2 = \frac{1.486}{0.019}(1.033)(0.0014)^{1/2}$

$= 3.19$ fps

$Q_2 = (3.19 \text{ fps})(25.20)$

$= 80.39$ cfs.

$Q_1 + Q_2 = 117$ cfs

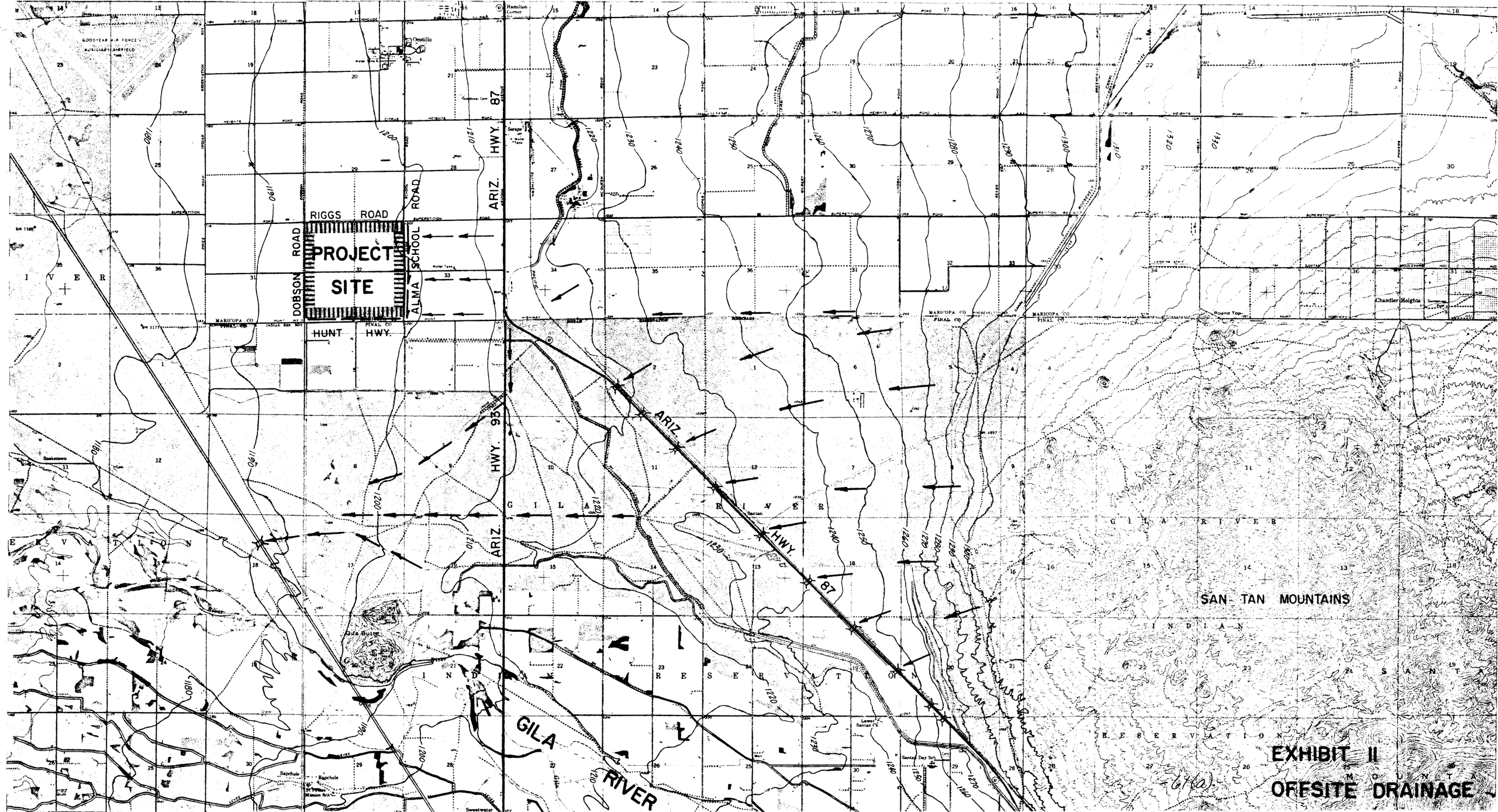
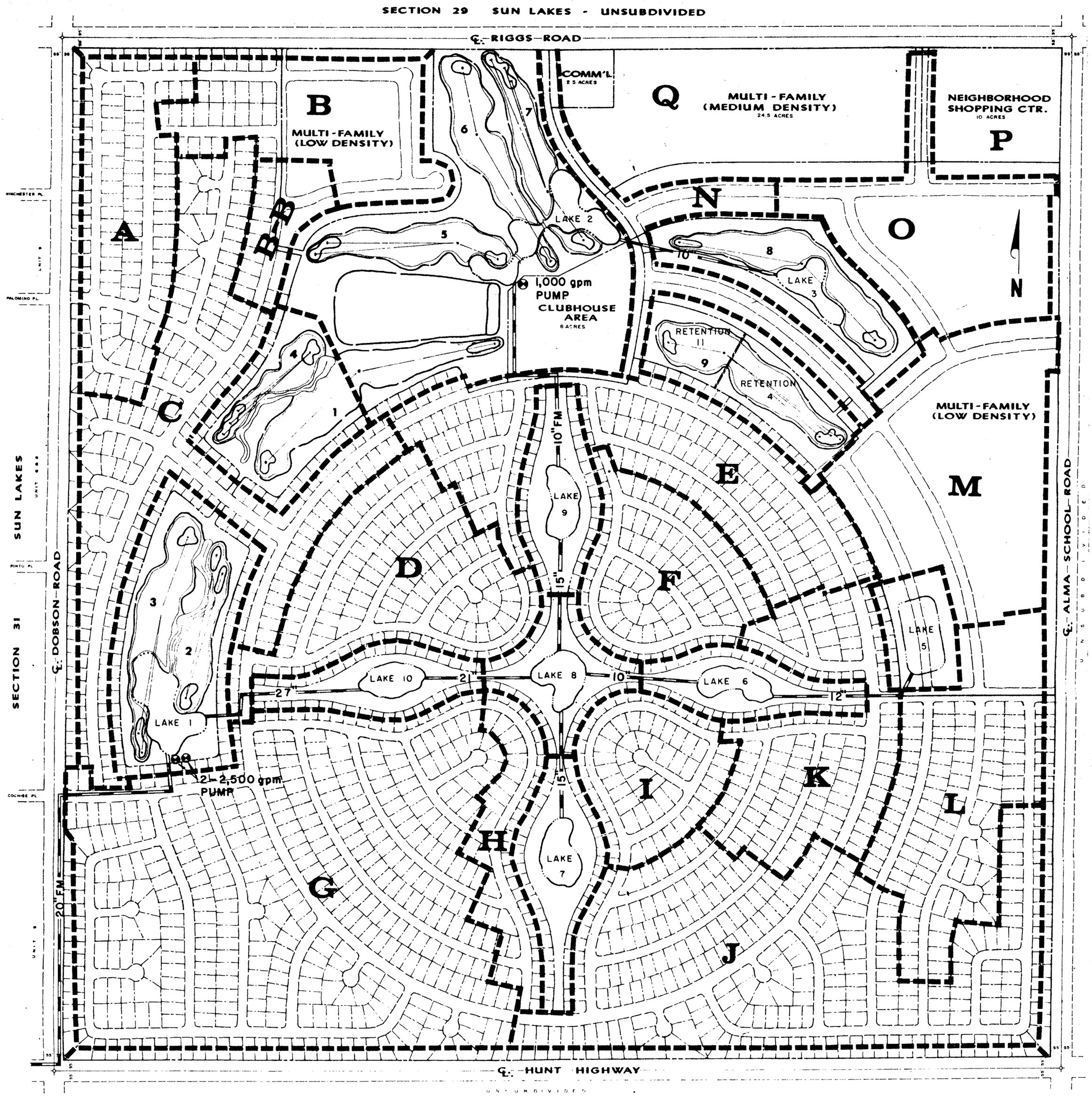
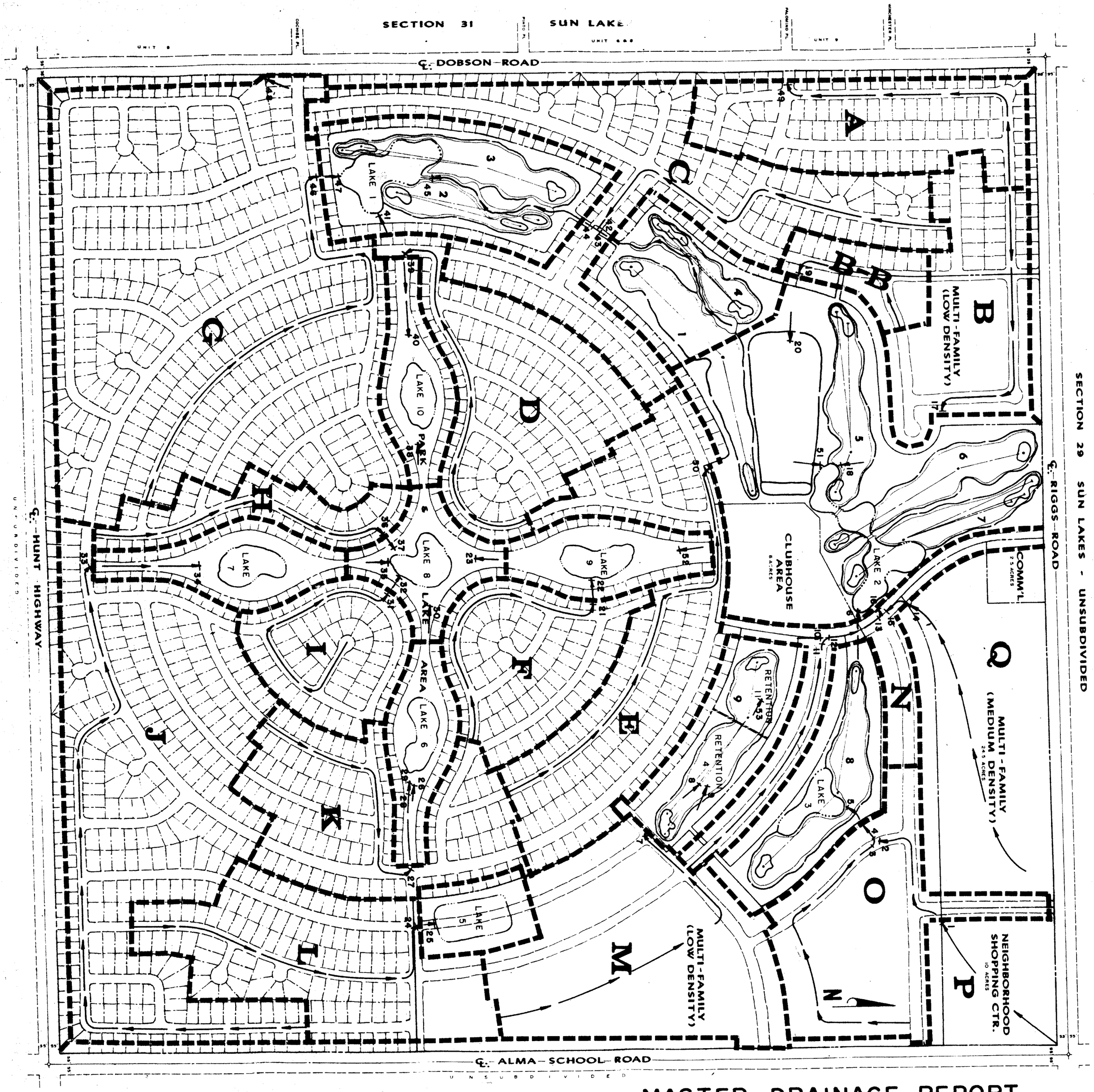


EXHIBIT II

OFFSITE DRAINAGE

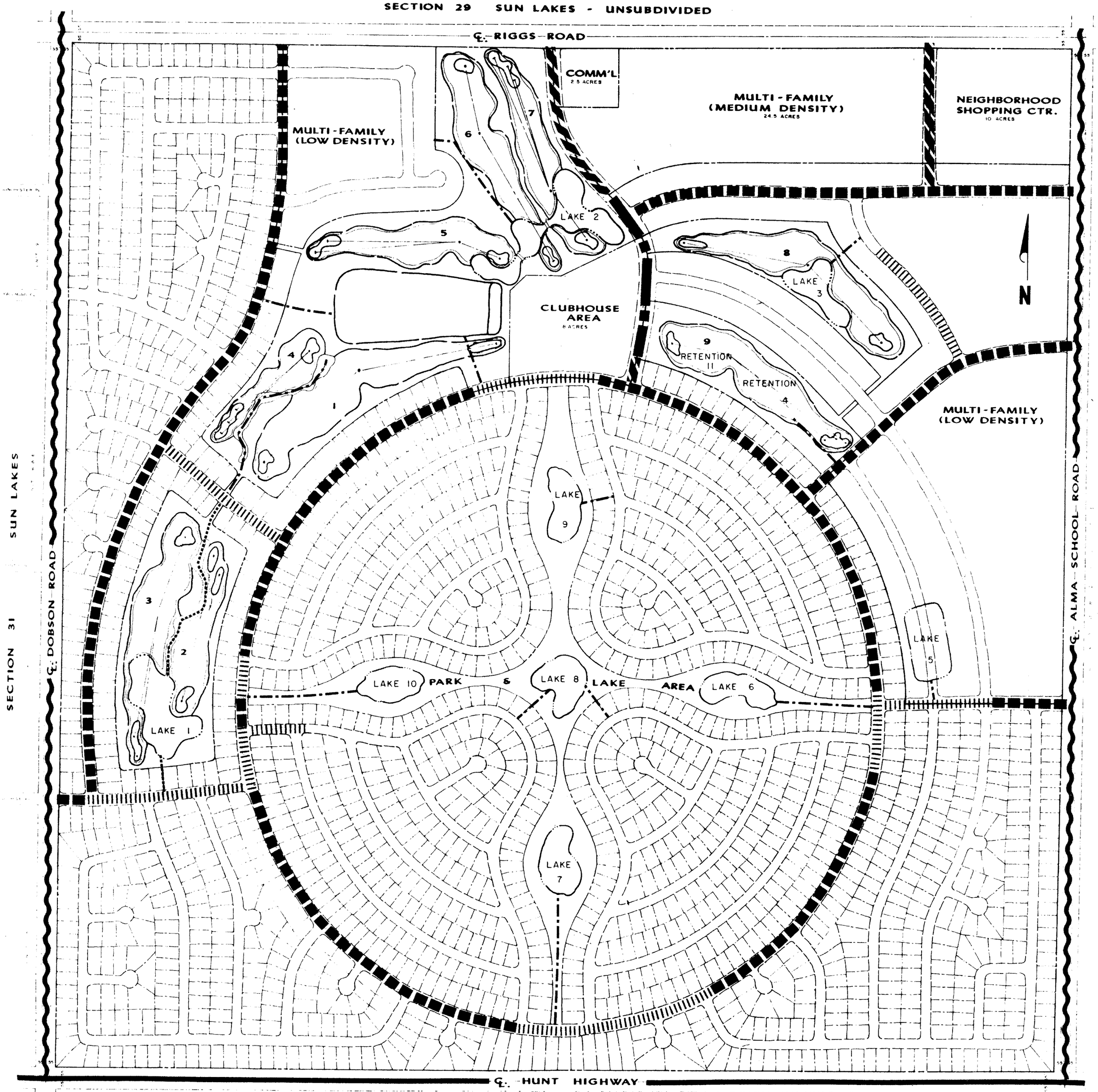


MASTER DRAINAGE REPORT
SECTION 32
EXHIBIT III



MASTER DRAINAGE REPORT
SECTION 32 EXHIBIT IV

STREET & CHANNEL PLAN
EXHIBIT V



LEGEND

- Residential Section "A"
- Residential Section "A-1"
- Collector Section "B"
- Collector Section "B-1"
- Arterial Section "C"
- Arterial Section "D"
- Channel Section "A"
- Channel Section "B"

HDR

Henningson, Durham & Richardson, Inc. of Arizona

00 W. Clarendon, Suite 1222
Phoenix, AZ 85013
(602) 264-0731

Sam A. Phillips, P.E.
J. Robert Kahl, A.I.A.
Melvin G. Chase

October 26, 1978

Mr. Edward J. Robson, President
Sun Lakes Properties, Inc.
25601 Sun Lakes Blvd.
Sun Lakes, Arizona 85224

Re: Master Planning
Sun Lakes Section 29 & 30

Dear Mr. Robson:

We plan on handling storm drainage in Section 29 and 30 the same way as it's handled in Section 32 Drainage Report. Storm runoff will be handled by a system of planned roadways, channels, lakes, golf course detention basins, storm drain pumps and force mains. The roadways and channels convey the runoff on the surface to a system of lakes for detention. Once the flow reaches the lake system, it will be temporarily stored then routed through the lake network by storm drains, pumps and force mains. Pumps and force mains will be constructed in low lakes for positive discharge. The pumps will operate depending on storm lake level with ultimate point of discharge to, probably, Riggs and Price Road intersection.

I trust this is sufficient data to give you generalized information regarding storm drainage on these two sections.

If you have any additional questions, please contact this office.

Sincerely,

HENNINGSON, DURHAM & RICHARDSON, INC. OF ARIZONA

Jason M. Burgess

Jason M. Burgess, P.E.

JMB/jd

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MASTER PLAN

WATER & SEWER UTILITIES

SUN LAKES SECTION 32

AUGUST, 1978

Henningson, Durham & Richardson
100 West Clarendon
Phoenix, Arizona 85013

ENGINEERING • ARCHITECTURE • PLANNING • SYSTEMS • ECONOMICS

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B. Engineering
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D. Sewers
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SECTION II — Sewers and Sewage Treatment

A. Sewer and Sewage Treatment Design
B. Design Analysis

SECTION III — Water Supply and Distribution

A. Water System Design
B. Design Criteria
C. Storage Facilities
D. Irrigation

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SECTION B — Arizona Water Commission-Pima Utility-Certification of Service Area

SECTION C — Rural Fire Department Certificate

SECTION D — Garbage Service Certificate

SUN LAKES - SECTION 32
WATER AND SEWER MASTER PLAN

SECTION I - GENERAL

A. Location

The proposed subdivisions are located seven miles south of Chandler, Arizona, the south line of Section being also the boundary line for Maricopa County. Section 32 is bordered on the south by the Gila Indian Reservation. The north line borders Riggs Road, the east line, Alma School Road and the west line, Dobson Road. The legal description of Section 32 is Section 32, T 2 S, R 5 E, Maricopa County, Arizona.

B. Engineering

A boundary and topographical survey of the site locating all monuments and showing ground elevation at one-foot intervals has been completed. The master plan has been reviewed and all acreage and lot estimates are within reasonable tolerances.

The survey shows all existing easements and rights-of-way for roadways, drainage, utilities and large trees.

C. Site Drainage

Present drainage is to the southwest, showing an average slope of 0.2 foot drop per horizontal 100 feet. From the southeast corner to the southwest corner, there is approximately 10 feet difference in elevation

in both sections. The average level slope of 0.2% is uniform throughout the site with no changes; therefore, no major problem to grade and drain streets, parking and lot areas is anticipated. Drainage can be accomplished within the roadway network with a minimum of storm drainage construction.

D. Sewers

Sewage treatment facilities will be located on the property to serve the sanitary sewage collection system by gravity flow. These facilities will be built to the standards and specification of the Maricopa and State Health Departments.

Treatment facilities will be planned and geared for stage development, commencing with connections to the existing system by lift stations and short force mains. All plant effluent is planned to be returned to storage areas inside the development boundary. Standby or emergency power equipment will be available at the treatment plant in the event of power or equipment failure.

The principals of this development have had extensive experience in developing water supply and sewage treatment facilities, and are prepared to provide adequate facilities as they are needed.

E. Domestic Water

Domestic water supply to the development will be from a well source located within the boundary. The water distribution system will be capable of providing minimum flows required for fire protection. The system will utilize ground storage for supply to booster pumps. The booster pumps

will be sustained by a pressure tank to handle system pressures on the smaller demands.

The water distribution system will be interconnected to the previous development in Section No. 1. For supplementary data, water system, well log information and wellsite locations, please refer to the "Report--Ground Water Supply", a copy of which is appended to this report and which was prepared for the Arizona Water Commission.
(Note: This Report--Ground Water Supply has been approved by the Commission.)

F. Electrical Power

Electrical power to the subdivision will be provided by Salt River Project Power Company.

G. Garbage Disposal

Sanitary Disposal Service has agreed to handle garbage disposal in Section 32.

H. Water Availability for Golf Courses and Lakes

For water supply information, reference should be made to the "Report--Ground Water Supply", in the Appendix.

It is planned to use existing irrigation wells owned by the developer to supply the golf courses and lake areas as outlined in the above mentioned report.

The lakes will serve primarily as storage facilities for irrigation

water requirements of the subdivision. In addition, the lakes will collect drainage from storm run-off and will serve as reservoirs for storage of waste water treatment plant effluent. Use of the lakes for run-off and treated waste water storage will permit salvage of these waters for use in the golf course-irrigation program.

SECTION II - SEWERS AND SEWAGE TREATMENT

A. Sewer and Sewage Treatment Design

This report covers the design of a trunk sanitary sewer system to serve Section 32-Sun Lakes Subdivision. The truck sewer system will utilize gravity sewers to two central locations, and will lift into the trunk sewer system now serving Section 31. The trunk sewers in Section 31 are adequately sized to conduct the accumulated wastes. The times of concentration will not coincide for both sections.

The master plan of the system is shown on the attached map. As indicated, the trunk lines will be from 8" to 12" in diameter, with 8" being the minimum size in the system. In the system there are approximately 2000 lots planned. Based on a criteria of 300 gallons per lot flow, the total daily average flow will be 600,000 gallons per day. Maximum flow rate will not exceed a factor of 2 times average. This data has been used in the design of the system.

The master map indicates the locations and sizes of all the major lines. None of the sewers will be required to carry more than 1/3 of the total maximum daily flow. According to Manning's Formula, using an "n" factor of 0.013 and assuming 8" pipe laid on a uniform slope of 0.33%, full flow capacity is 450,000 gallons per day. The system is therefore capable of accomodating maximum design flow, and will maintain velocities of 2 feet per second at design flow.

It is planned to transfer collected wastes at two locations by means of lift stations. The lift stations will be designed to pump the expected flows with the largest single pump out of service. Standby power will be provided. The final lift station will be enlarged as flows require.

The collected wastes will be delivered to the existing wastewater treatment plant site for treatment to secondary limits. The treated wastes will be utilized on site for irrigation of golf courses or agricultural crops. No effluent will be discharged to water courses. Chlorination and flash mixing of the treated effluent will be provided as necessary to meet existing effluent use policies.

Plans and specifications for the reconstruction of the existing treatment plant are being filed with Maricopa County Health Department. The re-constructed facilities are planned for stage type construction to keep pace with the anticipated flows. Sufficient area is available at the existing plant site to accommodate the planned expansion.

A copy of the design analysis for the phased construction is shown on the following pages.

B. Design Analysis

SUN LAKES WASTEWATER TREATMENT PLANT EXPANSION

Calculated Flow= 2067 Units in Sec. 31 + 2000 Units in Sec. 32 x 300gpd = 1.22 MGD

Assume 3 Lagoons in Series --Ultimate flow pattern

Assume 90% BOD Removal

Required Detention Time = Calculate from Thimsen Formula

$$KeT = N \left[\sqrt[N]{\frac{1}{P}} - 1 \right]$$

Where Ke = 0.28 @ 20° C
T = Time in days
N = No. Cells in Series
P = % BOD remaining as decimal

then--$KeT = 3 \left[\sqrt[3]{\frac{1}{P}} - 1 \right]$

$$KeT = 3 \left[\sqrt[3]{10} - 1 \right]$$

$$Ke\ T = 3.45$$

$$T = \frac{3.45}{.28} = 12.32 \text{ Days detention}$$

12.32 x 1.22 MG = 15.03 MG capacity req. minimum

Existing Lagoon = 2.4 A. x 43,560 x 5 x 7.48 = 3.91 MG

15.03 Mg - 3.91 = 11.12 MG required

Remaining 2 Lagoons = 2.4A. x 43,560 x 10 x 7.48 = 7.82 MG each

(7.82 x 2) + 3.91 = 19.55 mg Total provided

Then 3 Lagoons 1-5' + 2-10' deep x 2.4A are adequate for retention at design level.

Oxygen Requirements

1.22 ultimate flow x 200 mg/l x 8.34 = 2035 lb BOD_5

Ultimate O_2 demand = 2# O_2/lb BOD_5

then 1882 x 2 = 4070 lbs O_2

O_2 transfer @ 25° C = 1.6# O_2/hr/HP (From Tables)

then $\frac{3764}{1.6 \times 24}$ = 106 HP Req. - use 110 HP Total

Use 4 in First Lagoon @ 10 HP = 40HP

Use 4 in Second Lagoon @ 10 HP = 40 HP

Use 3 in Third Lagoon @ 10 HP = 30 HP

TOTAL 110 HP

Phase Construction

Existing Plant = 35,000 gpd Smith & Loveless EA
+ 2.4 A oxidation lagoon

35,000 gpd @ 90% BOD removal

$$\frac{35{,}000 \times 200\ mg/l \times .10 \times 8.34}{1 \times 10^6} = 5.8\ \#\ BOD_5 \text{ remaining}$$

$$2.4A \text{ lagoon - unaerated} = \frac{2.4 \times 43{,}560 \times 5 \times 7.48}{20} = 195{,}500 \text{ gpd capacity}$$

35,000 gpd (S & L EA Unit) + 195,500 Unaerated lagoon = 230,500 Total capacity

per criteria Engineering Bulletin No. 11

$$\frac{230{,}500 \text{ gpd Total Capacity}}{300 \text{ gallons/ unit}} = 768 \text{ Dwelling Units}$$

Assume Phase Construction Utilizing All Existing Facilities

Phase 1. - Consists of Addition of Mechanical Aerators to Existing Lagoon, and Addition of Chlorine Contact Basin

Aerator Requirement- Single Cell Application

Capability per formula from Oxy flow Aerators for single cell applications. (S & L Capacity same as above) Residual BOD_5 = 5.8 lbs.

For aerated Lagoon - Total Lagoon Volume = 3.91 mg.

$$T = \frac{So - Se}{(1.04)(Se)(K)}$$

Where T = time in days
So = Infl. BOD
Se = Effl BOD
K = 0.7 (day $^{-1}$) @ 20°C

$$T = \frac{185 - 18.5}{(1.04)(18.5)(0.7)} = 12.36 \text{ days required Det. Volume}$$

$$\frac{3.91 \text{ mg available}}{12.36} = .32 \text{ mg/day capacity}$$

0.32 mg + 0.035 mg (S&L) = 0.355 mgd Total Detention Cap.

BOD_5 Capability of Aerated Lagoon =

.355 mgd x 8.34 x 200 = 592 lb BOD_5 + 5.8 lb BOD residual from S & L

Aeration Requirement

Ultimate O_2 req. = 2.0 lb O_2/lb BOD_5

Then - 597 lbs BOD_5 x 2 = 1106 lbs O^2/ day req.

O_2 transfer @ 25° C = 1.6 lbs O_2/hr/HP

then-- $\frac{1194}{1.6 \times 24}$ = 31.1 HP required - For Phase I per final requirement- Use 40 HP - 4 @ 10 HP each.

Total Phase I Capability = $\frac{355,000 \text{ gpd}}{300 \text{ gal/D.U.}}$ = 1183 dewlling Units

Phase 2 - Add 2.4 A- Aerated Lagoon - 10' Deep (Construction to be completed when flow is 355,000 gpd)

Total Capability per calculations above

Existing S & L Unit = 35,000 gpd

.035 x 20 x 8.34 = 5.8 lbs BOD_5 residual from S & L

Retention Required per Thimsen Formula= For multicell application

$$Ke\ T = 2\left[\sqrt[2]{\frac{1}{0.1}} - 1\right]$$

$$Ke\ T = 2\sqrt{10} - 1$$

$$Ke = \frac{2 \times 2.16}{0.28} = 15.43 \text{ days total detention}$$

$$\frac{3.91 \text{ mg} + .035}{15.43} + 7.82 \text{ mg} = 760,000 \text{ gpd total capability}$$

Aeration Requirements

$\frac{760,000 \text{ gal/day} \times 200 \times 8.34}{1 \times 10^6}$ = 1268 BOD_5 Total + 5.8 Residual from S. & L.

5.8 + 1268 lbs BOD_5 x 2.0 lbs O_2/lb BOD = 2546 lbs O_2 day req.

O_2 transfer @ 25° C = 1.6 lb O_2/HP/hr

$\frac{2546}{1.6 \times 24}$ = 66 HP Total - use 70 HP

70 HP - 40HP in Phase I - Provide 30 HP use 3 @ 10 HP (1 additional to be added in Phase 3)

Total Capability-- 760,000 gal/day + 35,000 gal/day = 795,000 gpd

$\frac{795,000}{300 \text{ gal/D.U.}}$ = 2,650 Dewlling Units Capability

Phase 3 - Add 2.4 A aerated Lagoon @ 10' deep (Construction is to be completed when flow is 795,000 gpd)

Total Residual from S & L unit = 5.8 lb. BOD_5

Retention Time Required per Thimsen Formula

$$Ke\ T = 3\left[\sqrt[3]{\frac{1}{0.1}} - 1\right]$$

$$Ke\ T = 3\left[\sqrt[3]{10} - 1\right]$$

$$Ke = \frac{3 \times 1.15}{0.28} = 12.32 \text{ days Total Detention Req.}$$

$$\frac{3.91 \text{ mg} + .035 \text{ mg} + 7.82 \text{ mg} + 7.82 \text{ mg}}{12.32} = 1.59 \text{ mgd Total Daily Capability}$$

Aeration Requirement

$$\frac{1,220,000 \text{ gpd} \times 200 \times 8.34}{1 \times 10^6} = 2035 \text{ lbs } BOD_5 + 5. \text{ lbs } BOD_5 \text{ from S \& L}$$

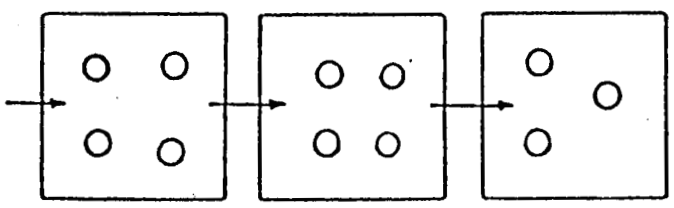
2035 + 5.8 x 2.0 lbs O_2/lb BOD_5 = 4075 lbs O_2 /day req.

O_2 transfer @ 25° C = 1.6 lb O_2/HP/Hr.

$\frac{3774}{1.6 \times 24}$ = 106 HP use 110 Hp

Previously Provided Phase I	= 40 HP
Phase 2	= 30 HP
Required this Phase	= 40 HP
Total	110 HP

Configuration of Aerators as below



SECTION III - WATER SUPPLY AND DISTRIBUTION

A. Water System Design

This report covers the design for a trunk water system to serve proposed Sun Lakes Subdivisions. The subdivisions are located approximately seven miles south of Chandler, Arizona in Section 32, T2S, R5E, Maricopa County, Arizona.

The water system will serve the entire above mentioned Section 32. System supply will be from an existing well that is presently being used for irrigation purposes. This well is located on the south side of Section 32 at the mid-section line. (See attached plan). Log data on this well is as follows:

Pump Rate	1700 GPM
Lift	260 ft.
Static	230 ft.
Pump Setting	290 ft.
Depth	502 ft.
Casing (Dia.)	20 in.
Perforations	200 ft. to 490 ft.

The chemical examination Report, from the wells tested, indicates water quality in Section 32 to be similar to the existing well in Section 31. (See Reports in Appendix). Wells to be used in future which do not meet required quality standards will have high solids strata sealed off and/or treatment as necessary to meet the standard.

It is intended to connect this system with the existing system at at least three points, however, the planned system would be self-supporting in all respects.

B. Design Criteria

The criteria developed and Design Data for the water system is as follows:

Total Residential Lots (Estimated)		2,000
Total People per unit	3.0	
Total daily consumption per person	100 gal.	
Maximum to average flow ratio	1.5	
Peak to maximum flow ratio	2.0	
Total Average Daily flow		600,000 gal.
Total Maximum Daily flow		900,000 gal.
Total Peak Daily flow		1,800,000 gal.

The Hardy Cross method for balancing flows in the pipes was programmed through a computer, with the resultant balanced flows being utilized to determine the pipe sizes shown on the attached plan. It can be noted from the pipe sizes that the main piping system is designed for the peak flow demand together with the requirements for fire flow. The plan shown was developed using the frictional pipe coefficient C of 120.

All interior pipes within the framework for the main pipe system shall be a minimum size of 6 inches diameter.

C. Storage Facilities

It is further planned to incorporate storage facilities to provide capacity for delivery of the fire flow and maximum flow demands. Booster Pumps delivering from storage will be designed to meet system pressures and flow demands.

Storage facilities and booster pumping capacities for the system are as follows:

Total Maximum daily demand =	900,000 gal.
Apply 60% of maximum demand for storage=	540,000 gal.
Total fire flow demand - Apply 1,000 gpm for 4 hours (Residential and mercantile) =	240,000 gal.
Total Storage Required =	780,000 gal.
Total Booster Pump Capacity to be provided =	2,000 gpm

D. Irrigation

Other existing wells in the area will be utilized for irrigation of green belts, golf courses and crops. These wells will also become available as required for supply of potable water. The proposed wells and storage will be adequate for the presently planned development.

Data on all of the available wells are included as a part of the report previously submitted to the Arizona Water Commission and included in the Appendix of this report.

APPENDIX

SECTION A

Report-Ground Water Supply

HENNINGSON, DURHAM & RICHARDSON
ENGINEERING • ARCHITECTURE • PLANNING • SYSTEMS • ECONOMICS

Suite 1222
100 West Clarendon
Phoenix, Arizona 85013
July 11, 1973.

Arizona Water Commission
222 North Central Avenue
Phoenix, Arizona 85004

Re: Water Supply
Pima Utilities
Sun Lakes, Arizona.

Attention: Mr. Philip C. Briggs,
Chief Hydrologist

Dear Sirs:

In compliance with your letter of June 25, 1973 regarding the above water supply, we are submitting herewith a report covering each of the elements listed.

We believe this report demonstrates the adequacy of supply for the entire franchised area and we therefore respectfully request your review and approval.

Yours very truly,

HENNINGSON, DURHAM & RICHARDSON, INC. OF ARIZONA.

Karl A. Hirlinger, P.E.

KAH/rn
Enc.

OMAHA • DENVER • PHOENIX • DALLAS • CHARLOTTE • WASHINGTON, D.C. • PENSACOLA • MINNEAPOLIS • NORFOLK, VA. • HELENA • TEXARKANA

REPORT

GROUND WATER SUPPLY

SECTIONS 31, 32, 29 and 30-T2S, R5E, MARICOPA COUNTY, ARIZONA
SUN LAKES DEVELOPMENT
PIMA UTILITIES COMPANY

July 1973

HENNINGSON, DURHAM & RICHARDSON, INC. OF ARIZONA

INDEX

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ELEMENTS OF DEMAND	1
ELEMENTS OF SUPPLY	3
ELEMENTS OF ADEQUACY	4
CONCLUSIONS	6

APPENDIX

Plate 1.	Vicinity Map
Plate 2.	Sun Lakes Development Map
Plate 3.	Master Plan- Water Distribution System

REPORT
GROUND WATER SUPPLY
SECTIONS 31, 32, 29 and 30-T2S, R5E, MARICOPA COUNTY, ARIZONA
SUN LAKES DEVELOPMENT
PIMA UTILITIES COMPANY

This report presents the results of the study and evaluation of ground water supplies available to service the total franchised area of Pima Utilities Company.

Pima Utilities Company was licensed by the Arizona Corporation Commission on April 5, 1972 to provide water service for Sun Lakes Development. The total franchised area of the Company encompasses Section 29, 30, 31 and 32, T2S, R5E Maricopa County, Arizona. See Plates 1 and 2 entitled "Vicinity Map" and "Sun Lakes Development Map Existing Wells- Service Area".

Elements of Demand.

Section 31 currently being developed was included in the July 1972 Master Water Plan Report, prepared for Sun Lakes Subdivision by Henningson, Durham and Richardson, Inc. of Arizona. In that Report domestic water requirements were analyzed. See Plate 3 entitled " Water Distribution System".

Water consumption for the total development of Section 31, as listed by type of water use is as follows:

Domestic Use

Total Lots in Section 31		1780	
1780 x 3	=	5340	Total Projected Population
5340 x 100	=	534,000	GPD Daily Consumption
0.534 x 365	=	195	MG Annual Consumption

Lawn Irrigation

Average probable Lawn size 4000 S.F.

1780 x 4000 = 7,020,000 S.F. Lawn Area

7.02 MSF x 4.0 F (Annual Water Application)= 28.08 MCF

28.08 x 7.48 = 210 MG (Annual Consumption)

Golf Course Irrigation

Total Area 81.8 acres

81.8 x 7.3F (Annual Water Application)= 597 Acre- ft. / yr.

597 x 326,000 = 195 MG (Annual Consumption)

Green Belt Irrigation

Total Area 18.4 acres

18.4 x 4.0 F (Annual Water Application)= 73.6 acre ft. / yr.

73.6 x 326,000= 24 MG (Annual Consumption)

Lake Level Maintenance

Green Belt Lake Area	=	6.7 acres
Golf Course	=	6.7 acres
Total Lake Area	=	13.4 acres

Total Evaporation and percolation loss	=	84.0" / yr.
Total Annual Average Rainfall	=	6.5" / yr.
Total Makeup required	=	77.5 " / yr.

$\frac{77.5}{12} \times 0.326 \times 13.4 = 28$ MG Annual Consumption

Summary of Annual Water Demand- Section 31- Sun Lakes

	Domestic Demand	Irrigation Demand
Domestic Use	195 MG	
Lawn Irrigation	210 MG	
Golf Course Irrigation		195 MG
Green Belt Irrigation		24 MG
Lake Maintenance		28 MG
Subtotals	405 MG	247 MG

TOTAL PROJECTED DEMAND	=	652 MG/Yea
	=	1240 GPM

Sun Lakes Development Company plans to develop the three remaining sections of the franchised area in similar fashion to their Section 31 development. Based on this plan assumption, the anticipated water demand for the total four sections when they are fully developed is 652 MG x 4 = 2608 MG Total Annual Consumption.

Elements of Supply

There are five wells available for supply within the boundaries of the report area. They are located as indicated on Plate 2 and are further identified as numbers 29, 31, 32, 33 and 34. The wells were originally drilled for R.W.Hanna of Chandler, Arizona to serve for irrigation purposes. Records of all available well data accompany this report. The latest pumping records for each well are also listed with this data. All of the wells have steel pipe casings that are perforated in the aquifer portions.

Well Number 31 was relined with a 16" plastic pipe and grout sealed to a depth of 300 feet. A new vertical turbine pump was installed in 1973 with a capacity of 940 GPM to supply the total present Sun Lakes Development in Section 31. The final test data for this well is included with the pumping records accompanying this report.

Elements of Adequacy

With reference to Arizona Water Commission Bulletin 1- Entitled "Annual Report on Ground Water in Arizona- Spring 1970 to Spring 1971" and Figure 13 of that Report, it is evident that the Sun Lakes Development Area is within a region of high potential well production.

The pumping records of Well 31 indicate that from the year 1955 to present, the water level in the well has remained fairly constant at a depth of approximately 150 feet.

Generally, the five available wells were producing at an average rate of 1680 GPM. according to the most recent records. In addition to Well 31, which is presently delivering at 940 GPM, Wells 29 and 34 are planned to be converted to domestic use to serve Sections 29 and 34. Each Well is expected to produce at a rate similar to Well 31. It is planned to retain Wells 32 and 33 to supply irrigation requirements of the four sections and to drill a new Well in Section 30 to supply domestic water for that section.

The thickness of the aquifer beneath the report area can be determined from data appearing on Pages 9 and 10 and On Plate 2 of the U.S. Geological Survey Paper 1860- Electrical Analog Analysis of Ground Water Depletion in Central Arizona. The aquifer thickness is 1100 feet, with a storage coefficient of 19 percent.

Using this data, the amount of storage available, underlying the four sections calculates to be 535,040 A$^{\underline{c}}$ ft., or 174.4 Billon Galions.

As mentioned earlier, static water level records from Well 31 did not indicate any appreciable change in water level for the past 17 years. However, from figure 13 of the previously mentioned Arizona Water Commission Bulletin 1, the greatest decline in the water table for a 5 year period, from all index wells in the project vicinity was noted to be 36 feet. Thusly, based on this rate, the yearly declining rate may be computed to be 7 feet .

An insight to the general quality of water available to the project may be made from the Arizona State Health Laboratory Chemical Examination Report for Well 31, a copy of which accompanies this report. This examination was performed after improvement work was complete on the well, and it indicates approval for a public water system.

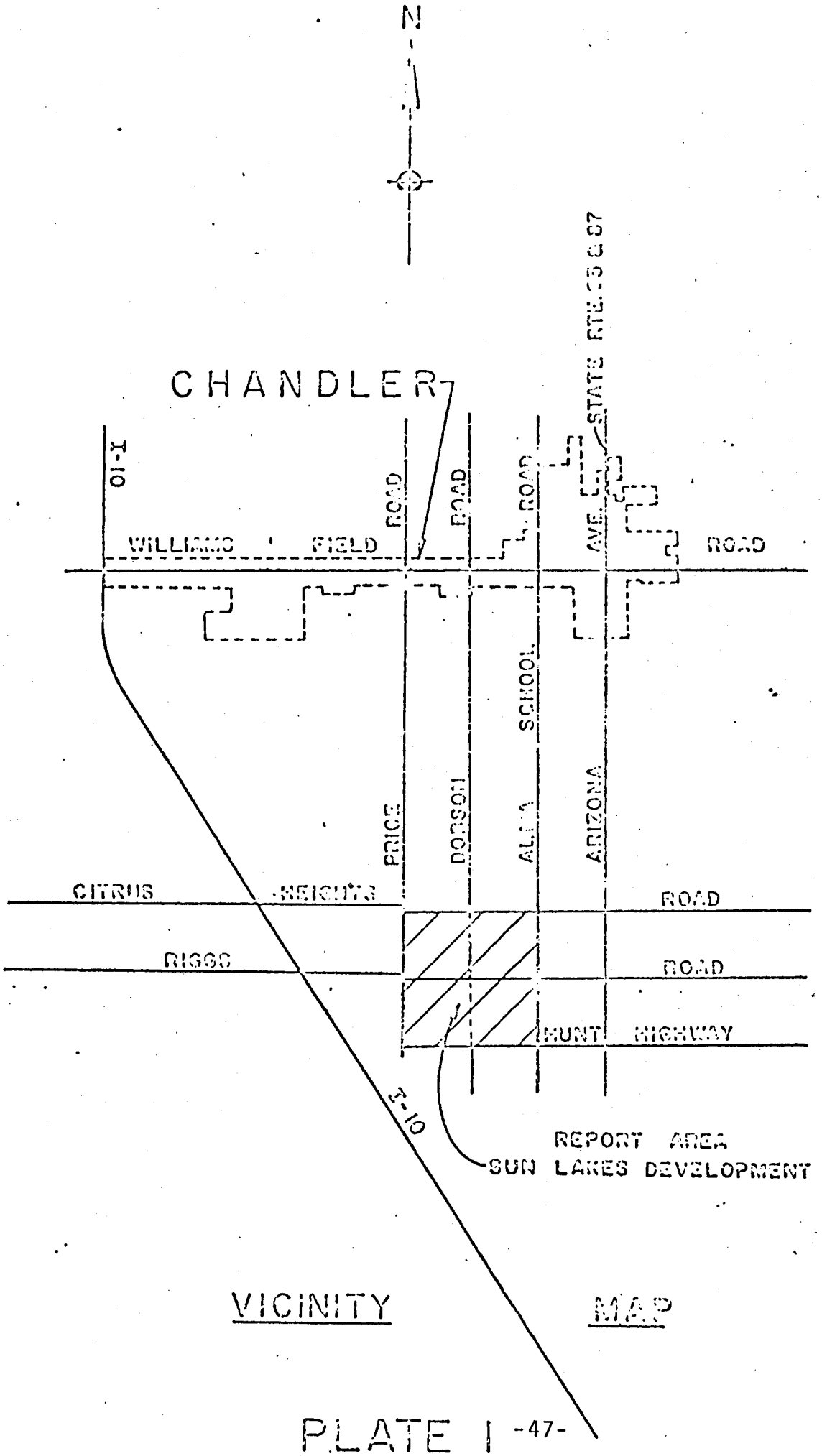
As previously discussed, the total yearly demand in the project area is 2.6 billion gallons and the total storage available from the aquifer underlying the project area is 174.4 billion gallons. Based on this data, the ground water reservoir could supply the project area for nearly 68 years, even if no replenishment to the table were contemplated .

If it were assumed that the ground water table receded at the constant rate of 7 feet per year, the ground water reservoir would decrease in capacity by 5.8 billion gallons per year, more than twice the annual withdrawal predicted for the project. Therefore based on the above assumption, a declining rate of 3 feet per year may be anticipated to meet the project yearly demand. The supply wells at their present depths would accommodate this decline rate for well over 100 years.

It would appear, however, from examination of the existing records that with the exception of one 5 year period, recharge of the aquifer is occurring at or near the past rate of pumping. Since domestic use will require substantially less pumpage than agriculture, it is reasonable to assume that the supply exceeds the demand for any foreseeable future period.

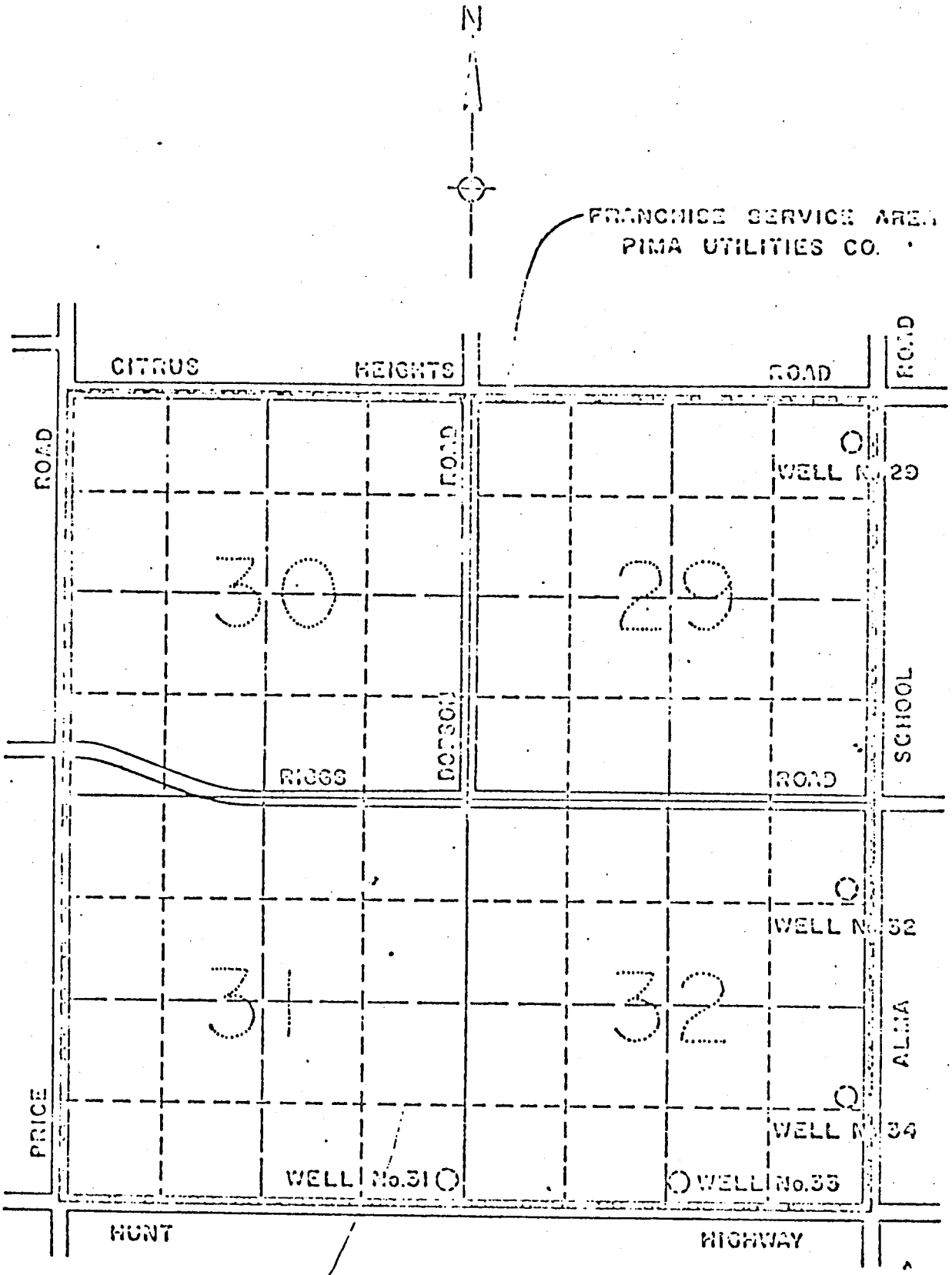
Conclusions

Based on the above findings, it is concluded that an adequate water supply exists to serve Sections 29, 30, 31 and 32, T2S, R5E, Maricopa County, Arizona for the developments proposed.



VICINITY MAP

PLATE I



SUN LAKES DEVELOPMENT
MAP
EXIST. WELLS-SERVICE AREA

PLATE 2

SECTION B

Arizona Water Commission-Pima Utilities Certification of Service Area

GEORGE E. LEONARD
CHAIRMAN

JOHN S. HOLMES
VICE-CHAIRMAN

WESLEY E. STEINER
EXECUTIVE DIRECTOR
AND
STATE WATER ENGINEER

Arizona Water Commission

222 NORTH CENTRAL AVENUE, SUITE 800
Phoenix, Arizona 85004
TELEPHONE (602) 256-7561

MEMBERS
PETER DIANCO
LINTON CLARIDGE
DAVID B. GIPE
DOUGLAS J. WALL
WILLIAM H. WHEELER

EX OFFICIO MEMBERS
ANDREW L. BETTWY
MARSHALL HUMPHREY

August 17, 1973

H. & R. INC.
RECEIVED
AUG 17 1973
AM 7,8,9,10,11,12,1,2,3,4,5,6 PM

Mr. Karl A. Hirlinger, P. E.
Henningson, Durham & Richardson
100 West Clarendon
Suite 1222
Phoenix, Arizona 85013

Dear Mr. Hirlinger:

As requested we have evaluated the Pima Utilities Company's currently certificated area for possible designation as a service area with an adequate water supply as prescribed in ARS 45-513. This evaluation was based on the material you have submitted to date and additional information available from other sources.

Pima Utilities Company is currently certificated to serve all of sections 29, 30, 31, and 32, T2S, R5E, G&S R E&M. The utility provides municipal water to the Sun Lakes development.

The Commission finds that the water supply available to the utility is adequate to meet the needs projected for the development and therefore designates the current certificated area of the Pima Utilities Company as a service area which the developer is not required to submit water supply plans to the Commission. The service area is considered to be the area served by the utility's system. Conversely, any subdivision built within the development but not served by the utility's system is considered to be outside of the designated service area.

Although the Commission may revoke this designation, it may be considered relatively permanent as we feel that their supplies are adequate to meet the projected needs for the foreseeable future. Future additions to this certificated area will require analysis to determine their water supply adequacy.

Please contact me if you have any questions.

Sincerely,

D. R. Bangs

for Wesley E. Steiner
Executive Director

ROUTE TO
SAP 8-20-73
MGC
JRK
JB 8-20
DS
CEB
FILE

SECTION C

Rural Fire Department
Certificate

RURAL/METRO FIRE DEPT., INC.

SERVING:
- TUCSON RURAL FIRE DEPARTMENT
- GREEN VALLEY FIRE, POLICE DEPARTMENTS
- NOGALES FIRE DEPARTMENT
- SCOTTSDALE FIRE DEPARTMENT
- SUN CITY - YOUNGTOWN FIRE DEPARTMENT
- LITCHFIELD PARK RURAL FIRE DEPARTMENT
- PARADISE VALLEY FIRE DEPARTMENT
- CAVE CREEK - CAREFREE FIRE DEPARTMENT
- RURAL FIRE DEPARTMENT

Mailing Address,
All Stations:
Drawer 8
Scottsdale, Arizona
85252

June 20, 1973

Sun Lakes Development Co., Inc.
12th Floor
Del Webb's TownsHouse
Phoenix, Az. 85013

Gentlemen:

In response to your recent letter concerning fire protection for Section 32 of Sun Lakes we wish to assure you that we will be able to provide fire protection on the same basis that we stated in our letter of November 1, 1971 concerning Section 31 & 29 of Sun Lakes.

We would be pleased to discuss further with you the formulation of a contract for this and other related services.

Should you have any questions please feel free to contact us.

Very truly yours,

RURAL FIRE DEPARTMENT, INC.

Ron Butler

Ron C. Butler
Vice President

mb

SECTION D

Garbage Service Certificate

ARIZONA STATE DEPARTMENT OF HEALTH
Environmental Health Services
Phoenix, Arizona

be filled out and signed, where appropriate, and submitted with application.

GARBAGE SERVICE AGREEMENT -

required by Arizona State Department of Health Rules and Regulations, and specifically Regulation 2-10-4.2, A.

Sanitary Disposal Service
NAME OF COLLECTION AGENCY
agrees to provide

refuse collection service to Sun Lakes Section 32 & 29
NAME OF SUBDIVISION

accordance with applicable rules and regulations governing refuse collection and disposal.

Date August 9, 1973 Signed [signature]

Title President

Address Rt. 6 Box 1358

City Apache Junction , Arizona

GARBAGE DISPOSAL AGREEMENT -

required by Arizona State Department of Health Rules and Regulations, and specifically Regulation 2-10-4.2, C.

Site Apache Junction Landfill
NAME OF DISPOSAL SITE

operated by Sanitary Disposal Service
NAME OF OPERATIONAL AUTHORITY

accordance with applicable rules and regulations governing refuse disposal and will accept refuse from persons living in

Sun Lakes Section 32 & 29
NAME OF SUBDIVISION

Date August 9, 1973 Signed [signature]

Title President

Address Rt. 6 Box 1358

City Apache Junction, Arizona

HDR

Henningson, Durham & Richardson, Inc. of Arizona

[illegible] W. Washington, Suite 1222
Phoenix, Az 85013
(602) [illegible]

Sam A. Rhodes, P.E.
J. Robert Kirk, AIA
Melvin G. Greene

October 27, 1978

Mr. Edward J. Robson, President
Sun Lakes Properties, Inc.
25601 Sun Lakes Blvd.
Sun Lakes, Arizona 85224

Dear Mr. Robson:

The wastewaters in Sections 29 and 30 will be handled similarly to the plans for Sections 31 and 32.

The sewers will be designed in accordance with pertinent Arizona State Department of Health Services engineering bulletins regarding sizes and flow velocities. The collected flows will be delivered to a centrally located lift station and the flow will be pumped by force main to the existing wastewater treatment location.

As flows are generated, the existing wastewater treatment plant will be re-constructed to treat the anticipated flows. Flow measuring equipment is being installed, and capacities will be provided to match the measured requirements. All treatment will be aerobic in nature. The treated effluent will be utilized for irrigation of green belt and golf course areas. Sufficient storage lakes will be designed to provide adequate detention and dilution. No wastewater will be discharged to natural water courses at any time.

We trust this information will provide you with sufficient information regarding wastewater handling in Sections 29 and 30.

Very truly yours,

HENNINGSON, DURHAM & RICHARDSON, INC. OF ARIZONA

Karl A. Hirlinger, P.E.

KAH/jd

Architecture
Engineering
Planning
Interior
Construction

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Chicago
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New Orleans
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F: SUMMARY OF CHANGES

The original Master Plan 1973 for Section 32 was submitted October 19, 1973, and was approved by the Maricopa County Board of Supervisors. No further zoning has been approved and no lots have been sold in Sections 29, 30 and 31. The zoning map which was approved in 1973 is included in this report on page 100.

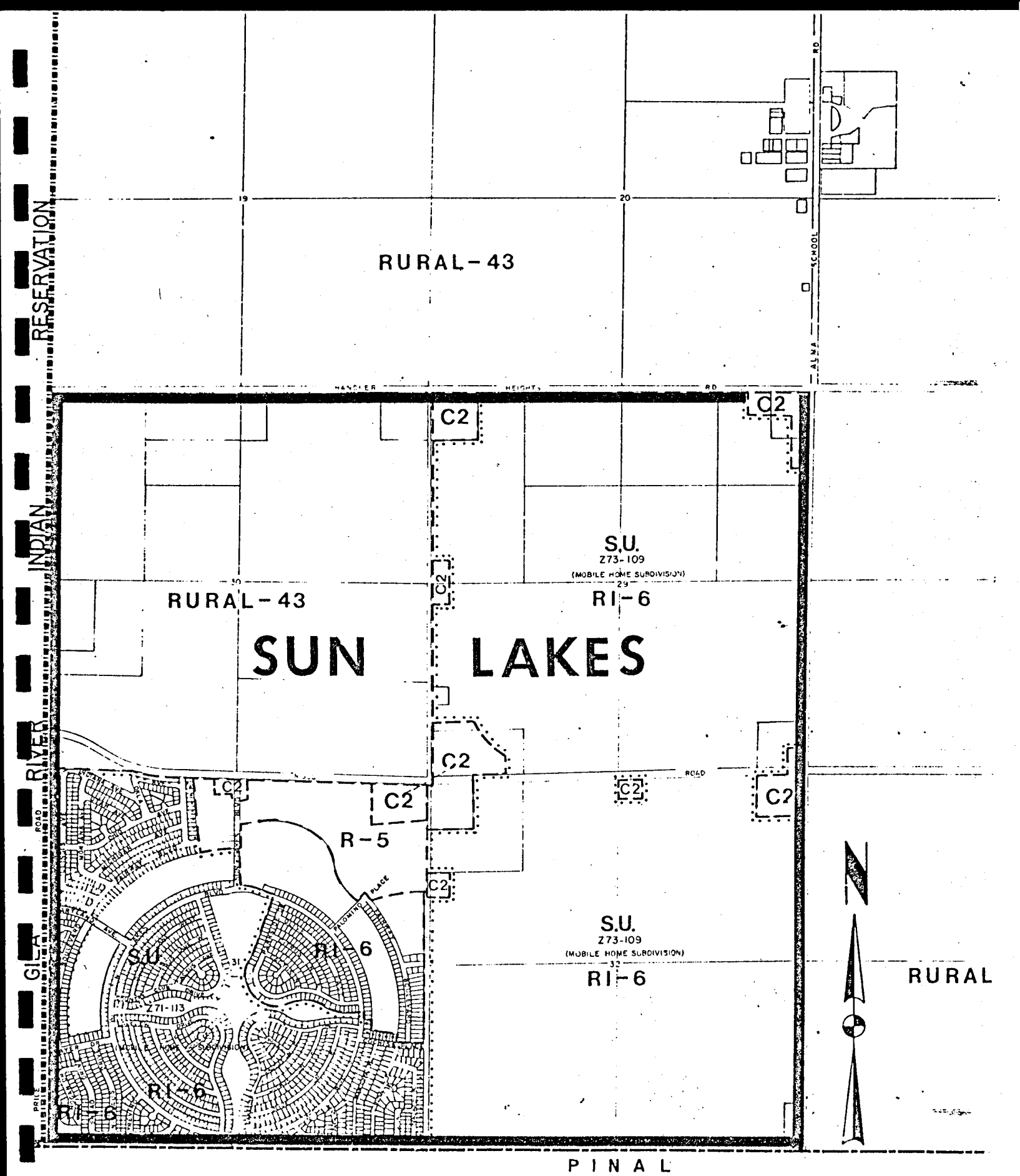
The principal changes from the 1973 approved plan to the presently proposed Master Plan 1978 are as follows:

1. Reduction in the amount of commercially zoned property;
2. Increased percentage of residential homesites;
3. Change in detached housing from doublewide mobile homes to single family onsite built homes;
4. Addition of multi-family housing plans to the Master Plan.

These changes are summarized in the table below.

MASTER PLAN CHANGES SUMMARY DATA 1973 - 1978

Land Use	Gross Area, Acres 1973	1978	Dwelling Units 1973	1978
Detached (single family)housing	510	370	2174	1480-1850
Multiple housing	0	139	0	910-1405
Recreation (club parks and lakes)	30	32		
Golf Course	83	81		
Commercial	25	12.5		
TOTAL	648	634.5	2174	2390-3255



LEGEND

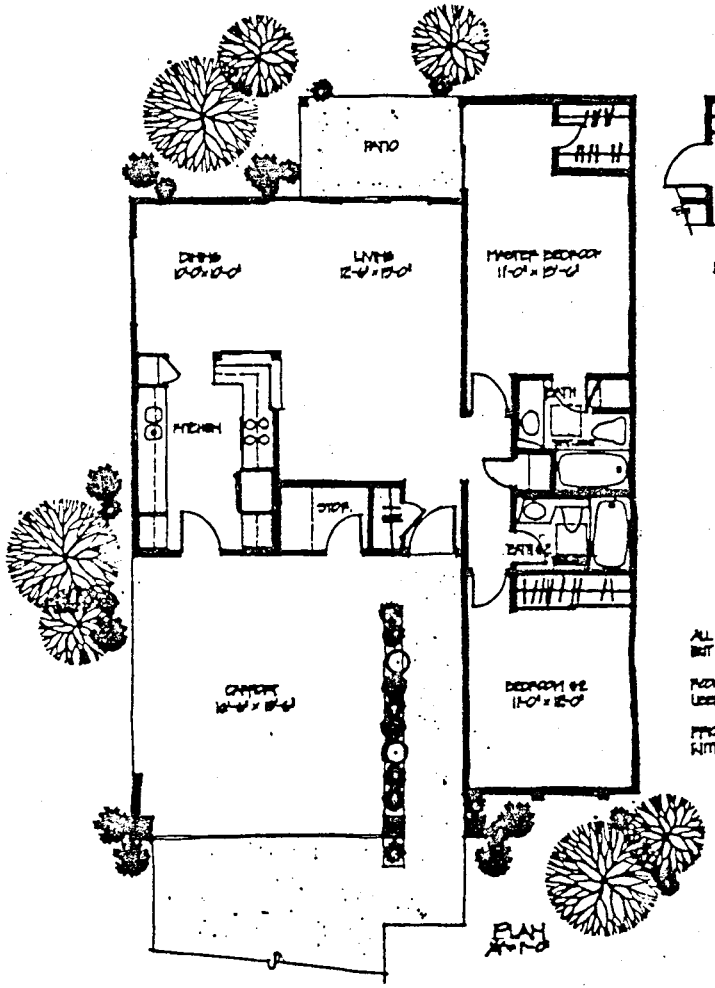
- - - - ZONING DISTRICT BOUNDARY

..... BOUNDARY DELINEATING SPECIAL USES OR UNIT PLANS OF DEVELOPMENT

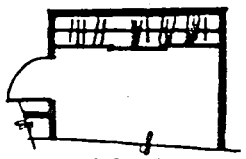
ZONING MAP

APPENDIX

RESIDENCE FOR SUNLAKES MODEL 300



PLAN

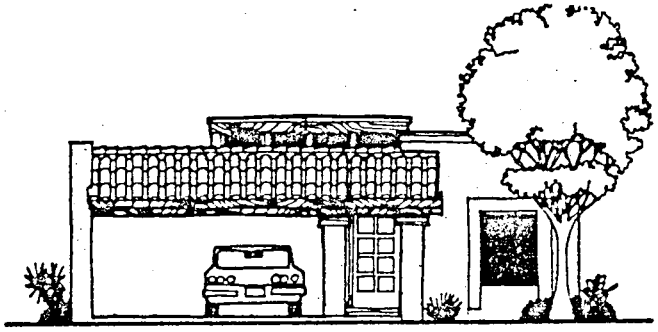


ALTERNATE MASTER BEDROOM CLOSET

ALL MODELS AND ELEVATIONS AVAILABLE BUT SUBJECT TO CHANGE WITHOUT NOTICE

FLOOR PLANS APPROXIMATE AND NOT TO BE USED FOR MEASUREMENT OF CARPET OR TILE

PRICING SUBJECT TO CHANGE WITHOUT NOTICE.



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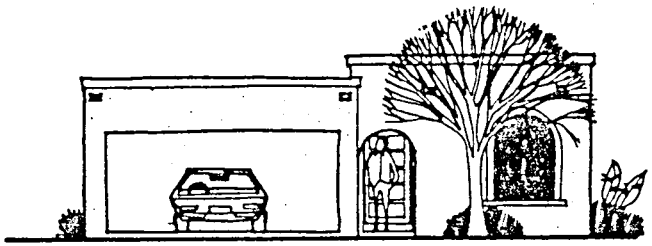

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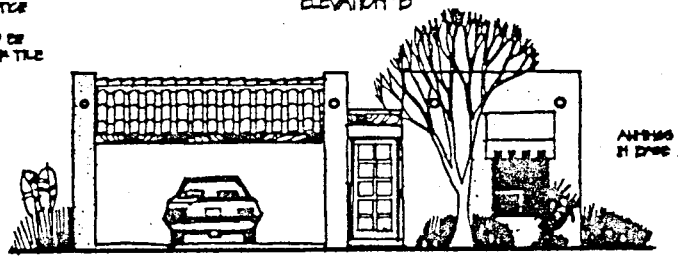


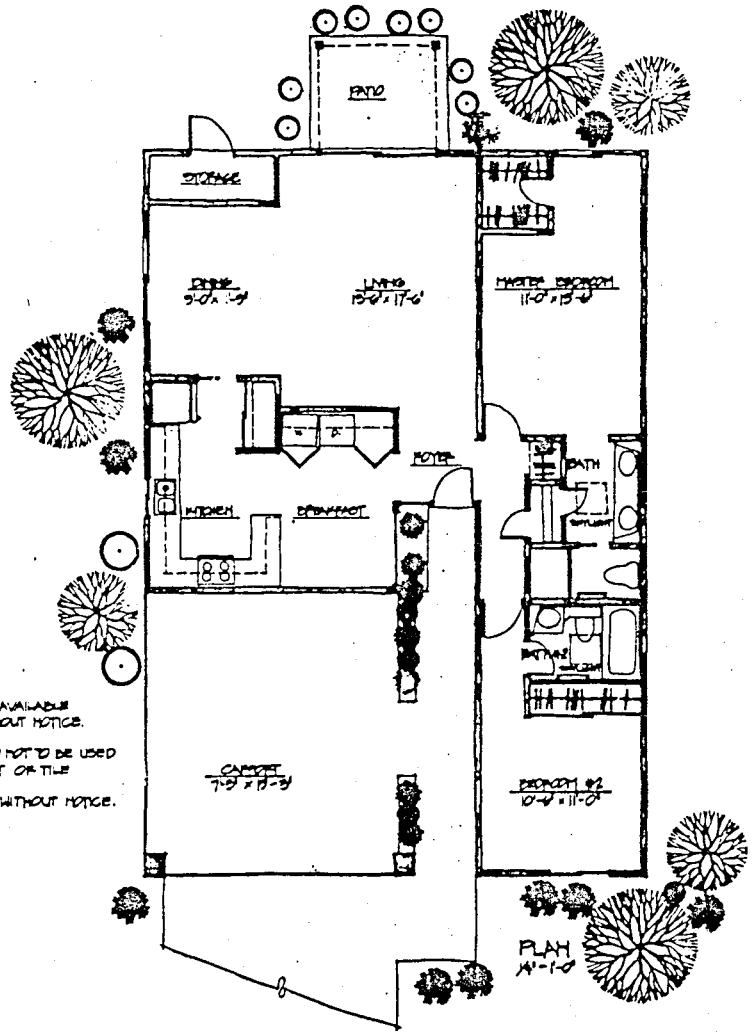
ELEVATION 'C'

AWNINGS NOT INCLUDED IN DRAWING PRICE.

MITCHELL ARCHITECTS

APPENDIX A

RESIDENCE FOR SUNLAKES MODEL 301

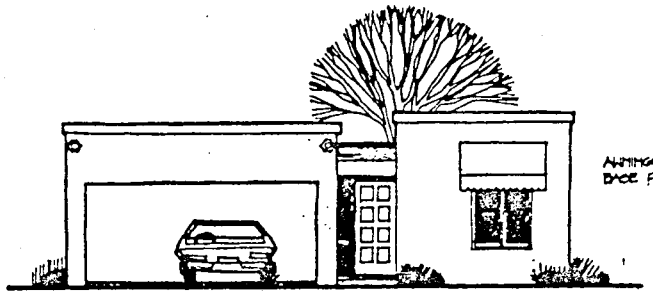


PLAN
14'-1"-0"

ALL MODELS AND ELEVATIONS AVAILABLE BUT SUBJECT TO CHANGE WITHOUT NOTICE.

ROOM SIZES APPROXIMATE AND NOT TO BE USED FOR MEASUREMENT OF CARPET OR TILE

PRICES SUBJECT TO CHANGE WITHOUT NOTICE.



AWNINGS NOT INCLUDED IN BASE PRICE

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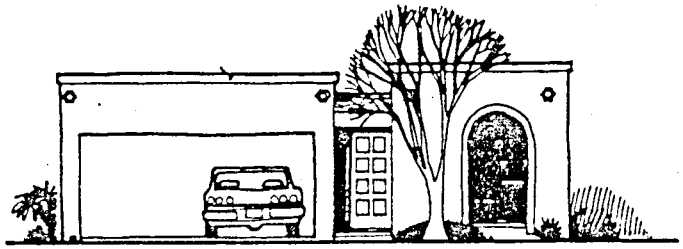

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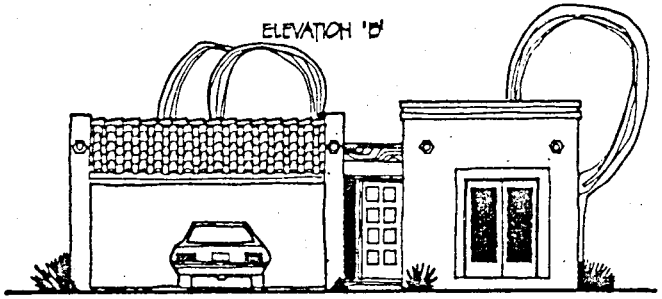
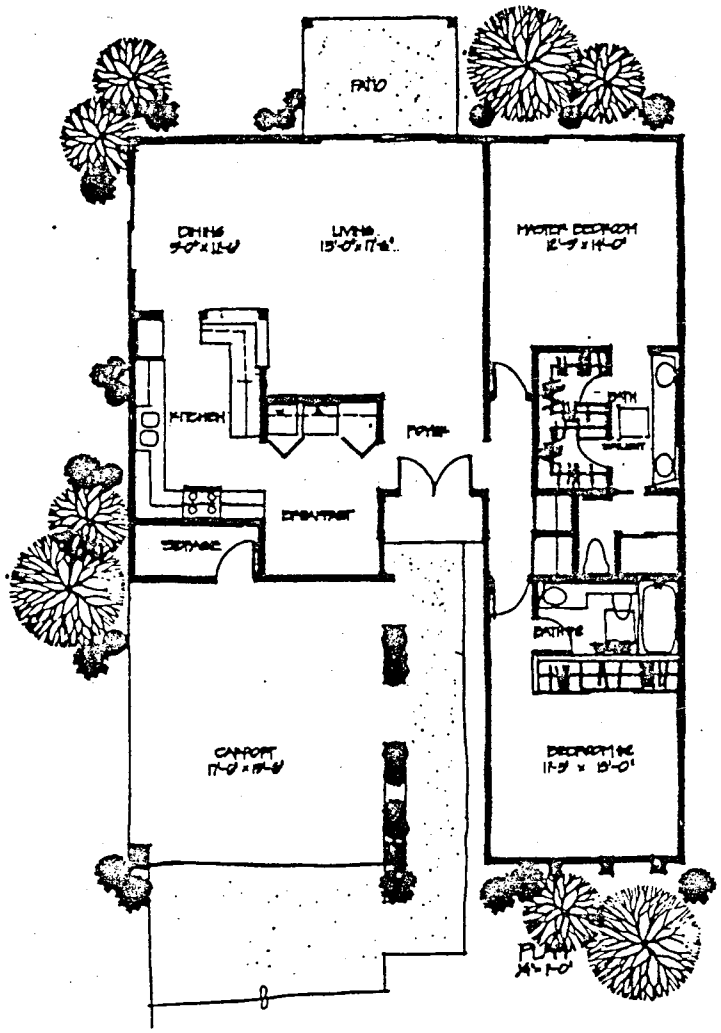
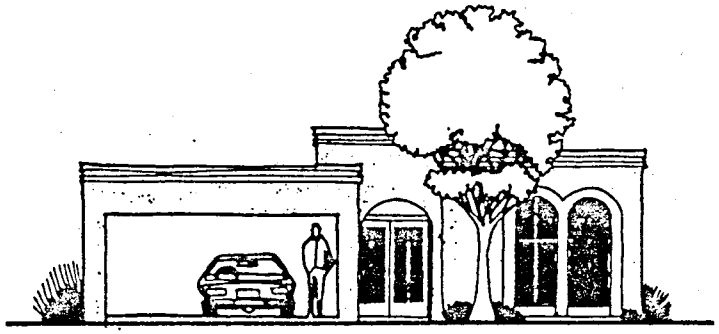


ELEVATION 'C'

MITCHELL ARCHITECTS

RESIDENCE FOR SUNLAKES MODEL 302





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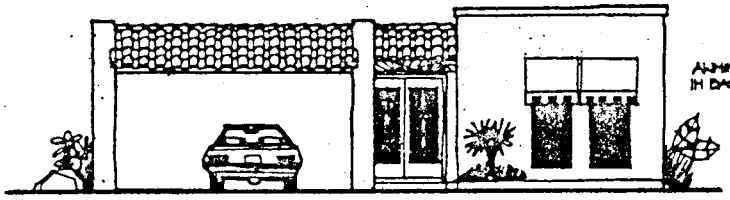
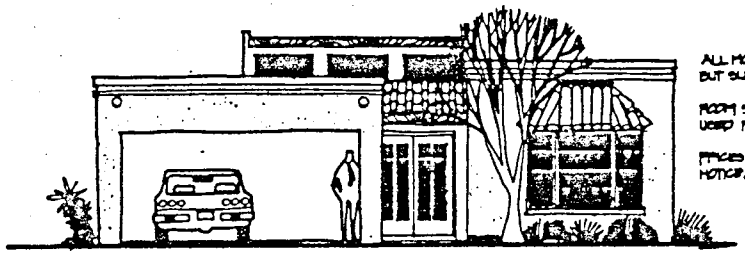


AWNINGS NOT INCLUDED IN BASE PRICE.

ELEVATION 'B'



ALL MODELS AND ELEVATIONS AVAILABLE BUT SUBJECT TO CHANGE WITHOUT NOTICE.

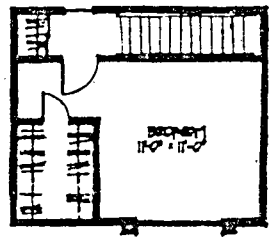
ROOM SIZES APPROXIMATE AND NOT TO BE USED FOR MEASUREMENT OF CARPET OR TILE.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

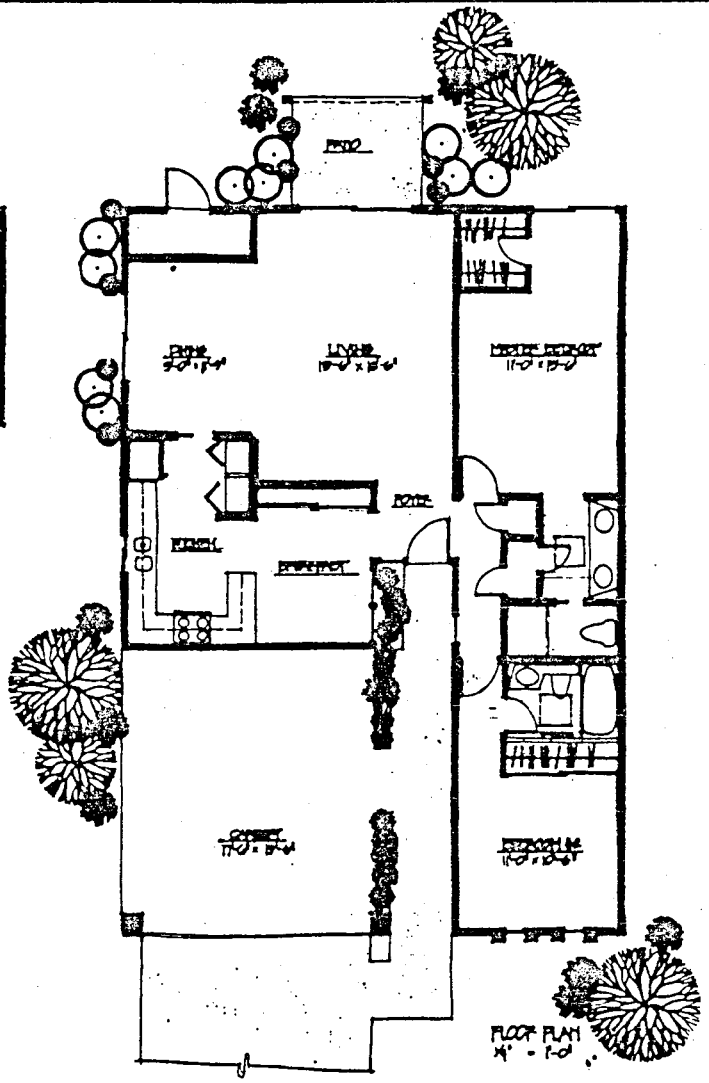
ELEVATION 'C'

MITCHELL ARCHITECTS

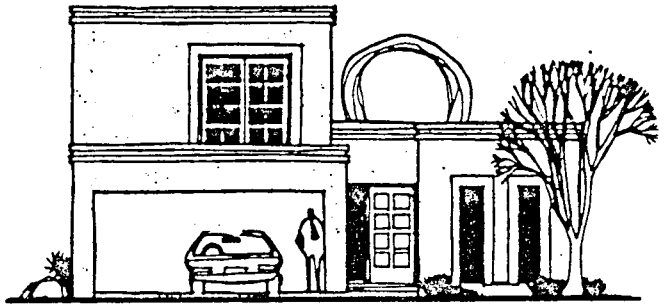
RESIDENCE FOR SUNLAKES MODEL 303



SECOND FLOOR PLAN
1/4" = 1'-0"



FLOOR PLAN
1/4" = 1'-0"



ELEVATION

ALL MODELS AND ILLUSTRATIONS AVAILABLE BUT SUBJECT TO CHANGE WITHOUT NOTICE

FLOOR SIZES APPROXIMATE AND NOT TO BE USED FOR CARPET AND TILE MEASUREMENT.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

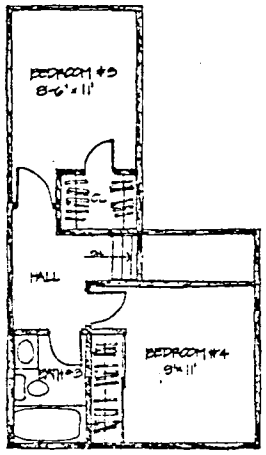
MITCHELL ARCHITECTS

RESIDENCE FOR SUNLAKES MODEL 304

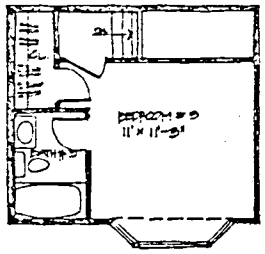
MODELS AND ELEVATIONS AVAILABLE BUT SUBJECT TO CHANGE TO CHANGE WITHOUT NOTICE.

ROOM SIZES ARE APPROXIMATE AND NOT TO BE USED FOR MEASUREMENT OF CARPET OR TILE

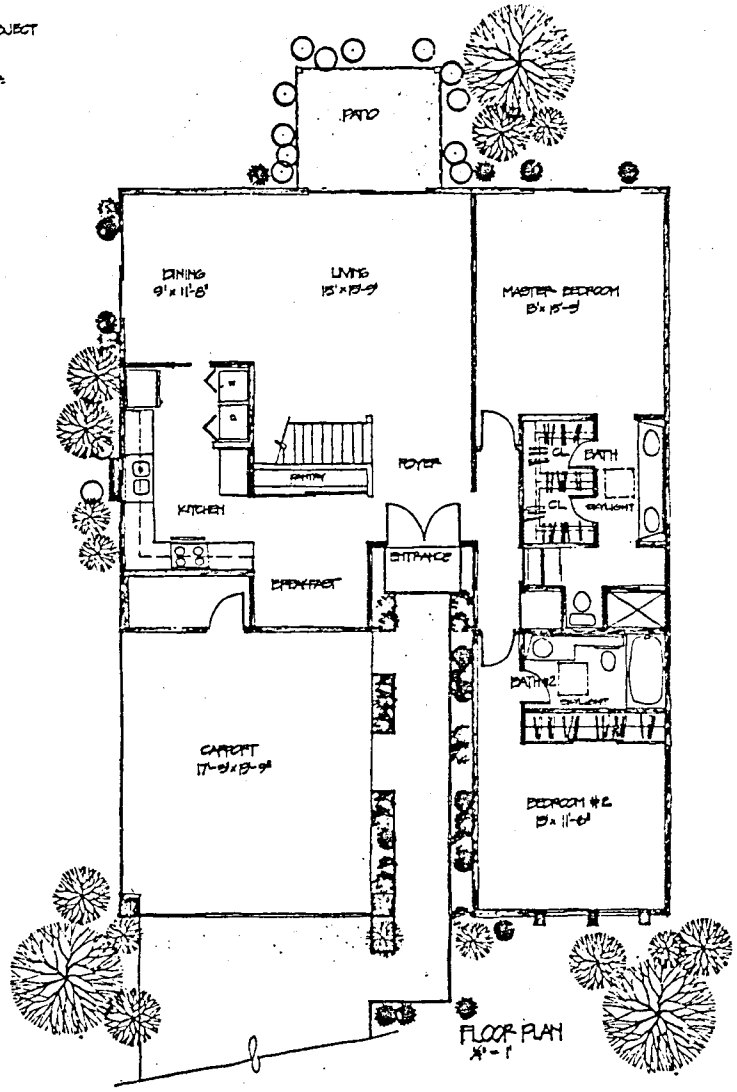
PRICES SUBJECT TO CHANGE WITHOUT NOTICE.



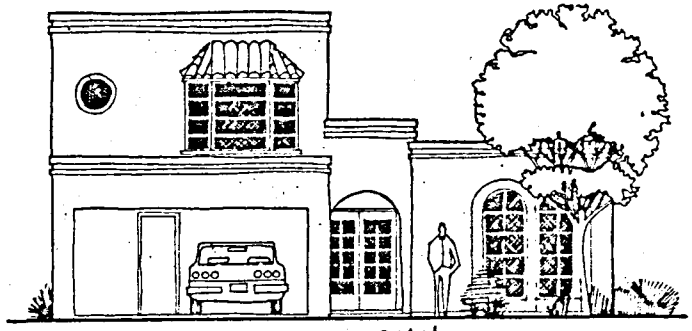
2ND FLOOR PLAN
MOD B&C.



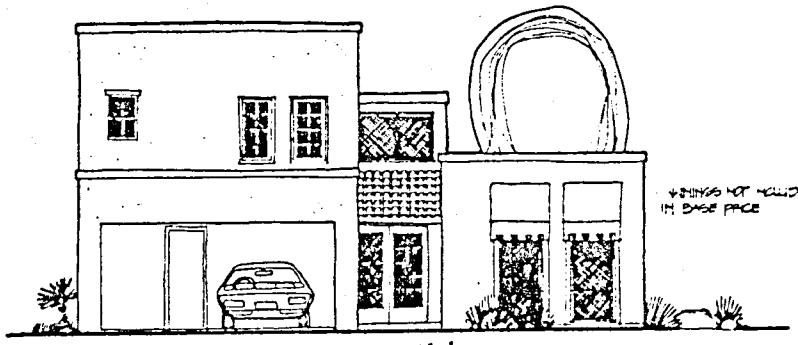
2ND FLOOR PLAN
MOD A.



FLOOR PLAN
1/4" = 1'

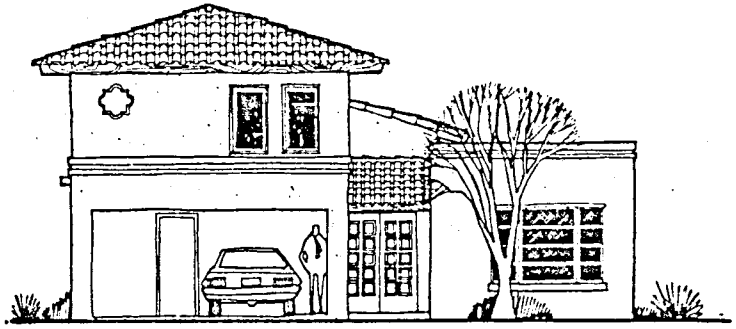


ELEVATION 'A'



*THINGS NOT INCLUDED IN BASE PRICE

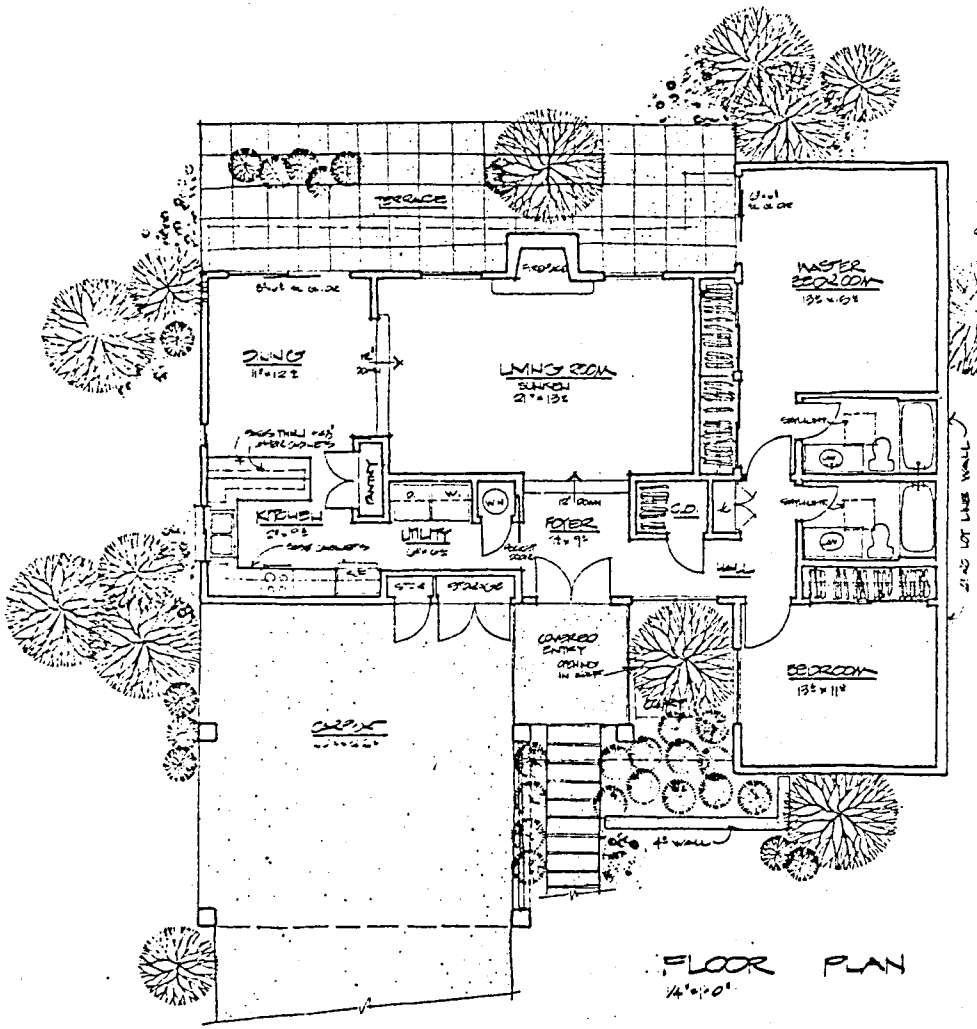
ELEVATION 'B'



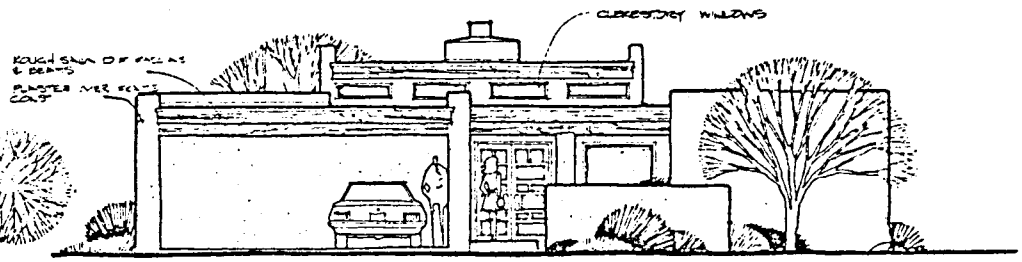
ELEVATION 'C'

MITCHELL ARCHITECTS
205 EAST OSBORN ROAD PHOENIX, ARIZONA 85012 264-2806

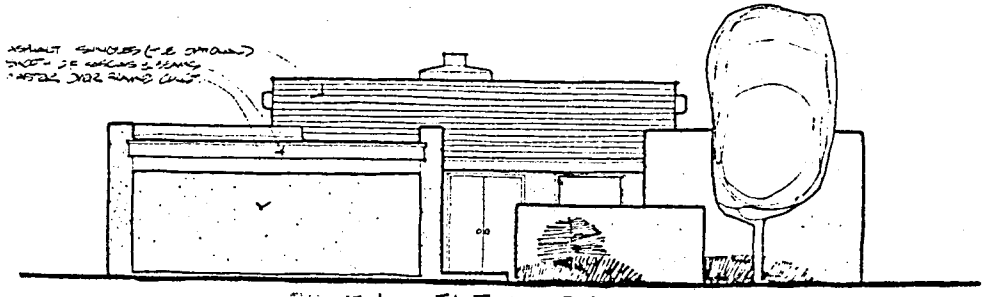
RESIDENCE FOR SUNLAKES MODEL 307



FLOOR PLAN
1/4"=1'-0"



'A' ELEVATION

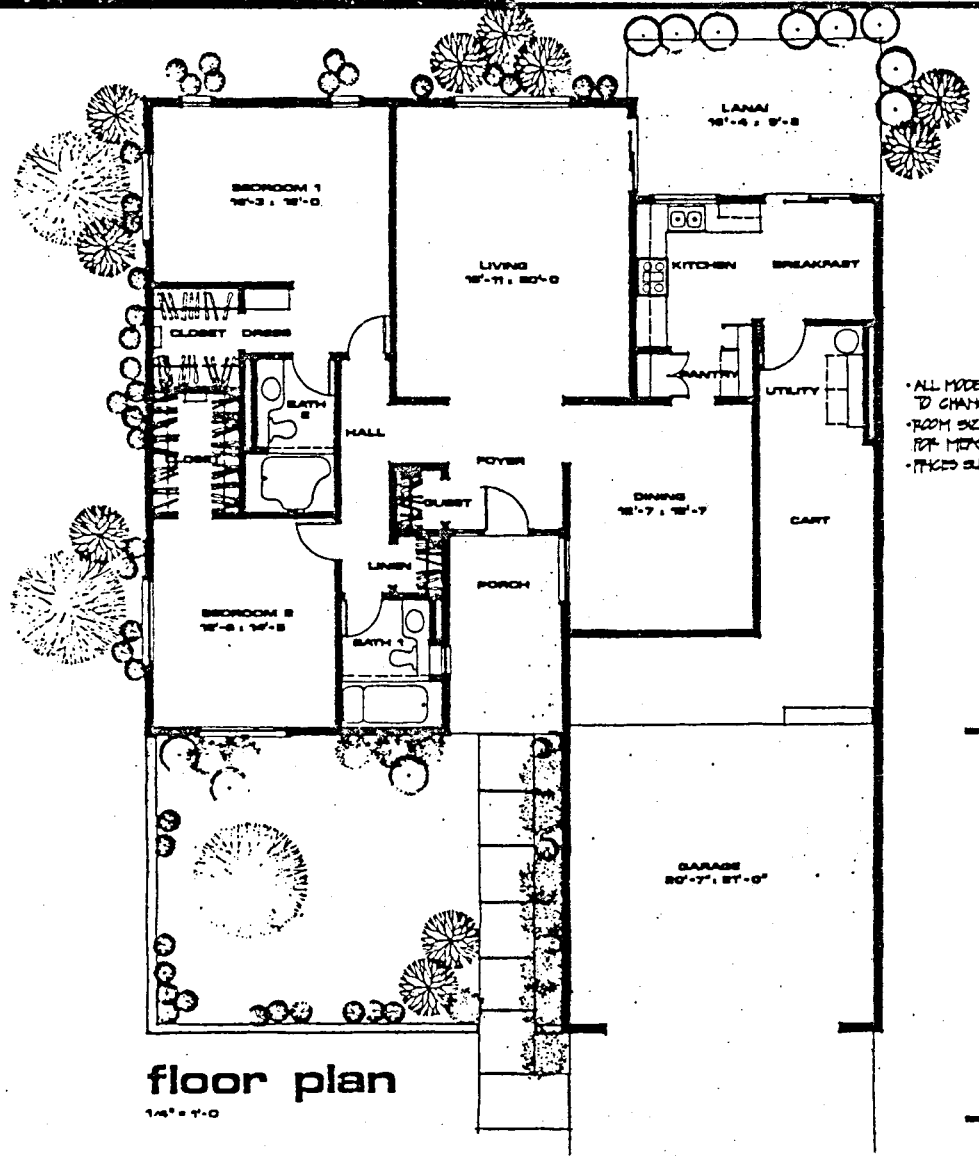


'B' ELEVATION

- ALL MODELS AND ELEVATIONS AVAILABLE, BUT SUBJECT TO CHANGE WITHOUT NOTICE
- ROOM SIZES APPROXIMATE AND NOT TO BE USED FOR MODULARIZATION OF CABINET OR TILE
- PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

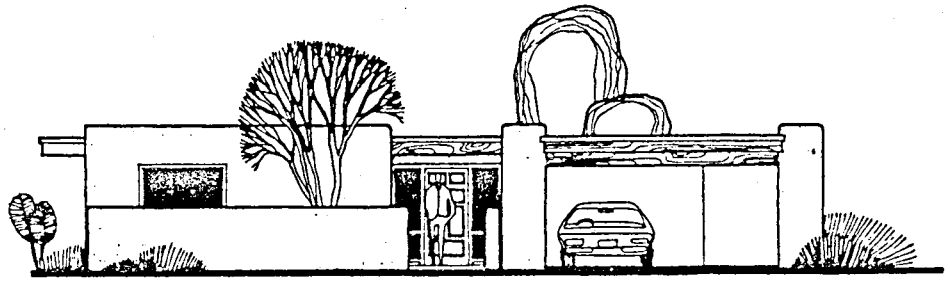
MITCHELL ARCHITECTS
225 EAST OSBORN ROAD PHOENIX ARIZONA 85012 264-2808

RESIDENCE FOR SUNLAKE'S MODEL 308



floor plan

1/4" = 1'-0



'a' elevation

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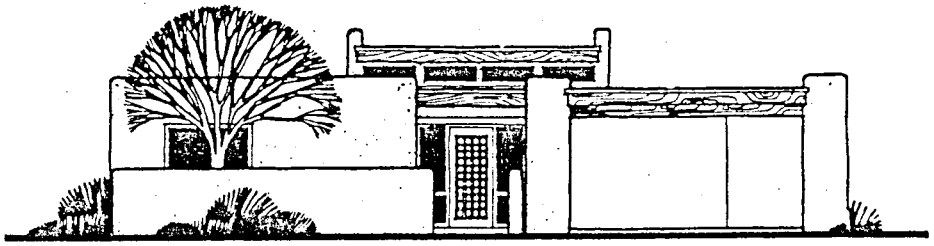
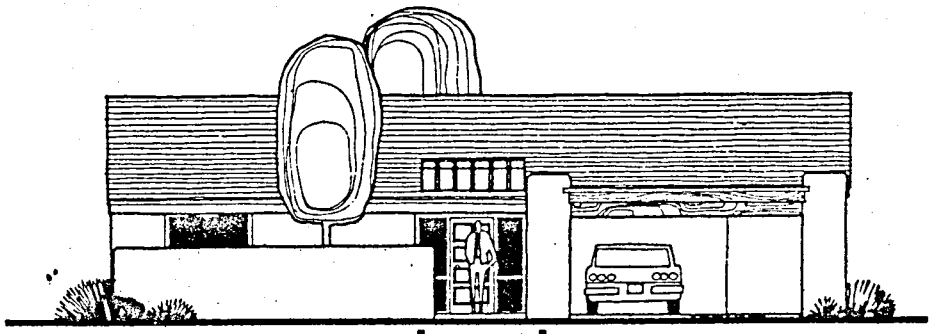
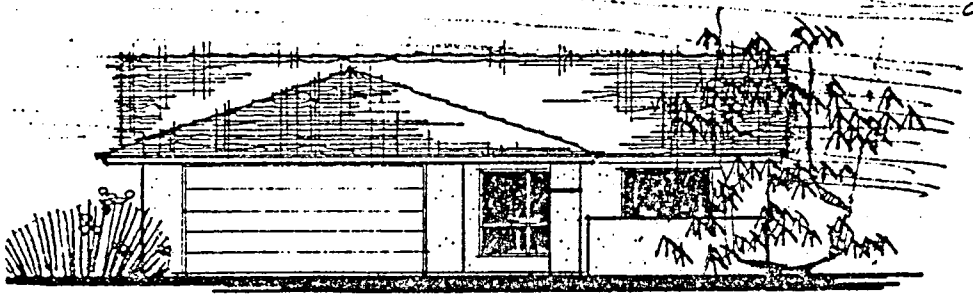


'b' elevation

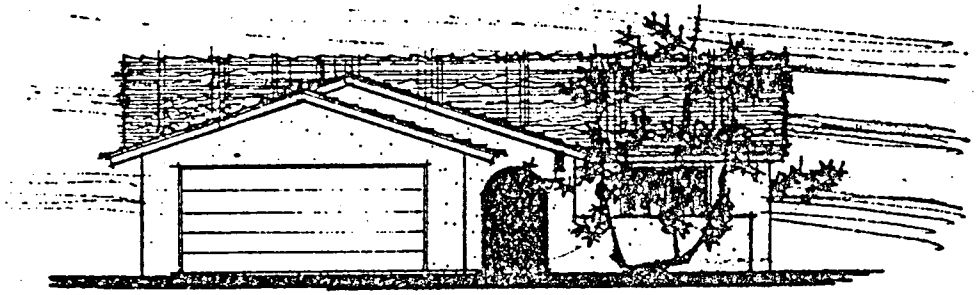


'c' elevation

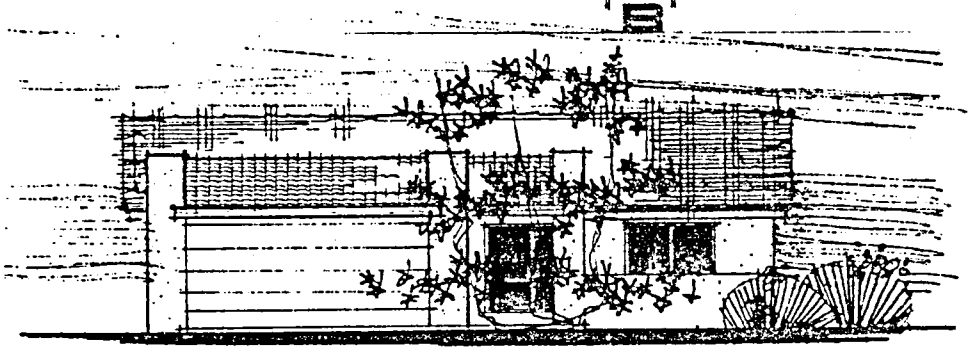
MITCHELL ARCHITECTS



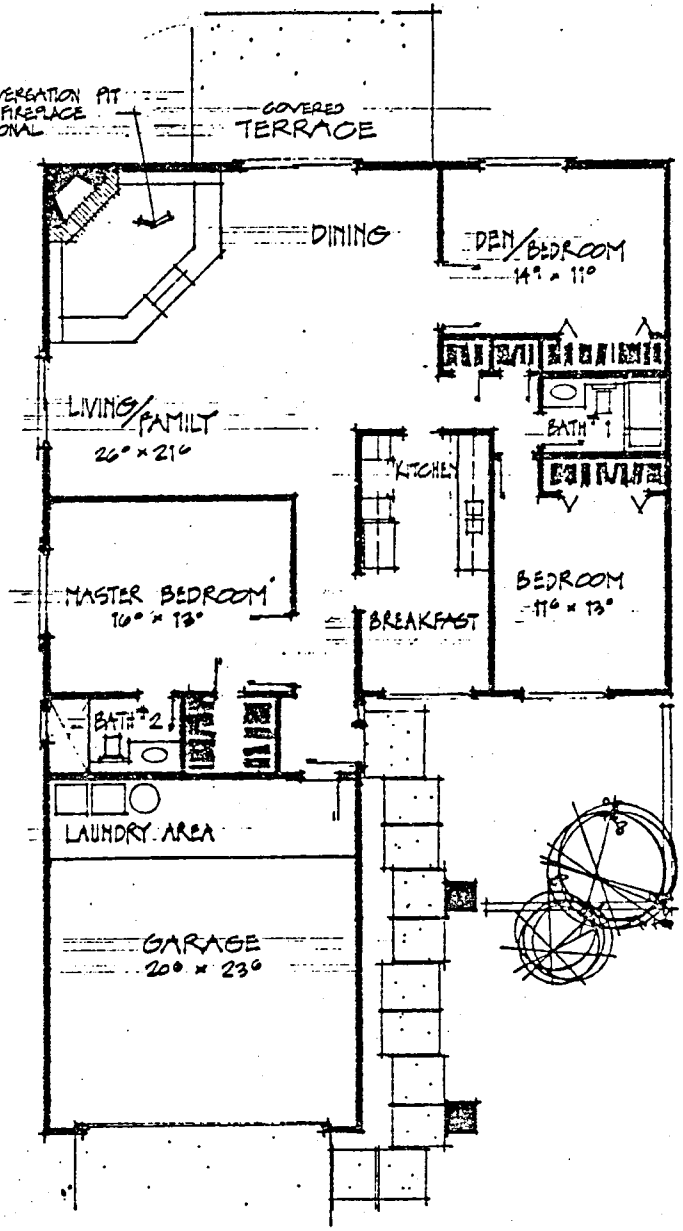
'A'



'B'



'C'

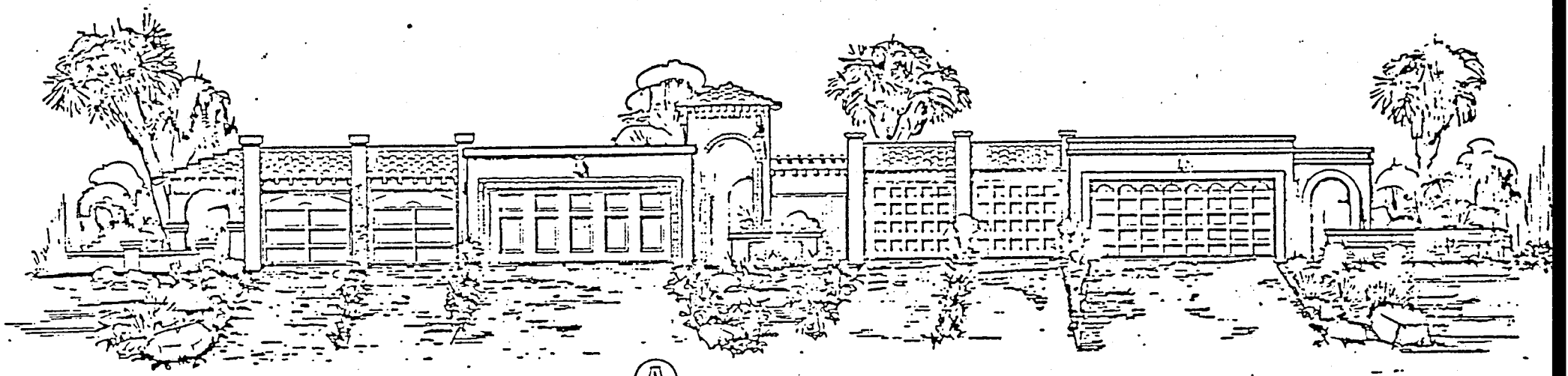


SUNLAKES MODEL '309'

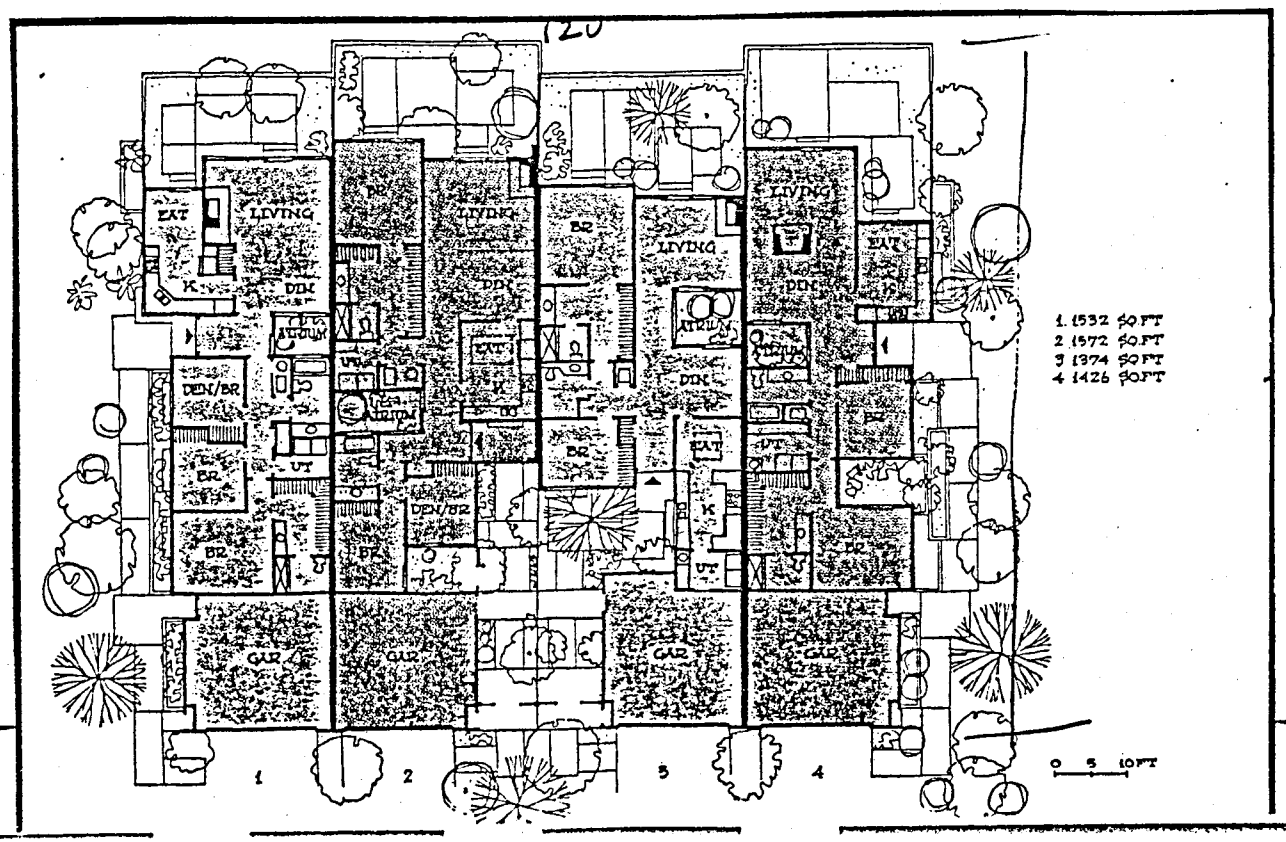
Nelson-Kubicek Architects aia.
2038 east camelback road, suite 210
phoenix, arizona 85016
telephone (602) 553-0030

MODEL '309' for SUN LAKES CONSTRUCTION CO.
SUN LAKES, ARIZONA
PLAN and ELEVATIONS

sheet 1 of 1 | design | drawn | check



(A) FRONT ELEVATION

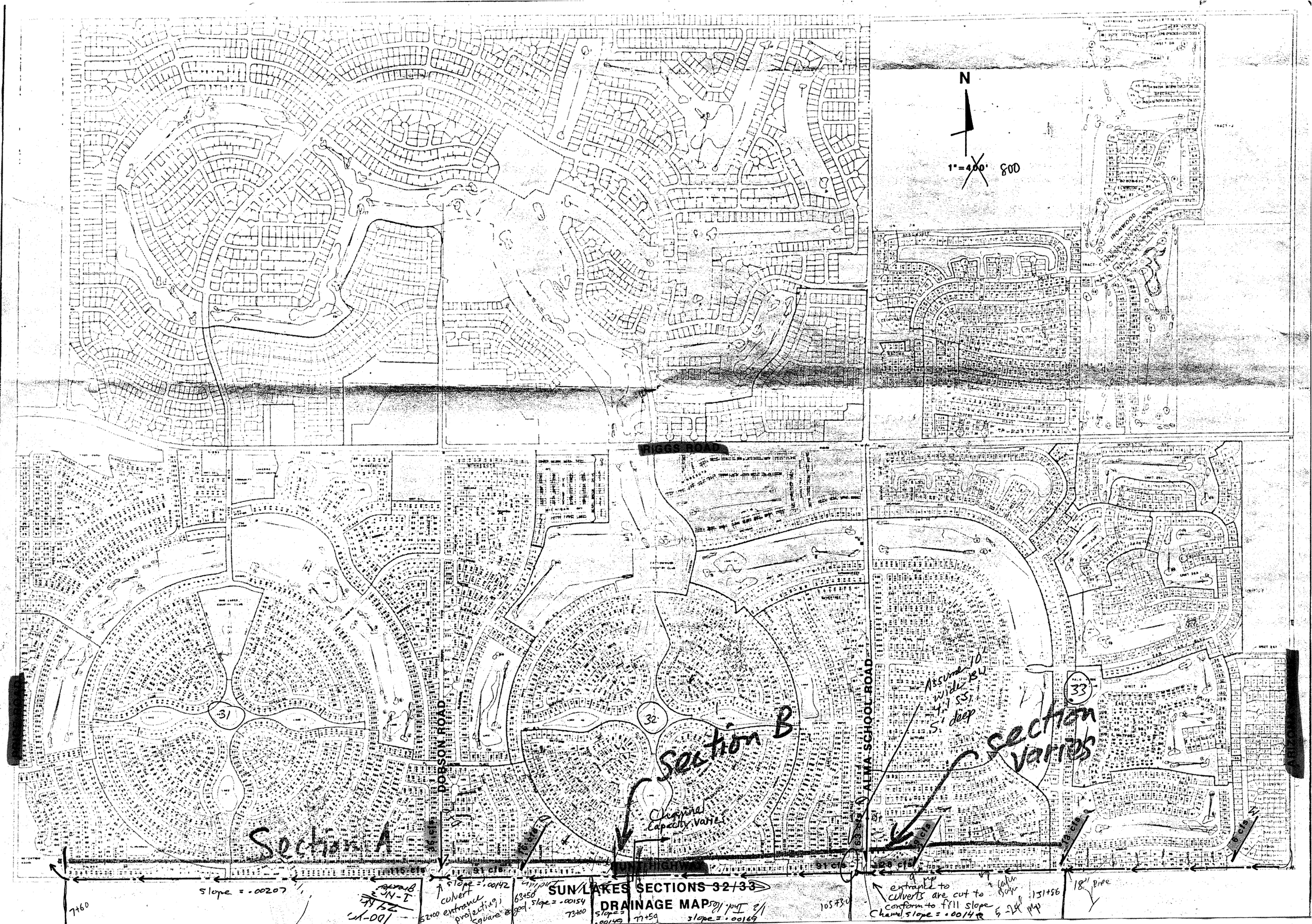


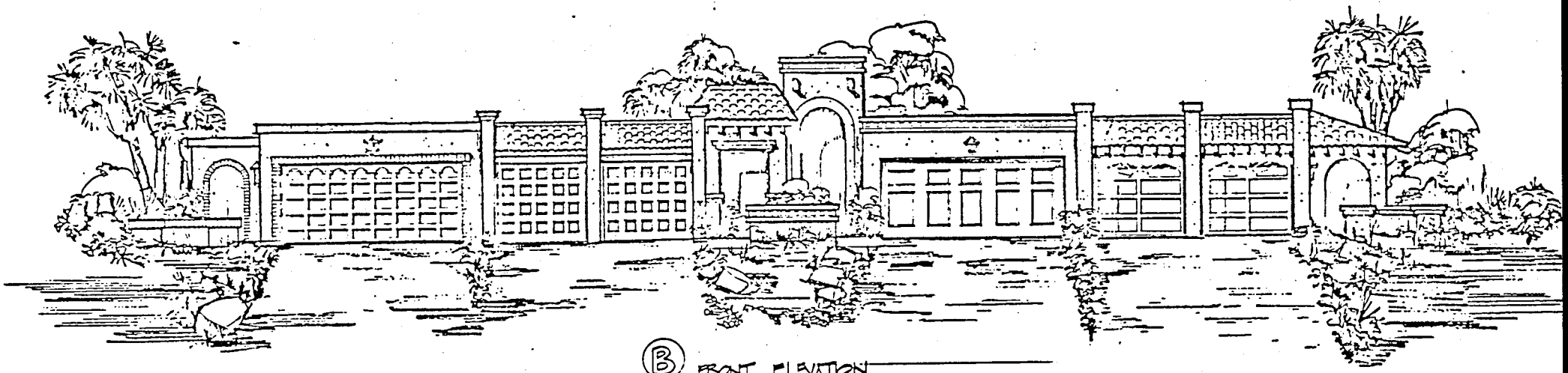
(B) ELEVATION

SUN LAKES of ARIZONA

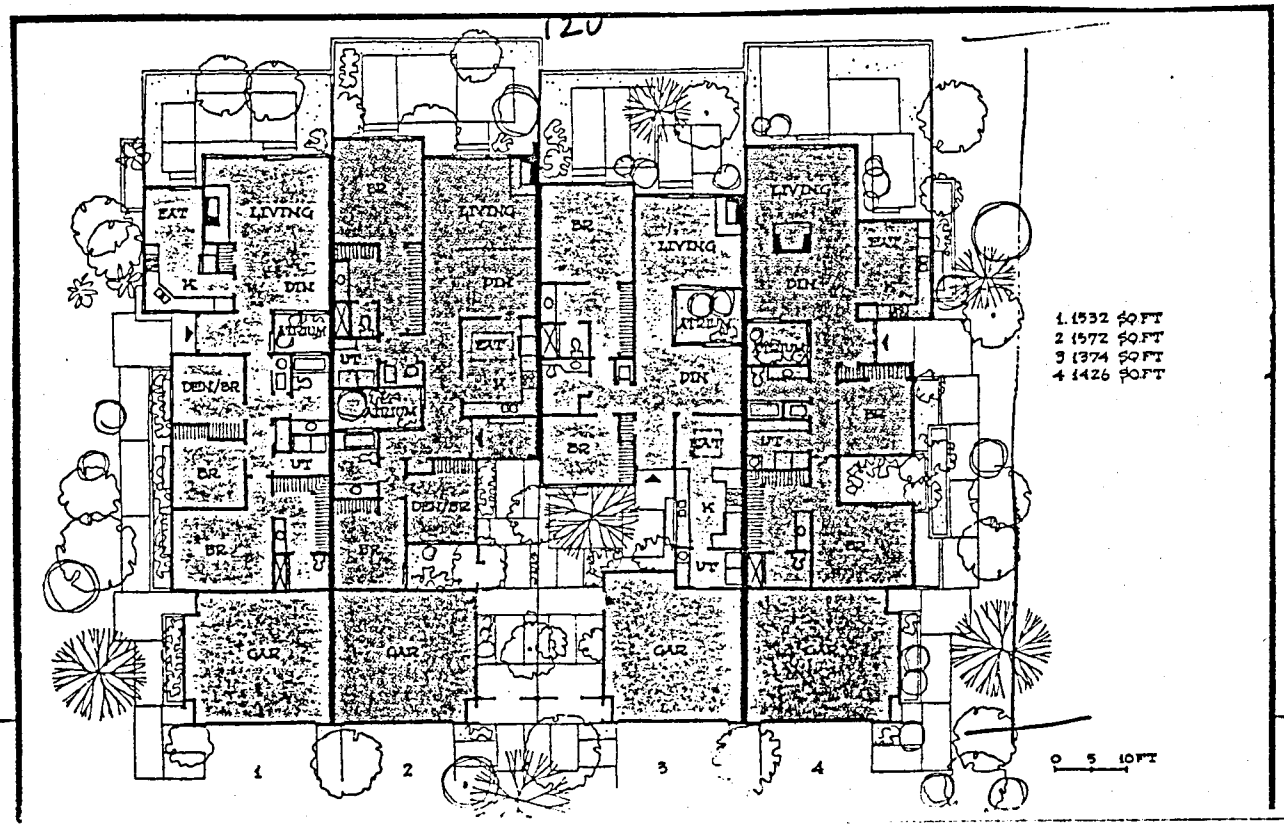
DALTON DESIGN
PHOENIX, ARIZONA
Job # L-7808B
Aug 9, 1988

APPENDIX 5


N
1" = 400' 800
IRONWOOD
RIGGS ROAD
DOBSON ROAD
ALMA SCHOOL ROAD
HUNT HIGHWAY
31
32
33
Section A
Section B
Section varies
Channel capacity varies
Assume 10' wide BW 4:1 SS 5' deep
36 cfs
91 cfs
115 cfs
63 cfs
28 cfs
18 cfs
9 cfs
slope = .00207
slope = .00142
slope = .00154
slope = .00149
slope = .00169
slope = .00147
7+60
62+00
63+50
73+60
77+59
105+73
131+56
culvert entrance projecting square & good.
entrance to culverts are cut to conform to fill slope
Channel slope = .00147
18" pipe
SUN LAKES SECTIONS 32/33
DRAINAGE MAP



(B) FRONT ELEVATION



(B) ELEVATION

SUN LAKES of ARIZONA

DOLTON DESIGN
PHOENIX, ARIZONA
Job # L-7803B
Aug 9, 1983

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-2-72 PAGE 1 OF _____

INITIAL DEVELOPEMENT - SECTION 31

PRESENT RUNOFF QUANTITIES FROM CULTIVATED FIELDS.

FROM ARIZ-BRIDGE DIVISION - "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN ARIZONA."

DURATION (HOURS)	PRECIPITATION (INCHES)		
	10 YEAR	25 YEARS	50 YEARS
6	1.9	2.3	2.6
24	2.3	2.8	3.2
1	1.5	1.8	2.0

50 yr

USE SCS METHOD : PART I < 10 SQ. MILES

AREA = 640 ACRES

LENGTH = 5200 FT

SLOPE = 0.2 %

T_c FOR OVERLAND FLOW : $T_c = \frac{K \times L^{0.37}}{S^{0.20}}$

WHERE : K = CONSTANT FOR GROUND COVER

L = LENGTH OF DRAINAGE AREA (FT)

S = SLOPE OF DRAINAGE AREA (%)

ASSUME K = 2.0

$$T_c = \frac{2.0 \times 5200^{0.37}}{0.2^{0.20}} = 67 \text{ MIN.}$$

SOIL GROUP = C

RUNOFF CURVE No = 80

FROM GRAPH - DIRECT RUNOFF -

$Q_{10} = 0.27$

$Q_{25} = 0.45$

$Q_{50} = 0.55$

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-2-72 PAGE 2 OF _____

PEAK RUNOFF :

$$Q_P = \frac{484 \times AQ}{T_P}$$

$$Q_{10} = \frac{484 \times 1 \times 0.27}{\frac{67}{60} \times 0.89} = 131 \text{ CFS}$$

$$Q_{25} = \frac{484 \times 1 \times 0.45}{0.99} = 220 \text{ CFS}$$

$$Q_{50} = \frac{484 \times 1 \times 0.55}{0.99} = 269 \text{ CFS}$$

STREET SECTIONS

32 FT BACK TO BACK OF CURB

H_2O TO TOP OF CURB

$A = 6.43 \text{ FT}^2$

$P = 32 \text{ FT}$

$R = 0.20 \quad \therefore R^{2/3} = 0.34$

H_2O WITHIN 2/W (0.7' ABOVE CURB)

$A = 14.2 \text{ FT}^2$

$P = 40 \text{ FT}$

$R = 0.36 \quad \therefore R^{2/3} = 0.51$

40 FT BACK TO BACK OF CURB

H_2O TO TOP OF CURB

$A = 7.0 \text{ FT}^2$

$P = 40$

$R = 0.18 \quad \therefore R^{2/3} = 0.32$

H_2O WITHIN 2/W (0.2' ABOVE CURB)

$A = 14.36 \text{ FT}^2$

$P = 48 \text{ FT}$

$R = 0.34 \quad \therefore R^{2/3} = 0.49$

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-3-72 PAGE 3 OF _____

AREA (1)

AREA = 40 AC.

LENGTH = 2300 FT

$n = 0.0149$

$S = 0.15\%$

STREET = 32 FT.

$$V = \frac{1.49}{0.0149} \times 0.34 \times \overset{0.0387}{0.0015}^{1/2} = 1.32 \text{ FPS}$$

$$T_c = \frac{2300}{1.32 \times 60} = 29 \text{ MIN.}$$

$Q_{10} = 0.6 \times 40 \times 2.4 = 58$ CFS

$Q_{25} = 0.6 \times 40 \times 2.9 = 70$ CFS

$Q_{50} = 0.6 \times 40 \times 3.2 = 77$ CFS

FCD
60
87
112

AREA (2)

AREA = 42 AC

LENGTH = 2600 FT

SLOPE = 0.15 %

$V = 1.32$ FPS

$$T_c = \frac{2600}{60 \times 1.32} = 33 \text{ MIN}$$

$Q_{10} = 0.6 \times 42 \times 2.2 = 55$ CFS

$Q_{25} = 0.6 \times 42 \times 2.65 = 67$ CFS

$Q_{50} = 0.6 \times 42 \times 2.9 = 73$ CFS

AREA (3)

AREA = 38 AC

LENGTH = 2300 FT

SLOPE = 0.15 %

$V = 1.32$ FPS

$$T_c = \frac{2300}{60 \times 1.32} = 29 \text{ MIN}$$

$Q_{10} = 0.6 \times 38 \times 2.4 = 55$ CFS

$Q_{25} = 0.6 \times 38 \times 2.9 = 66$ CFS

$Q_{50} = 0.6 \times 38 \times 3.2 = 73$ CFS

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-3-72 PAGE 4 OF _____

AREA (4)

AREA = 43 AC

LENGTH = 2200 FT

SLOPE = 0.12 %

$V = 100 \times 0.34 \times 0.0012^{1/2} = 1.18$ FPS

$T_c = \frac{2200}{60 \times 1.18} = 31$ MIN

$Q_{10} = 0.6 \times 43 \times 2.3 = 59$ CFS

$Q_{25} = 0.6 \times 43 \times 2.75 = 71$ CFS

$Q_{50} = 0.6 \times 43 \times 3.0 = 77$ CFS

50 YEAR STORM FREQUENCY

TOTAL FLOW FROM AREA 1 & 2 INTO 6

$Q = 0.6 \times 82 \times 2.9 \times \frac{1}{12} = 11.9$ ACRE-FT

ASSUME TOTAL LAKE SURFACE AREA IN AREA 6 TO BE 4×2 = 8 ACRES

TOTAL FLOW FROM REC AREA INTO LAKES

$Q = 0.25 \times (37-8)\, 2.9 \times \frac{1}{12} = 1.75$ ACRE-FT.

DIRECT RAINFALL ON LAKES

$Q = 8 \times 2.9 \times \frac{1}{12} = 1.93$ ACRE-FT

TOTAL QUANTITY INTO LAKES FROM AREA 1, 2 & 6

$Q = 15.58$ ACRE-FT.

RISE IN LAKE SURFACE ELEV: $h = \frac{15.58}{8} = 1.95$ FT

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AC CHECKED _____ DATE 2-3-72 PAGE 5 OF _____

TOTAL FLOW FROM AREA 3&4 INTO 6A & 5

$Q = 0.6 \times 81 \times 3.0 \times \frac{1}{12} = 12.15$ AC-FT

FLOW FROM REC. AREA 6A INTO LAKE 2.63

$Q = 0.25 \times 6 \times 3.0 \times \frac{1}{12} = 0.37$ AC.-FT

FLOW FROM GOLF COURSE INTO LAKE

$Q = 0.10 \times 50 \times 3.0 \times \frac{1}{12} = 1.25$ AC.-FT

RAINFALL DIRECT ON LAKES $= 3.0 \times 5.67 \times \frac{1}{12} = 1.42$ AC.-FT

TOTAL QUANTITY INTO LAKES FROM AREA 3, 4, 6A & GOLF COURSE

$Q = 15.19$ AC-FT

TOTAL RISE IN LAKE SURFACE ELEV: $h = \frac{15.19}{5.67} = 2.68'$

AREA 7

AREA = 24 AC

LENGTH = 2200 FT

SLOPE = 0.15 %

$V = 100 \times 0.34 \times 0.0015^{1/2} = 1.32$ FPS

$T_C = \frac{2200}{60 \times 1.32} = 28$ MIN

$Q_{10} = 0.6 \times 24 \times 2.5 = 36$ CFS

$Q_{25} = 0.6 \times 24 \times 2.9 = 42$ CFS 42

$Q_{50} = 0.6 \times 24 \times 3.2 = 46$ CFS

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-8-72 PAGE 6 OF _____

LAKES 1 & 2

ALLOW WATER LEVEL TO RISE 2.0 FT

TOTAL STORAGE CAPACITY = (2.25+1.35)2 = 7.20 AC-FT.

FOR TOTAL RUNOFF QUANTITIES, ASSUME A TOTAL RAINFALL OF 3 INCHES. 100yr-1hr 2.63"

TOTAL CONTRIBUTION FROM AREA 7

$Q = 0.6 \times 24 \times 3 \times \frac{1}{12} = 3.60$ AC-FT

TOTAL CONTRIBUTION FROM GOLF COURSE

$Q = 0.25 \times 34 \times 3 \times \frac{1}{12} = 2.13$ AC-FT

DIRECT RAINFALL ON LAKES

$Q = 3.60 \times 3 \times \frac{1}{12} = 0.90$ AC-FT

TOTAL QUANTITY = 3.60 + 2.13 + 0.90 = 6.63 AC.-FT.

TOTAL RISE IN WATER LEVEL = $\frac{6.63}{3.6}$ = 1.84 FT

PROVIDE WEIR STRUCTURE WITH OVERFLOW FROM LAKE 1 TO 3 & FROM LAKE 2 TO 4.

TRY 12" RCP - n = 0.012

1-3 SLOPE = 3/1000 = 0.003

2-4 SLOPE = 3/1300 = 0.0023

FROM CHART : Q_{1-3} = 2.2 CFS

Q_{2-4} = 1.9 CFS

TOTAL DISCHARGE PER HR. = $\frac{4.1 \times 3600}{43560}$ = 0.34 AC-FT/HR.

APPROX. TIME TO REDUCE WATER LEVEL = $\frac{6.63}{0.34}$ = 19.5 HRS

PROJECTS LANICOA - CHANDLER

SUBJECT MASTER DRAINAGE

COMPUTED AL CHECKED _____ DATE 2-8-72 PAGE 7 OF _____

TRY 18" RCP

FROM CHART : $Q_{1-3} = 6.2$ CFS

$Q_{2-4} = 5.5$ CFS

DISCHARGE PER HR $= \frac{11.7 \times 3600}{43560} = 0.97$ AC-FT

TIME $= \frac{6.63}{0.97} = 6.8$ HRS

TRY 15" RCP

FROM CHART : $Q_{1-3} = 4.0$ CFS

$Q_{2-4} = 3.4$ "

DISCHARGE PER HR $= \frac{7.4 \times 3600}{43560} = 0.61$ AC-FT

TIME $= \frac{6.63}{0.61} = 10.9$ HRS

USE 12" RCP FROM LAKE 1 TO 3 &
15" RCP FROM LAKE 2 TO 4

DISCHARGE PER HR $= \frac{5.6 \times 3600}{43560} = 0.46$ AC-FT

TIME $= 6.63/0.46 = 14.4$ HRS

CONNECT LAKE 1 WITH LAKE 2 WITH 18" RCP

PROVIDE WEIR STRUCTURE WITH OVERFLOW FROM LAKE 6 TO LAKE 7.

TRY 12" RCP

SLOPE $= 3/500 = 0.006$ '/FT

FROM CHART : $Q = 3.0$ CFS

DISCHARGE PER HR $= \frac{3 \times 3600}{43560} = 0.25$ AC-FT

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-8-72 PAGE 8 OF _____

TRY 18" RCP

FROM CHART : Q = 9.0 CFS

DISCHARGE PER HR = $\frac{9 \times 3600}{43560}$ = 0.74 AC.FT

TOTAL TIME = $\frac{15.58 + 6.63}{0.74}$ = 30 HRS

TRY 21" RCP

FROM CHART : Q = 13.0 CFS

DISCHARGE PER HR = $\frac{13 \times 3600}{43560}$ = 1.07 AC-FT

TOTAL TIME = $\frac{15.58 + 6.63}{1.07}$ = 20.75 HRS

USE 18" RCP BETWEEN LAKE 6 & 7

USE 24" RCP BETWEEN LAKE 3 & 6, 4 & 6, 5 & 6.

FLOW FROM LAKE 7 TO LAKE 8

ALLOW MAX. WATER LEVEL IN 7 TO RISE 3 FT.

ALLOW LAKE 8 TO RISE 1.9 FT

DIFF. IN ELEV = 83 - 81.9 = 1.1 FT

SLOPE = 0.001 V/FT

TRY 24" PIPE

FROM CHART : Q = 8.0 CFS NOT ENOUGH

TRY 27" PIPE

FROM CHART : Q = 11.0 CFS

TRY 30" PIPE

FROM CHART : Q = 14.0 CFS

USE 27" PIPE — DISCHARGE PER HR = $\frac{11 \times 3600}{43560}$ = 0.91 AC-FT

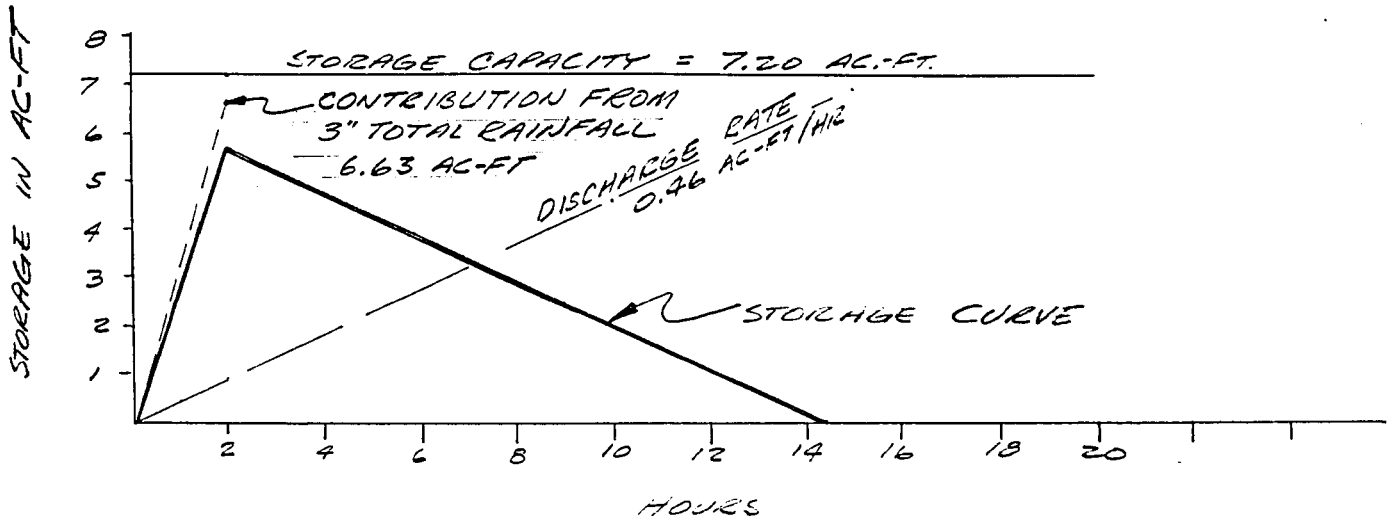
PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE REPORT

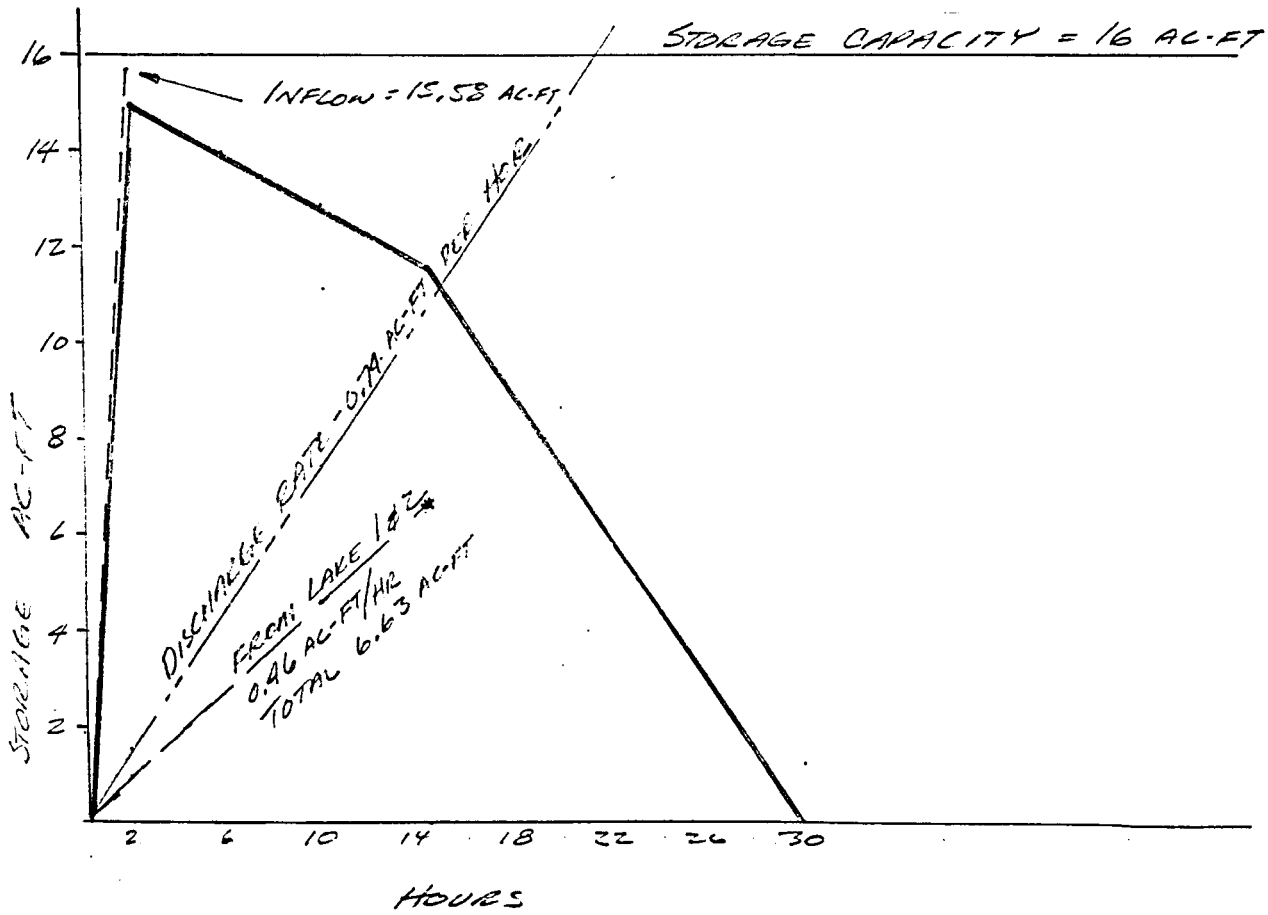
COMPUTED AL CHECKED _____ DATE 2-9-71 PAGE 9 OF _____

CONNECT LAKE 8 & 9 WITH 24" RCP

PROVIDE OVERFLOW SECTIONS FOR LAKE 8 TO ALLOW MAX. 2 FT RISE IN WATER LEVEL.



LAKES 1 & 2



LAKES 3, 4, 5 & 6

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-10-72 PAGE 10 OF _____

LAKE #8

CONTRIB. FROM DEV. AREA = $47 \times 0.6 \times 3 \times \frac{1}{12}$ = 7.05 AC-FT

CONTRIB FROM GOLF COURSE = $7 \times 0.25 \times 3 \times \frac{1}{12}$ = 0.43 AC-FT

CONTRIB DIRECT ON LAKE = $2 \times 3 \times \frac{1}{12}$ = 0.50 AC-FT

TOTAL = 7.98 AC-FT

STORAGE CAPACITY = 2 × 2 = 4 AC-FT

ALLOW DISCHARGE IN TWO HOURS OF 4 AC-FT

ASSUME 1 FT ELEV. DIFF BETWEEN LAKE 8 & 9

SLOPE = 0.0008 '/FT

TRY 24" RCP

FROM CHART: Q = 7 CFS

DISCHARGE PER HOUR = $\frac{7 \times 3600}{43560}$ = 0.58 AC-FT

TRY 30" RCP

FROM CHART: Q = 13 CFS

DISCHARGE PER HOUR = $\frac{13 \times 3600}{43560}$ = 1.07 AC-FT

PROVIDE OVERFLOW SECTION WITH WEIR ELEV. 81

SLOPE OF SWALE = 1.5/1200 = 0.00125 '/FT (0.001

ALLOW 1 FT DEPTH OF WATER

30 FT WIDE SWALE

A = 30 × 1 = 30 FT²

P = 30 + 2 = 32

R = 0.94 ∴ $R^{2/3}$ = 0.96

n = 0.030

$V = \frac{1.49}{0.030} \times 0.96 \times \overset{0.0316}{0.001}^{1/2} = 1.52$ FPS

$Q = \frac{1.52 \times 30 \times 3600}{43560} = 3.77$ AC-FT/HR.

PROJECTS LAMCOM - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

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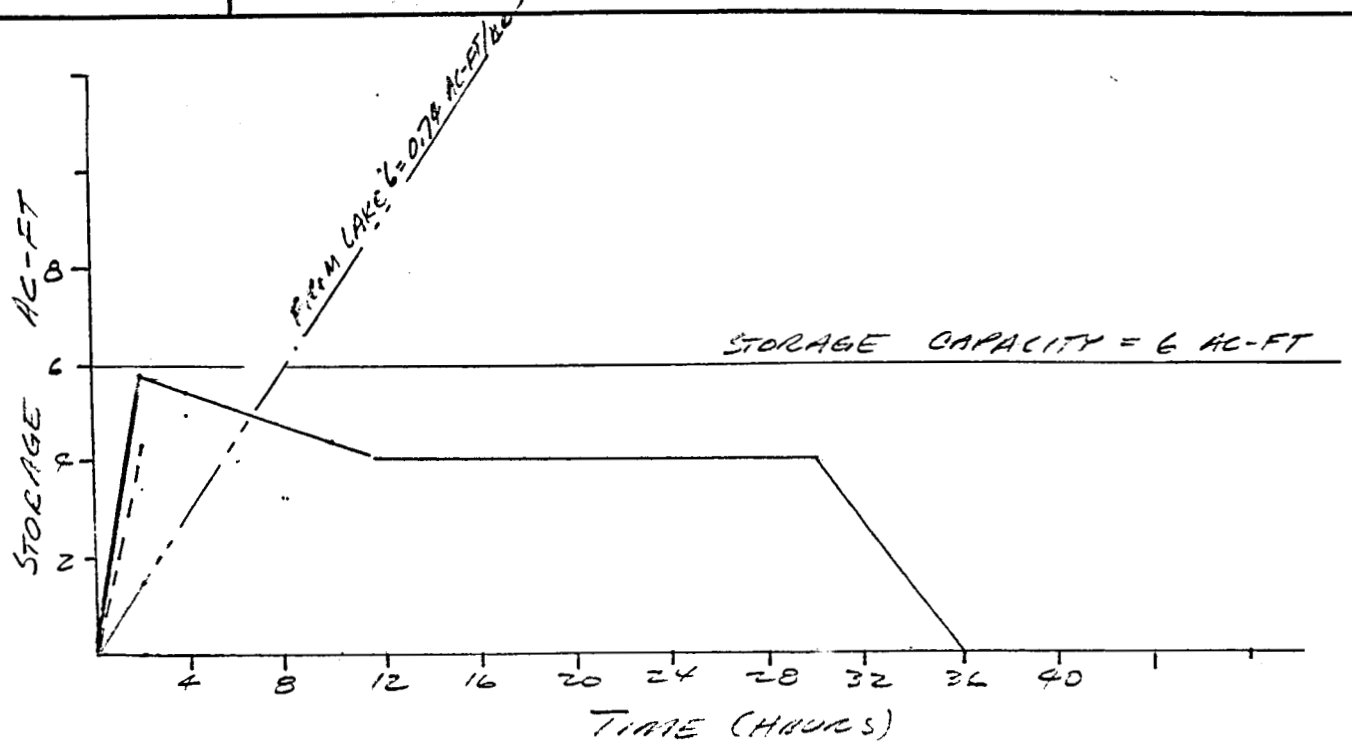
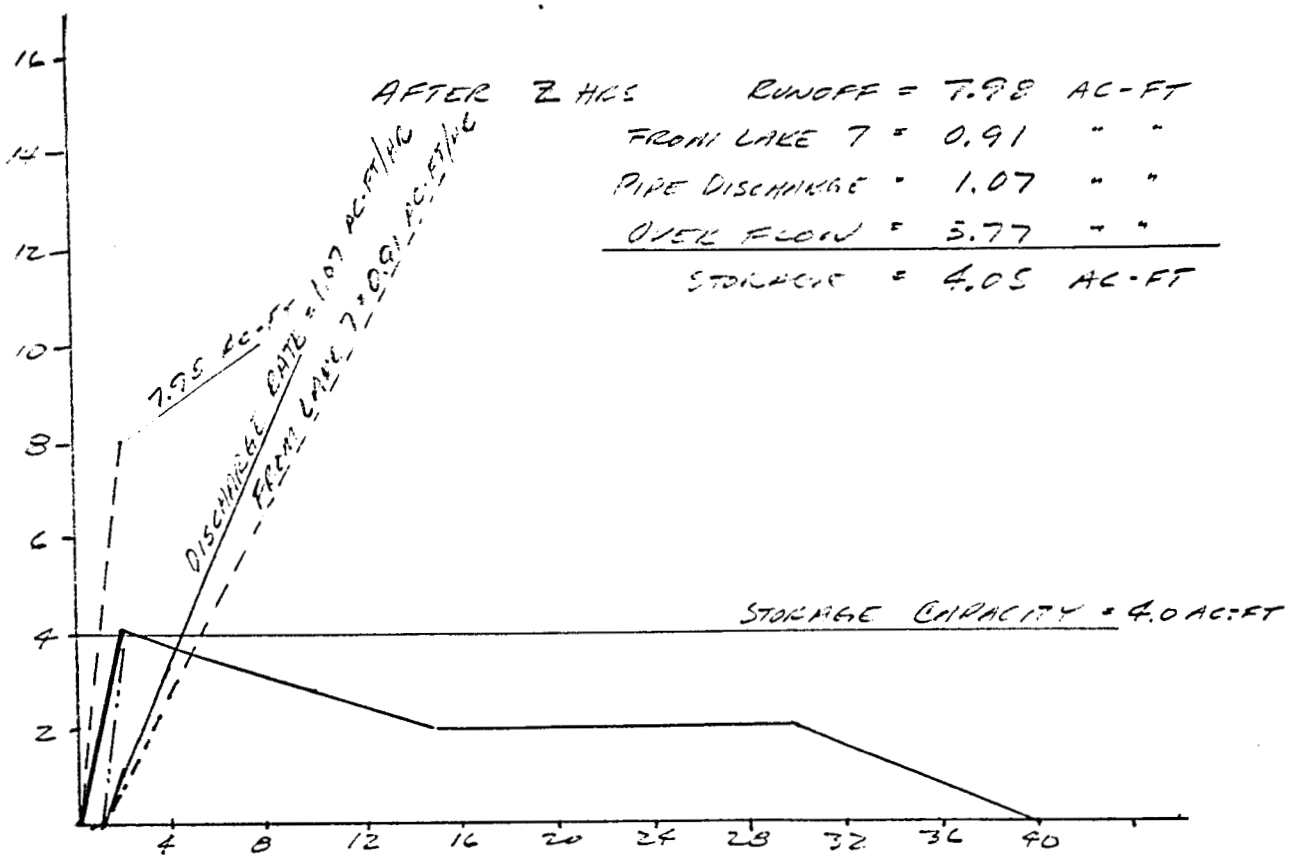


LAKE 7



PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-10-72 PAGE 12 OF _____

LAKE #9

TOTAL RUNOFF = 2.89 AC-FT
FROM LAKE 8 = 1.07 AC-FT/HR

ALLOW LAKE TO RISE 1 FT

TOTAL STORAGE 2.75 × 1 = 2.75 AC-FT

SET WEIR ELEV. EQUAL 80.0

DESIGN OUTFLOW CHANNEL FOR 1.5 AC-FT/HR CAPACITY
OR Q = 18.15 CFS
SET S = 0.002'/FT
n = 0.0149

TRY 20' WIDE & DEPTH = 0.5 FT

A = 10.0 FT²
P = 21.0 FT
R = 0.48 ∴ R^2/3 = 0.613

V = 100 × 0.613 × 0.0447 = 2.74 FPS
Q = 2.74 × 10 = 27.4 CFS ALSO BUT OK

MAKE STREET INVERTED WEST TO CHANNEL @ WEST BOUNDARY.

CHANNEL DESIGN

SLOPE = 0.001'/FT
n = 0.020

TRY 10 FT BOTTOM - 2:1 SIDE SLOPES & 2 FT DEPTH

A = 2 × 10 + 2 × 4 = 28 FT²
P = 10 + 2 × 4.5 = 19 FT
R = 1.47 ∴ R^2/3 = 1.293

V = 1.47/0.02 × 1.293 × 0.0316 = 3.13 FPS
Q = 3.13 × 28 = 88 CFS

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 2-10-72 PAGE 13 OF _____

TRY 20 FT BOTTOM

$A = 20 \times 2 + 2 \times 4 = 48 \text{ FT}^2$

$P = 29 \text{ FT}$

$R = 1.65 \quad \therefore R^{2/3} = 1.395$

$V = \frac{1.49}{0.02} \times 1.395 \times 0.0316 = 3.28 \text{ FPS}$

$Q = 3.28 \times 48 = 157 \text{ CFS}$

TRY 3 FT DEPTH

$A = 3 \times 20 + 6 \times 3 = 69 \text{ FT}^2$

$P = 20 + 6.7 \times 2 = 33.4$

$R = 2.06 \quad \therefore R^{2/3} = 1.619$

$V = \frac{1.49}{0.02} \times 1.619 \times 0.0316 = 3.81 \text{ FPS}$

$Q = 3.81 \times 69 = 263 \text{ CFS}$

PROJECTS LAMCOA - CHANDLER

SUBJECT MASTER DRAINAGE STUDY

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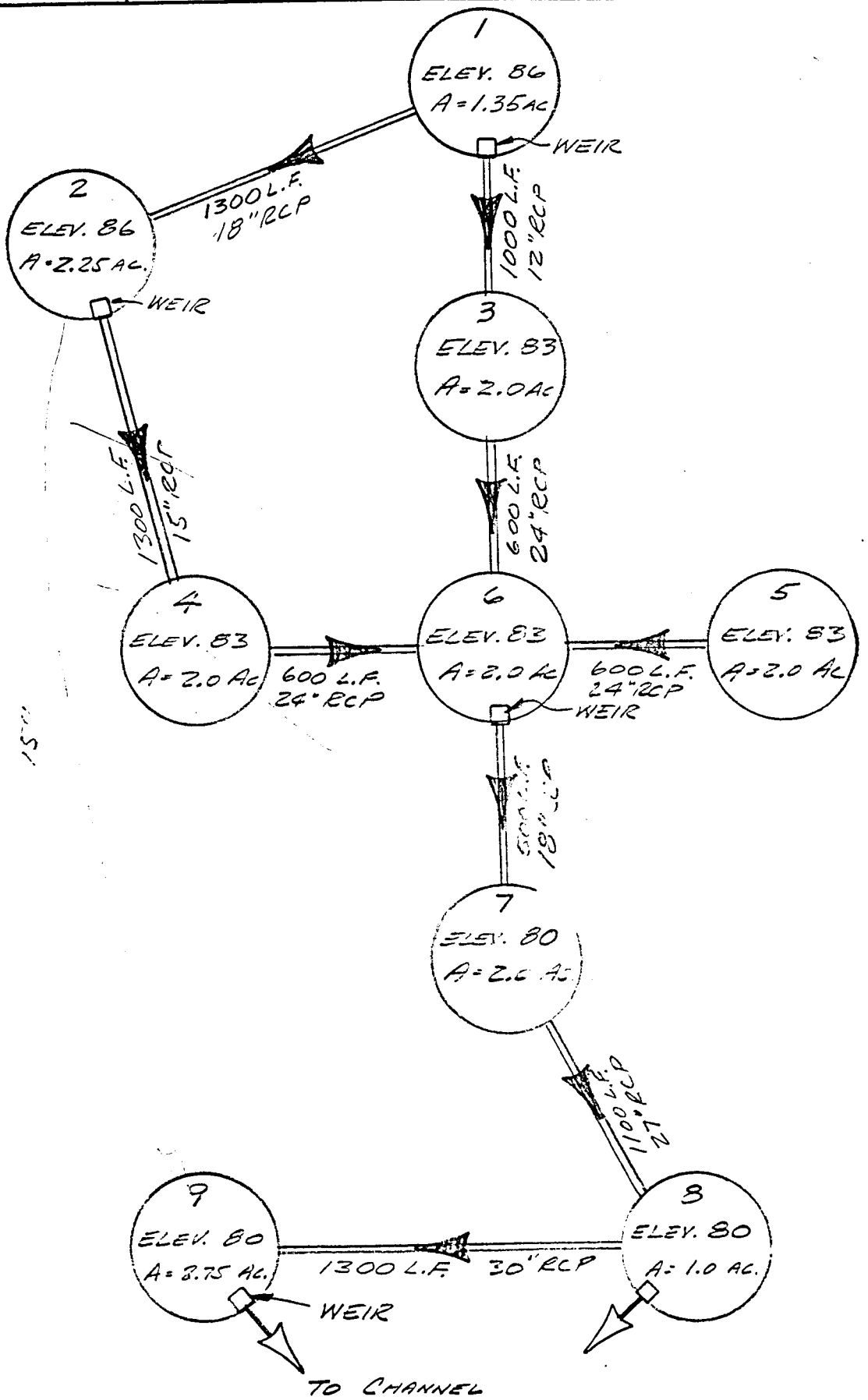


PROJECTS LAMKOA - CHANDLER SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 6-5-72 PAGE 15 OF _____

AREA	SIZE ACRES	LENGTH FT.	T_c MIN	INTENSITY - "/HR i_{10}	i_{25}	i_{50}	C	RUNOFF - CFS Q_{10}	Q_{25}	Q_{50}
1	26	5900	32	2.2	2.7	3.0	0.6	34	42	47
2	62	3900	43	1.8	2.2	2.5	0.6	67	82	93
3	49	3300	37	2.0	2.4	2.7	0.6	59	71	80
4	26	2100	23	2.8	3.3	3.6	0.6	44	51	56 *
5	37	2200	24	2.7	3.2	3.5	0.6	60	71	78 *
6	34	3400	38	2.0	2.4	2.7	0.6	41	49	55
7	69	3000	33	2.2	2.7	3.0	0.6	91	112	124
8	46	2000	67	1.4	1.7	1.9	0.1	6	8	9 *
9	33	2500	28	2.4	2.9	3.2	0.6	47	57	63
10	8	600	20	3.0	3.6	3.9	0.1	2	3	3 *
11	14	1200	13	3.7	4.4	4.8	0.6	31	37	40 *
12	30	1500	50	1.7	2.0	2.2	0.1	5	6	7 *
13	19	1500	17	3.2	3.8	4.3	0.6	36	43	49 *
14	38	3000	33	2.2	2.7	3.0	0.6	37	45	50 *
15	56	2000	67	1.4	1.7	1.9	0.1	8	10	11 *
16	29	2200	24	2.7	3.2	3.5	0.6	47	57	61 *
17	49	3000	33	2.2	2.7	3.0	0.6	63	78	86
18	21	1800	31	2.3	2.7	3.0	0.6	29	34	35
19	19	1500	31	2.3	2.7	3.0	0.6	26	31	34

RUNOFF @ CONCENTRATION POINTS ON PRICE RD

AREA	SIZE ACRES	LENGTH FT	T_c MIN	INTENSITY - "/HR i_{10}	i_{25}	i_{50}	C	RUNOFF CFS Q_{10}	Q_{25}	Q_{50}
1+2	88	6800	75	1.35	1.6	1.8	0.6	71	84	95
3	49	3300	37	2.0	2.4	2.7	0.6	59	71	80
6+9+17	115	6400	71	1.4	1.65	1.85	0.6	96	114	128
7	69	3000	33	2.2	2.7	3.0	0.6	91	112	124
18+19	40	5600	62	1.5	1.8	1.95	0.6	36	43	47
TOTAL	361	6800	75	1.35	1.6	1.8	0.6	292	346	390

PROJECTS LAMCOH - CHANDLER - SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 6-6-72 PAGE 16 OF _____

DISCHARGE AT A FROM 1 & 2 = 95 CFS
DISCHARGE AT E FROM 18 & 19 = 47 CFS

DISCHARGE AT LOW AREA ALONG PRICE RD.

$Q_{50} = 243$ CFS

ALL RUNOFF FROM AREA 4, 5, 8, 10, 11, 12, 13 14, 15 & 16 TO BE RETAINED IN LAKES & GOLFCOURSE. AND RELEASED GRADUALLY AFTER MOST OTHER RUNOFF IS GONE

PROJECTS SUN LAKES UNIT 1 SUB DIVISION

SUBJECT DRAINAGE

COMPUTED AL CHECKED _____ DATE 9-8-72 PAGE 1 OF _____

CONCENTRATION POINT @ MARYLAND AVE & SUN LAKES BLVD

AVERAGE VELOCITY IN STREET: $V = \frac{1.49}{n} \times R^{2/3} \times S^{1/2}$

$R = 100 \times 0.72 \times 0.0216^{1/2} = 1.07$ FT

$L = 2700'$

$T_c = \frac{2700}{60 \times 1.07} = 36$ MIN

$Q_{10} = 0.6 \times 77 \times 2.0 = 40$ CFS

$Q_{25} = 0.6 \times 77 \times 2.4 = 48$ CFS

$Q_{50} = 0.6 \times 77 \times 2.7 = 53$ CFS

[illegible] 60' STREET TO TOP OF CURB @ [illegible] SLOPE

$Q = 100 \times 0.72 \times 0.0216^{1/2} \times 7 = 7.05$ CFS

[illegible]

[illegible] = 25.[illegible] CFS

[illegible]

$A = 0.40 \times 12 + 0.20 \times 7 = 20.07$

$P = 41.5$

$R = 0.52$ $\therefore R^{2/3} = 0.67$

$Q = [illegible] = 42.87$ CFS TO TOP OF CURB

PROJECTS SUN LAKES UNIT 1 SUBDIVISION

SUBJECT DRAINAGE

COMPUTED A.L. CHECKED _____ DATE 9-8-72 PAGE 2 OF _____

CONCENTRATION POINT @ PLAYER DR & SUN LAKES BLVD.

DRAINAGE AREA = 25 ACRES

" L = 2300 FT

T_c = 36 MIN

Q_{10} = 0.6 × 25 × 2 = 30 CFS

Q_{25} = 0.6 × 25 × 2.4 = 36 CFS

Q_{50} = 0.6 × 25 × 2.7 = 40.5 CFS

SEE PREL / FDC SHEET SUMMARIES

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 9-19-72 PAGE 3 OF _____

FROM GOLF COURSE PLANS

AREA	LAKE STORAGE	FLOOD BERM STORAGE	TOTAL STORAGE
1	2.68	2.47	5.15
2	4.09	2.64	6.73
3	5.45	2.00	7.45
4	2.68	1.95	4.63
	14.90 A.F	9.06 A.F	33.96 A.F.

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 9-20-72 PAGE 3 OF _____

AREA	SIZE ACRES	LENGTH FT	T_c MIN	INTENCITY - "/HR i_{10}	i_{25}	i_{50}	C	RUNOFF - CFS Q_{10}	Q_{25}	Q_{50}	
1	62	3900	43	1.8	2.2	2.5	0.6	67	82	93	
2	26	2900	32	2.2	2.7	3.0	0.6	34	42	47	1179
3	49	3300	37	2.0	2.4	2.7	0.6	59	71	80	
4	29	2200	24	2.7	3.2	3.5	0.6	47	57	61	
5	50	3000	33	2.2	2.7	3.0	0.6	66	81	90	
6	20	2800	31	2.3	2.7	3.0	0.6	28	32	36	
7	19	2800	31	2.3	2.7	3.0	0.6	26	31	34	
8	69	3000	33	2.2	2.7	3.0	0.6	91	112	124	
9	28	3000	33	2.2	2.7	3.0	0.6	37	45	50	
10	33	2500	36	2.0	2.4	2.7	06	40	48	53	
11	14	1200	13	3.7	4.4	4.8	0.6	31	37	40	
12	22	2100	23	3.8	3.3	3.6	0.6	44	51	56	
13	37	2200	24	2.7	3.2	3.5	0.6	60	71	78	
14	19	1500	17	3.2	3.8	4.3	0.6	36	43	49	
15	8	600	20	3.0	3.6	3.9	0.25	6	7	8	
16	30	1500	50	1.7	2.0	2.2	0.25	13	15	17	
17	102	2000	67	1.4	1.7	1.9	0.1	14	17	19	116
18	34	3900	38	2.0	2.4	2.7	0.6	41	49	55	

AREAS CONTRIBUTING TO PEAK RUNOFF ON PRICE RD.

CONCENTRATION POINT @ SIG BOARD

AREA 1 & 2

A = 88 ACRES

T_c = 75 MIN

i_{50} = 1.5 "/HR

Q_{50} = 95 CFS

CONCENTRATION IN LOW AREA WHERE ALL EXISTING DRAINAGE GOES

AREAS 3, 8, HALF OF 5, HALF OF 9, 10 & 18

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 9-20-72 PAGE 4 OF _____

$A = 224$ ACRES

$T_c = 71$ MIN

$i_{50} = 1.8$ "/HR

$Q_{50} = 0.6 \times 224 \times 1.8 = 242$ CFS

CONCENTRATION POINT @ NW CORNER
(DRAIN ALONG RIGGS RD.)

$A = 39$ ACRES

$T_c = 64$ MIN

$i_{50} = 1.9$ "/HR

$Q = 0.6 \times 39 \times 1.9 = 44$ CFS

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 9-20-72 PAGE 5 OF _____

RUNOFF RETENTION SYSTEM

LAKES 1 & 2 INTERCONNECTED WITH 15" PIPE

AVERAGE SURFACE AREA = 3.65 ACRES

RUNOFF FROM AREA 4 : $Q = 0.6 \times 39 \times 3.5 \times \frac{1}{12}$ = 5.07 AC-FT

DIRECT RAINFALL ON LAKES : $Q = 3.65 \times 3.5 \times \frac{1}{12}$ = 1.06 AC-FT

TOTAL RUNOFF INTO LAKES = 6.13 AC-FT

TOTAL STORAGE CAPACITY IN LAKES 1 & 2 = 6.77 AC-FT

DISCHARGE FROM LAKE #1 TO LAKE #5

USE 12" CP - SLOPE = 0.25 %

FROM PIPE FLOW CHART : Q = 2.0 CFS OR 0.165 AC-FT/HR

DISCHARGE FROM LAKE #2 TO LAKE #3

USE 15" C.P. - SLOPE = 0.20 %

FROM PIPE FLOW CHART : Q = 3.0 CFS OR 0.248 AC-FT/HR

TOTAL DISCHARGE RATE : Q = 0.165 + 0.248 = 0.413 AC-FT/HR

LAKES 5, 6 & 7 INTERCONNECTED WITH 18" PIPES

AVERAGE SURFACE AREA = 6.0 ACRES

RUNOFF FROM AREA 13 = $0.6 \times 77 \times 3.5 \times \frac{1}{12}$ = 6.47 AC-FT

" " " 14 = $0.6 \times 42 \times 3.5 \times \frac{1}{12}$ = 3.33 "

" " " 16 = $0.25 \times (30-8) \times 3.5 \times \frac{1}{12}$ = 1.75 "

DIRECT RAINFALL ON LAKES = $3.5 \times 6 \times \frac{1}{12}$ = 1.75 "

TOTAL RUNOFF INTO LAKES = 13.30 AC-FT

TOTAL STORAGE CAPACITY IN LAKES 5, 6 & 7 = 13.8 AC-FT

DISCHARGE FROM LAKE #7 TO LAKE #6

USE 18" C.P. SLOPE = 0.40 %

FROM PIPE FLOW CHART : Q = 7.0 CFS OR 0.578 AC-FT/HR

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE REPORT

COMPUTED AC CHECKED _____ DATE 9-20-72 PAGE 6 OF _____

LAKE #8

AVERAGE SURFACE AREA = 1.70 AC.

RUNOFF FROM AREA 11 = 0.6 × 14 × 3.6 × 1/12 = 2.52 AC-FT

" " " 12 = 0.6 × 26 × 3.6 × 1/12 = 4.68 "

" " " 15 = 0.25 (8 - 1.7) × 3.6 × 1/12 = 0.47 "

DIRECT RAINFALL ON LAKE = 3.6 × 1.7 × 1/12 = 0.51 "

TOTAL RUNOFF INTO LAKE = 8.18 AC-FT

TOTAL STORAGE CAPACITY IN LAKE 8 = 6.4 AC-FT

DISCHARGE FROM LAKE #8 TO LAKES 3 & 4.

USE 24" C.P. - SLOPE = 0.15 %

FROM PIPE FLOW CHART : Q = 10 CFS OR 0.826 AC-FT/HR

ALLOW LAKE #8 TO OVERFLOW INTO SUN LAKES BLVD. WEST.

LAKES #3 & 4

AVERAGE SURFACE AREA = 4 ACRES

RUNOFF FROM AREA 5 = 0.6 × 25 × 3 × 1/12 = 3.75 AC-FT

" " " 9 = 0.6 × 14 × 3 × 1/12 = 2.10 "

" " GOLF COURSE = 0.1 × 46 × 3 × 1/12 = 1.15 "

DIRECT RAINFALL ON LAKE = 1.00 × 1/12 = 1.00 "

TOTAL RUNOFF = 8.00 AC-FT

STORAGE CAPACITY ON GOLF COURSE : 2.0 AC-FT

TOTAL STORAGE CAPACITY IN LAKES 3 & 4 = 8.13 AC-FT

FLOW RATE FROM LAKE #2 = 3.0 CFS

" " " " #8 = 10.0 CFS

TOTAL = 13.0 CFS

DISCHARGE INTO MARYLAND AVE = 13.0 CFS

PROJECTS SUN LAKES

SUBJECT MASTER DRAINAGE STUDY

COMPUTED AL CHECKED _____ DATE 9-20-72 PAGE 7 OF _____

LAKES 1 & 2

TIME OF DISCHARGE = $\frac{6.13}{0.413}$ = 14.84 HRS

DISCHARGE INTO LAKE #3 = 14.84 × 0.245 = 3.68 AC-FT

DISCHARGE INTO LAKE #5 = 14.84 × 0.165 = 2.45 AC-FT

LAKES 5, 6 & 7

TIME OF DISCHARGE = $\frac{13.20 + 2.45}{0.575}$ = 27.25 HRS

LAKE #3

ASSUME 1 HR FLOW TIME INTO LAKE

TOTAL RUNOFF INTO LAKE 3	=	8.180 AC-FT
DISCHARGE FROM LAKE 7	=	0.575 "
DISCHARGE OUT OF LAKE 3	=	−0.826 "
TOTAL LEFT	=	7.929 AC-FT

DIVERSION INTO SUN LAKES DAM = 7.92 − 6.6 = 1.32 AC-FT

TIME OF DISCHARGE = $\frac{6.6}{0.826 - 0.575}$ = 26.81 HRS

LEGEND

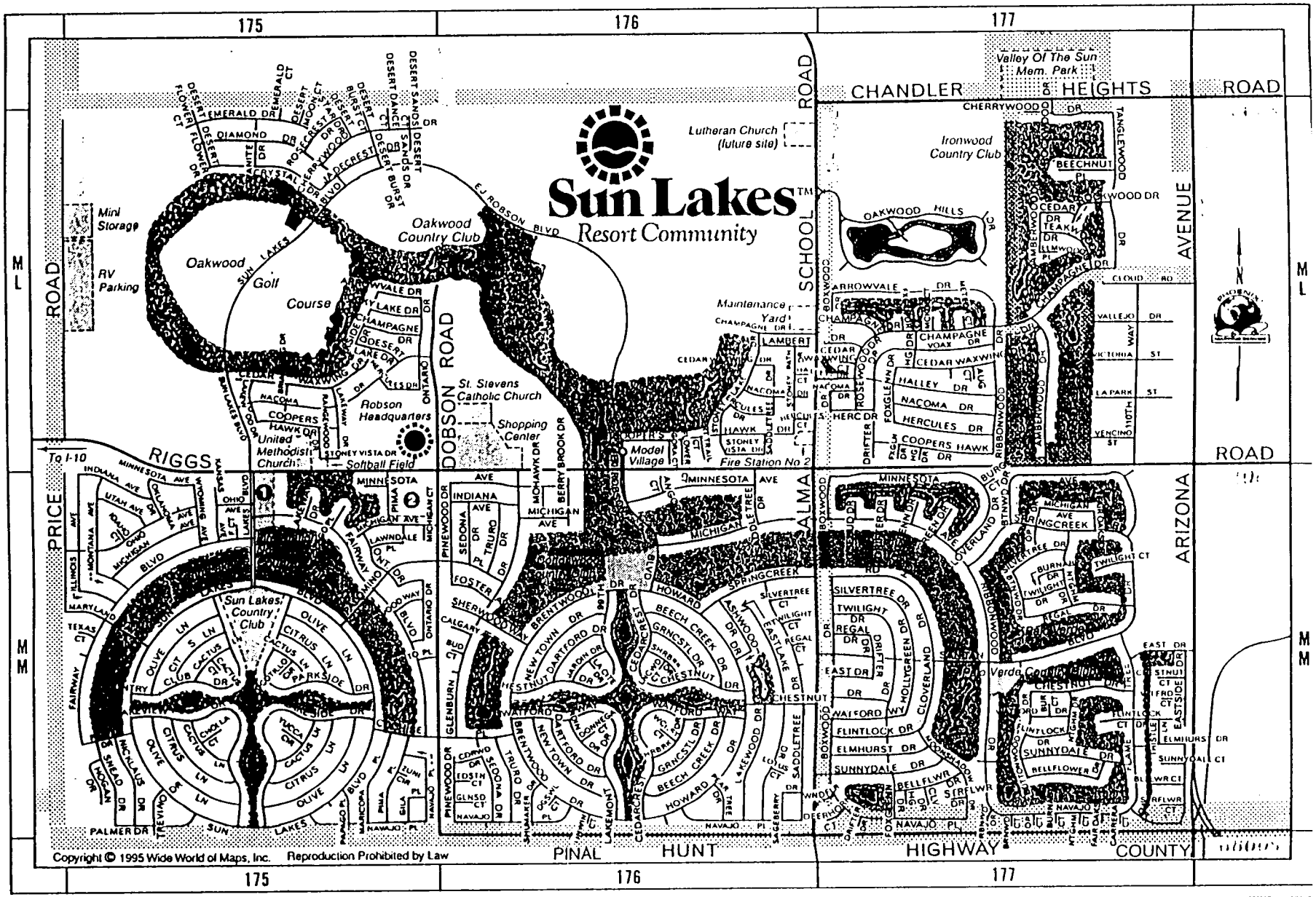
- 'een parks
- ɔil courses
- kes
- ıdress numbers
- ly limits
- ly strip annexations

1 Medical Facilities / Gas Station

2 Baptist Church (future site)

Sheriff's Posse

Sun Lakes™ Resort Community

Sun Lakes Index

MA SCHOOL RD	10400E	ML MM 176
ıBERWOOD DR	400W	ML 177
ıGORA CT	10050E	MM 176
RIZONA AVE	ZERO	MB ML 177
ıROWVALE DR	24400S	ML 175 177
ıRWOOD DR	10200E	MM 176
ıGUSTA CT (AUG)	10750E	ML 177
ıSHA RD	1000W	MJ ML 176
EECH CREEK DR	25800S	MM 176
EECHNUT PL	5200S	ML 177
ELLFLOWER CT (BLFLWR)	26600S	MM 177
ELLFLOWER DR (BLFLWR)	26475S	MM 177
ERRY BROOK DR	9900E	MM 176
OXWOOD DR (BXWD)	10450E	ML MM 177
RANCHWOOD CT (BRNWD)	10825E	MM 177
RENTWOOD DR	10000E	MM 176
RIARWING DR (BRW)	9275E	ML 175
ıO CT	26000S	MM 176
URGESS CT	9950E	MM 177
ıURNABY CT (BURN)	25250S	MM 177
ıURNABY DR	25700S	MM 177
UTTONWOOD DR (BTNWD)	10100E	MM 177
ACTUS CT (C)	21100S	MM 175
ACTUS LN	26400S	MM 175
ALGARY AVE	25900S	MM 176
ANNFIA CT	11050E	MM 177
EDAR DR	3300S	ML 177
EDAR WAXWING CT (CW)	24700S	ML 177
EDAR WAXWING DR	24700S	ML 175 177
EDARCREST DR	10050E	MM 176
EDARWOOD DR (CDRWD)	26400S	MM 176
HAMPAGNE DR	5550S	ML 177
	24600S	ML 175 177
HERRYWOOD DR	5050S	ML 177
	23700S	ML 175
HESTNUT CT	26125S	MM 177
HESTNUT DR	26200S	MM 176 177
HOLLA CT	26350S	MM 175
ITRUS LN	26400S	MM 175
LOUD RD	24400S	ML 177
LOVERLAND DR (CLV)	10650E	MM 177
OCHISE PL	26350S	MM 175 176
OOPERS HAWK DR	25100S	ML 175 177
OUNTRY CLUB DR	26400S	MM 175
RYSTAL DR	23800S	ML 175
ARTFORD DR	25800S	MM 176
EER HORN CIR	26750S	MM 177
ESERT BURST CT	9450E	ML 175
ESERT BURST DR	9450E	ML 175
ESERT DANCE CT	9500E	ML 175
ESERT FLOWER CT	9050E	ML 175
	10125E	ML 176
ESERT FLOWER DR	9075E	ML 175
ESERT LAKE DR	24650S	ML 175
ESERT MOON CT	9300E	ML 175
ESERT TRAIL CT	10175E	ML 176
ESERT SANDS CT	9550E	ML 175
ESERT SANDS DR	9550E	ML 175
ESERT STAR DR	9400E	ML 175
IAMOND DR	23700S	ML 175
ıGSWELL CT (DGSWL)	9850E	MM 176
DOBSON RD	9600E	ML MM 175
DONEGAL CT	26410S	MM 176
DRIFTER DR	10500E	ML MM 177
E J ROBSON BLVD	10000E	ML MM 176
EAST DR	28100S	MM 177
EASTLAKE DR	10250E	MM 176
EASTSIDE DR	11175E	MM 177
EDDYSTONE CT (EDSTN)	26000S	MM 176
ELMHURST DR	26400S	MM 177
ELMWOOD PL	5425S	ML 177
EMERALD CT	9250E	ML 175
EMERALD DR	23850S	ML 175
FAIR OAKS CT	11000E	MM 177
FAIR OAKS DR	11000E	MM 177
FAIRWAY BLVD	25450S	MM 175
FAIRWAY CT (F)	9150E	MM 175
FLAME TREE DR	10000E	MM 177
FLINTLOCK CT DR	26300S	MM 177
FOSTER AVE	25700S	MM 176
FOXGLENN DR (FXGLN)	10550E	ML MM 177
GILA PL	9550E	MM 175
GLENBURN DR	9700E	MM 176
GLENSIDE CT (GLNSD)	26700S	MM 176
GRANITE DR	9200E	ML 175
GREENCASTLE DR (GRNCSTL)	25950S	MM 176
HALLEY CT (HLY)	24800S	ML 176
HALLEY DR	24800S	ML 177
HERCULES CT (HERC)	24975S	ML 176
HERCULES DR (HERC)	25050S	ML 175 177
HOGAN DR	8850E	MM 175
HOLLYGREEN DR (HG)	10800E	ML MM 177
HOWARD DR	25850S	MM 176
HUNT HWY	26800S	MM 176 177
IDAHO CT	8925E	MM 175
ILLINOIS AVE	8850E	MM 175
INDIANA AVE	25300S	MM 175 176
JADECREST DR	23800S	ML 176
JARDIN DR	26000S	MM 176
KANSAS AVE	9100E	MM 175
LA CITE DR	26100S	MM 176
LAKE WOOD DR	9200E	ML 175
LAKEMONT DR	10000E	MM 176
LAKESIDE DR	9250E	MM 175
LAKEVIEW DR	26300S	MM 175
LAKEWAY DR	9300E	ML MM 175
LAKEWOOD DR	10200E	MM 176
LAMBERT DR	24650S	ML 176 177
LANCEWOOD CT (LNCWD)	26050S	MM 176
LAWNDALE PL	25500S	MM 175
LOTUS CT	26500S	MM 176
MARICOPA PL	8450E	MM 175
MARYLAND AVE	26000S	MM 175
MCCORKINDALE CT (MCKDL)	10650E	ML 177
METEOR CT	10700E	ML 177
MICHIGAN AVE	25400S	MM 175 177
MICHIGAN CT	9575E	MM 175
MINNESOTA AVE	25250S	MM 175 177
MINNESOTA CT	25250S	MM 175 177
MOHAWK DR	9850E	MM 176
MONTANA AVE	8900E	MM 175
MOONSHADOW DR	10650E	MM 177
NACOMA DR	24850S	ML 175 177
NAVAJO DR	26700S	MM 177
NAVAJO PL	26750S	MM 175 177
NEW TOWN DR	25800S	MM 176
NICKLAUS DR	8950E	MM 175
NOTTINGHAM CT	10150E	MM 177
NOTTINGHAM CT (NTGHM)	10950E	MM 177
NOTTINGHAM DR (NTGHM)	10950E	MM 177
OAKWOOD HILLS DR	24200S	ML 177
OCOTILLO CIR	9300E	MM 175
OHIO AVE	25350S	MM 175
OKLAHOMA	9000E	MM 175
OLIVE LN	26600S	MM 175
ONTARIO DR	9550E	ML MM 175
PALMER DR	26750S	MM 175
PALOMINO PL	25600S	MM 175 176
PAPAGO PL	9400E	MM 175
PARKSIDE DR	9250E	ML MM 175
PEAR TREE DR	10200E	MM 176
PIMA PL	9500E	MM 175
PINEWOOD DR	9650E	MM 176
PINTO PL	25800S	MM 175
PLAYER DR	26350S	MM 175
QUEEN PALM CT (QP)	10855E	MM 177
QUEEN PALM DR (QP)	10875E	MM 177
RANGE WOOD DR (RW)	9350E	ML 175
REGAL CT	25900S	MM 176
REGAL DR	25800S	MM 177
RIBBONWOOD DR (RBNWD)	10000E	MM 177
	10775E	ML 177
RIGGS RD	25200S	ML 169 189
ROCKWOOD DR (ROKWD)	350W	ML 177
ROCKY LAKE DR	24500S	ML 175
ROSEBUD DR	10450E	MM 177
ROSECREST DR	9350E	ML 175
ROSEWOOD DR	10475E	ML 177
SADDLETREE DR	10300E	ML MM 176
SAGEBERRY DR	10300E	MM 176
SAN TAN BLVD	26000S	MM 177
SEDONA DR	9700E	MM 176
SHERBROOK DR (SHRBRK)	26000S	MM 176
SHERWOOD WAY	25800S	MM 175 176
SHUMAKER DR	9800E	MM 176
SILVERTREE CT	25700S	MM 176
SILVERTREE DR	25800S	MM 177
SHEAD DR	8900E	MM 175
SPRINGCREEK RD	25700S	MM 176 177
STARFLOWER CT (STRFLWR)	26675S	MM 177
STARFLOWER DR (STRFLWR)	26650S	MM 177
STONEY LAKE DR	10250E	ML 176
STONEY PATH DR	10350E	ML 176
STONEY VISTA DR (SV)	25150S	ML 175 176
SUN LAKES BLVD	26700S	ML MM 175
	9200E	ML 175
SUNNYDALE CT	26500S	MM 177
SUNNYDALE DR	26450S	MM 177
TANGLEWOOD DR	200W	ML 177
TEAKWOOD DR	5375S	ML 177
TEXAS CT	26100S	MM 175
THISTLE LN	11125E	MM 177
TREVINO DR	9000E	MM 175
TRURO DR	9750E	MM 178
TWILIGHT CT	25800S	MM 176 177
TWILIGHT DR	25850S	MM 177
UNWIN CT	9900E	MM 178
UTAH	25300S	MM 175
VALLEJO DR	24600S	ML 177
VENCINO ST	25100S	ML 177
VICTORIA ST	24800S	ML 177
VILLA PARK ST	5800S	ML 177
VOAX DR	24650S	ML 177
WATFORD CT	26225S	MM 177
WATFORD DR	26200S	MM 177
WATFORD WAY	26200S	MM 176 177
WILDFLOWER CT	26700S	MM 177
WILLOWCREST CT (WCRST)	26300S	MM 176
WINDFLOWER CT (WNDFLR)	26700S	MM 177
WYOMING AVE	8100E	ML MM 175
YUCCA CIR	26350S	MM 177
ZUNI CIR	26500S	MM 177
99TH DR	9950E	MM 177
110TH WAY	200W	ML 177