LAKE SYSTEM STORM DRAINAGE MASTER PLAN

APRIL 25, 1986

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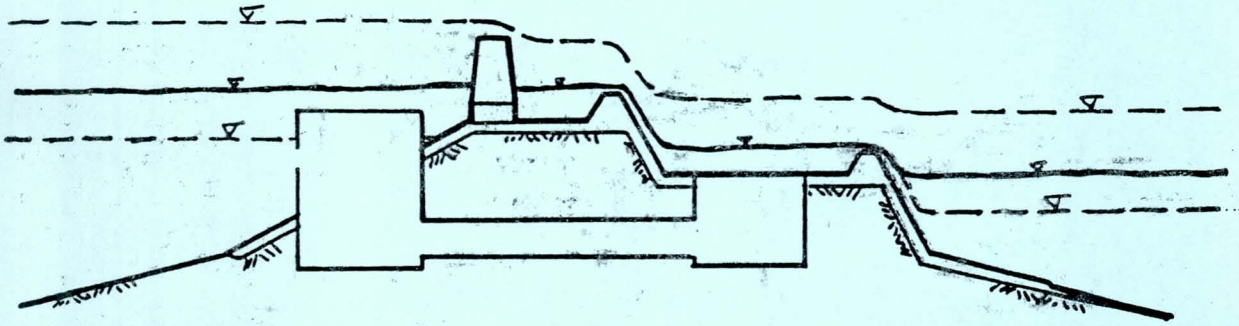
FOR

ARROWHEAD RANCH
SECTIONS 18 & 19
GLENDALE, ARIZONA



THE ARROWHEAD RANCH

PALOMA P.O. QA-5346
URS PROJECT NO. 6013

Prepared by:
URS CORPORATION
MAKING TECHNOLOGY WORK™

ARROWHEAD RANCH SECTIONS 18 AND 19

GLENDALE, ARIZONA

PROPOSED LAKE SYSTEM

STORM DRAINAGE MASTER PLAN

APRIL 25, 1986

VOLUME I EXECUTIVE SUMMARY AND MAIN REPORT
VOLUME II APPENDICES

PALOMA P.O. QA-5346

URS PROJECT NO. 6013

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EXECUTIVE SUMMARY

Arrowhead Ranch Sections 18 and 19 is a planned urban development located in the northern portion of the City of Glendale, Arizona. This development incorporates an 18 hole golf course in conjunction with a presently proposed series of approximately 18 lakes to provide storage of treated effluent for golf course irrigation in addition to providing storm water detention storage for flood control during the 100-year flood event. A hydrologic analysis of the flood control aspects of this proposed lake system was conducted for the one-hour and 24-hour 2-, 5-, 10-, 25-, 50-, and 100-year storm events using the U.S. Soil Conservation Service's TR-20 Computer Program for Project Formulation.

Lakes "B1", "B2", "D1", "H", and "I" were not incorporated into the TR-20 modeling of the proposed lake system because of their relatively small size and minimal storage volume.

The proposed lake outlet control structures are comprised of both orifice and weir flow elements. The number, size, and elevation of these orifices were sized to convey proposed lake recirculation flows based on the proposed normal upstream lake water surface elevations. The elevation and length of the proposed storm weir crests were set to limit the maximum lake water surface elevations during the 100-year event to provide at least one-foot of freeboard between the maximum 100-year lake water surface elevations and the proposed adjacent first floor building elevations. The proposed lake system will therefore provide flood protection up to the 100-year storm event. The 100-year storm event is the generally recognized nationwide standard for the design of flood protection improvements. The proposed lake system does not, however, eliminate all flood hazards because storms of greater magnitude and intensity than the 100-year design storm can and will occur.

The one-hour storm event was found to control peak lake system discharges and maximum water surface elevations in the upper portions of the system because of its intensity. The 24-hour storm was found to control peak lake system discharges and maximum water surface elevations in the lower portion of the system because of the greater total storm runoff volume associated with this storm event. 100-year peak rates of storm runoff obtained from the TR-20 model and the rational method were compared and found to be comparable provided the higher value from either the 1-hour or 24-hour storm is selected for comparison from the TR-20 model. It is recommended that planners and engineers utilizing the rational method to prepare subdivision drainage reports compare the

peak rates of storm runoff obtained using the rational method with both the 1-hour and 24-hour rates obtained from the TR-20 output contained in the Appendix as a check on the correct order of magnitude of peak storm runoff. It should be noted that the peak rates of storm runoff from the TR-20 output data, contained in the Appendix, do not include recirculation flows.

Parcel buyers and builders are assumed to be responsible for providing drainage improvements within their parcels in accordance with local storm drainage design criteria except for detention storage, which is provided by the proposed lake system, and also in accordance with the drainage basin boundaries and flow patterns delineated in this report. Any deviation from the major basin boundaries or flow patterns delineated in this report could significantly alter the results of this study. Drainage features of special note to be constructed by individual parcel buyers or builders include, but are not limited to, those discussed in this report. It is recommended that parcel development planners and engineers incorporate surface drainage elements such as streets, shallow swales and rundowns whenever possible to minimize the cost of storm sewer improvements. Should storm sewers, however, be deemed necessary they should generally be sized based on outlet control conditions because the normal and flood stage lake water surface elevations are relatively close to the surrounding ground elevations which results in high tailwater conditions at the storm sewer outfall. A minimum of six inches of freeboard is recommended between the design water surface elevation in the storm sewer inlet box and the elevation of the inlet apron or grate.

The planned lake outlet structure for Lake "W1" is affected by downstream conditions in the planned outfall channel to New River. The developer(s) of Sections 13 and 24 which are located to the west and downstream of planned Arrowhead Ranch Sections 18 and 19, must exercise caution in the planning and development of Sections 13 and 24 to assure that downstream drainage improvements do not adversely affect the proposed Lake "W1" outlet structure.

Concrete cutoff walls and riprap erosion protection are recommended at locations where the planned streams outfall into lakes or ponds.

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ARIZ

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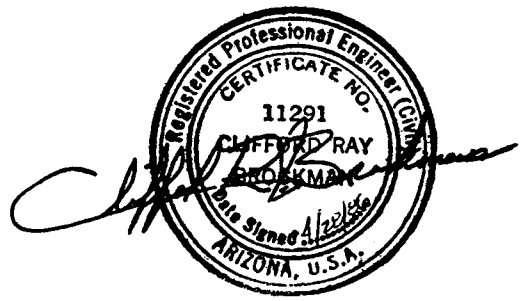

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INTRODUCTION

Arrowhead Ranch Sections 18 and 19 is a proposed urban development located in the northern portion of the City of Glendale, Arizona. The site of this proposed development, shown in Figure 1, encompasses a total of approximately 733 acres and is bounded by 59th Avenue on the east, Beardsley Road on the south, 67th Avenue on the west, and Thunderbird Park on the north. The general drainage pattern within the proposed development is from north to southwest towards the confluence of New River and Skunk Creek.

PURPOSE

This report presents analysis, design and flood control operation data associated with the proposed Arrowhead Ranch Sections 18 and 19 lake system located within the City of Glendale, Arizona.

The specific purposes of this report are to provide the Paloma Corporation with the following information:

- A storm drainage report suitable for submittal to the City of Glendale, Arizona for approval of the flood control elements of the proposed lake system.
- The basis of design of the flood control elements of the proposed lake system and associated lake outlet control structures and cross culverts.
- A master storm drainage report suitable for use by future on-site developers as a reference regarding the proposed lake system and assumed on-site drainage patterns.

ACKNOWLEDGEMENTS

This report was prepared by URS Corporation for the Paloma Corporation under Paloma Purchase Order QA-5346. The Paloma Corporation of Glendale, Arizona provided URS Corporation with base mapping, previous reports, design plans, and field survey data. Pacific Engineering of Westminster, California provided URS with base data related to the proposed lake system in addition to invaluable discussions and suggestions.

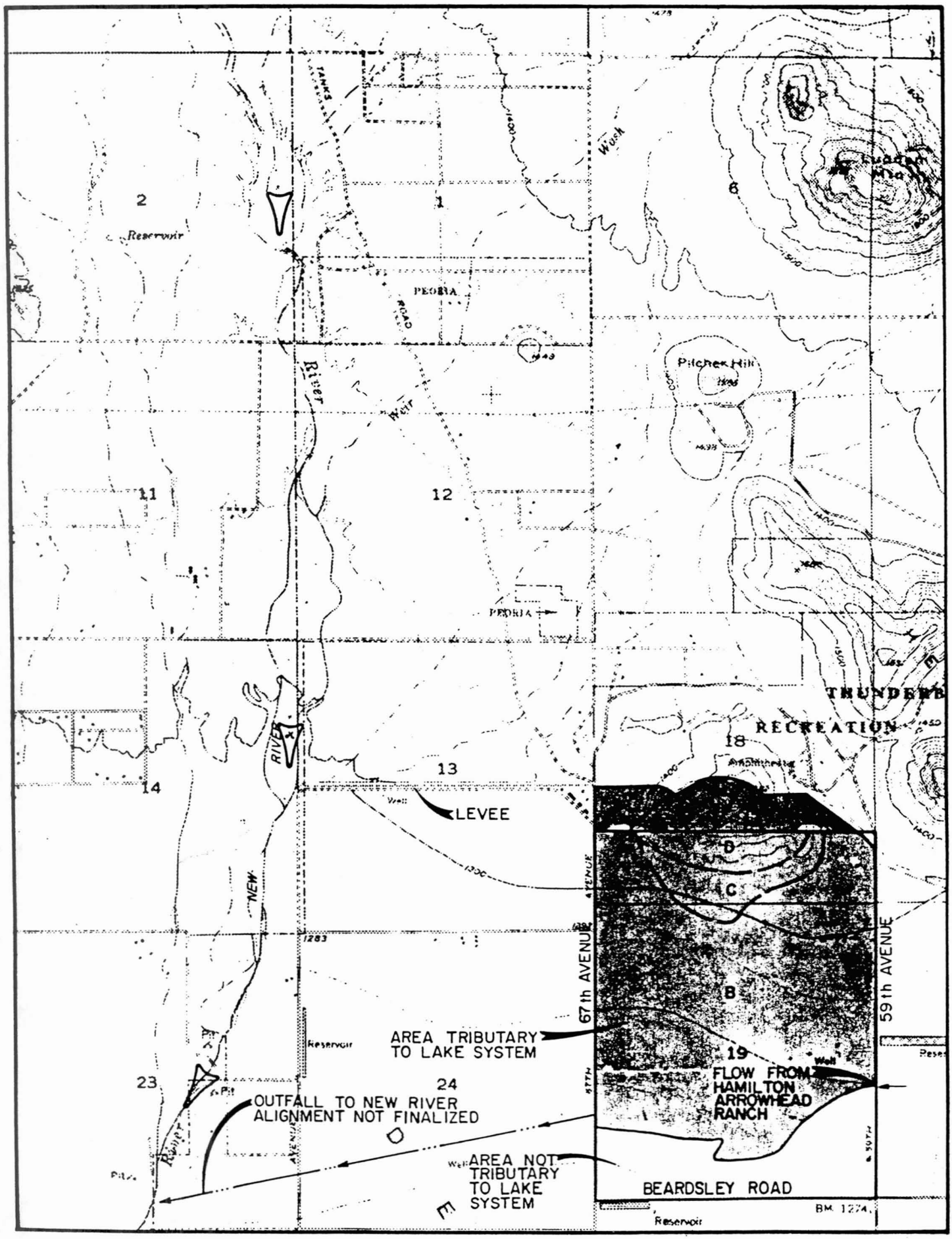

2
1
6
Reservoir
PEORIA
Pilcher Hill
River
Wash
11
12
PEORIA
THUNDERB
RECREATION
18
13
14
LEVEE
NEW
RIVER
D
C
B
67th AVENUE
59th AVENUE
AREA TRIBUTARY
TO LAKE SYSTEM
19
FLOW FROM
HAMILTON
ARROWHEAD
RANCH
23
24
OUTFALL TO NEW RIVER
ALIGNMENT NOT FINALIZED
AREA NOT
TRIBUTARY
TO LAKE
SYSTEM
BEARDSLEY ROAD
BM 1274
Reservoir

FIGURE 1

SITE DESCRIPTION

The proposed Arrowhead Ranch Sections 18 and 19 development site encompasses a total of approximately 733 acres. The site is bounded by 59th Avenue to the east, Beardsley Road on the south, 67th Avenue on the west and Thunderbird Park on the north. The site slopes towards the south. The gradient at the north property boundary is 20 percent. The gradient at Beardsley Road is approximately 0.50 percent. The site was originally used for agricultural purposes, principally citrus groves. Numerous irrigation berms and ditches are interspersed throughout the site. An 18 hole golf course has been constructed within the site and the various elements of the proposed lake system are presently at various stages of completion. Offsite storm runoff from an area encompassing approximately 75.3 acres enters the site from the north. Offsite storm runoff from 59th Avenue enters the site from the east at two locations by means of storm sewers and entrance roads. Offsite storm runoff from the Hamilton Arrowhead Ranch Subdivision, located east of 59th Avenue, enters the proposed "Z" series of lakes from the east by means of storm sewer pipes. Offsite storm runoff from 67th Avenue enters the site from the west approximately 180 feet north of proposed Deer Valley Road by means of two 17-foot curb opening inlets and a 24-inch diameter storm sewer.

MAJOR WATER COURSES

New River drains from north to south approximately 1.5 miles west of 67th Avenue. As presently planned storm runoff released from the proposed lake system at the west end of Lake "W1" will cross 67th Avenue by means of three 48-inch diameter RCP culverts and a 14'x9'-8" structural plate arch golf cart crossing and then outfall approximately 7,300 feet to New River by means of an open channel having a 20-foot bottom width, side slopes of 2H to 1V and a bed slope of approximately 0.15 percent. A report entitled Technical Data for Request for a Letter of Map Amendment for New River in Glendale, Arizona prepared by Carter Associates, Inc. of Phoenix, Arizona March 1984 discusses floodway and floodplain boundaries and water surface profiles on New River. No attempt was made to verify the results of this study.

PROPOSED LAKE SYSTEM HYDROLOGY

Onsite drainage areas, flow patterns, hydrologic soil groups, proposed lakes and streams associated with the proposed Arrowhead Ranch Sections 18 and 19 development are shown in Figure 2 which is attached to the back of this report. A schematic diagram of the proposed lake system is shown in Figure 3 which is attached to the back of this report.

PREVIOUS REPORTS

Previous reports related to storm runoff and drainage improvements in the vicinity of Arrowhead Ranch Sections 18 and 19 are listed as follows:

- Preliminary Storm Drainage Master Plan
  Arrowhead Ranch
  Glendale, Arizona
  July, 1982
  Prepared by Dibble and Associates,
  Phoenix, Arizona

- Hydrology and Hydraulics Report for Hamilton Arrowhead Ranch
  February, 1985
  Revised March, 1985
  Prepared by Clouse Engineering, Inc.
  Phoenix, Arizona

DESIGN CRITERIA

Storm drainage design criteria for the proposed lake system were obtained from Design Guidelines for Site Development and Infrastructure Construction, City of Glendale, Arizona, Second Edition 1985. The City of Glendale's general policies upon which these criteria are based are presented as follows:

- "It is the City's policy that all development within the City shall be designed and constructed in such manner as to provide a safe and pleasant environment for the future citizens of Glendale. To that end, the appropriate standards have been established for site development to include: public and/or private access for general and special uses; public water and sewerage systems; on-site and off-site drainage; landscaping; storm retention; and street lighting and public utilities as may be required.

The structures themselves are to be constructed in accordance with the Subdivision and/or Zoning Ordinance, the current adopted Uniform Building Code, Standard Specification and these guidelines, as appropriate."

- "It is not intended by these guidelines to repeal, abrogate, annul, or in way impair or interfere with existing provisions of other laws or ordinances except those specifically repealed with private agreement, or with restrictive covenants running with the land to which the City is a party. Where these guidelines impose a greater restriction on land, building, or structures than is imposed or required by such existing provisions of law, ordinance, contract, or deed, the provision of these guidelines shall prevail."

- "It is the City's policy that all developments within the City shall provide sufficient retention so as to minimize the adverse impact to that development on its downstream neighbors. To that end, all development shall provide sufficient on-site retention to contain, at the least, the runoff generated by 10-year two-hour storm falling on that property. Such retention facilities shall be separate and distinct parcels within the development and shall be planned for accordingly. In single-family developments this facility may be turned over to the City for operation and maintenance, presuming it meets those requirements as indicated in the Grading and Drainage Ordinance and in the appropriate sections of these guidelines."

  "Further, it is the City's policy that all developments shall provide adequate drainage facilities so as to convey runoff generated both on and off the project around or through the project in such a manner as to insure that the structures will be free from flooding and that there is reasonable access for emergency and public service vehicles. The developer shall install storm sewer, channels and/or other physical improvements necessary to achieve this result."

Specific storm drainage design criteria incorporated into the analysis of the proposed lake system are as follows:

DESIGN STORM

The proposed lake system is designed to provide flood protection up to the 100-year storm event. The 100-year storm event is the generally recognized nationwide standard for the design of flood protection improvements. The proposed lake system does not,

however, eliminate all flood hazards because storms of greater magnitude and intensity than the 100-year design storm can and will occur.

MAXIMUM ALLOWABLE LAKE FLOOD STAGE ELEVATION

Maximum allowable lake water flood stage elevations were set to provide at least one foot of freeboard between the maximum 100-year lake flood stage elevation and the proposed adjacent first floor building elevations.

DESIGN ASSUMPTIONS

Due to the preliminary status of the present development plans, it was necessary to make assumptions regarding land use characteristics, boundaries, flow patterns, and routings. Any deviation from the assumptions presented herein could significantly alter the results of this study.

It is URS' understanding that most of the proposed lakes were designed to store a maximum of two vertical feet of treated effluent below "normal" lake water surface elevation for golf course irrigation. The "normal" lake water surface elevations used in the analysis of the proposed lake system assume that the lakes are full to capacity with treated effluent when the design storm occurs. "Low" lake water surface elevations are by definition two feet below "normal" lake water surface elevations. At "low" water conditions no treated effluent is stored within the proposed lake system for golf course irrigation.

Parcel buyers and builders are assumed to be responsible for providing drainage improvements within their parcels in accordance with local storm drainage design criteria, except for detention storage which is provided by the proposed lake system, and also in accordance with the drainage basin boundaries and flow patterns shown in Figure 2. It is the responsibility of the City of Glendale, Arizona and also the Paloma Corporation to ensure compliance with these requirements. Any deviation from the major basin boundaries or flow patterns delineated in Figures 1 and 2 could significantly alter the results of this study.

DRAINAGE BASIN DELINEATION

Off-site drainage areas located north of the proposed development and tributary to the proposed lake system were delineated using the U.S.G.S. 7-1/2 minute quadrangle mapping of Hedgpeth Hills, Arizona (photo revised 1981). These off-site drainage areas are shown in Figure 1.

An existing berm or levee extends from west to east between New River and 67th Avenue at about the center of Section 13, Township 4 North, Range 1 East. This levee is intended to intercept storm runoff from the north and carry it to the west to New River. This levee does not presently extend to the east of 67th Avenue. It is our understanding however that the City of Glendale is going to require the developers of the parcel located east of 67th avenue and north of the existing levee (extended) to extend this levee east of 67th Avenue and construct adequate cross drainage improvements to intercept and convey the estimated 100-year storm runoff from the north to New River via the existing levee along the center of Section 13.

Off-site drainage areas from the east from 59th Avenue were delineated based on the street plans for 59th Avenue.

Off-site drainage areas from the west from 67th Avenue were delineated based on the 67th Avenue street plans.

Off-site flows tributary to the proposed Section 18 and 19 lake system from the Section 20 development located east of 59th Avenue were obtained from the Preliminary Storm Drainage Master Plan of July 1982 prepared by Dibble and Associates and the Hydrology and Hydraulics Report for Hamilton Arrowhead Ranch revised March of 1985 prepared by Clouse Engineering, Inc.

On-site drainage areas and flow patterns associated with the proposed lake system are shown in Figure 2. These on-site drainage areas were delineated based on the following information:

- U.S.G.S. 7-1/2 minute quadrangle mapping of Hedgepeth Hills, Arizona
- 1" = 40' Grading Plan prepared by Pacific Engineering
- Conceptual Sketch Plan, prepared by Florian Martinez Associates 7/10/85
- Preliminary Storm Drainage Master Plan prepared by Dibble and Associates, dated July 1982.

- Hydrology and Hydraulics Report for Hamilton Arrowhead Ranch
  Prepared by Clouse Engineering, Inc.
  Revised March 1985

- Street plans for 59th and 67th Avenues.

The 1" = 40' Grading Plan prepared by Pacific Engineering shows existing ground contours, proposed finished grade elevations and the as-constructed contours of the golf course. The 1" = 300' Conceptual Sketch Plan prepared by Florian Martinez Associates 07/10/85 shows proposed land uses and street layouts. These plans were used in conjunction to delineate major on-site basin boundaries and flow patterns.

Any deviation from the major basin boundaries or flow patterns delineated in Figures 1 and 2 could significantly alter the results of this study.

HYDROLOGIC SOILS DATA

Hydrologic soils data were obtained from the U.S. Soil Conservation Services (SCS) Soil Survey of Maricopa County, Central Part issued September 1977. On-site hydrologic soil groups in the vicinity of the project site are shown in Figures 1 and 2. On-site soils are principally group B hydrologic soils having moderate infiltration rates when thoroughly wetted however the soils in the northern portion of the site and the off-site areas to the north are group C and D soils which have slow to very slow infiltration rates when thoroughly wetted and a high runoff potential.

LAND USE

Assumed land uses within the project site are shown in Figure 2. These land uses were based on the Development Parcel Map dated 5/13/85 prepared by Florian Martinez Associates.

ANTECEDENT MOISTURE CONDITION

Antecedent moisture conditions affect the amount of runoff which infiltrates into the soil. In the SCS procedure antecedent moisture conditions are determined by the total rainfall during the five day period preceeding the design storm. The SCS has identified three levels of antecedent moisture conditions; AMC-I, AMC-II, and AMC-III. AMC-I representes the lower (dry) soil moisture limit and AMC-III

represents the upper (wet) soil moisture limit. This study assumes average soil moisture conditions corresponding to AMC-II.

RUNOFF CURVE NUMBERS

Runoff curve numbers used in the TR-20 analysis of the proposed lake system were obtained from the City of Phoenix Storm Drain Design Manual dated September, 1985 in conjunction with the U.S. Soil Conservation Service Technical Release TR-55 Urban Hydrology for Small Watersheds and are presented in Table 1. Off-site drainage areas located north of the project site were assumed to have a desert brush cover complex with a 10% cover density. Composite sub-basin runoff curve numbers were calculated based on area, land use and hydrologic soil groups within each sub-basin. These calculations are presented in Table 2.

RAINFALL DEPTHS AND DISTRIBUTIONS

Rainfall depth and frequency data for the 2-, 5-, 25-, 50-, and 100-year storm events, obtained from the City of Phoenix Storm Drain Design Manual of September 1985, are presented in Table 3. These rainfall data are slightly higher than the rainfall depths obtained using precipitation maps prepared by the U.S. Weather Bureau for the U.S. Soil Conservation Service in March 1967 and revised by the Arizona Highway Department in 1970 in conjunction with the rainfall analysis procedures presented in Hydrologic Design for Highway Drainage in Arizona dated December 1, 1968 and revised March 1969 as shown in Figure 4.

Rainfall data obtained from the City of Phoenix Storm Drain Design Manual dated September 1985 were used in the lake system analysis for the following reasons:

- To maintain consistency with the overall Preliminary Storm Drainage Master Plan of July 1982.
- Differences in rainfall depth are relatively minor for the 24-hour storm event which generally controls the proposed lakes system peak discharges and maximum flood stage water surface elevations.
- The rainfall depths obtained from the City of Phoenix Storm Drain Design Manual of September 1985 are conservative.

TABLE 1
RUNOFF CURVE NUMBERS BASED ON ZONING, LAND USE AND SOIL GROUP
ARROWHEAD RANCH, SECTIONS 18 & 19
GLENDALE, ARIZONA
PALOMA CORP. P.O. QA-5346
URS PROJECT NO. 6013
FEBRUARY 27, 1986
FILE: ARROWCN

RUNOFF CURVE NUMBERS FOR ONSITE DEVELOPED AREAS

ZONING	SOIL GROUP B	SOIL GROUP C	SOIL GROUP D
R1-8	82	87	90
R1-6	84	88	90
R-3	85	88	90
R-4	86	89	91

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985, PAGE 15

LAND USE	SOIL GROUP B	SOIL GROUP C	SOIL GROUP D
GOLF COURSE AND LAWNS	61	74	80
LAKES	98	98	98
STREETS	98	98	98

SOURCE: TR-55 URBAN HYDROLOGY FOR SMALL WATERSHEDS
U.S. SOIL CONSERVATION SERVICE

RUNOFF CURVE NUMBERS FOR OFFSITE UNDEVELOPED AREAS

ASSUMED COVER DENSITY %	SOIL GROUP B	SOIL GROUP C	SOIL GROUP D
10	83	89	92
20	83	88	91
30	82	88	91
40	81	87	90
50	81	86	89

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985, PAGE 20

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA TABLE 2
PALOMA P.O. DA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - ONSITE
* SEE OFFSITE/ONSITE CURVE NUMBER CALCULATIONS PG 6 OF 6 FOR FINAL CN
FILE: AHCOMPCN REVISED APRIL 25, 1986
PAGE 1 OF 6

(1) DESIGN POINT	(2) LAKE	(3) TOTAL AREA (sqmi)	(4) TOTAL AREA (ac)	(5) LAND USE	(6) AREA (sqmi)	(7) AREA (ac)	(8) SUB-AREA (sqmi)	(9) SUB-AREA (ac)	(10) SOIL GROUP	(11) SUB-AREA CN	(12) CN x A	(13) sum CN x A/At (CN)
11	D	0.0301	19.26									
				G.C.	0.0084	5.38						
							0.0055	3.52	D	80	0.4400	
							0.0029	1.86	C	74	0.2146	
				LAKE D	0.0014	0.90	0.0014	0.90		98	0.1372	
				R-4	0.0203	12.99						
							0.0142	9.09	D	91	1.2922	
							0.0061	3.90	C	89	0.5429	
TOTAL					0.0301	19.26	0.0301	19.26			2.6269	87 *
12	C	0.0200	12.80									
				G.C.	0.0037	2.37						
							0.0024	1.54	D	80	0.1920	
							0.0013	0.83	C	74	0.0962	
				LAKE C	0.0019	1.22	0.0019	1.22		98	0.1862	
				R-4	0.0144	9.22						
							0.0052	3.33	D	91	0.4732	
							0.0092	5.89	C	89	0.8188	
TOTAL					0.0200	12.80	0.0200	12.80			1.7664	88 *
13	B	0.1040	66.56									
				67th	0.0068	4.35	0.0068	4.35		94	0.6392	
				G.C.	0.0145	9.28						
							0.0013	0.83	D	80	0.1040	
							0.0061	3.90	C	74	0.4514	
							0.0071	4.54	B	61	0.4331	
				LAKE B	0.0014	0.90	0.0014	0.90		98	0.1372	
				R-4	0.0813	52.03						
							0.0123	7.87	D	91	1.1193	
							0.0077	4.93	C	89	0.6853	
							0.0613	39.23	B	86	5.2718	
TOTAL					0.1040	66.56	0.1040	66.56			8.8413	85 *
14		0.0245	15.68									
				G.C.	0.0006	0.38	0.0006	0.38	B	61	0.0366	
				R-4	0.0239	15.30						
							0.0061	3.90	C	89	0.5429	
							0.0178	11.39	B	86	1.5308	
TOTAL					0.0245	15.68	0.0245	15.68			2.1103	86

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA TABLE 2
PALOMA P.O. QA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - ONSITE
* SEE OFFSITE/ONSITE CURVE NUMBER CALCULATIONS PG 6 OF 6 FOR FINAL CN
FILE: AHCOMPCN REVISED APRIL 25, 1986
PAGE 2 OF 6

(1) DESIGN POINT	(2) LAKE	(3) TOTAL AREA (sqmi)	(4) TOTAL AREA (ac)	(5) LAND USE	(6) AREA (sqmi)	(7) AREA (ac)	(8) SUB-AREA (sqmi)	(9) SUB-AREA (ac)	(10) SOIL GROUP	(11) SUB-AREA CN	(12) CN x A	(13) sum CN x A/At (CN)
014		0.0145	9.28									
				G.C.	0.0116	7.42	0.0116	7.42	B	61	0.7076	
				D.V.RD	0.0029	1.86	0.0029	1.86		98	0.2842	
TOTAL					0.0145	9.28	0.0145	9.28			0.9918	68
015		0.0213	13.63									
				G.C.	0.0213	13.63	0.0213	13.63	B	61	1.2993	
TOTAL					0.0213	13.63	0.0213	13.63			1.2993	61
21	E	0.0569	36.42									
				G.C.	0.0125	8.00						
							0.0034	2.18	D	80	0.2720	
							0.0091	5.82	C	74	0.6734	
				LAKE E	0.0043	2.75	0.0043	2.75		98	0.4214	
				R-4	0.0401	25.66						
							0.0119	7.62	D	91	1.0829	
							0.0132	8.45	C	89	1.1748	
							0.0150	9.60	B	86	1.2900	
TOTAL					0.0569	36.42	0.0569	36.42			4.9145	86 *
22	G	0.0138	8.83									
				LAKE G	0.0005	0.32	0.0005	0.32		98	0.0490	
				R-4	0.0133	8.51	0.0133	8.51	B	86	1.1438	
TOTAL					0.0138	8.83	0.0138	8.83			1.1928	86
022		0.0205	13.12									
				R-1	0.0205	13.12	0.0205	13.12	B	84	1.7220	
TOTAL					0.0205	13.12	0.0205	13.12			1.7220	84
31	F	0.0611	39.10									
				G.C.	0.0135	8.64	0.0135	8.64	B	61	0.8235	
				LAKE F	0.0041	2.62	0.0041	2.62		98	0.4018	
				R-4	0.0435	27.84	0.0435	27.84	B	86	3.7410	
TOTAL					0.0611	39.10	0.0611	39.10			4.9663	81 *
031		0.0087	5.57									
TOTAL				R-4	0.0087	5.57	0.0087	5.57	B	86	0.7482	86

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA TABLE 2
PALOMA P.O. QA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - ONSITE
* SEE OFFSITE/ONSITE CURVE NUMBER CALCULATIONS PG 6 OF 6 FOR FINAL CN
FILE: AHCOMPCN REVISED APRIL 25, 1986
PAGE 3 OF 6

(1) DESIGN POINT	(2) LAKE	(3) TOTAL AREA (sqmi)	(4) TOTAL AREA (ac)	(5) LAND USE	(6) AREA (sqmi)	(7) AREA (ac)	(8) SUB-AREA (sqmi)	(9) SUB-AREA (ac)	(10) SOIL GROUP	(11) SUB-AREA CN	(12) CN x A	(13) sum CN x A/At (CN)
032		0.0074	4.74									
				G.C.	0.0051	3.26	0.0051	3.26	B	61	0.3111	
				R-1	0.0023	1.47	0.0023	1.47	B	84	0.1932	
TOTAL					0.0074	4.74	0.0074	4.74			0.5043	68
35	J	0.0335	21.44									
				G.C.	0.0072	4.61	0.0072	4.61	B	61	0.4392	
				LAKE J	0.0039	2.50	0.0039	2.50		98	0.3822	
				R-1	0.0224	14.34	0.0224	14.34	B	84	1.8816	
TOTAL					0.0335	21.44	0.0335	21.44			2.7030	81
36	J1	0.0463	29.63									
				G.C.	0.0039	2.50	0.0039	2.50	B	61	0.2379	
				LAKE J1	0.0016	1.02	0.0016	1.02		98	0.1568	
				R-1	0.0408	26.11	0.0408	26.11	B	84	3.4272	
TOTAL					0.0463	29.63	0.0463	29.63			3.8219	83
37	U	0.0103	6.59									
				LAKE U	0.0007	0.45	0.0007	0.45		98	0.0686	
				R-1	0.0096	6.14	0.0096	6.14	B	84	0.8064	
TOTAL					0.0103	6.59	0.0103	6.59			0.8750	85
038		0.0365	23.36									
				R-1	0.0365	23.36	0.0365	23.36	B	84	3.0660	
TOTAL					0.0365	23.36	0.0365	23.36			3.0660	84
40		0.0219	14.02									
				R-1	0.0219	14.02	0.0219	14.02	B	84	1.8396	
TOTAL					0.0219	14.02	0.0219	14.02			1.8396	84
41		0.0137	8.77									
				G.C.	0.0137	8.77	0.0137	8.77	B	61	0.8357	
TOTAL					0.0137	8.77	0.0137	8.77			0.8357	61

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA TABLE 2
PALOMA P.O. QA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - ONSITE
* SEE OFFSITE/ONSITE CURVE NUMBER CALCULATIONS PG 6 OF 6 FOR FINAL CN
FILE: AHCOMPCN REVISED APRIL 25, 1986
PAGE 4 OF 6

(1) DESIGN POINT	(2) LAKE	(3) TOTAL AREA (sqmi)	(4) TOTAL AREA (ac)	(5) LAND USE	(6) AREA (sqmi)	(7) AREA (ac)	(8) SUB-AREA (sqmi)	(9) SUB-AREA (ac)	(10) SOIL GROUP	(11) SUB-AREA CN	(12) CN x A	(13) sum CN x A/At (CN)
42	R	0.1282	82.05									
				LAKE R	0.0115	7.36	0.0115	7.36		98	1.1270	
				R-1	0.1167	74.69	0.1167	74.69	B	84	9.8028	
TOTAL					0.1282	82.05	0.1282	82.05			10.9298	85
43	V	0.0056	3.58									
				G.C.	0.0028	1.79	0.0028	1.79	B	61	0.1708	
				LAKE V	0.0026	1.66	0.0026	1.66		98	0.2548	
				R-4	0.0002	0.13	0.0002	0.13	B	86	0.0172	
TOTAL					0.0056	3.58	0.0056	3.58			0.4428	79
44	W	0.0551	35.26									
				G.C.	0.0169	10.82	0.0169	10.82	B	61	1.0309	
				LAKE W	0.0054	3.46	0.0054	3.46		98	0.5292	
				R-4	0.0328	20.99	0.0328	20.99	B	86	2.8208	
TOTAL					0.0551	35.26	0.0551	35.26			4.3809	80
45	W1	0.0319	20.42									
				LAKE W1	0.0049	3.14	0.0049	3.14		98	0.4802	
				R-4	0.0270	17.28	0.0270	17.28	B	86	2.3220	
TOTAL					0.0319	20.42	0.0319	20.42			2.8022	88
72	Z3	0.0270	17.28									
				LAKE Z3	0.0015	0.96	0.0015	0.96		98	0.1470	
				59th	0.0143	9.15	0.0143	9.15		98	1.4014	
				R-3	0.0112	7.17	0.0112	7.17	B	85	0.9520	
TOTAL					0.0270	17.28	0.0270	17.28			2.5004	93
73	Z2	0.0093	5.95									
				LAKE Z2	0.0011	0.70	0.0011	0.70		98	0.1078	
				R-3	0.0082	5.25	0.0082	5.25	B	85	0.6970	
TOTAL					0.0093	5.95	0.0093	5.95			0.8048	87

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA TABLE 2
PALOMA P.O. QA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - ONSITE
* SEE OFFSITE/ONSITE CURVE NUMBER CALCULATIONS PG 6 OF 6 FOR FINAL CN
FILE: AHCOMPCN REVISED APRIL 25, 1986
PAGE 5 OF 6

(1) DESIGN POINT	(2) LAKE	(3) TOTAL AREA (sqmi)	(4) TOTAL AREA (ac)	(5) LAND USE	(6) AREA (sqmi)	(7) AREA (ac)	(8) SUB-AREA (sqmi)	(9) SUB-AREA (ac)	(10) SOIL GROUP	(11) SUB-AREA CN	(12) CN x A	(13) sum CN x A/At (CN)
74	Z1	0.0058	3.71									
				LAKE Z1	0.0011	0.70	0.0011	0.70		98	0.1078	
				R-3	0.0047	3.01	0.0047	3.01	B	85	0.3995	
TOTAL					0.0058	3.71	0.0058	3.71			0.5073	87
75	Z	0.0510	32.64									
				LAKE Z	0.0054	3.46	0.0054	3.46		98	0.5292	
				R-3	0.0456	29.18	0.0456	29.18	B	85	3.8760	
TOTAL					0.0510	32.64	0.0510	32.64			4.4052	86

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA
PALOMA P.O. DA-5346 URS PROJ NO. 6013
COMPOSITE RUNOFF CURVE NUMBER CALCULATIONS - OFFSITE/ONSITE AREAS
FILE: AHCOMPCN

(1) DESIGN POINT	(2) LAKE	(3) ONSITE AREA (sqmi)	(4) ONSITE sum CNxA	(5) OFFSITE AREA (sqmi)	(6) OFFSITE SOIL GROUP	(7) OFFSITE CN	(8) OFFSITE CNxA	(9) ONSITE & OFFSITE sum CNxA	(10) sum CN x A/At (CN)
11	D	0.0301	2.6269	0.0100	D	92	0.9200		
TOTAL				0.0100			0.9200	3.5469	88
12	C	0.0200	1.7664	0.0273	D	92	2.5116		
TOTAL				0.0273			2.5116	4.2780	90
13	B	0.1040	8.8413						
				0.0302	D	92	2.7784		
				0.0100	B	83	0.8300		
TOTAL				0.0402			3.6084	12.4497	86
21	E	0.0569	4.9145	0.0172	D	92	1.5824		
TOTAL				0.0172			1.5824	6.4969	88
31	F	0.0611	4.9663						
				0.0057	D	92	0.5244		
				0.0086	C	89	0.7654		
				0.0087	B	83	0.7221		
TOTAL				0.0230			2.0119	6.9782	83

TABLE 3
RAINFALL DEPTHS AND DISTRIBUTIONS
ARROWHEAD RANCH, SECTIONS 18 & 19
GLENDALE, ARIZONA
PALOMA CORP. P.O. QA-5346
URS PROJECT NO. 6013
FEBRUARY 27, 1986
FILE: ARHDRAIN
PAGE 1 OF 2

RAINFALL DEPTH (INCHES)

	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
1-HOUR	0.88	1.30	1.61	2.02	2.35	2.66
24-HOUR	1.44	2.10	2.53	3.12	3.57	4.04

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985

RAINFALL DEPTHS FOR DURATIONS LESS THAN 1 HOUR

DURATIONS (MINUTES)	5	10	15	30
RATIO TO 1 HOUR	0.29	0.45	0.57	0.79

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985

1-HOUR RAINFALL DISTRIBUTION

TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL
0.000	0.000	0.250	0.105	0.500	0.500	0.750	0.895
0.042	0.015	0.292	0.139	0.542	0.645	0.792	0.915
0.083	0.032	0.333	0.176	0.583	0.725	0.833	0.934
0.125	0.049	0.375	0.215	0.625	0.785	0.875	0.951
0.167	0.066	0.417	0.275	0.667	0.824	0.917	0.968
0.283	0.085	0.458	0.355	0.708	0.861	0.958	0.985
						1.000	1.000

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985

TABLE 3
RAINFALL DEPTHS AND DISTRIBUTIONS
ARROWHEAD RANCH, SECTIONS 18 & 19
GLENDALE, ARIZONA
PALOMA CORP. P.O. QA-5346
URS PROJECT NO. 6013
FEBRUARY 27, 1986
FILE: ARHDRAIN
PAGE 2 OF 2

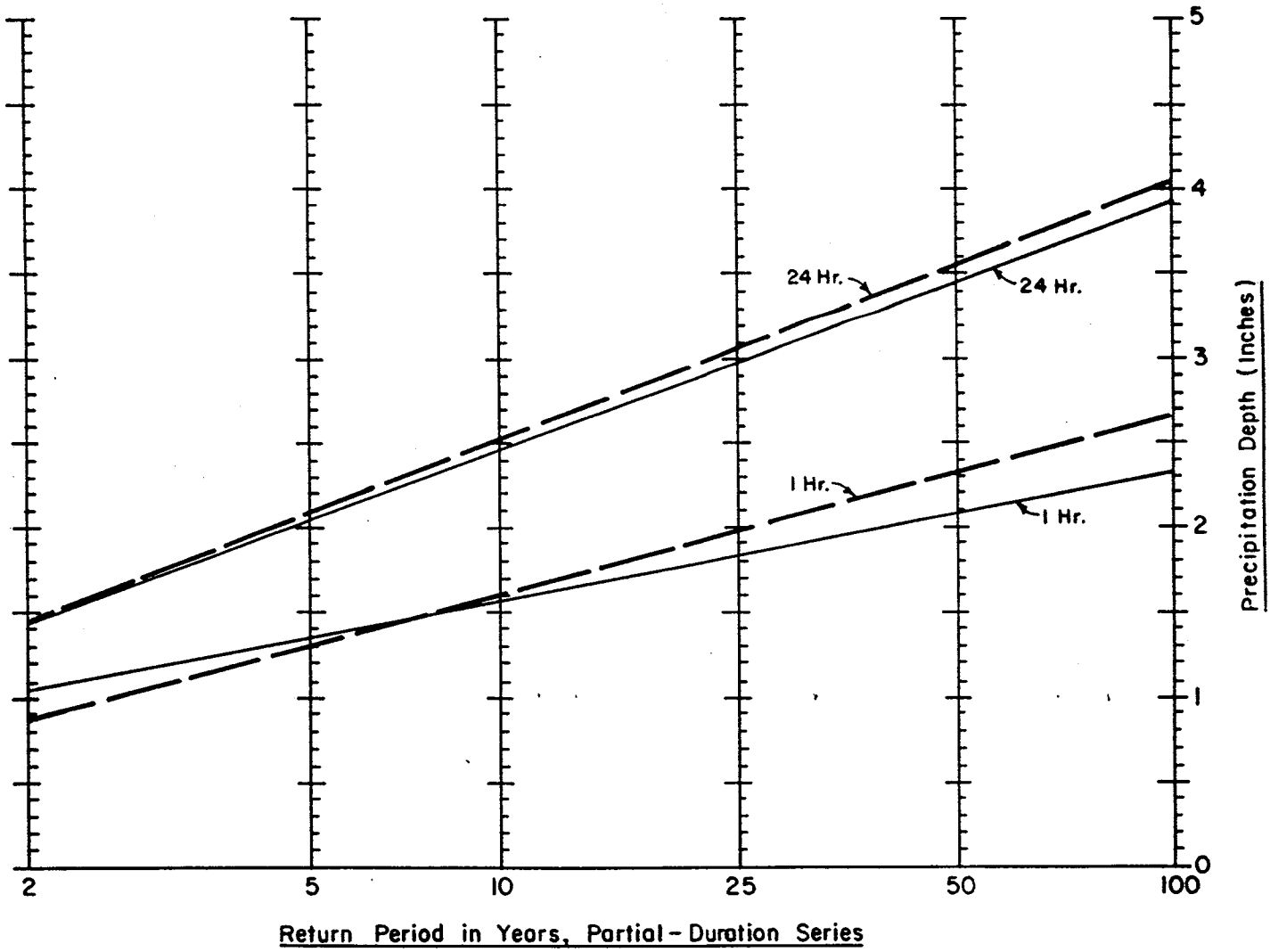
24-HOUR RAINFALL DISTRIBUTION

TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL	TIME (HOURS)	% TOTAL RAINFALL
0.000	0.000	6.000	0.053	12.000	0.500	18.000	0.947
0.500	0.004	6.500	0.057	12.500	0.830	18.500	0.951
1.000	0.008	7.000	0.062	13.000	0.860	19.000	0.956
1.500	0.013	7.500	0.066	13.500	0.880	19.500	0.960
2.000	0.018	8.000	0.071	14.000	0.893	20.000	0.964
2.500	0.022	8.500	0.075	14.500	0.907	20.500	0.969
3.000	0.026	9.000	0.080	15.000	0.920	21.000	0.973
3.500	0.031	9.500	0.093	15.500	0.924	21.500	0.978
4.000	0.035	10.000	0.107	16.000	0.928	22.000	0.982
4.500	0.040	10.500	0.120	16.500	0.933	22.500	0.987
5.000	0.044	11.000	0.140	17.000	0.937	23.000	0.991
5.500	0.048	11.500	0.170	17.500	0.942	23.500	0.995
						24.000	1.000

SOURCE: STORM DRAINAGE DESIGN MANUAL
SUBDIVISION DRAINAGE DESIGN
CITY OF PHOENIX
SEPTEMBER 1985

ARROWHEAD RANCH, SECTIONS 18 AND 19
GLENDALE, ARIZONA

PALOMA CORP. P.O. QA-5346
U.R.S. PROJ. NO. 6013



— — — — Source: Storm Drain Design Manual, Subdivision Drainage Design
City of Phoenix - September 1985
24Hr. - Tech. Memo WBTM WR44
1 Hr - Phoenix WBO : Lat. 33° 26'; Long. 112° 01'; Elev. 117

——— Source: Hydraulic Design for Highway Drainage in Arizona, Dec. 1, 1968;
Revised March 1969, With Addendum April 1975

PRECIPITATION DEPTH VERSUS RETURN PERIOD FOR PARTIAL-DURATION SERIES

FIGURE 4

It is suggested however that the rainfall data obtained using the methods described in the reference Hydrologic Design of Highway Drainage in Arizona dated December 1, 1968 and revised March 1969 be submitted to the City of Glendale for review and approval for use in the analysis and design of on-site minor drainage improvements for the following reasons:

- The City of Glendale regards the Rational Method as the primary method of computing project hydrology.
- In the Rational Method rainfall depths directly affect rainfall intensity and peak storm runoff values.
- Peak storm runoff from local areas affects the size and extent of required on-site local drainage improvements.
- The size and extent of local storm drainage improvements directly affects the cost of local storm drainage improvements.

The 24-hour synthetic rainfall distribution obtained from the City of Phoenix Storm Drain Design Manual of September 1985 was used in the TR-20 modeling of the proposed lake system. This rainfall distribution is presented in Table 3. This is the same 24-hour rainfall distribution used in the Preliminary Storm Drainage Master Plan of July 1982. The one-hour rainfall distribution used in the TR-20 modeling of the proposed lake system was based on the rainfall depth-duration relationships obtained from Hydrologic Design of Highway Drainage in Arizona. The rainfall depth-duration values presented in Table 3 are applicable to any return period. The one-hour rainfall distribution used in the TR-20 modeling of the proposed lake system is presented in Table 3. This is the same one-hour rainfall distribution used in the Preliminary Storm Drainage Master Plan of 1982.

PROPOSED LAKE STAGE-STORAGE CURVES

The relationship between lake water surface elevation and storm water detention storage volume was calculated for each proposed lake based on the proposed normal water surface area, length of shoreline and vertical side slopes for six inches above the normal lake water surface elevation with 4H to 1V side slopes beyond the edge of the lake. Stage-storage data for each lake in 0.20 foot increments are presented in Table 4.

TABLE 4 PAGE 1 OF 4
ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. DA-5346, URS #6013 2/20/86
PROPOSED LAKE STAGE-STORAGE DATA
FILE: LAKESTOR
NOTE: FIRST ELEVATION IS THE NORMAL WATER SURFACE ELEVATION

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
D	11	1297.00	0.00	0.00	0.88	1260.00
		1297.20	0.20	0.18		
		1297.40	0.40	0.35		
		1297.60	0.60	0.53		
		1297.80	0.80	0.71		
		1298.00	1.00	0.89		
		1298.20	1.20	1.08		
		1298.40	1.40	1.28		
		1298.60	1.60	1.48		
		1298.80	1.80	1.68		
		1299.00	2.00	1.89		
		1299.20	2.20	2.10		
		1299.40	2.40	2.32		
		1299.60	2.60	2.54		
		1299.80	2.80	2.77		
		1300.00	3.00	3.00		
		1300.20	3.20	3.24		
		1300.40	3.40	3.48		
		1300.60	3.60	3.72		
		1300.80	3.80	3.97		
		1301.00	4.00	4.23		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
B	13	1290.00	0.00	0.00	0.83	1470.00
		1290.20	0.20	0.17		
		1290.40	0.40	0.33		
		1290.60	0.60	0.50		
		1290.80	0.80	0.67		
		1291.00	1.00	0.85		
		1291.20	1.20	1.03		
		1291.40	1.40	1.22		
		1291.60	1.60	1.41		
		1291.80	1.80	1.61		
		1292.00	2.00	1.81		
		1292.20	2.20	2.02		
		1292.40	2.40	2.24		
		1292.60	2.60	2.46		
		1292.80	2.80	2.68		
		1293.00	3.00	2.91		
		1293.20	3.20	3.15		
		1293.40	3.40	3.39		
		1293.60	3.60	3.64		
		1293.80	3.80	3.89		
		1294.00	4.00	4.15		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	LINE (ft)
C	12	1294.00	0.00	0.00	1.23	1380.00
		1294.20	0.20	0.25		
		1294.40	0.40	0.49		
		1294.60	0.60	0.74		
		1294.80	0.80	0.99		
		1295.00	1.00	1.25		
		1295.20	1.20	1.51		
		1295.40	1.40	1.77		
		1295.60	1.60	2.04		
		1295.80	1.80	2.32		
		1296.00	2.00	2.60		
		1296.20	2.20	2.89		
		1296.40	2.40	3.18		
		1296.60	2.60	3.48		
		1296.80	2.80	3.78		
		1297.00	3.00	4.09		
		1297.20	3.20	4.40		
		1297.40	3.40	4.71		
		1297.60	3.60	5.04		
		1297.80	3.80	5.36		
		1298.00	4.00	5.70		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	LINE (ft)
E	21	1300.00	0.00	0.00	2.77	3070.00
		1300.20	0.20	0.55		
		1300.40	0.40	1.11		
		1300.60	0.60	1.66		
		1300.80	0.80	2.23		
		1301.00	1.00	2.81		
		1301.20	1.20	3.39		
		1301.40	1.40	3.99		
		1301.60	1.60	4.60		
		1301.80	1.80	5.22		
		1302.00	2.00	5.86		
		1302.20	2.20	6.50		
		1302.40	2.40	7.16		
		1302.60	2.60	7.82		
		1302.80	2.80	8.50		
		1303.00	3.00	9.19		
		1303.20	3.20	9.89		
		1303.40	3.40	10.60		
		1303.60	3.60	11.33		
		1303.80	3.80	12.06		
		1304.00	4.00	12.81		

TABLE 4 PAGE 2 OF 4
ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. 9A-5346, URS 86013 2/20/86
PROPOSED LAKE STAGE-STORAGE DATA
FILE: LAKESTOR
NOTE: FIRST ELEVATION IS THE NORMAL WATER SURFACE ELEVATION

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
G	22	1294.00	0.00	0.00	0.33	530.00
		1294.20	0.20	0.07		
		1294.40	0.40	0.13		
		1294.60	0.60	0.20		
		1294.80	0.80	0.27		
		1295.00	1.00	0.34		
		1295.20	1.20	0.41		
		1295.40	1.40	0.48		
		1295.60	1.60	0.56		
		1295.80	1.80	0.64		
		1296.00	2.00	0.71		
		1296.20	2.20	0.80		
		1296.40	2.40	0.88		
		1296.60	2.60	0.97		
		1296.80	2.80	1.05		
		1297.00	3.00	1.14		
		1297.20	3.20	1.23		
		1297.40	3.40	1.33		
		1297.60	3.60	1.42		
		1297.80	3.80	1.52		
		1298.00	4.00	1.62		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
J	35	1289.00	0.00	0.00	2.40	1445.00
		1289.20	0.20	0.48		
		1289.40	0.40	0.96		
		1289.60	0.60	1.44		
		1289.80	0.80	1.93		
		1290.00	1.00	2.42		
		1290.20	1.20	2.91		
		1290.40	1.40	3.41		
		1290.60	1.60	3.92		
		1290.80	1.80	4.43		
		1291.00	2.00	4.95		
		1291.20	2.20	5.47		
		1291.40	2.40	6.00		
		1291.60	2.60	6.53		
		1291.80	2.80	7.07		
		1292.00	3.00	7.61		
		1292.20	3.20	8.16		
		1292.40	3.40	8.72		
		1292.60	3.60	9.28		
		1292.80	3.80	9.84		
		1293.00	4.00	10.41		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
F	31	1303.00	0.00	0.00	2.63	2260.00
		1303.20	0.20	0.53		
		1303.40	0.40	1.05		
		1303.60	0.60	1.58		
		1303.80	0.80	2.11		
		1304.00	1.00	2.66		
		1304.20	1.20	3.21		
		1304.40	1.40	3.77		
		1304.60	1.60	4.33		
		1304.80	1.80	4.91		
		1305.00	2.00	5.49		
		1305.20	2.20	6.09		
		1305.40	2.40	6.69		
		1305.60	2.60	7.30		
		1305.80	2.80	7.91		
		1306.00	3.00	8.54		
		1306.20	3.20	9.17		
		1306.40	3.40	9.81		
		1306.60	3.60	10.47		
		1306.80	3.80	11.12		
		1307.00	4.00	11.79		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
J1	36	1287.00	0.00	0.00	0.89	717.00
		1287.20	0.20	0.18		
		1287.40	0.40	0.36		
		1287.60	0.60	0.53		
		1287.80	0.80	0.72		
		1288.00	1.00	0.90		
		1288.20	1.20	1.08		
		1288.40	1.40	1.27		
		1288.60	1.60	1.46		
		1288.80	1.80	1.66		
		1289.00	2.00	1.85		
		1289.20	2.20	2.05		
		1289.40	2.40	2.25		
		1289.60	2.60	2.46		
		1289.80	2.80	2.67		
		1290.00	3.00	2.88		
		1290.20	3.20	3.09		
		1290.40	3.40	3.30		
		1290.60	3.60	3.52		
		1290.80	3.80	3.74		
		1291.00	4.00	3.96		

TABLE 4 PAGE 3 OF 4
ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS 86013 2/20/86
PROPOSED LAKE STAGE-STORAGE DATA
FILE: LAKESTOR
NOTE: FIRST ELEVATION IS THE NORMAL WATER SURFACE ELEVATION

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
U	37	1285.00	0.00	0.00	0.58	635.00
		1285.20	0.20	0.12		
		1285.40	0.40	0.23		
		1285.60	0.60	0.35		
		1285.80	0.80	0.47		
		1286.00	1.00	0.59		
		1286.20	1.20	0.71		
		1286.40	1.40	0.84		
		1286.60	1.60	0.96		
		1286.80	1.80	1.09		
		1287.00	2.00	1.23		
		1287.20	2.20	1.36		
		1287.40	2.40	1.50		
		1287.60	2.60	1.64		
		1287.80	2.80	1.78		
		1288.00	3.00	1.92		
		1288.20	3.20	2.07		
		1288.40	3.40	2.22		
		1288.60	3.60	2.37		
		1288.80	3.80	2.52		
		1289.00	4.00	2.68		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
V	43	1273.00	0.00	0.00	1.57	1170.00
		1273.20	0.20	0.31		
		1273.40	0.40	0.63		
		1273.60	0.60	0.94		
		1273.80	0.80	1.26		
		1274.00	1.00	1.58		
		1274.20	1.20	1.91		
		1274.40	1.40	2.24		
		1274.60	1.60	2.58		
		1274.80	1.80	2.92		
		1275.00	2.00	3.26		
		1275.20	2.20	3.61		
		1275.40	2.40	3.96		
		1275.60	2.60	4.32		
		1275.80	2.80	4.68		
		1276.00	3.00	5.05		
		1276.20	3.20	5.42		
		1276.40	3.40	5.79		
		1276.60	3.60	6.17		
		1276.80	3.80	6.55		
		1277.00	4.00	6.94		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
R	42	1277.00	0.00	0.00	7.26	4550.00
		1277.20	0.20	1.45		
		1277.40	0.40	2.90		
		1277.60	0.60	4.36		
		1277.80	0.80	5.83		
		1278.00	1.00	7.31		
		1278.20	1.20	8.81		
		1278.40	1.40	10.33		
		1278.60	1.60	11.87		
		1278.80	1.80	13.42		
		1279.00	2.00	14.99		
		1279.20	2.20	16.58		
		1279.40	2.40	18.18		
		1279.60	2.60	19.80		
		1279.80	2.80	21.43		
		1280.00	3.00	23.09		
		1280.20	3.20	24.75		
		1280.40	3.40	26.44		
		1280.60	3.60	28.14		
		1280.80	3.80	29.86		
		1281.00	4.00	31.60		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
W	44	1265.00	0.00	0.00	3.52	2500.00
		1265.40	0.40	1.41		
		1265.80	0.80	2.83		
		1266.20	1.20	4.28		
		1266.60	1.60	5.77		
		1267.00	2.00	7.30		
		1267.40	2.40	8.86		
		1267.80	2.80	10.46		
		1268.20	3.20	12.10		
		1268.60	3.60	13.78		
		1269.00	4.00	15.49		
		1269.40	4.40	17.23		
		1269.80	4.80	19.02		
		1270.00	5.00	19.92		
		1270.50	5.50	22.23		
		1271.00	6.00	24.59		

TABLE 4 PAGE 4 OF 4
ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. 0A-5346, URS 86013 2/20/86
PROPOSED LAKE STAGE-STORAGE DATA
FILE: LAKESTOR
NOTE: FIRST ELEVATION IS THE NORMAL WATER SURFACE ELEVATION

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
W1	45	1265.00	0.00	0.00	3.23	2200.00
		1265.40	0.40	1.29		
		1265.80	0.80	2.59		
		1266.20	1.20	3.93		
		1266.60	1.60	5.29		
		1267.00	2.00	6.69		
		1267.40	2.40	8.12		
		1267.80	2.80	9.58		
		1268.20	3.20	11.07		
		1268.60	3.60	12.60		
		1269.00	4.00	14.16		
		1269.40	4.40	15.75		
		1269.80	4.80	17.37		
		1270.00	5.00	18.20		
		1270.50	5.50	20.29		
		1271.00	6.00	22.44		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
Z2	73	1275.00	0.00	0.00	0.71	1180.00
		1275.20	0.20	0.14		
		1275.40	0.40	0.28		
		1275.60	0.60	0.43		
		1275.80	0.80	0.57		
		1276.00	1.00	0.72		
		1276.20	1.20	0.88		
		1276.40	1.40	1.04		
		1276.60	1.60	1.20		
		1276.80	1.80	1.37		
		1277.00	2.00	1.54		
		1277.20	2.20	1.72		
		1277.40	2.40	1.90		
		1277.60	2.60	2.08		
		1277.80	2.80	2.27		
		1278.00	3.00	2.47		
		1278.20	3.20	2.67		
		1278.40	3.40	2.87		
		1278.60	3.60	3.08		
		1278.80	3.80	3.29		
		1279.00	4.00	3.50		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
Z	75	1267.50	0.00	0.00	3.49	3205.00
		1267.60	0.10	0.35		
		1267.80	0.30	1.05		
		1268.00	0.50	1.75		
		1268.20	0.70	2.44		
		1268.40	0.90	3.14		
		1268.60	1.10	3.84		
		1268.80	1.30	4.54		
		1269.00	1.50	5.31		
		1269.20	1.70	6.05		
		1269.40	1.90	6.81		
		1269.60	2.10	7.58		
		1269.80	2.30	8.36		
		1270.00	2.50	9.15		
		1270.20	2.70	9.95		
		1270.40	2.90	10.77		
		1270.60	3.10	11.60		
		1270.80	3.30	12.44		
		1271.00	3.50	13.29		
		1271.20	3.70	14.15		
		1271.40	3.90	15.03		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
Z3	72	1276.60	0.00	0.00	0.85	1350.00
		1276.80	0.20	0.17		
		1277.00	0.40	0.34		
		1277.20	0.60	0.51		
		1277.40	0.80	0.68		
		1277.60	1.00	0.85		
		1277.80	1.20	1.02		
		1278.00	1.40	1.19		
		1278.20	1.60	1.39		
		1278.40	1.80	1.58		
		1278.60	2.00	1.78		
		1278.80	2.20	1.97		
		1279.00	2.40	2.18		
		1279.20	2.60	2.39		
		1279.40	2.80	2.60		
		1279.60	3.00	2.82		
		1279.80	3.20	3.05		
		1280.00	3.40	3.28		
		1280.20	3.60	3.51		
		1280.40	3.80	3.75		
		1280.60	4.00	4.00		

LAKE	STRUCTURE	ELEV. (msl)	ELEV. DIFF.	STORAGE (ac-ft)	AREA (ac)	SHORE LINE (ft)
Z1	74	1272.00	0.00	0.00	0.72	1020.00
		1272.20	0.20	0.14		
		1272.40	0.40	0.29		
		1272.60	0.60	0.43		
		1272.80	0.80	0.58		
		1273.00	1.00	0.73		
		1273.20	1.20	0.89		
		1273.40	1.40	1.05		
		1273.60	1.60	1.21		
		1273.80	1.80	1.38		
		1274.00	2.00	1.55		
		1274.20	2.20	1.72		
		1274.40	2.40	1.90		
		1274.60	2.60	2.08		
		1274.80	2.80	2.26		
		1275.00	3.00	2.45		
		1275.20	3.20	2.65		
		1275.40	3.40	2.84		
		1275.60	3.60	3.04		
		1275.80	3.80	3.25		
		1276.00	4.00	3.45		

LAKE SYSTEM RECIRCULATION FLOWS

Small amounts of water are to be recirculated around the proposed lake system to maintain water quality. These lake recirculation flows are incorporated into attractive water features such as waterfalls and streams.

PROPOSED LAKE OUTLET STRUCTURE STAGE-DISCHARGE CURVES

Each of the lake outlet control structures were designed to meet the following performance objectives:

1. Convey proposed lake recirculation flows at the "normal" upstream lake water surface elevation.

2. Convey proposed lake recirculation flows and peak 100-year flood flows while limiting the rise in lake water surface elevations during the 100-year flood event to elevations that will provide at least one foot of vertical freeboard between the maximum 100-year lake water surface elevation and the adjacent first floor building elevations.

3. Convey proposed lake recirculation flows at low water conditions corresponding to lake water surface elevations two vertical feet below "normal" water surface elevations.

The proposed lake outlet control structures are comprised of a combination of orifice and weir flow control devices as illustrated in Figure 5. The orifices are intended to convey the proposed lake system recirculation flows at normal upstream lake water surface elevations. The proposed storm weirs are intended to discharge the estimated 100-year storm runoff while limiting the rise in upstream lake water surface elevations.

Lake outflow versus upstream lake water surface elevation was calculated for each of the proposed lake outlet control structures as presented in Table 5. These stage-discharge calculations were based on orifice flow until the crests of the proposed storm weirs were overtopped. Orifice flow was assumed between the orifice crown elevations and the storm weir crest elevation. A combination of orifice flow and weir flow was assumed to exist once the storm weir crest elevation was exceeded. Discharge coefficients used to calculate lake outlet control structure stage-discharge curves were obtained from the Handbook of Hydraulics, sixth edition, Brater and King, 1982.

Initially, an attempt was made to enter the proposed lake system recirculation flows as base flow in the TR-20 computer model. The results of this attempt were unsatisfactory because of the additional complexity of both the input and output data. Recirculation flows were incorporated into the proposed lake outlet stage-discharge curves as follows:

1. Orifices sizes and invert elevations were calculated to pass the proposed lake system recirculation flows at the normal upstream lake water surface elevation.

2. Stage-discharge curves were calculated for each of the proposed lake outlet control structures.

3. Recirculation flows were subtracted from each of the stage-discharge curves by linear superposition.

The resulting stage-discharge curves (discharge minus recirculation flow) were input to the TR-20 model. The structure water surface elevations shown in the TR-20 output are sufficient to carry recirculation flows plus flood flow however the output shows only the peak storm runoff. Proposed recirculation flows must be added to the discharges shown in the TR-20 model to obtain total peak discharge.

EQUALIZER PIPES AND CULVERTS

Equalizer pipes and culverts are those conveyance elements which under static conditions equalize the water surface elevations on either side of a street or road. When recirculation flows are being conveyed through the equalizer pipes there is a small difference in water surface elevations (generally on the order of one inch) between the upstream (headwater) pool and downstream (tailwater) pools. During a flood event the headwater pool will rise until the available head (difference between headwater and tailwater elevations) is sufficient to pass the peak flood flow. Equalizer pipes were sized to pass peak flood flows based on the maximum flood stage water surface elevation in the downstream lake or pool and the maximum allowable flood stage elevation in the upstream lake or pool.

ARROWHEAD RANCH, SECTIONS 18 AND 19
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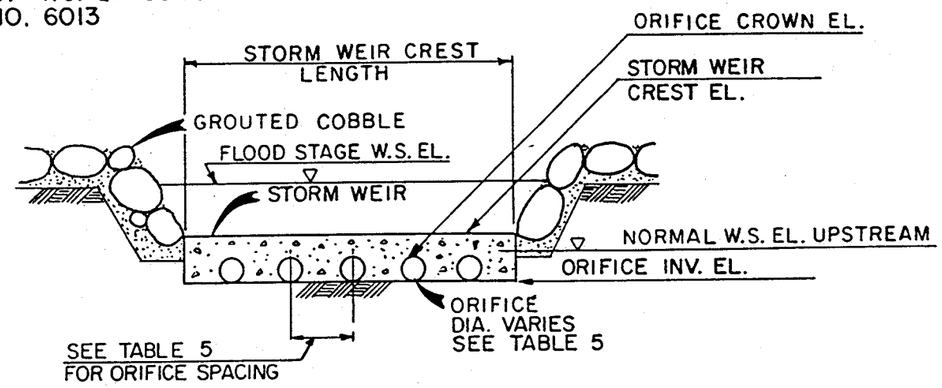
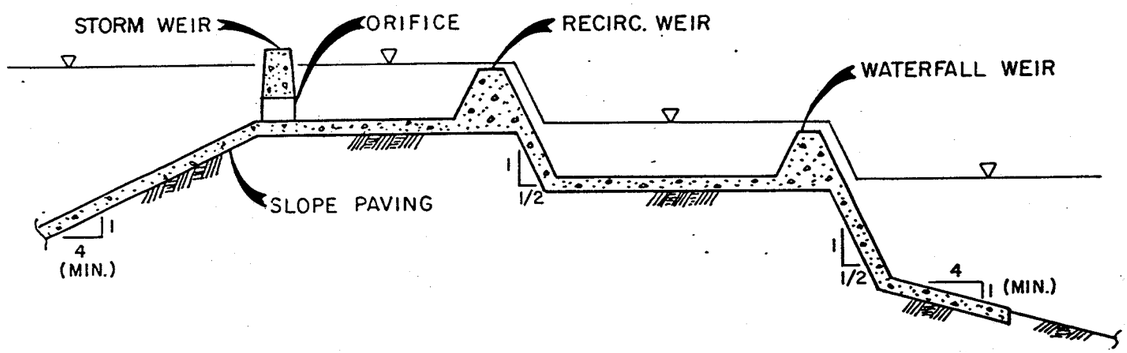
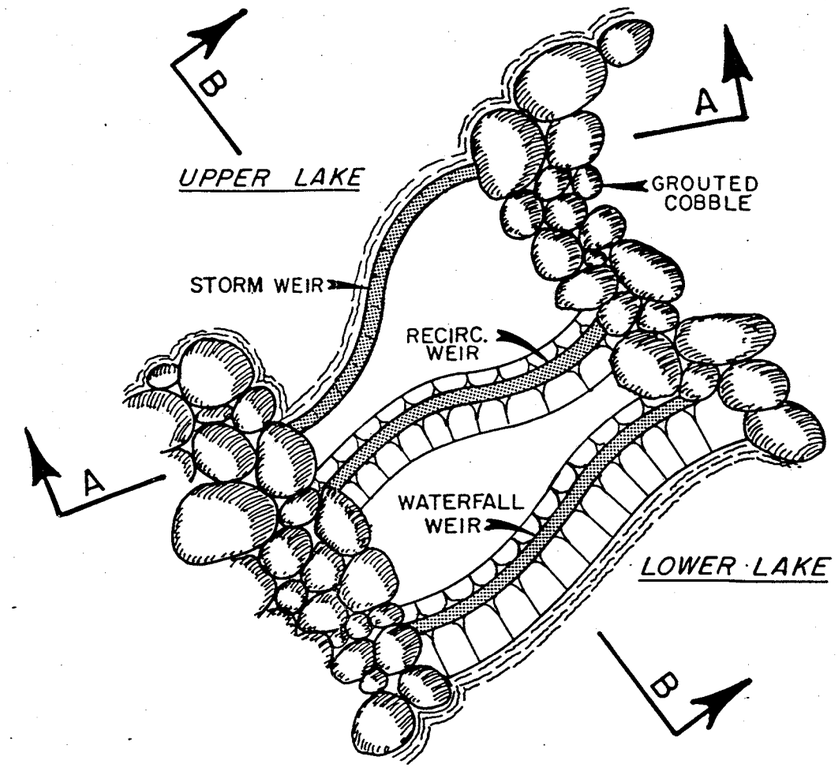


SECTION A-A



SECTION B-B



PLAN VIEW

REVISED: 4/21/86

TYPCIAL LAKE OUTLET CONTROL STRUCTURE

NOT TO SCALE

FIGURE 5

EFFECTS OF CLOGGING

The proposed lake outlet control structures incorporate orifices consisting of 8-inch diameter PVC pipes to convey recirculation flows. Concrete boxes associated with the proposed equalizer pipes are covered with grates consisting of 5/8-inch diameter bars, 6-inches on-centers. The upstream water surface elevations would rise, should these orifices or grates become clogged, until the increase in head is sufficient to overcome the obstruction. The consequences of clogging of the 8-inch diameter PVC orifices should be relatively minor because of the relatively large increase in storm weir flow for small increases in head on the storm weir. However, should the equalizer pipe grates become clogged the headwater ponds could overflow in an uncontrolled manner. The TR-20 modeling of the proposed lake system did not incorporate any capacity reduction factors to account for debris.

TR-20 MODELING OF THE PROPOSED LAKE SYSTEM

The following data were entered into the TR-20 model: Rainfall data, sub-basin areas, composite runoff curve numbers, proposed lake system stage-discharge and stage-storage relationships. Time of concentration for each sub-basin was assumed to be 0.167 hours (10 minutes). Travel time through the proposed lake system was assumed to be negligible because the expected translatory wave velocity for a minimum lake depth of approximately 6-feet is approximately 13.9 feet per second.

The TR-20 model was executed and the output reviewed for maximum allowable 100-year flood stage lake water surface elevations and outlet structure discharges. The proposed lake system outlet structures were modified based on this review and new stage-discharge relationships were developed. Output from the final TR-20 run is contained in the Appendix.

The following points should be kept in mind while reviewing the TR-20 output data contained in the Appendix.

1. The proposed orifice sizes and elevations are sufficient to convey the proposed lake system recirculation flows at the proposed normal upstream lake water surface elevations.

2. The output structure water surface elevations are sufficient to carry recirculation flows plus flood flows <u>however</u> the computer output shows flood flows only.

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TABLE 5
PAGE 1 OF 19
FILE: WEIR11D

CONTROL STRUCTURE 11 LAKE D (WSEL 1297) TO LAKE C (WSEL 1294) AKA WATERFALL C-D

RECIRC. WEIR CREST ELEV. 1296.8
RECIRC. WEIR CREST LENGTH 20 (FT)

ORIFICE CROWN ELEV 1296.67 TOTAL NUMBER OF ORIFICES 8 @ 2' O.C.

STORM WEIR CREST ELEV. 1298.2
STORM WEIR CREST LENGTH 20 (FT)

ORIFICE INV. ELEV. 1296 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 4.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/2FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	'Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1297.00	0.20	0.3600	3.60				3.60	-0.90
1297.20	0.40	0.8000	8.00				8.00	3.50
1297.40	0.60	1.1200	11.20				11.20	6.70
1297.60	0.80	1.4100	14.10				14.10	9.60
1297.80	1.00	1.6700	16.70				16.70	12.20
1298.00	1.20	1.9000	19.00				19.00	14.50
1298.20	1.40	2.1000	21.00				21.00	16.50
1298.40	1.60	2.3000	23.00	0.20	2.80	5.01	28.01	23.51
1298.60	1.80		23.00	0.40	2.86	14.47	37.47	32.97
1298.80	2.00		23.00	0.60	3.00	27.89	50.89	46.39
1299.00	2.20		23.00	0.80	3.19	45.65	68.65	64.15
1299.20	2.40		23.00	1.00	3.31	66.20	89.20	84.70
1299.40	2.60		23.00	1.20	3.32	87.29	110.29	105.79
1299.60	2.80		23.00	1.40	3.32	109.99	132.99	128.49
1299.80	3.00		23.00	1.60	3.32	134.38	157.38	152.88
1300.00	3.20		23.00	1.80	3.32	160.35	183.35	178.85
1300.20	3.40		23.00	2.00	3.32	187.81	210.81	206.31
1300.40	3.60		23.00	2.20	3.32	216.67	239.67	235.17
1300.60	3.80		23.00	2.40	3.32	246.88	269.88	265.38
1300.80	4.00		23.00	2.60	3.32	278.37	301.37	296.87
1301.00	4.20		23.00	2.80	3.32	311.10	334.10	329.60

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(4) (WEIR LENGTH / 2) x (3)

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-3, PAGE 5-40

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(4) + (7)

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TABLE 5
PAGE 2 OF 19
FILE: WEIR12B

CONTROL STRUCTURE 12 LAKE C (WSEL 1294) TO LAKE B (WSEL 1290) AKA WATERFALL B-C

RECIRC. WEIR CREST ELEV. 1293.8
RECIRC. WEIR CREST LENGTH 20 (FT)

ORIFICE CROWN ELEV 1293.67 TOTAL NUMBER OF ORIFICES 8 @ 2' O.C.

STORM WEIR CREST ELEV. 1294.7
STORM WEIR CREST LENGTH 20 (FT)

ORIFICE INV. ELEV. 1293 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 4.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/2FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1294.00	0.20	0.3600	3.60				3.60	-0.90
1294.20	0.40	0.8000	8.00				8.00	3.50
1294.40	0.60	1.1200	11.20				11.20	6.70
1294.60	0.80	1.4100	14.10				14.10	9.60
1294.80	1.00	1.6700	16.70	0.10	2.80	1.77	18.47	13.97
1295.00	1.20		16.70	0.30	2.86	9.40	26.10	21.60
1295.20	1.40		16.70	0.50	3.00	21.21	37.91	33.41
1295.40	1.60		16.70	0.70	3.19	37.37	54.07	49.57
1295.60	1.80		16.70	0.90	3.31	56.52	73.22	68.72
1295.80	2.00		16.70	1.10	3.32	76.60	93.30	88.80
1296.00	2.20		16.70	1.30	3.32	98.42	115.12	110.62
1296.20	2.40		16.70	1.50	3.32	121.98	138.68	134.18
1296.40	2.60		16.70	1.70	3.32	147.18	163.88	159.38
1296.60	2.80		16.70	1.90	3.32	173.90	190.60	186.10
1296.80	3.00		16.70	2.10	3.32	202.07	218.77	214.27
1297.00	3.20		16.70	2.30	3.32	231.61	248.31	243.81
1297.20	3.40		16.70	2.50	3.32	262.47	279.17	274.67
1297.40	3.60		16.70	2.70	3.32	294.59	311.29	306.79
1297.60	3.80		16.70	2.90	3.32	327.92	344.62	340.12
1297.80	4.00		16.70	3.10	3.32	362.42	379.12	374.62
1298.00	4.20		16.70	3.30	3.32	398.05	414.75	410.25

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(4) (WEIR LENGTH / 2) x (3)

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-3, PAGE 5-40

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(4) + (7)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 3 OF 19
FILE: WEIRBB2

CONTROL STRUCTURE 13 LAKE B (WSEL 1289.9) TO LAKE B2 (WSEL 1286) AKA WATERFALL B-B2

STORM WEIR CREST ELEV. 1289.75

STORM WEIR CREST LENGTH 30 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 4.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	STAGE 1 WEIR FLOW					
ASSUME UPSTREAM NORMAL LAKE WSEL	HEAD ON WEIR (FT)	WEIR LENGTH (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1289.75					0.00	0.00
1290.00	0.25	30.00	2.70	10.13	10.13	5.63
1290.20	0.45	30.00	2.79	25.27	25.27	20.77
1290.40	0.65	30.00	2.92	45.91	45.91	41.41
1290.60	0.85	30.00	3.14	73.82	73.82	69.32
1290.80	1.05	30.00	3.32	107.16	107.16	102.66
1291.00	1.25	30.00	3.44	144.23	144.23	139.73
1291.20	1.45	30.00	3.55	185.95	185.95	181.45
1291.40	1.65	30.00	3.61	229.54	229.54	225.04
1291.60	1.85	30.00	3.61	272.51	272.51	268.01
1291.80	2.05	30.00	3.61	317.88	317.88	313.38
1292.00	2.25	30.00	3.61	365.51	365.51	361.01
1292.20	2.45	30.00	3.61	415.31	415.31	410.81
1292.40	2.65	30.00	3.61	467.19	467.19	462.69
1292.60	2.85	30.00	3.61	521.07	521.07	516.57

(4) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING 6th EDITION
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(5) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. 0A-5346, URS #6013 4/24/86

TABLE 5
PAGE 4 OF 19
FILE: WEIR15D

CONTROL STRUCTURE 15 STRUCTURE TO ALLOW PONDING ONTO GOLF COURSE DRIVING RANGE ABOVE LAKE R

PIPE CROWN ELEV. 1280.5

PIPE INV. ELEV. 1278.5

TOTAL NUMBER OF PIPES 3

DIAMETER OF PIPES 2.00 (FT)
LENGTH OF PIPE = 15 FT

STORM WEIR CREST ELEV. 1282.75
STORM WEIR CREST LENGTH 70 (FT)
STORM WEIR IS A 70' SAG V.C. IN GOLF CART PATH
GRADE IN = -2.86% GRADE OUT = +2.86% P.I. EL = 1282.25
PROPOSED RECIRCULATION FLOWS (CFS) 4.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ASSUMED UPSTREAM LAKE WSEL	Q via 3-24" RCP PIPES (CFS)	Q via OVERFLOW (CFS)	Q TOTAL (CFS)	H weir L = 25' C = 2.56 (FT)	TWEL (Hweir + 1279.75)	H (FT)	Q PIPES (CFS)
1281.00	40.00	0.00	40.00	0.731	1280.48	0.52	42.97
1282.00	67.00	0.00	67.00	1.030	1280.78	1.22	65.88
1283.00	86.00	0.00	86.00	1.220	1280.97	2.03	84.98
1283.50	94.00	0.00	94.00	1.292	1281.04	2.46	93.51
1284.00	74.00	210.00	284.00	2.700	1282.45	1.55	74.26
1284.50	55.00	440.00	495.00	3.911	1283.66	0.84	54.63

DOWNSTREAM WEIR:
CREST LENGTH = 25 FT
CREST ELEV. = 1279.75

Qpipes = (Ht / 0.00253)^1/2 x 3

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 5 OF 19
FILE: WEIR21C

CONTROL STRUCTURE 21 LAKE E (WSEL 1300) TO LAKE G (WSEL 1294) AKA WATERFALL E-G NOTE: TWO (2) SIDE WEIRS

RECIRC. WEIR CREST ELEV. 1299.7
RECIRC. WEIR CREST LENGTH 50 (FT)

ORIFICE CROWN ELEV 1299.67 TOTAL NUMBER OF ORIFICES 10 @ 4' O.C.

STORM WEIR CREST ELEV. 1301.55
STORM WEIR CREST LENGTH 50 (FT)

ORIFICE INV. ELEV. 1299 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 9.0

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUME UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/4FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1300.00	0.30	0.8000	10.00				10.00	1.00
1300.20	0.50	1.1500	14.38				14.38	5.37
1300.40	0.70	1.5000	18.75				18.75	9.75
1300.60	0.90	1.7500	21.88				21.88	12.88
1300.80	1.10	2.0000	25.00				25.00	16.00
1301.00	1.30	2.2000	27.50				27.50	18.50
1301.20	1.50	2.4000	30.00				30.00	21.00
1301.40	1.70	2.6000	32.50				32.50	23.50
1301.60	1.90	2.8000	35.00	0.05	2.80		35.00	26.00
1301.80	2.10		35.00	0.25	2.81	17.50	52.50	43.50
1302.00	2.30		35.00	0.45	2.93	42.41	77.41	68.41
1302.20	2.50		35.00	0.65	3.09	76.77	111.77	102.77
1302.40	2.70		35.00	0.85	3.31	121.08	156.08	147.08
1302.60	2.90		35.00	1.05	3.32	178.07	213.07	204.07
1302.80	3.10		35.00	1.25	3.32	231.99	266.99	257.99
1303.00	3.30		35.00	1.45	3.32	289.84	324.84	315.84
1303.20	3.50		35.00	1.65	3.32	351.83	386.83	377.83
1303.40	3.70		35.00	1.85	3.32	417.70	452.70	443.70
1303.60	3.90		35.00	2.05	3.32	487.24	522.24	513.24
1303.80	4.10		35.00	2.25	3.32	560.25	595.25	586.25
1304.00	4.30		35.00	2.45	3.32	636.59	671.59	662.59

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(4) (WEIR LENGTH / 4) x (3)

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-3, PAGE 5-40

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(7) + (4)

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ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. OA-5346, URS #6013 4/24/86

CONTROL STRUCTURE 22 LAKE G (WSEL 1294) TO NORTH STREAM

PIPE CROWN ELEV.= 1295
PIPE INV. ELEV.= 1292

TOTAL NUMBER OF CULVERTS 1
SIZE OF CULVERT 4' x 3' BOX
LENGTH OF CULVERT 100 (FT)
n = .013 Ke = 0.5

CHANNEL:
b = 6.0' z = 4 : 1
s = 1.0%
INV 1293.2

WEIR
L = 10 FT.
CREST EL.= 1293.5

PROPOSED RECIRCULATION FLOWS (CFS) 9.0

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STAGE 1 EQUALIZER FLOW		STAGE 2 WEIR FLOW		WEIR AND EQUALIZER TOTAL REQUIRED HEAD (FT)	REQUIRED LAKE WSEL TO PASS COL. (3)	ASSUMED LAKE WSEL	ACTUAL HEAD (FT)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
ASSUMED LAKE DISCH. (CFS)	REQUIRED HEAD (FT)	ASSUMED LAKE DISCH. (CFS)	REQUIRED HEAD (FT)						
9.00	0.02	9.00	0.50	0.52	1294.02	1294.00	0.50	9.00	0.00
10.00	0.02	10.00	0.53	0.55	1294.05	1294.20	0.70	14.00	5.00
12.00	0.03	12.00	0.60	0.63	1294.13	1294.40	0.90	19.00	10.00
14.00	0.04	14.00	0.67	0.71	1294.21	1294.60	1.10	25.00	16.00
16.00	0.06	16.00	0.73	0.79	1294.29	1294.80	1.30	30.00	21.00
18.00	0.07	18.00	0.79	0.86	1294.36	1295.00	1.50	35.00	26.00
20.00	0.09	20.00	0.85	0.94	1294.44	1295.20	1.70	40.00	31.00
25.00	0.14	25.00	0.98	1.12	1294.62	1295.40	1.90	45.00	36.00
30.00	0.21	30.00	1.11	1.32	1294.82	1295.60	2.10	50.00	41.00
35.00	0.28	35.00	1.23	1.51	1295.01	1295.80	2.30	53.70	44.70
40.00	0.36	40.00	1.35	1.71	1295.21	1296.00	2.50	56.00	47.00
45.00	0.46	45.00	1.46	1.92	1295.42	1296.20	2.70	62.50	53.50
50.00	0.57	50.00	1.56	2.13	1295.63	1296.40	2.90	66.60	57.60
55.00	0.69	55.00	1.67	2.36	1295.86	1296.60	3.10	68.60	59.60
60.00	0.82	60.00	1.76	2.58	1296.08				
65.00	0.96	65.00	1.86	2.82	1296.32				
70.00	1.12	70.00	1.95	3.07	1296.57				
75.00	1.28	75.00	2.05	3.33	1296.83				
80.00	1.46	80.00	2.14	3.60	1297.10				

(2) HEAD REQUIRED TO PASS (1) THROUGH CULVERT

(4) HEAD REQUIRED TO PASS (3) THROUGH CHANNEL

(5) TOTAL HEAD REQUIRED TO PASS ASSUMED LAKE DISCHARGE (2) + (4)

(6) WEIR CREST ELEV. + (5)

(8) ASSUMED WSEL - WEIR CREST ELEVATION

(9) INTERPOLATED DISCHARGE

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. 0A-5346, URS #6013 4/24/86

TABLE 5
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FILE: WEIR31B

CONTROL STRUCTURE 31 LAKE F (WSEL 1303) TO EAST STREAM (LAKE H)

RECIRC. WEIR CREST ELEV. 1302.75
RECIRC. WEIR CREST LENGTH 14 (FT)

OVERFLOW WEIR TO G.C. CROSSING
L = 15'
CREST ELEV. = 1304.5

SIZE OF EQUALIZER PIPE = 21"
L = 165 FT
INVERT OF EQUALIZER = 1297.75

STORM WEIR CREST ELEV. 1302.75
STORM WEIR CREST LENGTH 14 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 4.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	STAGE 1 WEIR BOX			STAGE 2 STORM WEIR FLOW					
ASSUMED UPSTREAM LAKE WSEL	HEAD ON WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	U.S. WSEL MINUS D.S. WSEL (FT)	Q PIPE (CFS)	HEAD ON 15' OVERFLOW WEIR TO G.C. CROSSING (FT)	Q FOR 15' OVERFLOW WEIR (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1302.75	0.00		0.00	1.75	13.50			0.00	-4.50
1303.00	0.25	2.70	4.73	2.00	14.50			4.73	0.23
1303.20	0.45	2.79	11.79	2.20	15.00			11.79	7.29
1303.40	0.65	2.92	21.42	2.40	16.00			16.00	11.50
1303.60	0.85	3.14	34.45	2.60	17.00			17.00	12.50
1303.80	1.05	3.32	50.01	2.80	17.50			17.50	13.00
1304.00	1.25	3.44	67.31	3.00	18.00			18.00	13.50
1304.20	1.45	3.55	86.78	3.20	18.50			18.50	14.00
1304.40	1.65	3.61	107.12	3.40	19.00	0	0	19.00	14.50
1304.60	1.85	3.61	127.17	3.60	19.50	0.1	1.21	20.71	16.21
1304.80	2.05	3.61	148.34	3.80	20.00	0.3	6.31	26.31	21.81
1305.00	2.25	3.61	170.57	4.00	20.50	0.5	13.58	34.10	29.60

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(3) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(4) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(5) ASSUMED WSEL - 1301.0

(9) LESSER OF COLUMNS (4) OR (6)+(8)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 8 OF 19
FILE: WEIR35B

CONTROL STRUCTURE 35 LAKE J (WSEL 1289) TO LAKE J1 (WSEL 1287)

RECIRC. WEIR CREST ELEV. 1288.5
RECIRC. WEIR CREST LENGTH 14 (FT)

SIZE OF EQUALIZER PIPE = 24"
= 138 FT
INV. ELEV. OF EQUALIZER PIPE 1283.5

GOLF COURSE OVERFLOW CHANNEL
b = 22' n = .035
Z = 10:1 S = 1.67%
CHANNEL INVERT 1289.9

STORM WEIR CREST ELEV. 1288.5
STORM WEIR CREST LENGTH 14 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 13.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW			GOLF COURSE OVERFLOW CHANNEL			
ASSUMED UPSTREAM LAKE WSEL	HEAD ON WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	HEAD WATER DEPTH (FT)	U.S. WSEL MINUS D.S. WSEL (FT)	Q SUBMERGED PIPE (CFS)	HEAD ON CHANNEL (FT)	PEAK DISCH. (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1289.00	0.50	2.92	14.45	5.50	2.00	20.00			14.45	0.95
1289.20	0.70	3.14	25.75	5.70	2.20	20.00			20.00	6.50
1289.40	0.90	3.32	39.69	5.90	2.40	20.00			20.00	6.50
1289.60	1.10	3.44	55.56	6.10	2.60	20.00			20.00	6.50
1289.80	1.30	3.55	73.67	6.30	2.80	20.00			20.00	6.50
1290.00	1.50	3.61	92.85	6.50	3.00	25.00	0.1	5.71	30.70	17.20
1290.20	1.70	3.61	112.02	6.70	3.00	25.00	0.3	13.07	38.10	24.60
1290.40	1.90	3.61	132.36	6.90	3.00	25.00	0.5	29.14	54.20	40.70
1290.60	2.10	3.61	153.80	7.10	3.00	25.00	0.7	49.80	74.80	61.30
1290.80	2.30	3.61	176.29	7.30	3.00	25.00	0.9	75.60	100.60	87.10
1291.00	2.50	3.61	199.78	7.50	3.00	25.00	1.1	107.00	132.00	118.50
1291.20	2.70	3.61	224.22	7.70	3.00	25.00	1.3	142.60	167.60	154.10

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(3) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(4) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(10) LESSER OF COLUMNS (4) OR (7)+(9)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

CONTROL STRUCTURE 36 LAKE J1 (WSEL 1287) TO SOUTH STREAM

RECIRC. WEIR CREST ELEV. 1286.6
RECIRC. WEIR CREST LENGTH 20 (FT)

EQUALIZER = 2 - (8' x 3') RCB

CHANNEL:
b = 10' n = .035
Z = 4:1 S = 0.5%

STORM WEIR CREST ELEV. 1286.6
STORM WEIR CREST LENGTH 20 (FT)

WEIR LENGTH = 20'
C = VARIES

PROPOSED RECIRCULATION FLOWS (CFS) 13.5

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	STAGE 1 EQUALIZER FLOW		STAGE 2 EQUALIZER FLOW AND CHANNEL FLOW								
ASSUMED DISCH. TOTAL (CFS)	ASSUMED DISCH. EACH PIPE (CFS)	REQUIRED HEAD ON PIPE (FT)	ASSUMED DISCH.	DISCH. COEFF. Cd	REQUIRED HEAD ON WEIR (FT)	TOTAL REQUIRED HEAD (FT)	REQUIRED WSEL TO PASS COL. (4)	ASSUMED LAKE WSEL	ACTUAL HEAD (FT)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
13.50	6.75	0.0023	13.50	2.72	0.39	0.40	1287.00	1287.00	0.40	13.50	0.00
15.00	7.50	0.0028	15.00	2.72	0.42	0.43	1287.03	1287.20	0.60	25.00	11.50
20.00	10.00	0.0050	20.00	2.73	0.51	0.52	1287.12	1287.40	0.80	40.00	26.50
25.00	12.50	0.0078	25.00	2.75	0.59	0.60	1287.20	1287.60	1.00	56.30	42.80
30.00	15.00	0.0113	30.00	2.80	0.66	0.67	1287.27	1287.80	1.20	74.20	60.70
40.00	20.00	0.0200	40.00	2.85	0.79	0.81	1287.41	1288.00	1.40	93.00	79.50
50.00	25.00	0.0313	50.00	2.95	0.90	0.93	1287.53	1288.20	1.60	113.00	99.50
60.00	30.00	0.0450	60.00	3.03	0.99	1.04	1287.64	1288.40	1.80	131.80	118.30
70.00	35.00	0.0613	70.00	3.08	1.09	1.15	1287.75	1288.60	2.00	149.60	136.10
80.00	40.00	0.0800	80.00	3.10	1.19	1.27	1287.87	1288.80	2.20	167.00	153.50
100.00	50.00	0.1250	100.00	3.24	1.34	1.46	1288.06	1289.00	2.40	184.20	170.70
120.00	60.00	0.1800	120.00	3.30	1.49	1.67	1288.27	1289.20	2.60	200.00	186.50
140.00	70.00	0.2450	140.00	3.30	1.65	1.90	1288.50	1289.40	2.80		
160.00	80.00	0.3200	160.00	3.30	1.80	2.12	1288.72	1289.60	3.00		
180.00	90.00	0.4050	180.00	3.30	1.95	2.36	1288.96	1289.80	3.20		
200.00	100.00	0.5000	200.00	3.30	2.09	2.59	1289.19				

(3) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(5) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(6) H = (Q/(CL))^2/3
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= head on crest

(7) = (3) + (6)
(8) = STORM WEIR CREST ELEV. + (7)
(10) = ASSUMED WSEL - WEIR CREST ELEV.
(11) = INTERPOLATED DISCHARGE

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. 0A-5346, URS #6013 4/24/86

TABLE 5
PAGE 10 OF 19
FILE: WEIR37B

CONTROL STRUCTURE 37 LAKE U (WSEL 1285) TO SOUTH STREAM

RECIRC. WEIR CREST ELEV. 1284.9
RECIRC. WEIR CREST LENGTH 14 (FT)

EQUALIZER PIPE = 24"
L = 114 FT
INVERT ELEV. = 1277

STORM WEIR CREST ELEV. 1284.9
STORM WEIR CREST LENGTH 14 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 1.1

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	WEIR BOX FLOW					
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	DISCH. COEFF., Cd	TOTAL Q (CFS)	DISCHARGE BASED ON A HEAD OF 1 FT	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1284.90	0.00		0.00	14.00	0.00	-1.10
1285.00	0.10	2.70	1.20	14.00	1.20	0.10
1285.20	0.30	2.79	6.42	14.00	6.42	5.32
1285.40	0.50	2.92	14.45	14.00	14.00	12.90
1285.60	0.70	3.14	25.75	14.00	14.00	12.90
1285.80	0.90	3.32	39.69	14.00	14.00	12.90
1286.00	1.10	3.44	55.56	14.00	14.00	12.90
1286.20	1.30	3.55	73.67	14.00	14.00	12.90
1286.40	1.50	3.61	92.85	14.00	14.00	12.90
1286.60	1.70	3.61	112.02	14.00	14.00	12.90
1286.80	1.90	3.61	132.36	14.00	14.00	12.90
1287.00	2.10	3.61	153.80	14.00	14.00	12.90

(2) NORMAL WSEL - RECIRC.WEIR ELEV.

(3) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(4) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(7) LESSER OF COLUMNS (5) OR (6)

CONTROL STRUCTURE 42 LAKE R (WSEL 1277) TO LAKE V (WSEL 1273) AKA WATERFALL R-V

STORM WEIR CREST ELEV. 1277.5
STORM WEIR CREST LENGTH 45 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 0.0

(1)	(2)	(3)	(4)	(5)
	STORM WEIR FLOW			
ASSUMED UPSTREAM LAKE WSEL	HEAD ON WEIR (FT)	DISCH. COEFF., Cd	TOTAL Q (CFS)	TOTAL DISCH. (CFS)
1277.50	0.00		0.00	0.00
1277.60	0.10	2.80	3.98	3.98
1277.80	0.30	2.86	21.15	21.15
1278.00	0.50	3.00	47.73	47.73
1278.20	0.70	3.19	84.07	84.07
1278.40	0.90	3.31	127.18	127.18
1278.60	1.10	3.32	172.36	172.36
1278.80	1.30	3.32	221.44	221.44
1279.00	1.50	3.32	274.47	274.47
1279.20	1.70	3.32	331.15	331.15
1279.40	1.90	3.32	391.27	391.27
1279.60	2.10	3.32	454.65	454.65
1279.80	2.30	3.32	521.13	521.13
1280.00	2.50	3.32	590.56	590.56

(2) ASSUMED WSEL - RECIRC.WEIR ELEV.

(3) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-3, PAGE 5-40

(4) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. OA-5346, URS #6013 4/24/86

CONTROL STRUCTURE 43 LAKE V (WSEL 1273) TO LAKE W (WSEL 1265)

RECIRC. WEIR CREST ELEV. 1272.86
RECIRC. WEIR CREST LENGTH 50 (FT)

STORM WEIR CREST ELEV. 1272.86
STORM WEIR CREST LENGTH 50 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 6.7

(1)	(2)	(3)	(4)	(5)	(6)
	STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	HEAD ON WEIR (FT)	DISCH. COEFF., Cd	TOTAL Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS RECIRC. FLOWS (CFS)
1272.86	0.00		0.00	0.00	0.00
1273.00	0.14	2.70	7.07	7.07	0.37
1273.20	0.34	2.79	27.66	27.66	20.96
1273.40	0.54	2.92	57.94	57.94	51.24
1273.60	0.74	3.14	99.94	99.94	93.24
1273.80	0.94	3.32	151.29	151.29	144.59
1274.00	1.14	3.44	209.36	209.36	202.66
1274.20	1.34	3.55	275.33	275.33	268.63
1274.40	1.54	3.61	344.95	344.95	338.25
1274.60	1.74	3.61	414.29	414.29	407.59
1274.80	1.94	3.61	487.73	487.73	481.03
1275.00	2.14	3.61	565.06	565.06	558.36

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(3) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(4) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 13 OF 19
FILE: WEIR45C

CONTROL STRUCTURE 45 LAKE W1 (WSEL 1264.5) TO STRUCTURE UNDER 67th AVENUE

RECIRC. WEIR CREST ELEV. N/A
RECIRC. WEIR CREST LENGTH N/A (FT)

PIPE CROWN ELEV. 1269.5 TOTAL NUMBER OF ORIFICES 3

STORM WEIR CREST ELEV. 1268
STORM WEIR CREST LENGTH 70 (FT)

PIPE INV. ELEV. 1265.5 DIAMETER OF ORIFICE 4 (FT)

C = 2.56
PROPOSED RECIRCULATION FLOWS (CFS) 0.0

(1)	(2)	(3)	(4)	(5)
STAGE 1 PIPE FLOW		STAGE 2 WEIR & PIPE FLOW		
ASSUMED LAKE WSEL	3-48" PIPES Q (CFS)	HEAD ON STORM WEIR (FT)	70' WEIR Q (CFS)	TOTAL Q (CFS)
1265.50	0.00			0.00
1266.00	18.00			18.00
1266.50	36.00			36.00
1267.00	54.00			54.00
1267.50	72.00			72.00
1268.00	105.00	0.00	0.00	105.00
1268.50	141.00	0.50	63.36	204.36
1269.00	180.00	1.00	179.20	359.20
1269.50	210.00	1.50	329.21	539.21
1270.00	240.00	2.00	506.85	746.85

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 14 OF 19
FILE: WEIR72B

CONTROL STRUCTURE 72 LAKE Z3 (WSEL 1276.6) TO LAKE Z2 (WSEL 1275) AKA WATERFALL Z3-Z2 (SEE DETAIL FOR Z-71)

RECIRC. WEIR CREST ELEV. 1276.3
RECIRC. WEIR CREST LENGTH 22 (FT)

ORIFICE CROWN ELEV 1276.67 TOTAL NUMBER OF ORIFICES 10 @ 2' O.C.

STORM WEIR CREST ELEV. 1278
STORM WEIR CREST LENGTH 22 (FT)

ORIFICE INV. ELEV. 1276 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 6.7

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/2FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1276.60	0.30	0.6000	6.60				6.60	-0.10
1276.80	0.50	0.8800	9.68				9.68	2.98
1277.00	0.70	1.2500	13.75				13.75	7.05
1277.20	0.90	1.5500	17.05				17.05	10.35
1277.40	1.10	1.7800	19.58				19.58	12.88
1277.60	1.30	2.0000	22.00				22.00	15.30
1277.80	1.50	2.2200	24.42				24.42	17.72
1278.00	1.70	2.4000	26.40				26.40	19.70
1278.20	1.90		26.40	0.20	2.70	5.31	31.71	25.01
1278.40	2.10		26.40	0.40	2.79	15.53	41.93	35.23
1278.60	2.30		26.40	0.60	2.92	29.86	56.26	49.56
1278.80	2.50		26.40	0.80	3.14	49.43	75.83	69.13
1279.00	2.70		26.40	1.00	3.32	73.04	99.44	92.74
1279.20	2.90		26.40	1.20	3.44	99.48	125.88	119.18
1279.40	3.10		26.40	1.40	3.55	129.37	155.77	149.07
1279.60	3.30		26.40	1.60	3.61	160.73	187.13	180.43

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(4) (WEIR LENGTH / 2) x (3)

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(4) + (7)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 15 OF 19
FILE: WEIR73A

CONTROL STRUCTURE 73 LAKE Z2 (WSEL 1275) TO LAKE Z1 (WSEL 1272) AKA WATERFALL Z2-Z1 (SEE DETAIL FOR Z-Z1)

RECIRC. WEIR CREST ELEV. 1274.7
RECIRC. WEIR CREST LENGTH 22 (FT)

ORIFICE CROWN ELEV 1274.67 TOTAL NUMBER OF ORIFICES 10 @ 2' O.C.

STORM WEIR CREST ELEV. 1276.4
STORM WEIR CREST LENGTH 22 (FT)

ORIFICE INV. ELEV. 1274 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 6.7

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/2FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1275.00	0.30	0.6000	6.60				6.60	-0.10
1275.20	0.50	0.8800	9.68				9.68	2.98
1275.40	0.70	1.2500	13.75				13.75	7.05
1275.60	0.90	1.5500	17.05				17.05	10.35
1275.80	1.10	1.7800	19.58				19.58	12.88
1276.00	1.30	2.0000	22.00				22.00	15.30
1276.20	1.50	2.2200	24.42				24.42	17.72
1276.40	1.70	2.4000	26.40				26.40	19.70
1276.60	1.90		26.40	0.20	2.70	5.31	31.71	25.01
1276.80	2.10		26.40	0.40	2.79	15.53	41.93	35.23
1277.00	2.30		26.40	0.60	2.92	29.86	56.26	49.56
1277.20	2.50		26.40	0.80	3.14	49.43	75.83	69.13
1277.40	2.70		26.40	1.00	3.32	73.04	99.44	92.74
1277.60	2.90		26.40	1.20	3.44	99.48	125.88	119.18
1277.80	3.10		26.40	1.40	3.55	129.37	155.77	149.07
1278.00	3.30		26.40	1.60	3.61	160.73	187.13	180.43

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(4) (WEIR LENGTH / 2) x (3)

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-7, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(4) + (7)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 16 OF 19
FILE: WEIR74B

CONTROL STRUCTURE 74 LAKE Z1 (WSEL 1272) TO LAKE Z (WSEL 1267.5) AKA WATERFALL Z1-Z (SEE DETAIL FOR Z-Z1)

RECIRC. WEIR CREST ELEV. 1271.7
RECIRC. WEIR CREST LENGTH 22 (FT)

ORIFICE CROWN ELEV 1271.67 TOTAL NUMBER OF ORIFICES 10 @ 2' O.C.

STORM WEIR CREST ELEV. 1273.4
STORM WEIR CREST LENGTH 22 (FT)

ORIFICE INV. ELEV. 1271 DIAMETER OF ORIFICE 0.67 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 6.7

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	STAGE 1 RECIRCULATION FLOW			STAGE 2 STORM WEIR FLOW				
ASSUMED UPSTREAM LAKE WSEL	DIFFR. HEAD (FT)	UNIT DISCH. (Q/2FT)	TOTAL Q (CFS)	HEAD ON STORM WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)	TOTAL DISCH. (CFS)	TOTAL DISCH. MINUS PROPOSED RECIRC. FLOWS (CFS)
1272.00	0.30	0.6000	6.60				6.60	-0.10
1272.20	0.50	0.8800	9.68				9.68	2.98
1272.40	0.70	1.2500	13.75				13.75	7.05
1272.60	0.90	1.5500	17.05				17.05	10.35
1272.80	1.10	1.7800	19.58				19.58	12.88
1273.00	1.30	2.0000	22.00				22.00	15.30
1273.20	1.50	2.2200	24.42				24.42	17.72
1273.40	1.70	2.4000	26.40				26.40	19.70
1273.60	1.90		26.40	0.20	2.70	5.31	31.71	25.01
1273.80	2.10		26.40	0.40	2.79	15.53	41.93	35.23
1274.00	2.30		26.40	0.60	2.92	29.86	56.26	49.56
1274.20	2.50		26.40	0.80	3.14	49.43	75.83	69.13
1274.40	2.70		26.40	1.00	3.32	73.04	99.44	92.74
1274.60	2.90		26.40	1.20	3.44	99.48	125.88	119.18
1274.80	3.10		26.40	1.40	3.55	129.37	155.77	149.07
1275.00	3.30		26.40	1.60	3.61	160.73	187.13	180.43

(2) (ASSUMED WSEL - RECIRC.WEIR ELEV.)

(5) ASSUMED WSEL - STORM WEIR ELEV.

(6) SOURCE: HANDBOOK OF HYDRAULICS, BRATER & KING
6th EDITION, TABLE 5-9, PAGE 5-43
SLOPE: UPSTREAM 1H : 2V, DOWNSTREAM 2H : 1V

(7) Q= CLH^3/2
Q= discharge (cfs)
C= coefficient of discharge for orifices
L= effective length of crest
H= total head on crest

(8) =(4) + (7)

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. QA-5346, URS #6013 4/24/86

TABLE 5
PAGE 17 OF 19
FILE: WEIR75B

CONTROL STRUCTURE 75 LAKE Z (WSEL 1267.5) OUTLET STRUCTURE

ORIFICE CROWN EL. 1269 TOTAL NUMBER OF ORIFICES 1

ASSUME WEIR FLOW UNTIL ELEV. 1269.0
THEN ASSUME ORIFICE FLOW FOR REMAINDER

ORIFICE INV. EL. 1267.75 ORIFICE IS A 3' x 1.25' OPENING WITH 1/2" DIA. VERTICAL BARS @ 4' O.C.

PROPOSED RECIRCULATION FLOWS 0.0 (CFS)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	STAGE 1 WEIR FLOW			STAGE 2 TRASHRACK AND ORIFICE FLOW ABOVE WSEL 1269.0							
ASSUMED UPSTREAM LAKE WSEL	HEAD ON WEIR (FT)	EFFEC. WEIR LENGTH (FT)	FREE FLOW DISCH. (CFS)	ASSUMED Q (CFS)	TRASH RACK VELOCITY (FT/SEC)	TRASH RACK LOSSES (FT)	PIPE & ORIFICE LOSSES (FT)	H (FT)	WSEL	ASSUMED WSEL	TOTAL DISCH. (CFS)
1267.50				2.00	0.60	0.001	0.008	0.010	1269.01	1267.50	0.00
1267.75	0.00	2.67	0.00	4.00	1.20	0.006	0.034	0.039	1269.04	1267.75	0.00
1268.00	0.25	2.58	0.85	6.00	1.80	0.013	0.076	0.089	1269.09	1268.00	0.85
1268.50	0.75	2.40	4.10	8.00	2.40	0.023	0.134	0.158	1269.16	1268.50	4.10
1269.00	1.25	2.22	8.16	10.00	3.00	0.037	0.210	0.247	1269.25	1269.00	8.16
1269.50	1.75	2.04	12.42	12.00	3.60	0.053	0.302	0.355	1269.36	1269.50	14.00
1270.00	2.25	1.86	16.51	14.00	4.20	0.072	0.412	0.484	1269.48	1270.00	20.00
1270.50	2.75	1.68	20.15	16.00	4.80	0.094	0.538	0.632	1269.63		
1271.00	3.25	1.50	23.11	18.00	5.41	0.119	0.681	0.799	1269.80		
				20.00	6.01	0.147	0.840	0.987	1269.99		

NOTE: OUTFALL PIPE FROM THE LAKE 'Z' OUTLET STRUCTURE IS TO BE SET SUCH THAT THERE IS AT LEAST SIX INCHES OF FREEBOARD BETWEEN THE HEADWATER ELEVATION IN THE OUTLET BOX AND THE WEIR CREST ELEVATION OF 1267.75

(7) = (0.262 x V^2) / (2 x g)

(8) = (1.5 x V^2)/ (2 x g)

(9) = (7) + (8)

(10) = 1267.75 + 1.25 + (COL. 9)

(12) = (4) BELOW WSEL 1269.0
= INTERPOLATED FROM (5) ABOVE WSEL 1269.0

CONTROL STRUCTURE 80 UPPER HAMILTON (WSEL 1281) LAKE TO LOWER HAMILTON LAKE (WSEL 1277)

OVERFLOW WEIR CREST ELEV. 1280.8

OVERFLOW WEIR CREST LENGTH 15 (FT)

PROPOSED RECIRCULATION FLOWS (CFS) 3.53

(1)	(2)	(3)	(4)
ASSUMED UPSTREAM NORMAL LAKE WSEL	WEIR FLOW		
	HEAD ON WEIR (FT)	DISCH. COEFF., Cd	Q (CFS)
1281.00	0.20	2.63	3.53
1281.20	0.40	2.63	9.98
1281.40	0.60	2.63	18.33
1281.60	0.80	2.63	28.23
1281.80	1.00	2.63	39.45
1282.00	1.20	2.63	51.86
1282.20	1.40	2.63	65.35
1282.40	1.60	2.63	79.84
1282.60	1.80	2.63	95.27
1282.80	2.00	2.63	111.58
1283.00	2.20	2.63	128.73
1283.20	2.40	2.63	146.68
1283.40	2.60	2.63	165.39
1283.60	2.80	2.63	184.83
1283.80	3.00	2.63	204.99
1284.00	3.20	2.63	225.82

(4) Q= CLH^3/2

Q= discharge (cfs)
C= coefficient of discharge for weir
L= length of crest
H= total head on crest

ARROWHEAD RANCH, SECTIONS 18 & 19, GLENDALE, ARIZONA, PALOMA CORP P.O. OA-5346, URS #6013 4/24/86

CONTROL STRUCTURE 81 LOWER HAMILTON LAKE (WSEL 1277) OUTLET STRUCTURE

ORIFICE CROWN EL. 1269 TOTAL NUMBER OF ORIFICES 1

ORIFICE INV. EL. 1267.75 ORIFICE IS A 3' x 1.25' OPENING WITH 1/2" DIA. VERTICAL BARS @ 4' O.C.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ASSUMED DISCH. BETWEEN PROP. JUNCTION BOX AND LAKE 'Z3' (CFS)	HEAD REQUIRED FOR 2-24" PVC PIPES L=250 (FT)	ASSUMED WSEL IN JUNCTION BOX	DIFFR. HEAD BETWEEN STORM SEWER AND PROP. JUNCTION BOX (FT)	67th AVE STORM SEWER DISCH. FOR DIFFR. HEAD (CFS)	DISCH. FROM HAMILTON SUBDIV. (CFS)	HEAD REQ'D FOR DISCH. FROM HAMILTON SUBDIV. (FT)	LOWER HAMILTON LAKE WSEL	INTER-POLATED LOWER HAMILTON LAKE WSEL	INTER-POLATED DISCH. FROM HAMILTON SUBDIV. (CFS)
2	0.005	1279.01	1.99	10.55					
4	0.021	1279.02	1.98	10.52				1279.20	2.00
6	0.047	1279.05	1.95	10.44				1279.40	4.10
8	0.084	1279.08	1.92	10.36				1279.60	6.40
10	0.130	1279.13	1.87	10.22	0.00	0.00	1279.13	1279.80	7.50
12	0.190	1279.19	1.81	10.06	1.94	0.03	1279.22	1280.00	8.60
14	0.260	1279.26	1.74	9.87	4.13	0.13	1279.39	1280.20	9.80
16	0.340	1279.34	1.66	9.64	6.36	0.30	1279.64	1280.40	11.00
18	0.420	1279.42	1.58	9.40	8.60	0.54	1279.96	1280.60	11.80
20	0.530	1279.53	1.47	9.07	10.93	0.88	1280.41	1280.80	12.50
22	0.640	1279.64	1.36	8.72	13.28	1.30	1280.94		
24	0.760	1279.76	1.24	8.33	15.67	1.81	1281.57		

(2) = (Q/27.59)^2

(3) = 1279.0 + (2)

(4) = 1281.0 - (3)

(5) = (Q/7.48)^2

(6) = (1) - (5)

(7) = (Q/11.65)^2

(8) = (3) + (7)

Proposed lake system recirculation flows must be added to the discharges shown in the TR-20 output to obtain total peak discharges.

SUMMARY OF PROPOSED LAKE SYSTEM ANALYSIS

PEAK FLOWS AND MAXIMUM LAKE ELEVATIONS

Peak flood stage lake water surface elevations and storm runoff for the 10-, 50-, and 100-year, 1-hour and 24-hour storm event obtained from the TR-20 modeling of the proposed lake system are summarized in Table 6.

RECOMMENDED LAKE OUTLET STRUCTURE AND EQUALIZER PIPE SIZES, LENGTHS AND ELEVATIONS

Recommended lake outlet structure and equalizer pipe sizes, lengths and elevations are summarized in Table 7.

COMPARISON OF TR-20 MODELING WITH RATIONAL METHOD

Peak 100-year rates of storm runoff for the 1-hour storm, obtained from the TR-20 output data contained in the Appendix range from 4.92 cfs per acre to 0.61 cfs per acre for townhouse and golf course areas respectively. On a similar basis the 100-year 24-hour rates of runoff range from 2.5 cfs per acre to 1.0 cfs per acre for townhouse and golf course areas respectively. For comparison the Rational Method for an assumed time of concentration of 10 minutes, yields peak 100-year rates of storm runoff of 4.68 cfs per acre and 1.44 cfs per acre for townhouse/condominium and golf course areas respectively based on assumed runoff coefficients of 0.65 and 0.20.

TABLE 6
UMMARY OF LAKE FLOOD STAGE ELEVATIONS AND PEAK DISCHARGES
RROWHEAD RANCH SECTIONS 18 & 19
GLENDALE, ARIZONA
PROPOSED LAKE SYSTEM 1-HOUR STORM URS FILE: TR20.1HR.STORMS.A.OUT
PRIL 29, 1986
FILE: 1HRSUMA
PAGE 1 OF 2

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	X-SECTN			10-YEAR (#5)			50-YEAR (#9)			100-YEAR (#11)		
DESCRIPTION	OR STRUCT NO.	NORMAL WSEL	Qrecirc. (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)
AKE D1	---	1297.00	4.50	1299.13	5.00	5.00	1300.82	8.50	8.50	1301.49	9.80	9.80
AKE D	11	1297.00	4.50	1297.97	49.74	14.19	1298.65	94.55	36.53	1298.86	115.08	52.01
LAKE C	12	1294.00	4.50	1295.16	75.97	30.91	1295.71	137.12	79.62	1295.97	164.75	107.27
AKE B1	---	1289.90	4.50	1291.10	30.91	30.91	1292.10	79.62	79.62	1292.71	107.27	107.27
AKE B	13	1289.90	4.50	1291.00	139.74	139.74	1291.75	329.83	301.81	1292.09	415.78	382.58
G.C. CROSSING	14	1286.00	4.50	1289.16	162.77	162.77	1290.53	343.79	343.79	1291.11	434.05	434.05
EST STREAM	014	N/A	4.50	3.35 ft	162.77	159.58	4.53 ft	343.79	348.03	4.92 ft	434.05	441.58
EST STREAM	015	N/A	4.50	3.30 ft	159.58	158.17	4.55 ft	348.03	351.14	4.95 ft	441.58	448.02
OLF COURSE POND	15	1280.00	4.50	1282.50	158.17	75.04	1283.81	351.14	210.72	1284.06	448.02	307.79
AKE E	21	1300.00	8.30	1300.72	91.91	14.78	1301.38	174.72	23.30	1301.67	212.65	31.86
AKE G	22	1294.00	8.30	1294.72	22.83	18.83	1295.27	42.78	32.65	1295.50	51.82	38.57
NORTH STREAM	022	N/A	8.30	1.20 ft	18.83	25.86	1.68 ft	42.78	50.97	1.92 ft	38.57	63.32
. STREAM TO J	---	1289.00	8.30	1290.36	25.86	25.86	1291.31	50.97	50.97	1291.86	63.32	63.32
LAKE F	31	1303.00	4.50	1303.46	56.42	11.78	1304.15	131.03	13.87	1304.49	167.67	15.28
EAST STREAM	032	N/A	4.50	0.60 ft	15.95	16.50	1.04 ft	29.95	32.68	1.14 ft	34.71	39.39
AKE J	35	1289.00	12.80	1290.09	58.75	20.39	1290.51	129.77	52.39	1290.69	102.65	66.79
AKE J1	36	1287.00	12.80	1287.44	42.73	29.95	1287.83	88.31	63.96	1290.64	109.54	91.31
LAKE U	37	1285.00	1.10	1285.20	9.97	5.20	1285.38	20.51	12.13	1285.40	25.47	12.90
OUTH STREAM	037	N/A	13.90	1.28 ft	29.95	34.25	1.88 ft	63.96	74.97	2.19 ft	91.31	101.98
OUTH STREAM	038	N/A	13.90	1.54 ft	34.25	50.68	2.30 ft	74.97	112.46	2.57 ft	101.98	141.35
	40	NO LAKE	N/A	N/A	19.43	19.43	N/A	41.11	41.11	N/A	51.42	51.42
LAKE R	42	1277.00	0.00	1278.29	198.01	103.46	1278.95	425.73	261.57	1279.33	533.76	371.58
LAKE V	43	1273.00	6.70	1273.64	103.63	102.24	1274.17	261.87	258.58	1274.48	372.22	366.53
LAKE W	44	1265.00	0.00	-------	102.46	102.46	-------	259.87	259.87	-------	369.38	369.38
LAKE W1	45	1265.00	0.00	1266.63	102.72	40.57	1268.00	261.10	104.99	1268.32	372.11	185.23
HAMILTONS SUB.	81	1277.00	0.00	1278.15	34.67	0.00	1279.29	72.08	2.91	1279.72	89.80	7.08
LAKE Z3	72	1276.60	6.70	1277.57	48.77	14.88	1278.23	83.34	26.31	1278.43	98.23	37.27
LAKE Z2	73	1275.00	6.70	1275.77	21.44	12.45	1276.37	37.07	19.37	1276.69	49.16	29.62
LAKE Z1	74	1272.00	6.70	1272.62	13.39	10.64	1273.10	21.32	16.49	1273.44	31.49	20.64
LAKE Z	75	1267.50	0.00	1268.30	55.26	2.80	1268.89	110.83	7.27	1269.17	136.94	10.17

NOTES: 1) Qin and Qout summarized herein do not include recirculation flows

TABLE 6
SUMMARY OF LAKE FLOOD STAGE ELEVATIONS AND DISCHARGES
ARROWHEAD RANCH SECTIONS 18 & 19
GLENDALE, ARIZONA
PROPOSED LAKE SYSTEM 24-HOUR STORM URS FILE: TR20.24HR.STORMS.A.OUT
APRIL 29, 1986
FILE: 24HRSUMA

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	X-SECTN OR			10-YEAR (#6)			50-YEAR (#10)			100-YEAR (#12)		
DESCRIPTION	STRUCT NO.	NORMAL WSEL	Qrecirc. (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)	MAX WSEL	Qin (CFS)	Qout (CFS)
LAKE D1	---	1297.00	4.50	1300.00	7.00	7.00	1301.51	10.00	10.00	1301.89	10.70	10.70
LAKE D	11	1297.00	4.50	1298.37	34.43	22.32	1298.81	52.96	47.14	1298.93	61.47	57.55
LAKE C	12	1294.00	4.50	1295.45	62.69	54.18	1295.91	110.37	100.34	1296.09	131.37	121.78
LAKE B1	---	1289.90	4.50	1291.28	54.18	54.18	1292.17	100.34	100.34	1292.64	121.78	121.78
LAKE B	13	1289.90	4.50	1291.11	165.63	162.59	1291.63	278.04	273.70	1291.85	330.72	326.33
G.C. CROSSING	14	1286.00	4.50	1289.32	181.78	181.78	1290.23	301.96	301.96	1290.63	359.62	359.62
WEST STREAM	014	N/A	4.50	3.53 ft	181.78	184.63	4.33 ft	301.96	309.99	4.63 ft	359.62	370.41
WEST STREAM	015	N/A	4.50	3.54 ft	184.63	186.02	4.25 ft	309.99	316.24	4.68 ft	370.41	379.58
GOLF COURSE POND	15	1280.00	4.50	1283.44	186.02	93.08	1284.04	316.24	301.63	1284.20	379.58	367.64
LAKE E	21	1300.00	8.30	1301.11	63.62	19.86	1301.79	97.86	42.99	1302.00	113.60	68.45
LAKE G	22	1294.00	8.30	1295.04	29.58	26.88	1295.85	54.01	45.31	1296.81	83.64	65.87
NORTH STREAM	022	N/A	8.30	1.45 ft	26.88	39.37	1.89 ft	45.31	61.65	2.11 ft	65.87	75.69
N. STREAM TO J	---	1269.00	8.30	1290.95	39.37	39.37	1292.00	61.65	61.65	1292.70	75.69	75.69
LAKE F	31	1303.00	4.50	1303.87	55.70	13.17	1304.72	93.32	19.69	1305.08	111.07	32.68
EAST STREAM	032	N/A	4.50	0.77 ft	19.76	22.05	1.01 ft	26.23	30.17	1.40 ft	39.74	43.20
LAKE J	35	1289.00	12.80	1290.43	82.93	43.73	1290.89	128.41	100.66	1291.09	158.55	132.57
LAKE J1	36	1287.00	12.80	1287.72	60.56	53.68	1288.52	144.48	129.10	1288.94	184.07	165.40
LAKE U	37	1285.00	1.10	1285.25	7.98	7.12	1285.37	12.70	11.83	1285.40	14.90	12.90
SOUTH STREAM	037	N/A	13.90	1.67 ft	53.68	60.12	2.63 ft	129.10	140.23	2.88 ft	165.40	178.54
SOUTH STREAM	038	N/A	13.90	1.90 ft	60.12	76.35	2.75 ft	140.23	162.98	3.10 ft	178.54	205.34
	40	NO LAKE	N/A	N/A	16.34	16.34	N/A	26.35	26.35	N/A	31.01	31.01
LAKE R	42	1277.00	0.00	1278.65	268.40	185.02	1279.55	604.13	439.94	1279.94	755.40	569.20
LAKE V	43	1273.00	6.70	1273.93	185.84	183.64	1274.68	440.80	436.35	1275.02	570.90	565.86
LAKE W	44	1265.00	0.00	-------	189.17	189.17	-------	443.46	443.46	-------	575.64	575.64
LAKE W1	45	1265.00	0.00	1267.84	210.36	97.01	1268.74	448.43	292.44	1269.17	582.64	425.66
HAMILTONS SUB.	81	1277.00	0.00	1279.13	30.05	1.31	1280.19	48.39	9.76	1280.67	56.93	12.06
LAKE Z3	72	1276.60	6.70	1277.79	26.81	17.60	1278.41	45.98	35.90	1278.57	54.54	47.18
LAKE Z2	73	1275.00	6.70	1276.08	24.65	16.22	1276.76	45.92	33.15	1276.99	59.98	49.09
LAKE Z1	74	1272.00	6.70	1272.94	19.36	14.54	1273.62	34.92	25.89	1273.88	53.41	40.66
LAKE Z	75	1267.50	0.00	1268.85	51.52	6.94	1269.58	79.34	15.03	1269.90	92.99	18.76

NOTES: 1) Qin and Qout summarized herein do not include recirculation flows

TABLE 7
SUMMARY OF RECOMMENDED LAKE SYSTEM OUTLET STRUCTURE IMPROVEMENTS,
EQUALIZER PIPE AND BOX SIZES, LENGTHS, AND ELEVATIONS.
ARROWHEAD RANCH, SECTONS 18 & 19
GLENDALE, ARIZONA
PALOMA CORP. P.O. GA-5346
URS PROJECT NO. 6013
APRIL 27, 1986
LOTUS FILE: AHSUMMA
PAGE 1 OF 2

(1)	(2)	(3)			(4)	(5)	(6)	(7)	(8)	(9)	(10)
					PLANNED IMPROVEMENTS						
TR-20 DESIGN POINT	DESCRIPTION	PROPOSED IMPROVEMENT	DESCR.	TR-20 DESIGN POINT	PROPOSED LAKE SYSTEM RECIRC. FLOWS (CFS)	PEAK 100-YEAR STORM RUNOFF (CFS)	NORMAL LAKE WSEL (MSL)	MAXIMUM ALLOWABLE WSEL (MSL)	ALLOWABLE RISE H (FT)	MAXIMUM ACTUAL WSEL (MSL)	ACTUAL RISE H (FT)
--	LAKE 'D1' TO LAKE 'D'		D1	--	4.50	10.70	1297.00	1302.00	5.00	1301.89	4.89
11	WATERFALL BETWEEN LAKE 'C' AND LAKE 'D'	LAKE OUTLET CONTROL STRUCTURE	D	11	4.50	57.55	1297.00	1299.00	2.00	1298.93	1.93
12	WATERFALL BETWEEN LAKE 'C' AND LAKE 'B'	LAKE OUTLET CONTROL STRUCTURE	C	12	4.50	121.78	1294.00	1296.00	2.00	1296.09	2.09
--	STRUCTURE FROM LAKE 'B1' TO LAKE 'B'	EQUALIZER PIPE			4.50	121.73	1289.90	1296.00	6.10	1292.71	2.81
13	OUTFALL FROM LAKE 'B'	LAKE OUTLET CONTROL STRUCTURE	B	13	4.50	382.58	1289.90	1292.00	2.10	1292.09	2.19
--	STRUCTURE FROM LAKE 'B1' TO POND	EQUALIZER PIPE	B1	--	4.50	434.05	1286.00	1291.50	5.50	1291.11	5.11
14	GOLF COURSE CROSSING UNDER DEER VALLEY ROAD, STA 13+00	CROSS CULVERT	B1	14	4.50	434.05	1286.00	1291.50	5.50	1291.11	5.11
014	AT APPROXIMATELY THE MIDDLE OF THE WEST STREAM	WEST STREAM	W STREAM	014	4.50	441.58	N/A	N/A	N/A	N/A	4.92
015	WEST STREAM	WEST STREAM	W STREAM		4.50	448.02	N/A	N/A	N/A	N/A	4.95
15	AT OUTFALL OF WEST STREAM TO LAKE 'R'	CROSS CULVERTS		15	4.50	367.64	1280.00	1284.33	4.33	1284.20	4.20
21	WATERFALL BETWEEN LAKE 'E' AND LAKE 'G'	LAKE OUTLET CONTROL STRUCTURE	E	21	8.30	68.48	1300.00	1302.00	2.00	1302.00	2.00
22	CROSS CULVERT UNDER DEER VALLEY ROAD, STA 35+80	CROSS CULVERT	G	22	8.30	65.87	1294.00	1297.00	3.00	1296.81	2.81
022	NORTH STREAM	NORTH STREAM	N STREAM	022	8.30	75.69	N/A	N/A	N/A	N/A	2.11
--	OUTFALL FROM NORTH STREAM TO LAKE 'J'	CROSS CULVERT		--	8.30	75.69	1289.00	1293.00	4.00	1292.70	3.70
31	LAKE 'F' TO LAKE 'H'		F	31	4.50	32.68	1303.00	1305.00	2.00	1305.08	2.08
032	OUTFALL FROM EAST STREAM TO LAKE 'J'	EAST STREAM	E STREAM	032	4.50	43.20	N/A	N/A	N/A	N/A	1.40
35	OUTFALL FROM LAKE 'J' TO LAKE 'J1'	CULVERT & OVERLAND FLOW	J	35	12.80	132.57	1289.00	1291.00	2.00	1291.09	2.09
36	OUTFALL FROM LAKE 'J1' TO SOUTH STREAM	LAKE OUTLET CONTROL STRUCTURE	J1	36	12.80	165.40	1287.00	1289.00	2.00	1288.94	1.94
37	OUTFALL FROM LAKE 'U' TO SOUTH STREAM	LAKE OUTLET CONTROL STRUCTURE	U	37	1.11	12.90	1285.00	1287.00	2.00	1285.40	0.40
037	SOUTH STREAM DOWNSTREAM FROM 37	SOUTH STREAM	S STREAM	037	13.90	178.54	N/A	N/A	N/A	N/A	2.71
038	OUTFALL FROM SOUTH STREAM TO LAKE 'R'	SOUTH STREAM	S STREAM	038	13.90	205.34	N/A	N/A	N/A	N/A	2.87
40	CROSS CULVERT UNDER LOOP ROAD, STA 244+60	CROSS CULVERT		40	N/A	51.42	N/A	N/A	N/A	N/A	N/A
42	WATERFALL BETWEEN LAKE 'R' AND LAKE 'V'	LAKE OUTLET CONTROL STRUCTURE	R	42	0.00	569.20	1277.00	1280.00	3.00	1279.94	2.94
43	WATERFALL BETWEEN LAKE 'V' AND LAKE 'W'	LAKE OUTLET CONTROL STRUCTURE	V	43	6.70	565.86	1273.00	1275.00	2.00	1275.02	2.02
44	STRUCTURE BETWEEN LAKE 'W' AND LAKE 'W1'	CROSS CULVERT	W	44	0.00	575.64	1265.00	1270.00	5.00	---	----
45	WATERFALL BETWEEN LAKE 'W1' TO OUTFALL STRUCTURE	LAKE OUTLET CONTROL STRUCTURE	W1	45	0.00	425.66	1265.00	1270.00	5.00	1269.17	4.17
81	STORM SEWER INPROVEMENTS INTO LAKE 'Z3'	LAKE OUTLET CONTROL STRUCTURES AND CULVERTS	HAMILT.	81	0.0	12.06	1277.00	1281.00	4.00	1280.67	3.67
72	WATERFALL BETWEEN LAKE 'Z3' AND LAKE 'Z2'	LAKE OUTLET CONTROL STRUCTURE	Z3	72	6.7	47.13	1276.60	1279.00	2.40	1278.57	1.97
73	WATERFALL BETWEEN LAKE 'Z2' AND LAKE 'Z1'	LAKE OUTLET CONTROL STRUCTURE	Z2	73	6.7	49.09	1275.00	1277.00	2.00	1276.99	1.99
74	WATERFALL BETWEEN LAKE 'Z1' AND LAKE 'Z'	LAKE OUTLET CONTROL STRUCTURE	Z1	74	6.7	40.66	1272.00	1274.00	2.00	1273.88	1.88
75	OUTFALL FROM LAKE 'Z' TO OVERLAND FLOW OR STORM SEWER SYSTEM	LAKE OUTLET CONTROL STRUCTURE	Z	75	0.00	15.76	1267.50	1270.00	2.50	1269.90	2.40

TABLE 7
SUMMARY OF RECOMMENDED LAKE SYSTEM OUTLET STRUCTURE IMPROVEMENTS,
EQUALIZER PIPE AND BOX SIZES, LENGTHS, AND ELEVATIONS.
ARROWHEAD RANCH, SECTONS 18 & 19
GLENDALE, ARIZONA
PALOMA CORP. P.O. 0A-5346
URS PROJECT NO. 6013
APRIL 27, 1986
FILE: AHSUMMA

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
	ORIFICES			RECIRCULATION WEIRS		STORM WEIRS		OUTLET STRUCTURES		CULVERTS		STREAM SECTIONS						OVERFLOW AND OUTFALL CHANNEL SECTS.				
TR-20 DESIGN POINT	INVERT ELEV. (MSL)	DIAMETER (FT)	NO.	CREST ELEV. (MSL)	LENGTH (FT)	CREST ELEV. (MSL)	LENGTH (FT)	SIZE	TYPE	CULVERT LENGTH (FT)	ROUGHNESS COEFF., n	b (FT)	d1 (FT)	Z1	Z2	So %	n	b (FT)	Z	n	So %	INVERT ELEV.
D1 TO D	1299.00	0.67	5	1299.70	20	1302.00	20	18" DIA.	PVC	100	0.01											
11	1296.00	0.67	8	1296.80	20	1298.20	20	N/A	N/A	N/A	N/A											
12	1293.00	0.67	8	1293.80	20	1294.70	20	N/A	N/A	N/A	N/A											
B1 TO B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8' x 3'	RCB	92	0.013											
13	N/A	N/A	N/A	1289.75	30	1289.75	30	N/A	N/A	N/A	N/A											
B2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*24" DIA*	RCP	2 x 156	0.013											
14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8'x10'	RCB	90	0.013											
014	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	2	0.5	4	0.53	0.035					
015												8	2	0.5	4	0.53	0.035					
15	1278.50	2.00	3	N/A	N/A	1282.75	145	3-24" DIA.	RCP	3 x 15	0.013							70 FT. SAG VERTICAL CURVE				
21	1299.00	0.67	11.5	1299.70	50	1301.55	50	N/A	N/A	N/A	N/A											
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4' x 3'	RCB	100	0.013											
022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4' x 3'	RCB	100	0.013	8	2	0.5	2	0.63	0.035	15	2			1304.50
31	N/A	N/A	N/A	1302.75	14	1302.75	14	21" DIA.	PVC	166	0.013											
032	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	1.5	0.5	4	1.19	0.035					
35	N/A	N/A	N/A	1288.50	14	1288.50	14	24" DIA.	PVC	137	0.013							22	10	0.035	0.5	1289.90
36	N/A	N/A	N/A	1286.60	20	1286.60	20	2-8'x3'	RCB	100	0.013											
37	N/A	N/A	N/A	1284.90	14	1284.90	14	24" DIA.	PVC	113	0.013											
037	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	2	0.5	2	1.00	0.035					
038	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	2	0.5	2	1.00	0.035					
40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A											
42	N/A	N/A	N/A	N/A	N/A	1277.50	45	N/A	N/A	N/A	N/A											
43	N/A	N/A	N/A	1272.86	50	1272.86	50	3-8' x 4'	RCB	60	0.013											
44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3-8' x 4'	RCB	80	0.013											
45						1268.00	70	3 x48" DIA	RCP	3 x 180	0.013							20	2	0.035	0.015	1264.00
81	N/A	1.25'x3.0'	1	N/A	N/A	N/A	N/A	2x24" DIA.	RCP	2 x 250	0.013											
72	1276.00	0.67	10	1276.30	22	1278.00	22	N/A	N/A	N/A	N/A											
73	1274.00	0.67	10	1274.70	22	1276.40	22	N/A	N/A	N/A	N/A											
74	1271.00	0.67	10	1271.70	22	1273.40	22	N/A	N/A	N/A	N/A											
75	N/A	1.25'x3.0'	1	N/A	N/A	N/A	N/A	36" DIA.	RCP	150	0.013											

* USE OF 24" DIA. PIPE FROM B2 TO POND WILL RESULT IN FREQUENT FLOODING OF THE GOLF COURSE CROSSING

DRAINAGE FEATURES OF SPECIAL NOTE

Drainage features of special note to be constructed by individual parcel buyers or builders include but are not limited to the following:

AREA LOCATED NORTH OF DEER VALLEY ROAD

1. Builders within the area located north of Deer Valley Road must accept and accommodate offsite storm runoff from the north through their respective parcels to the proposed lake system as shown by the drainage basin boundaries and flow patterns in Figure 2. As presently planned, waterway openings would be provided in the proposed two-foot high concrete block wall surrounding the perimeter of golf course holes 2, 3, 4, and 5 to allow offsite storm runoff to flow across the golf course.

2. Builders in the north west corner of the development are required to construct onsite drainage improvements to drain the area located west and north of the Lake "B" outlet structure into Lake "B". These required onsite drainage improvements could take the form of open channel swales or local streets with storm sewer. These drainage improvements are required to outfall the 67th Avenue storm sewer located north of Deer Valley Road.

3. Builders in the parcel located north of Deer Valley Road between Station 14+50 and Station 31+50 are required to drain the area located north of Deer Valley Road, 80-feet south of the proposed lake system and east of the Lake "B" outlet structure, into Lake "B" by means of local drainage improvements.

4. Builders in the parcel located north of Deer Valley Road between Station 31+50 and Station 49+00 are required to drain the area north of Deer Valley Road and 80-feet south of Lakes "E" and "F" into Lake "G" by means of local drainage improvements.

5. Builders in the northwest quadrant of the intersection of Deer Valley Road and 59th Avenue are expected to provide local onsite drainage improvements to drain this area into Lake "F".

AREA LOCATED SOUTH OF DEER VALLEY ROAD AND WEST OF LOOP ROAD

1. Builders in the development parcel located southeast of the intersection of Deer Valley Road and 67th Avenue are expected to provide local onsite drainage improvements to drain this area into Lake "R".

2. Builders in the development parcel south of Deer Valley Road and north of Lake "R" between Deer Valley Road Station 1+50 and Station 13+00 are expected to provide local onsite drainage improvements to drain storm runoff from this area into Lake "R".

3. Builders in the development parcel located south of Deer Valley Road between Station 16+00 and Station 20+00 and southwest of Loop Road between Station 259+00 and Station 268+47 are expected to provide local onsite drainage improvements to drain storm runoff from this area into the proposed north channel.

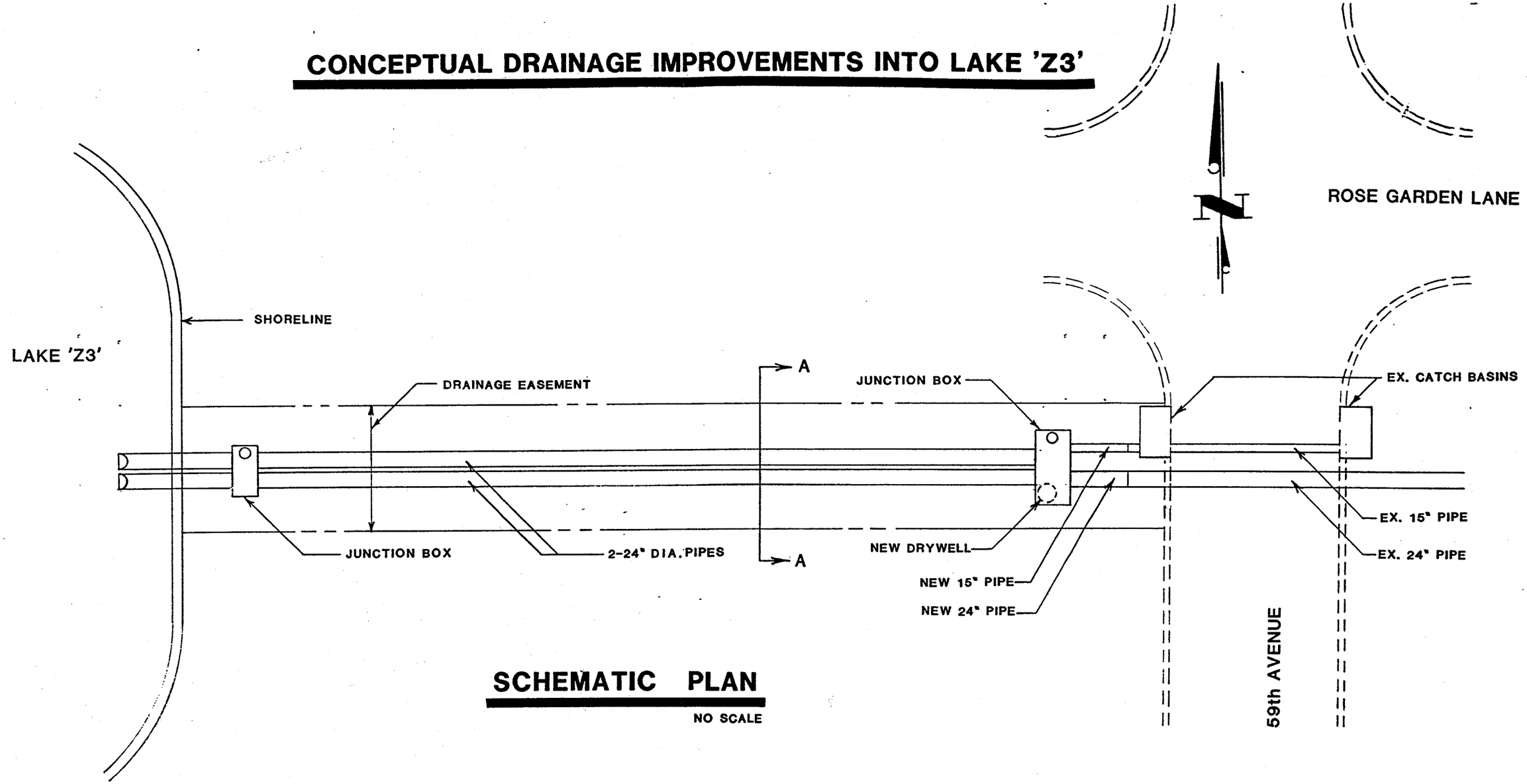
4. Builders in the development parcel located northwest of Loop Road Station 245+00 and Station 258+47 are expected to provide local onsite drainage improvements to drain storm runoff from this area into the proposed south channel.

5. Builders in the development parcel located east of 67th Avenue between 67th Avenue Station 221+70 and Station 231+70 and west of Lake "V" are expected to provide local onsite drainage improvements to drain storm runoff from this area into Lake "W1".

6. Builders in the development parcel located between golf course holes 9 and 18 are expected to provide local onsite drainage improvement to drain storm runoff from this area into Lake "W".

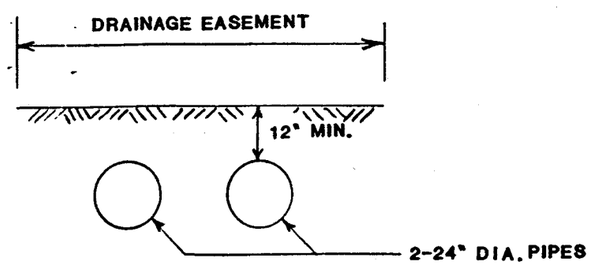
7. Builders in the development parcel located west of 59th Avenue between 59th Avenue Station 221+92 and Station 228+92 are expected to provide storm drainage improvements to convey storm runoff from the 59th Avenue storm sewer system, 59th Avenue, and the Hamilton Arrowhead Ranch Subdivision lake system located east of 59th Avenue to proposed Lake "Z3". The developer of this parcel must exercise caution in the design and construction of these required drainage improvements to avoid adversely affecting 59th Avenue or the Hamilton Arrowhead Ranch lake system located east of 59th Avenue. Conceptual plan and profile drawings of these minimum recommended storm drainage improvements are shown in Figure 6 and Figure 7. Hydraulic calculations associated with these conceptual storm drainage improvements are shown in Table 8.

CONCEPTUAL DRAINAGE IMPROVEMENTS INTO LAKE 'Z3'



SCHEMATIC PLAN

NO SCALE



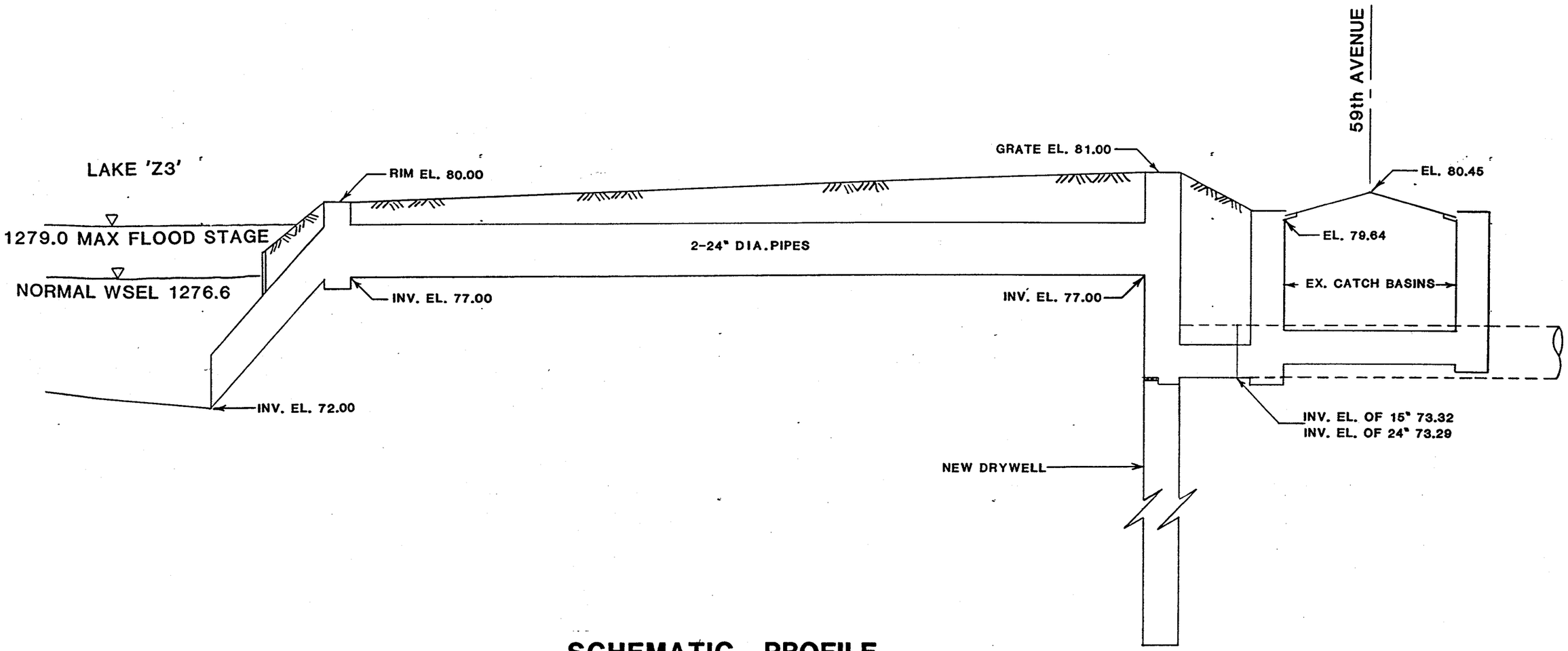
SECTION A-A

NO SCALE

ARROWHEAD RANCH
SECTIONS 18 & 19
GLENDALE, ARIZONA

FIGURE 6

CONCEPTUAL DRAINAGE IMPROVEMENTS INTO LAKE 'Z3'



SCHEMATIC PROFILE

NO SCALE

ARROWHEAD RANCH
SECTIONS 18 & 19
GLENDALE, ARIZONA

FIGURE 7

TABLE 8
HYDRAULIC CALCULATIONS FOR CONCEPTUAL DRAINAGE IMPROVEMENTS INTO LAKE 'Z3'
ARROWHEAD RANCH SECTIONS 18 & 19
GLENDALE, ARIZONA
APRIL 22, 1986
FILE: 59SUM
PAGE 1 OF 1

FROM	TO	d (INCHES)	D (FT)	PIPE MATERIAL	MANNING'S COEFF.	LENGTH (FT)	Ke	Q (CFS)	MAXIMUM HEADWATER ELEV	MAXIMUM TAILWATER ELEV	H (FT)	Q (CFS)
HAMILTON ARROWHEAD RANCH	PROPOSED JUNCTION BOX ON THE WEST SIDE OF 59th	24	2	RGRCP	0.013	235	0.762	11.65 Ht^.5	1280.57	1279.60	0.97	11.5
59th AVENUE STORM SEWER SYSTEM	PROPOSED JUNCTION BOX ON THE WEST SIDE OF 59th	15	1.25	RGRCP	0.013	10	0.50	7.48 Ht^.5	1281.00	1279.60	1.40	8.9
PROPOSED JUNCTION BOX ON THE WEST SIDE OF 59th	LAKE 'Z3'	2-24	2-2	PVC	0.01	250	0.50	27.59 Ht^.5	1279.60	1279.00	0.60	21.4

AREA LOCATED SOUTH OF DEER VALLEY ROAD AND EAST OF LOOP ROAD

Builders in the development parcel located east of golf course hole 6 and west of 59th Avenue between 59th Avenue Station 32+20 and Station 48+67 are expected to provide local onsite drainage improvements to drain storm runoff from this area to Lake "J1". These required storm drainage improvements include improvements to accommodate storm runoff from the 59th Avenue storm sewer.

67TH AVENUE CROSSING

Three 48-inch diameter RCP culverts or hydraulically equivalent CMP or reinforced concrete box culverts are to be provided under 67th Avenue to convey peak flows of up to 105 cfs from Lake "W1" just prior to overtopping of the proposed 70-foot storm weir. A schematic plan and profile of the proposed 67th Avenue crossing is shown in Figure 8. The outlet structure from planned Lake "W1" under 67th Avenue is affected by downstream conditions in the planned outfall channel to New River.

The developer(s) of Sections 13 and 24, which are located to the west and downstream of planned Arrowhead Ranch Sections 18 and 19, must exercise caution in the planning and development of Sections 13 and 24 to assure that downstream conditions do not adversely affect the proposed Lake "W1" outlet structure.

NOTE:
Do Not Disturb the two rows of trees immediately south of the Golf Cart Maintenance Facility! Remove trees within slope limits only. Protect all other trees from damage. Coordinate tree removals with Paloma Corporation.

New Handplaced Riprap. Overexcavate 1'-0" Within Riprap Limits. (Coordinate with Paloma)
Riprap to be furnished and installed by Paloma Corp.

Berm 1'-0" Min. Above Surrounding Terrain

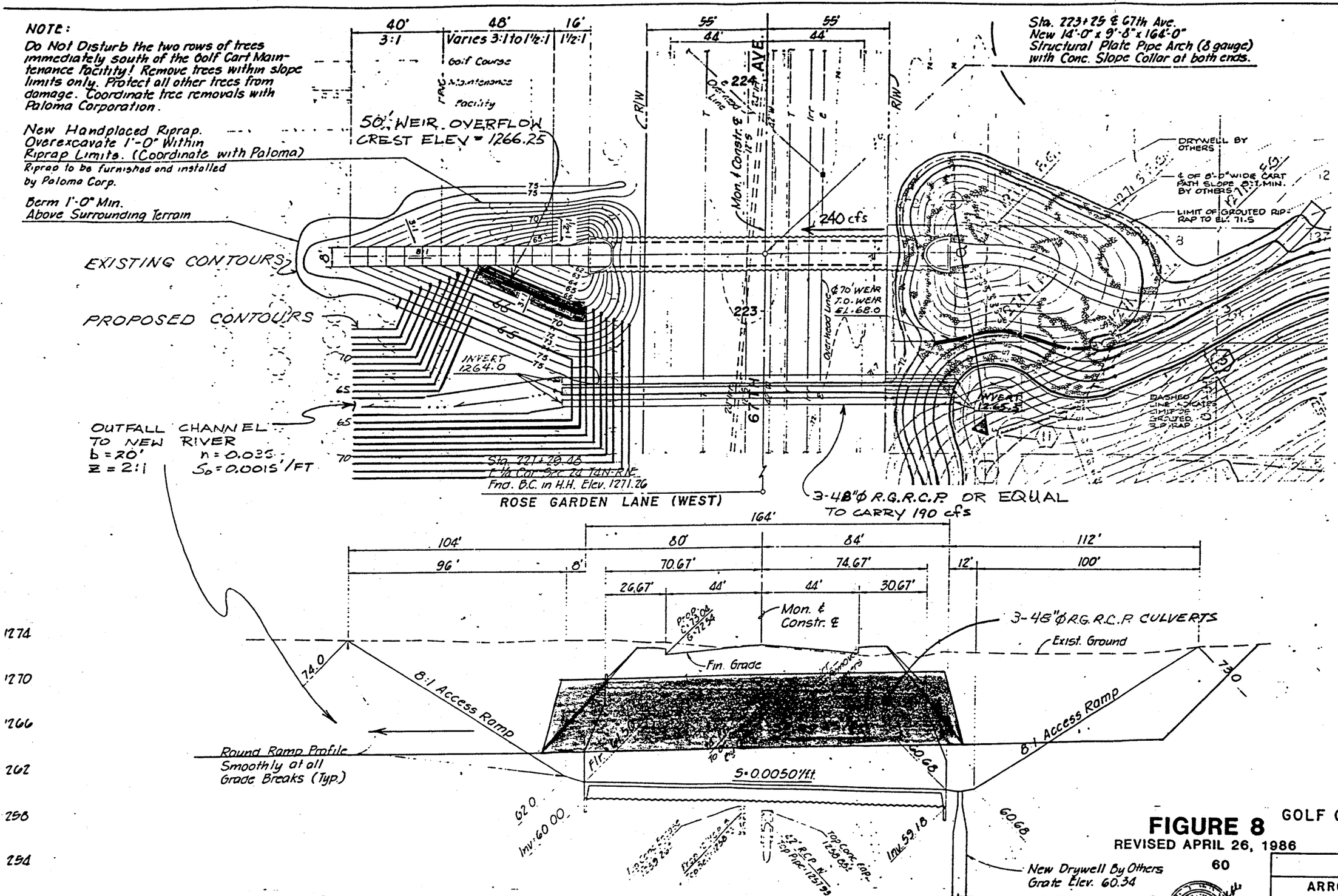


FIGURE 8 GOLF CART CROSSING DETAILS
REVISED APRIL 26, 1986

SCHEMATIC PLAN AND PROFILE OF PROPOSED 67th AVENUE CROSSING

PREPARED BY URS MARCH 31, 1986 PALOMA P.O. QA-5346 URS # 6013

ARROWHEAD RANCH
67TH AVENUE

DIBBLE & ASSOCIATES, CONSULTING ENGINEERS

DES	DR	CK	SHEET NO	TOTAL SHEETS	AS BUILT
SCALE 1" = 20' HORIZONTAL, 4' VERTICAL			2	3	

CONCLUSIONS AND RECOMMENDATIONS

The proposed Arrowhead Ranch Section 18 and 19 lake system will provide flood protection up to the 100-year storm event with at least one foot of freeboard between the 100-year lake water surface elevations and the proposed first floor building elevations. The proposed lake system does not, however, eliminate all flood hazards because storms having a greater magnitude and intensity than the 100-year design storm can and will occur.

The proposed lakes tributary to Lake "W1" (Structure 45) provide a 10-year, 24-hour storm water detention volume ot approximately 55.91 acre-feet for a drainage area encompassing approximately a total of approximately 564-acres of which approximately 490-acres are located on-site. The City of Glendale 10-year, 2-hour storm water retention requirements for this area is estimated to be approximately 42.8 acre-feet based on a total area of approximately 564-acres, an average runoff coefficient of 0.66 and a 10-year, 2-hour rainfall depth of 1.72 inches.

The "Z" series of lakes provide a 10-year, 24-hour storm water detention volume of approximately 7.03 acre-feet for a drainage area encompassing a total of approximately 60-acres. The City of Glendale 10-year, 2-hour storm water retention requirement for this area is estimated to be approximately 5.83 acre-feet based on a total area of 60-acres, an average runoff coefficient of 0.74 and a 10-year, 2-hour rainfall depth of 1.72 inches.

Parcel buyers and builders are responsible for providing the necessary drainage improvements within their individual parcels in accordance with local storm drainage design criteria in addition to the drainage basin boundaries and flow patterns shown in Figure 2 which is attached to the back of this report.

It is recommended that parcel development planners and engineers incorporate surface drainage elements such as streets, shallow swales and rundowns wherever possible to minimize the cost of storm sewer improvements. Should storm sewers, however, be deemed necessary they should generally be sized based on outlet control because the normal and flood stage lake water surface elevations are relatively close to the surrounding ground elevations which results in high tailwater conditions of the storm sewer outfall. A minimum of six-inches of freeboard is recommended between the design water surface elevation in the inlet box and the elevation of the inlet apron or grate.

It is recommended that developers utilizing the Rational Method to prepare subdivision drainage reports compare the peak rates of storm runoff obtained using the Rational Method with both the 1-hour and 24-hour rates obtained from the TR-20 output contained in the Appendix as a check on the correct order of magnitude of peak storm runoff.

As the planning and engineering design of individual parcels proceeds it may be found desirable to revise local drainage basin boundaries and flow patterns. This report should be updated periodically, because any such revisions could significantly affect the results of this study.

The outlet structure from planned Lake "W1" under 67th Avenue is affected by downstream conditions in the planned outfall channel to New River. The developer(s) of Sections 13 and 24, which are located to the west and downstream of planned Arrowhead Ranch Sections 18 and 19, must exercise caution in the planning and development of Sections 13 and 24 to assure that downstream conditions do not adversely affect the proposed Lake "W1" outlet structure.

Concrete cutoff walls and riprap erosion protection are recommended at locations where the planned streams outfall into lakes or ponds.

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