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Gilbert - Chandler
Area Drainage Master Study

Volume II
Future Conditions Hydrology

Prepared by the

Flood Control District of Maricopa County
Watershed Management Branch
&
Hydrologic Information Systems Branch

for the
Planning Branch

January
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GILBERT-CHANDLER ADMS
VOLUME II
FUTURE CONDITIONS HYDROLOGY

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EXECUTIVE SUMMARY

1.0 Introduction

This report presents analyses of the hydrologic response of the Gilbert-Chandler area watershed to the future conditions. The future conditions analyses included the consideration of four different future condition scenarios. Scenario One considered the watershed under existing land uses with the Price Expressway drainage facilities in place including the Santan Collector Channel and ADOT Basin B adjacent to the Gila Drain. Also included in Scenario One were the proposed future City of Chandler storm drains as recommended in their Stormwater Management Master Plan Update. Scenario Two examined the watershed including all of the facilities in Scenario One as well as the proposed facilities for the Santan Freeway east of Dobson Road. Scenario Three analyzed the watershed with the same facilities considered in Scenario One with fully developed land uses according to local land use plans. Scenario Four examined the watershed with the Scenario Two freeway condition and the Scenario Three land use condition. The study area covered the same area as the Volume I, Current Conditions Hydrology report.

2.0 Study Area

The watershed for the future condition hydrology is the same as for the current condition with an area of approximately 120 square miles (307 km^2). The area lies generally between U. S. Highway 60 (a.k.a. Superstition Freeway) on the north, the Roosevelt Water Conservation District Canal (RWCDC) on the east, Ocotillo Road on the south, and Interstate 10 (I-10) on the west (Figure 1). The study area covers portions of the Cities of Mesa and Tempe, and the Gila River Indian Community (GRIC), most of the City of Chandler and the Town of Gilbert, and a large portion of unincorporated Maricopa County. Rapid urbanization continues in the area.

3.0 Methods

The three major subwatersheds or model components remain essentially the same as in the Volume I report. The general rainfall-runoff modeling procedures also remained the same. Future condition land uses were derived from localities land use plans. Proposed freeway facilities were taken from available published reports. The ARC/INFO Geographic Information System (GIS) was more extensively utilized in the development of new model parameters.

4.0 Results and Discussion

Scenarios One and Two

The results for Scenarios One and Two remain the same as those in the Volume I models for those areas unaffected by the redelineation of subbasins or the addition of drainage facilities associated with the Price Expressway, the Santan Freeway, or the proposed City of Chandler storm drains because the models are exactly the same. The results at locations in the third model component have changed due to the inclusion of the proposed drainage facilities. Total flows in the Gila Drain are notably higher due to the removal of several large ponding areas adjacent to the drain and more efficient routing of runoff within the watershed in the Santan Collector Channel.

The addition of the Santan Freeway facilities east of Dobson Road drastically reduces flows into Crossroads Park due to the inclusion of a 350 acre-foot (43.2 ha-m) Basin Q near the intersection of Ray and Greenfield Roads. Also, the volume on the falling limb of the Gila Drain eastern inflows increases. This reflects the cummulative effect of collecting runoff in detention basins along the freeway and slowly bleeding it off to the Gila Drain.

The same patterns can generally be observed in both the 6- and 24-hour models with the six hour statistics generally lower in both peak discharge and volume.

Scenarios Three and Four

Full urbanization of the watershed has a dramatic impact on runoff for both the 6- and 24-hour events. Inflows from north of US 60 at the Eastern Canal are greatly impacted by the retention accompanying development. The peak discharge under the freeway drops almost in half. At the Consolidated Canal crossing, the effect is not as pronounced since most of the area of Mesa west (downstream) of the Eastern Canal is already urbanized.

In general the retention which accompanies new development has the effect of reducing both peak discharges and runoff volumes by as much as half. The impact of retention is more dramatic on the 6-hour event than the 24-hour event. Reductions in runoff volumes range between 30 to 40 percent for the 24-hour storm and 40 to 60 percent for the 6-hour storm. Peak discharges show similar trends.

The effects of the proposed Santan Freeway facilities east of Dobson Road under future land use assumptions parallel those seen with the current land uses. Peak flows are not greatly affected, while total runoff volumes delivered to the Gila Drain dramatically increase.

5.0 Conclusion

This study and the resulting HEC-1 models should be viewed as tools for the consideration and evaluation of alternatives for regional drainage systems in the area and their impact on one another. This study presents the impacts of four possible future conditions. Although none of them may predict the actual future, they may serve as an excellent basis for the evaluation of refined projections as they become available or necessitated.

1.0 SYNOPSIS

This report presents analyses of the hydrologic response of the Gilbert-Chandler area watershed to the future conditions. The future conditions analyses included the consideration of four different future condition scenarios. The first considered the watershed under existing land uses (i.e. the same as used in the Volume I study) with the Price Expressway drainage facilities in place including the Santan Collector Channel and ADOT Basin B adjacent to the Gila Drain. Also included in the first scenario were the proposed future City of Chandler storm drains as recommended in their Stormwater Management Master Plan Update (Ref. 6). The second scenario examined the watershed including all of the facilities in Scenario One as well as the proposed facilities for the Santan Freeway east of Dobson Road. The third scenario analyzed the watershed with the same facilities considered in Scenario One with fully developed land uses according to local land use plans. Likewise, the fourth scenario examined the watershed with the Scenario Two freeway condition and land uses fully developed. The study area (Figure 1) covers the same area as the Current Conditions Hydrology report (Ref. 18).

This hydrologic investigation was conducted as a logical extension of the analyses performed in Volume I, of the Gilbert-Chandler Area Drainage Master Study (ADMS). Again the main objective was to provide an analytic tool for the purposes of well-informed planning decisions with respect to drainage solutions in the east valley. As in the current conditions hydrology, this study was based on the Flood Control District of Maricopa County's hydrologic design criteria. Much of the data developed in the Volume I study was reused in the Volume II study. This was greatly facilitated by the fact that most of the original data had been developed in a geographic information system (GIS). The following tables summarize the results at selected locations for the 100-year 6- and 24-hour duration storms for the four scenarios.

Table 1.1 100-Year 24-Hour Peak Discharges and Volumes

Location	Scenario 1 (CLU)		Scenario 2 (FWY CLU)		Scenario 3 (FLU)		Scenario 4 (FWY FLU)	
	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)
Eastern Canal Inflow	1080	NA	1080	NA	550	NA	550	NA
Consolidated Canal Inflow	1350	NA	1350	NA	1210	NA	1210	NA
Inflow from north at SPRR and US60	300	180	300	180	270	160	270	160
Crossroads Park Inflow	2900	790	1770	540	1520	570	870	330
Freestone Park Inflow	940	150	940	150	620	90	620	90
Center Street Basin Inflow	1500	660	990	490	820	350	820	350
Detroit Basin Inflow	760	270	760	270	610	230	610	230
SPRR over/throughflow near Commonwealth Ave	350	240	350	240	180	200	180	200
SPRR over/throughflow 1/4 mile s. of Germann Rd.	290	670	180	310	210	480	70	60
Outlet E	650	290	650	290	480	250	480	250
Outlet F	300	42	300	42	170	36	170	36
HC60 (Ray and Arrowhead)	410	90	410	90	290	80	290	80
ADOT Basin G Inflow	500	205	500	205	340	180	340	180
Flow at Outlet H	650	510	690	1370	390	440	430	1180
Pecos and McClintock (HC68)	850	780	890	1630	660	680	680	1420
HC78 (I-10 near Germann Rd. alignment)	1490	1080	1490	710	1360	870	1360	460
Gila Drain eastern inflows in the Santan Collector	1390	1020	1430	1880	820	840	840	1590
Outlet C	510	100	510	100	70	30	70	30
Gila Drain western inflows in the Santan Collector	660	120	660	120	80	50	80	50
Total Gila Drain Inflows, North of Santan Fwy	1810	2180	1850	3030	970	1930	990	2670
Basin B inflows	240	10	290	12	0	0	0	0
Total Gila Drain Inflows, South of Santan Fwy	1040	1090	1040	720	970	860	970	440
Total Gila Drain flows at I-10	2600	3260	2610	3740	1040	2780	1050	3110

Table 1.2 100-Year 6-Hour Peak Discharges and Volumes

Location	Scenario 1 (CLU)		Scenario 2 (FWY CLU)		Scenario 3 (FLU)		Scenario 4 (FWY FLU)	
	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)
Eastern Canal Inflow	850	NA	850	NA	250*	NA	250*	NA
Consolidated Canal Inflow	1020	NA	1020	NA	590	NA	590	NA
Inflow from north at SPRR and US60	50	10	50	10	40	3	40	3
Crossroads Park Inflow	2720	740	1690	480	1360	370	750	210
Freestone Park Inflow	860	140	860	140	620	80	620	80
Center Street Basin Inflow	960	220	960	210	360	70	360	70
Detroit Basin Inflow	650	190	650	160	570	130	570	130
SPRR over/throughflow near Commonwealth Ave	190	150	190	120	110	80	110	80
SPRR over/throughflow 1/4 mile s. of Germann Rd.	180	280	100	130	80	40	0	0
Outlet E	480	190	480	190	290	130	290	130
Outlet F	160	16	160	16	40	4	40	4
HC60 (Ray and Arrowhead)	380	70	380	70	260	50	260	50
ADOT Basin G Inflow	420	120	420	120	220	80	220	80
Flow at Outlet H	320	300	410	860	140	160	180	530
Pecos and McClintock (HC68)	400	430	440	990	220	240	260	610
HC78 (I-10 near Germann Rd. alignment)	850	440	850	290	760	170	760	150
Gila Drain eastern inflows in the Santan Collector	770	550	780	1110	220	270	260	640
Outlet C	330	40	330	40	0	0	0	0
Gila Drain western inflows in the Santan Collector	420	60	420	60	0	0	0	0
Total Gila Drain Inflows, North of Santan Fwy	950	1640	970	2200	300	1300	340	1680
Basin B inflows	0	0	0	0	0	0	0	0
Total Gila Drain Inflows, South of Santan Fwy	420	430	420	270	370	140	370	120
Total Gila Drain flows at I-10	1280	2070	1310	2470	450	1440	450	1800

2.0 INTRODUCTION

The hydrologic analyses for the Gilbert-Chandler ADMS for the future conditions were developed by the Watershed Management Branch (WMB) of the Hydrology Division of the Flood Control District of Maricopa County (FCDMC) for the Planning Branch of the Planning and Project Management Division (PPM) of the FCDMC. The future conditions analyses were performed to examine the hydrologic impacts of future urbanization, urban retention, and proposed freeway and storm drain construction. The general land use plans of the municipalities in the area were consulted to identify future land uses. The proposed Santan Freeway location and drainage features were taken from studies performed for the Arizona Department of Transportation (ADOT) (Ref.s 2, 3, 15, 26, & 27). Proposed storm drains in the City of Chandler were taken from their Stormwater Management Master Plan Update (Ref. 6).

The purpose of this report is to present the future condition hydrology, compare it to the current condition, and establish a basis for regional drainage planning in the Gilbert-Chandler watershed. As was the case for the current condition hydrology (Volume I), the methodologies used were based on the FCDMC hydrologic design criteria. The future condition hydrologic models reflect updated versions of the current condition models which include full urbanization and account for subwatersheds delineated by the proposed Santan Freeway alignment and City of Chandler storm drains. This report assumes an understanding of the current condition report. Therefore, only the assumptions and methodologies particular to the future condition analysis are thoroughly documented herein.

2.1 Study Area

The watershed for the future condition hydrology is the same as for the current condition with an area of approximately 120 square miles (307 km^2). The area lies generally between U. S. Highway 60 (a.k.a. Superstition Freeway) on the north, the Roosevelt Water Conservation District Canal (RWCDC) on the east, Ocotillo Road on the south, and Interstate 10 (I-10) on the west (Figure 1). The study area covers portions of the Cities of Mesa and Tempe, and the Gila River Indian Community (GRIC), most of the City of Chandler and the Town of Gilbert, and a large portion of unincorporated Maricopa County.

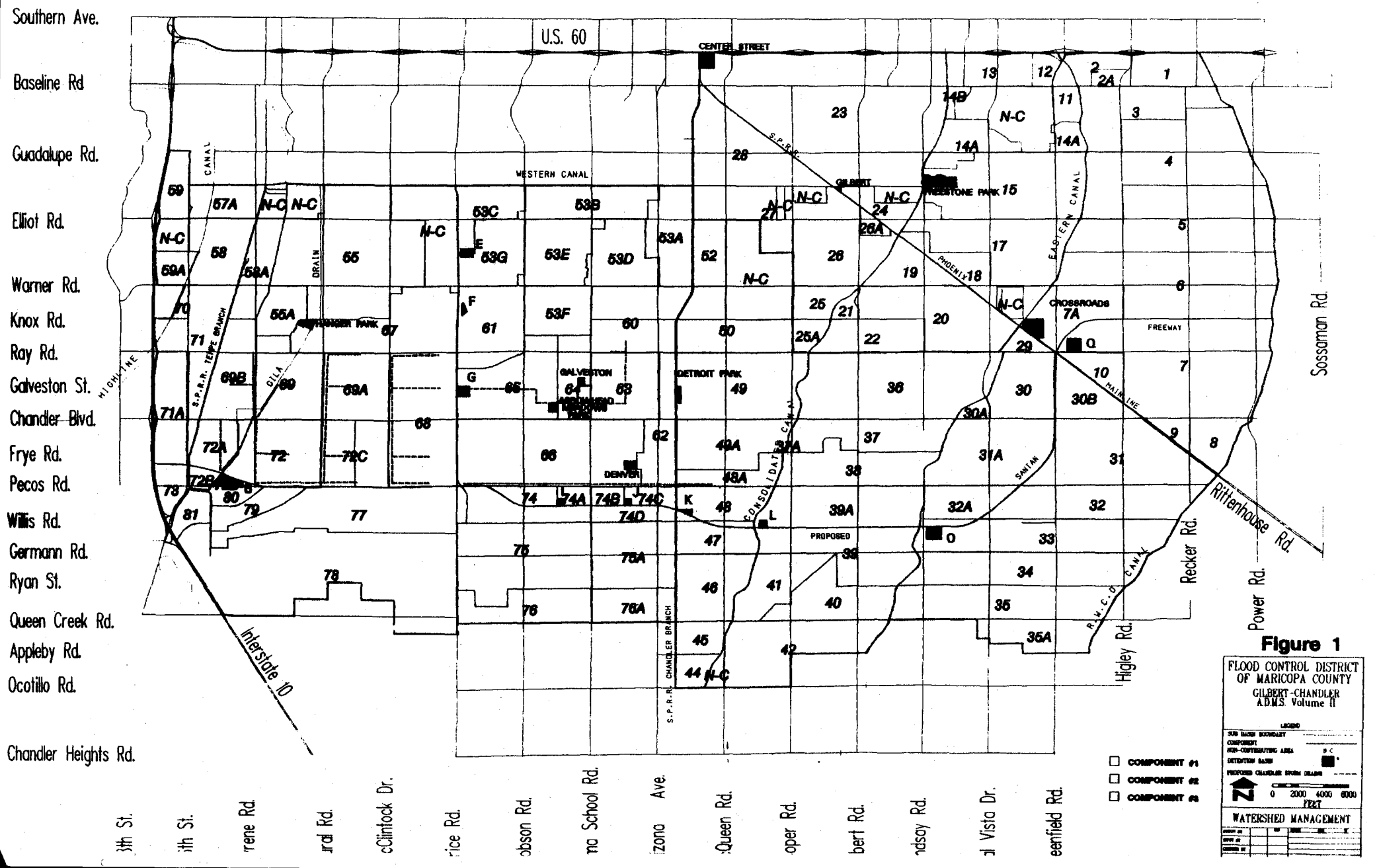
The three major subwatersheds or model components remain essentially the same as in the Volume I report with one important exception. For the future condition scenarios which include the proposed Santan Freeway and facilities east of Dobson Road, subbasins 31 and 30B have been taken out of model component 2 and placed in model component 1 (compare Plates 1 and 2). These two subbasins are assumed to be collected along the freeway and drain to the proposed Basin Q near the intersections of Ray and Greenfield Roads (Ref. 3).

Again the HEC Data Storage System (DSS) was used to write hydrographs between model components.

2.2 Study Criteria

As in the Current Conditions Hydrology, calculations were performed for the 100-year frequency for the 6- and 24-hour durations using the U.S. Army Corps of Engineers (COE) large array version 4.01 E, April 1991 of HEC-1. The Phoenix Valley S-graph method was used for the generatation of subbasin unit hydrographs via the Maricopa County Unit Hydrograph Procedure number 2 (MCUHP2).

Figure 1 Location Map



2.3 Definition of Modeled Scenarios

At the request of the Planning Branch, four future condition scenarios were analyzed. For all four scenarios, the subbasins used in the modeling were those created by the addition of the Santan Freeway alignment and consideration of the proposed City of Chandler storm drains.

Scenario One

The first scenario considered current land uses, the proposed City of Chandler storm drains, and the proposed Price Expressway drainage facilities. The construction of the Price Expressway will necessitate the construction of the Santan Collector Channel to drain Basin G and provide outfall for the flows intercepted by the expressway south of Chandler Boulevard. Therefore, in the HEC-1 model for Scenario One, temporary Basin H was removed and Basin G was provided with its ultimate outlet. Proposed Basins E and F were not actually modeled. However, the configuration of the model assumes them to be in place and operational. In other words, flows contributing to those two locations were assumed to be handled by the basins and therefore not to contribute to the rest of the watershed.

Scenario Two

Scenario Two is the same as Scenario One except that the proposed Santan Freeway facilities east of Dobson Road were also added to the modeling. The facilities considered were those described in the 1988 reports by Dames & Moore (Ref.s 3 & 15). Although this may no longer represent the best guess about the nature of the future freeway drainage facilities, it is the best published information from ADOT describing these facilities. A new study is just beginning under ADOT contract to update this work. The detention basins associated with the freeway were assumed to be drained by a four foot diameter gravity drain. The open channels adjacent to the freeway were assumed to convey only those flows beyond those handled by the

detention basins. Channel dimensions and capacities were also taken from the Dames & Moore work. Flows in excess of the channel capacities were assumed to continue in their original path as determined in the Volume I study. Subbasins 30B and 31 were moved from model component 2 to component 1 based on the assumption that runoff from these two areas would be collected along the proposed freeway and collected in proposed Basin Q.

Scenario Three

Future condition Scenario Three considered the same drainage facilities as Scenario One. The difference between Scenarios One and Three is that the land uses assumed in Scenario Three were those for the fully developed condition as shown in Plate 3.

Scenario Four

Scenario Four is to Scenario Two as Scenario Three is to One. That is, Scenario Four examines the same drainage facilities as Scenario Two except for with the fully developed land uses.

3.0 MAPPING AND SURVEY INFORMATION

The mapping and survey information utilized were essentially the same as in the Volume I study. The digital version of the subbasin map was used as the basis for the future subbasin map. Also the existing land use ARC/INFO coverage served as the starting point for the future land use coverage.

4.0 HYDROLOGY

4.1 General

The future condition hydrology for the Gilbert-Chandler watershed was analyzed for the same 100-year storms as in the Current Conditions report. Storm durations of 6- and 24-hours were evaluated for this storm frequency. The watershed was modeled using the Corps of Engineers HEC-1 computer program (large array, version 4.01 E, April 1991). The Phoenix Valley S-graph method was used to represent runoff characteristics for the watershed and converted to unit hydrographs using the FCDMC's MCUHP2 program for input into the HEC-1 models. The entire watershed was divided into three major components (models), and then into subbasins. Each of these components generates outflow hydrographs that are used as inflow hydrographs to the downstream model.

In addition to the formal ADMS study boundary, the contributing area north of the Superstition Freeway was also modeled for both precipitation events and both land use scenarios. For the current land use condition, the hydrographs from the Current Conditions report were used. The future condition land uses were modeled as part of this study. The rainfall depths over the contributing watershed area north of the freeway were also areally reduced. The outflow hydrographs from north of the freeway were input to model component #1 using the HEC Data Storage System (DSS).

The area west of I-10 and north of Pecos Road was again included in the analyses. This area contributes to an agricultural tailwater ditch with limited capacity (estimated at 100 cfs (2.8 cms)). The approximately two square mile (5 km^2) area was modeled as a single subbasin. From the resulting runoff hydrograph, 100 cfs (2.8 cms) were diverted and written to DSS for retrieval into model component #3. Land

uses for the future condition in this watershed were assumed on average to be similar to the medium density residential category used elsewhere in this study.

4.2 Drainage Area Boundaries

As mentioned in the introduction, the subbasin delineations used in the Volume I report were modified to account for the proposed Santan Freeway and some of the proposed City of Chandler storm drains. The freeway was added by simply superimposing the freeway alignment over the existing subbasin coverage in ARC/INFO. For the Chandler storm drains, new subbasins were added where concentration points were needed to allow for the diversion of storm drain capacities. The other change in subbasin delineations was subbasin 53. After further consideration of the Volume I results, it was decided to further subdivide subbasin 53. These new delineations are reflected in Figure 1 and Plate 1.

4.3 Soils

The soils data from the Volume I study was used directly in the Volume II work.

4.4 Future Land Uses

The future land uses were derived from the Current Conditions land use map as modified to reflect the land use plans of Gilbert, Chandler, Tempe, Mesa, and the County. After a draft version of the fully developed condition had been assembled, copies were sent to the municipalites for comment as to the reasonableness of the projections. Comments were received from the cities and incorporated into the finalized digital version of the future land use map (Plate 3). The areal distribution of land uses in each subbasin was calculated by the GIS in a similar fashion as in the Volume I study. At the Town of Gilbert's request, a "mixed use area" category was added to accommodate uncertainties in an area of the Town south of the SPRR and east of the Eastern Canal. "Mixed use area" has been added to Tables 4.1, 4.2, & 4.5

to reflect the parameter values assumed for this new land use category.

4.5 Lag Times

Lag times for the Phoenix Valley S-graph were calculated in the same manner as in the Volume I study. The COE lag time equation below (Ref. 19) was again used to compute basin lag:

$$\mathbf{Lag} = 24\mathbf{Kn}\left[\frac{L\,L_{ca}^{\;0.38}}{S^{0.5}}\right]$$

where

Lag	=	basin lag, in hours
L	=	length of the longest watercourse, in miles
$\mathbf{L_{ca}}$	=	length along the watercourse to a point opposite the basin centroid, in miles
S	=	watercourse slope, in feet/mile
Kn	=	estimated mean Manning's roughness coefficient for all channels within a basin

Only for those subbasins affected by the redelineations were lag times recalculated. Again, as in Volume I, the Kn value used for urbanized areas was 0.15. Representative Kn values for each land use category were selected as shown in Table 4.2.

Table 4.1 Classification of Zoning Types for Estimation of Imperviousness

Gilbert-Chandler ADMS Land Use Category	Impervious Area (percent)	Gilbert Zoning Unit	Gilbert Description	Chandler Zoning Unit	Chandler Description	Mesa Zoning Unit	Mesa Description	Tempe Zoning Unit	Tempe Description	County Zoning Unit	County Description	Phoenix Zoning Unit	Phoenix Description	Cave Creek FIS % Imp. Area (including R.O.W.)
Agriculture	0	AG	Agriculture	AG-1	Agriculture	AG	Agriculture	AG	Agriculture					
Very Low Density Residential	15					R1-90	Single Residence			RURAL-190	190,000 sq. ft./dwelling unit	S-1	Ranch or Farm Residential, > 1 acre	15
						SR	Suburban Ranch			RURAL-70	70,000 sq. ft./dwelling unit	S-2	Ranch or Farm Commercial	18
		R1-43	Rural							RURAL-43	one acre/dwelling unit	RE-43	Single Family, 1 acre minimum	20
Low Density Residential	25	R1-35	Rural Residential	SF-33	Single Family	R1-35	Single Residence			R1-35	Single Family Residential, 35,000 sq. ft./dwelling unit	RE-35	SF, 35,000 sq.ft min.	22
												RE-24	SF, 24,000 sq.ft min.	25
		R1-20	SF, Residential	SF-18	Single Family					R1-18	SFR, 18,000 sq. ft./unit	R1-18	SF, 18,000 sq.ft min.	25
		R1-15	" "			R1-15	Single Residence	R1-15	One Family Residential			R1-14	SF, 14,000 sq.ft min.	30
Medium Density Residential	45	R1-10	" "	SF-10	Single Family	R1-9	Single Residence	R1-10	One Family Residential	R1-10	SFR, 10,000 sq. ft./unit	R1-10	SF, 10,000 sq.ft min.	38
		R1-8	" "					R1-8	One Family Residential	R1-8	SFR, 8,000 sq. ft./unit	R1-8	SF, 8,000 sq.ft min.	45
		R1-7	" "	SF-7	Single Family	R1-7	Single Residence	R1-7	One Family Residential					
						R1-6	Single Residence	R1-6	One Family Residential	R1-6	SFR, 6,000 sq. ft./unit	R1-6	SF, 6,000 sq.ft min.	50
						TCR-1	Town Center, Single Family	RO	Residence/Office			R-O	Res. Office	50
Multiple Family Residential	65	R-2	Duplex	MF-1	Medium Density	R-2	Restricted Multiple Resid.	R-2	Multi-Family Residential	R-2	2 Family Residence	R-2	MF, 4,000 sq.ft./unit	60
		R-3	Multi-Family, Apartments	MF-2	Multi-Family	R-3	Limited Multiple Resid.	R-3R	Multi-Family Restricted	R-3	Multiple Family, Residential	R-3	MF, 3,000 sq.ft./unit	65
		R-4	Multi-Family, General	MF-3	High Density	R-4	General Multiple Resid.	R-3	Multi-Family Limited	R-4	Multiple Family, Residential	R-4	MF, 1,500 sq.ft./unit	65
		R-5	Townhouse Residential					R-4	Multi-Family General	R-5	Multiple Family, Residential	R-4A	MF, 1,000 sq.ft./unit	70
								R-Th	Townhouse			R-5	MF, 1,000 sq.ft./unit	70
		MH	Mobile Home	MH-1	Mobile Homes	TCR-2	TC, Restricted Multi-Res.	RMH	Mobile Home Residence	MHR	Manufactured Housing, Resid.	CP/BP	Business Park	65
		CTP	Commercial Trailer Park			TCR-3	TC, General Res.	MHS	Manufactured Housing Subd.			R-H	Resort District	65
								TP	Trailer Park					
Industrial	75	I-1	Garden Type Industrial			M-1	Limited Industrial	I-1	Light Industrial			IND PARK	Industrial Park	75
		I-2	Light Industrial	I-1	Light Industrial			I-2	General Industrial	I-2	Light Industrial	A-1	Light Industrial	75
		I-3	General Industrial	I-2	General Industrial	M-2	General Industrial	I-3	Heavy Industrial	I-3	Heavy Industrial	A-2	Heavy Industrial	75
Commercial	90	C-1	Light Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Comm.	CCR	Convenience Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Commercial	95
		C-2	General Commercial	C-2	Community Commercial	C-2	Limited Comm.	C-1	Neighborhood Commercial	C-2	Intermediate Commercial	C-2	Intermediate Commercial	95
		C-3	Central Commercial	C-3	Regional Comercial	C-3	General Comm.	C-2	General Commercial	C-3	General Commercial	C-3	General Commercial	95
		RS	Residential Services			OS	Office-Sercives	CCD	Central Comm. District	C-O	Commercial Office	C-O	Commercial Office	75
		RCC	Residential Conveniences			TCC	TC,High Intensity Mixed Use					HR	High Rise District	85
						TCB-1	TC, Limited Comm./General Manufacturing							
						TCB-2	TC, General Comm./ Light Manufacturing							
		MISCELLANEOUS CATEGORIES: These map units should be evaluated on a case by case basis.												
		PAD	Planned Area Development	PAD	Planned Area Development			S	Private School	PD	Planned Development Overlay	PAD	Planned Area Development	85
		PSC-1	Planned Neighborhood Shopping											
		PSC-2	Planned Shopping Center							CS	Planned Shopping Center	PSC	Planned Shopping Center	85
		IB	Industrial Buffer											
				PCO	Planned C Offices	PEP	Planned Employment Park							
						PF	Public Facilities			SU	Special Uses			
										SC	Senior Citizen Overlay	PCD	Planned Community Development	60
										NUP	Neighborhood Plan of Development			
										RUP	Residential Plan of Development			
										IUP	Industrial Plan of Development			
												R.O.W.	Right of Way	VARIABLE
												P-1	Parking, Open	VARIABLE
												P-2	Parking, Structures	VARIABLE
												D.G	Dwelling Group	85
Mixed Use Area	55	Town of Gilbert ONLY -- added for future conditions land uses for an area east of the Eastern Canal south of the SPRR												

TABLE 4.2 Kn Categories

Kn category	Land use categories	Kn value
Urban	Very Low Density Residential Low Density Residential Medium Density Residential Multi-Family Residential Industrial Commercial Miscellaneous Urban Uses Parks Mixed Use Area	0.15
Agriculture	Row Crops Orchards Dairies	0.07
Barren, desert, vacant	Barren Desert, Open	0.03

Table 4.3 shows the data used in the calculation of lag time for Scenarios One and Two. Data for Scenarios Three and Four follows in Table 4.4. The shaded cells in both tables represent data used unchanged from Volume I. All clear cells reflect new measurements and calculations performed in Volume II. All new values generated for this study were derived with the use of the ARC/INFO GIS. In the process of developing the new data it was discovered that an error had been made in the estimation of the slope for subbasin 14A in the Volume I study. Therefore, subbasin 14A shows up in clear cells in Table 4.3.

Table 4.3 Lag Tme Calculations for Scenarios One and Two

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
1	Valley	0.078	1.66	1.44	20.5	1.47	88
2A	Valley	0.081	0.56	0.25	23.2	0.51	31
2	Valley	0.078	1.38	0.69	18.1	1.06	64
3	Valley	0.095	2.90	1.53	20.7	2.25	135
4	Valley	0.088	3.43	2.11	24.5	2.45	147
5	Valley	0.074	3.44	1.94	15.7	2.17	130
6	Valley	0.072	3.35	1.72	15.5	1.99	119
7	Valley	0.070	3.72	2.71	11.5	2.54	152
7A	Valley	0.080	1.28	0.45	8.8	1.03	62
8	Valley	0.070	0.92	0.47	7.6	0.83	50
9	Valley	0.076	0.83	0.52	14.5	0.80	48
10	Valley	0.070	1.25	0.78	15.2	0.99	59
11	Valley	0.091	0.96	0.76	7.3	1.33	80
12	Valley	0.030	0.81	0.43	23.0	0.27	16
13	Valley	0.084	1.60	1.40	12.5	1.70	102
14A	Valley	0.081	2.28	0.99	40.8	1.31	79
14B	Valley	0.140	0.83	0.26	4.1	1.44	86
15	Valley	0.110	1.93	0.96	14.0	2.01	121
17	Valley	0.094	2.67	1.36	11.6	2.31	139
18	Valley	0.103	2.84	1.27	12.0	2.52	151
19	Valley	0.100	1.50	0.70	13.3	1.49	89
20	Valley	0.101	3.00	1.76	9.6	2.98	179
21	Valley	0.072	0.39	0.15	15.4	0.35	21
22	Valley	0.073	1.50	0.78	11.7	1.17	70
23	Valley	0.112	4.44	3.10	7.9	4.94	296
24	Valley	0.142	1.26	0.98	9.5	2.40	144
25	Valley	0.113	1.00	0.70	5.0	1.75	105
25A	Valley	0.082	0.61	0.24	9.0	0.62	37
26	Valley	0.110	1.90	1.44	7.1	2.67	160
26A	Valley	0.140	0.61	0.32	9.7	1.17	70
27	Valley	0.080	2.92	1.57	8.1	2.30	138
28	Valley	0.075	2.94	1.59	6.5	2.26	136
29	Valley	0.150	1.09	0.67	10.1	2.06	124
30	Valley	0.070	1.23	0.79	11.1	1.05	63
30A	Valley	0.070	0.49	0.27	10.2	0.50	30
30B	Valley	0.080	1.24	0.42	13.1	0.92	55
31	Valley	0.090	2.62	0.91	13.5	1.83	110
31A	Valley	0.060	2.29	1.38	9.6	1.45	87
32	Valley	0.070	2.59	1.13	15.2	1.51	90
32A	Valley	0.100	1.38	0.53	12.3	1.32	79
33	Valley	0.085	4.18	1.94	14.1	2.74	164
34	Valley	0.072	4.00	1.97	14.2	2.28	137
35	Valley	0.067	3.78	2.07	14.3	2.13	128
35A	Valley	0.096	3.47	2.69	15.1	3.22	193
36	Valley	0.098	3.35	1.82	9.0	3.10	186
37	Valley	0.100	2.88	1.58	11.0	2.72	163

Table 4.3 Lag Tme Calculations for Scenarios One and Two

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
37A	Valley	0.150	0.39	0.14	2.6	1.00	60
38	Valley	0.074	2.82	1.54	11.7	1.94	116
39	Valley	0.070	2.20	1.34	14.9	1.52	91
39A	Valley	0.080	2.72	1.53	12.2	2.05	123
40	Valley	0.080	2.20	1.07	13.2	1.63	98
41	Valley	0.080	1.72	0.85	10.2	1.43	86
42	Valley	0.065	2.60	1.21	13.1	1.48	89
43	NON - CONTRIBUTING AREA						
44	Valley	0.070	0.74	0.44	12.2	0.68	41
45	Valley	0.069	1.13	0.83	7.1	1.11	67
46	Valley	0.075	1.25	0.82	12.8	1.12	67
47	Valley	0.070	1.38	0.51	10.2	0.95	57
48	Valley	0.100	1.74	0.73	10.7	1.68	101
48A	Valley	0.083	2.04	1.35	8.9	1.94	116
49	Valley	0.094	2.23	0.85	9.6	1.87	112
49A	Valley	0.113	1.59	0.83	10.4	1.93	116
50	Valley	0.095	1.88	0.86	9.0	1.80	108
51	NON - CONTRIBUTING AREA						
52	Valley	0.054	1.45	1.21	7.5	1.09	65
53A	Valley	0.120	1.62	1.34	5.4	2.81	168
53B	Valley	0.130	2.71	1.50	5.0	3.92	235
53C	Valley	0.130	1.90	1.36	4.7	3.34	200
53D	Valley	0.140	1.77	1.01	2.3	3.58	215
53E	Valley	0.140	1.83	1.15	3.3	3.55	213
53F	Valley	0.140	1.28	0.78	6.9	2.33	140
53G	Valley	0.150	1.43	0.50	4.0	2.44	146
54	NON - CONTRIBUTING AREA						
55	Valley	0.133	2.93	1.92	3.3	4.93	296
55A	Valley	0.143	1.15	0.94	9.6	2.30	138
56	NON - CONTRIBUTING AREA						
57	NON - CONTRIBUTING AREA						
57A	Valley	0.060	1.50	0.79	29.0	0.80	48
58	Valley	0.072	1.47	1.03	23.3	1.12	67
58A	Valley	0.081	1.42	0.83	11.3	1.30	78
59	Valley	0.097	1.28	1.15	27.3	1.44	86
59A	Valley	0.030	0.63	0.28	36.5	0.19	11
60	Valley	0.114	2.83	1.52	5.7	3.42	205
61	Valley	0.099	1.95	1.04	5.1	2.28	137
62	Valley	0.139	2.29	0.68	3.1	3.20	192
63	Valley	0.143	1.55	0.77	6.8	2.55	153
64	Valley	0.146	1.19	0.85	0.4	4.16	250
65	Valley	0.098	1.93	0.74	5.7	1.93	116
66	Valley	0.082	3.46	1.80	8.1	2.64	158
67	Valley	0.126	2.69	1.26	4.5	3.61	217
68	Valley	0.094	2.83	2.31	4.2	3.50	210
69	Valley	0.080	1.50	1.09	0.5	2.64	158

Table 4.3 Lag Tme Calculations for Scenarios One and Two

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
69A	Valley	0.070	1.84	0.45	4.6	1.17	70
69B	Valley	0.100	1.90	0.66	10.9	1.66	100
70	Valley	0.078	0.48	0.16	16.7	0.41	25
71	Valley	0.080	2.83	1.29	14.9	1.88	113
71A	Valley	0.070	2.06	0.80	23.3	1.12	67
72	Valley	0.090	1.87	0.44	4.2	1.53	92
72A	Valley	0.090	0.82	0.48	9.1	1.00	60
72B	Valley	0.070	0.35	0.17	12.3	0.36	21
72C	Valley	0.090	1.84	1.35	5.6	2.20	132
73	Valley	0.070	0.42	0.24	18.3	0.40	24
74	Valley	0.070	0.98	0.58	11.6	0.85	51
74A	Valley	0.070	0.46	0.23	7.5	0.49	29
74B	Valley	0.060	0.45	0.23	7.6	0.41	25
74C	Valley	0.070	0.72	0.38	9.5	0.67	40
74D	Valley	0.070	1.21	0.60	8.2	1.00	60
75	Valley	0.070	1.83	0.80	11.4	1.23	74
75A	Valley	0.099	1.45	0.63	6.2	1.63	98
76	Valley	0.071	2.25	1.13	8.0	1.63	98
76A	Valley	0.070	1.25	0.63	7.2	1.05	63
77	Valley	0.060	3.90	2.39	8.0	2.25	135
78	Valley	0.044	4.88	2.31	7.6	1.80	108
79	Valley	0.046	1.46	0.50	7.5	0.66	40
80	Valley	0.050	1.07	0.63	6.7	0.72	43
81	Valley	0.091	0.67	0.32	6.0	0.87	52

Table 4.4 Lag Time Calculations for Scenarios Three and Four

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
1	Valley	0.14	1.66	1.44	20.5	2.64	158
2	Valley	0.14	1.38	0.69	18.1	1.90	114
2A	Valley	0.15	0.56	0.25	23.2	0.94	56
3	Valley	0.15	2.90	1.53	20.7	3.57	214
4	Valley	0.15	3.43	2.11	24.5	4.16	250
5	Valley	0.15	3.44	1.94	15.7	4.39	263
6	Valley	0.15	3.35	1.72	15.5	4.16	250
7	Valley	0.15	3.72	2.71	11.5	5.45	327
7A	Valley	0.15	1.28	0.45	8.8	1.93	116
8	Valley	0.15	0.92	0.47	7.6	1.78	107
9	Valley	0.15	0.83	0.52	14.5	1.57	94
10	Valley	0.15	1.25	0.78	15.2	2.13	128
11	Valley	0.15	0.96	0.76	7.3	2.19	131
12	Valley	0.14	0.81	0.43	23.0	1.24	74
13	Valley	0.14	1.60	1.40	12.5	2.83	170
14A	Valley	0.15	2.28	1.26	14.7	3.23	194
14B	Valley	0.15	0.83	0.26	4.1	1.54	92
15	Valley	0.15	1.93	0.96	14.0	2.76	165
17	Valley	0.15	2.67	1.36	11.6	3.69	221
18	Valley	0.15	2.84	1.27	12.0	3.66	219
19	Valley	0.15	1.50	0.70	13.3	2.24	135
20	Valley	0.15	3.00	1.76	9.6	4.41	265
21	Valley	0.15	0.39	0.15	15.4	0.73	44
22	Valley	0.15	1.50	0.78	11.7	2.40	144
23	Valley	0.15	4.44	3.10	7.9	6.59	396
24	Valley	0.15	1.26	0.98	9.5	2.54	153
25	Valley	0.15	1.00	0.70	5.0	2.32	139
25A	Valley	0.15	0.61	0.24	9.0	1.14	69
26	Valley	0.15	1.90	1.44	7.1	3.64	218
26A	Valley	0.15	0.61	0.32	9.7	1.26	75
27	Valley	0.15	2.92	1.57	8.1	4.31	259
28	Valley	0.15	2.94	1.59	6.5	4.54	272
29	Valley	0.15	1.09	0.67	10.1	2.06	124
30	Valley	0.15	1.23	0.79	11.1	2.25	135
30A	Valley	0.15	0.49	0.27	10.2	1.07	64
30B	Valley	0.15	1.24	0.42	13.1	1.72	103
31	Valley	0.15	2.62	0.91	13.5	3.05	183
31A	Valley	0.15	2.29	1.38	9.6	3.63	218
32	Valley	0.15	2.59	1.13	15.2	3.23	194
32A	Valley	0.15	1.38	0.53	12.3	1.98	119
33	Valley	0.15	4.18	1.94	14.1	4.83	290
34	Valley	0.15	4.00	1.97	14.2	4.77	286
35	Valley	0.15	3.78	2.07	14.3	4.75	285
35A	Valley	0.15	3.47	2.69	15.1	5.03	302
36	Valley	0.15	3.35	1.82	9.0	4.72	283
37	Valley	0.15	2.88	1.58	11.0	4.06	244

Table 4.4 Lag Time Calculations for Scenarios Three and Four

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
37A	Valley	0.15	0.39	0.14	2.6	1.00	60
38	Valley	0.15	2.82	1.54	11.7	3.95	237
39	Valley	0.15	2.20	1.34	14.9	3.25	195
39A	Valley	0.15	2.72	1.53	12.2	3.85	231
40	Valley	0.15	2.20	1.07	13.2	3.05	183
41	Valley	0.14	1.72	0.85	10.2	2.50	150
42	Valley	0.15	2.60	1.21	13.1	3.41	205
43	NON - CONTRIBUTING AREA						
44	Valley	0.15	0.74	0.44	12.2	1.46	88
45	Valley	0.15	1.13	0.83	7.1	2.42	145
46	Valley	0.15	1.25	0.82	12.8	2.24	134
47	Valley	0.15	1.38	0.51	10.2	2.03	122
48	Valley	0.15	1.74	0.73	10.7	2.51	151
48A	Valley	0.15	2.04	1.35	8.9	3.50	210
49	Valley	0.15	2.23	0.85	9.6	2.99	179
49A	Valley	0.15	1.59	0.83	10.4	2.57	154
50	Valley	0.15	1.88	0.86	9.0	2.84	171
51	NON - CONTRIBUTING AREA						
52	Valley	0.15	1.45	1.21	7.5	3.04	182
53A	Valley	0.15	1.62	1.34	5.4	3.51	210
53B	Valley	0.14	2.71	1.50	5.0	4.22	253
53C	Valley	0.14	1.90	1.36	4.7	3.59	216
53D	Valley	0.15	1.77	1.01	2.3	3.83	230
53E	Valley	0.15	1.83	1.15	3.3	3.81	228
53F	Valley	0.15	1.28	0.78	6.9	2.49	150
53G	Valley	0.15	1.43	0.50	4.0	2.44	146
54	NON - CONTRIBUTING AREA						
55	Valley	0.15	2.93	1.92	3.3	5.55	333
55A	Valley	0.15	1.15	0.94	9.6	2.41	145
56	NON - CONTRIBUTING AREA						
57	NON - CONTRIBUTING AREA						
57A	Valley	0.15	1.50	0.79	29.0	2.03	122
58	Valley	0.15	1.47	1.03	23.3	2.32	139
58A	Valley	0.15	1.42	0.83	11.3	2.42	145
59	Valley	0.15	1.28	1.15	27.3	2.22	133
59A	Valley	0.14	0.63	0.28	36.5	0.88	53
60	Valley	0.15	2.83	1.52	5.7	4.51	271
61	Valley	0.15	1.95	1.04	5.1	3.45	207
62	Valley	0.15	2.29	0.68	3.1	3.44	207
63	Valley	0.15	1.55	0.77	6.8	2.68	161
64	Valley	0.15	1.19	0.85	0.4	4.26	256
65	Valley	0.15	1.93	0.74	5.7	2.96	178
66	Valley	0.15	3.46	1.80	8.1	4.85	291
67	Valley	0.15	2.69	1.26	4.5	4.31	259
68	Valley	0.15	2.83	2.31	4.2	5.58	335
69	Valley	0.15	1.50	1.09	0.5	4.95	297

Table 4.4 Lag Time Calculations for Scenarios Three and Four

Basin ID	S-Graph	Kn	L (miles)	Lca (miles)	Slope (ft/mile)	Lag (hrs)	Lag (min)
69A	Valley	0.15	1.84	0.45	4.6	2.51	150
69B	Valley	0.15	1.90	0.66	10.9	2.49	150
70	Valley	0.15	0.48	0.16	16.7	0.80	48
71	Valley	0.15	2.83	1.29	14.9	3.52	211
71A	Valley	0.14	2.06	0.80	23.3	2.23	134
72	Valley	0.15	1.87	0.44	4.2	2.55	153
72A	Valley	0.15	0.82	0.48	9.1	1.66	100
72B	Valley	0.15	0.35	0.17	12.3	0.76	46
72C	Valley	0.15	1.84	1.35	5.6	3.67	220
73	Valley	0.14	0.42	0.24	18.3	0.81	49
74	Valley	0.15	0.98	0.58	11.6	1.82	109
74A	Valley	0.15	0.46	0.23	7.5	1.05	63
74B	Valley	0.15	0.45	0.23	7.6	1.03	62
74C	Valley	0.15	0.72	0.38	9.5	1.43	86
74D	Valley	0.15	1.21	0.60	8.2	2.14	128
75	Valley	0.15	1.83	0.80	11.4	2.62	157
75A	Valley	0.15	1.45	0.63	6.2	2.46	147
76	Valley	0.15	2.25	1.13	8.0	3.46	207
76A	Valley	0.15	1.25	0.63	7.2	2.26	136
77	Valley	0.06	3.90	2.39	8.0	2.27	136
78	Valley	0.05	4.88	2.31	7.6	2.05	123
79	Valley	0.06	1.46	0.50	7.5	0.87	52
80	Valley	0.05	1.07	0.63	6.7	0.72	43
81	Valley	0.12	0.67	0.32	6.0	1.14	69

4.6 Loss Parameters

Rainfall losses were estimated using the Green and Ampt method and the procedures outlined in the Drainage Design Manual, Volume I (Ref. 19) and Volume I of the Gilbert-Chandler ADMS (Ref. 18).

The "Normal" DTHETA condition was again assumed for all land uses in the study. Values for IA, the assumed DTHETA conditions and vegetation cover for each land use category are the same as in Volume I and are given in Table 4.5.

TABLE 4.5 IA, DTHETA, and Percent Vegetation by Land Use

LAND USE	IA (inches)	DTHETA	% VEG. COVER
Desert / Barren Land	0.35	Normal	10
Very Low Density Resid.	0.20	Normal	90
Low Density Resid.	0.20	Normal	75
Medium Density Resid.	0.15	Normal	50
Multi-Family Resid.	0.15	Normal	40
Commercial	0.07	Normal	90
Industrial	0.10	Normal	40
Park and golf course	0.20	Normal	95
Orchard	0.75	Normal	80
Row Crops	0.50	Normal	80
Dairy	0.50	Normal	5
MIxed Use Area	0.15	Normal	50

NOTE: "% vegetation cover" is a percentage of the pervious area contained within the specified land use, e.g. if the study area is Multi-Family Resid. with 65% imperviousness then the " % vegetation cover" is 40% of the remaining 35% of the total area.

The effective impervious area (RTIMP) for each subbasin for future land uses were based upon the same assumptions made in Volume I. Areally weighted average values for each subbasin were based upon the distribution of land uses as stored in the GIS and the total impervious values for each land use category shown in Table

4.1. Again, the total values were assumed to be 80 percent effective. The effective value was taken as the RTIMP value for use in HEC-1.

The calculations of loss parameters for all subbasin affected by the new subbasin delineations were performed using the ARC/INFO GIS. ARC/INFO was used to determine areal distributions of land uses and soil types to perform parameter lookups and calculate average values for each subbasin using the STATISTICS command. Summary reports were generated using the INFO report procedures and then transferred manually to MCUHP2 input files. The results of these calculations for each subbasin are summarized in Tables 4.6 and 4.7. The parameters affected by the redelineations are shown in unshaded cells. All unaffected parameters are displayed in shaded cells.

4.7 Precipitation

The design storms considered in the future conditions analyses were exactly the same as those used in the current conditions study. For the 100-year 24-hour event, the SCS Type II temporal distribution was used with NOAA Technical Memorandum NWS HYDRO-40 (Ref. 32) areal reduction factors. For the 100-year 6-hour event, MCUHP2 performed both the areal reduction and the selection of temporal distribution. Point rainfall depths for both durations were reduced over the area of each model component in order to generate critical hydrographs from one model component to the next. The point rainfall depths and areally reduced depths for the 6- and 24-hour durations for each model component are shown again in Table 4.8. These values were not changed in Scenarios Three and Four despite the move of subbasins 31 and 30B from model component 2 to 1.

Table 4.6 Summary of MCUHP2 Input and Retention Volumes for Scenarios One and Two

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
1	0.606	0.566	0.250	3.50	0.435	1.57	88	1	0.0
2	0.288	0.435	0.250	5.36	0.322	1.88	64	2	0.0
2A	0.115	0.459	0.170	7.32	0.196	1.66	30	2A	0.0
3	1.243	0.417	0.190	7.14	0.215	3.78	135	3	4.8
4	2.618	0.430	0.150	7.78	0.154	5.30	147	4	20.3
5	2.629	0.484	0.130	10.10	0.053	0.63	130	5	4.1
6	2.733	0.495	0.100	9.40	0.035	0.21	119	6	0.0
7	3.539	0.490	0.150	8.20	0.070	1.00	152	7	3.0
7A	0.897	0.480	0.100	9.40	0.040	0.00	62	7A	21.8
8	0.488	0.498	0.250	3.50	0.440	0.00	50	8	0.0
9	0.184	0.469	0.250	3.50	0.434	4.59	48	9	0.0
10	0.396	0.500	0.100	9.40	0.035	0.00	60	10	0.0
11	0.310	0.363	0.150	8.60	0.095	4.88	80	11	0.6
12	0.180	0.350	0.170	7.32	0.110	0.00	16	12	0.0
13	0.629	0.345	0.150	8.40	0.073	12.27	102	13	15.8
14A	0.840	0.320	0.150	7.50	0.140	15.00	117	14A	29.0
14B	0.093	0.194	0.150	8.20	0.065	25.00	86	14B	3.4
15	2.206	0.317	0.150	8.40	0.084	10.34	121	15	39.5
17	1.761	0.401	0.130	10.10	0.052	7.67	139	17	10.8
18	0.667	0.346	0.130	10.10	0.052	6.31	151	18	5.6
19	0.575	0.338	0.150	8.05	0.128	11.57	90	19	17.8
20	1.622	0.376	0.150	8.20	0.071	5.59	179	20	27.1
21	0.117	0.492	0.150	7.50	0.177	0.51	21	21	0.1
22	0.767	0.485	0.250	6.29	0.283	1.19	70	22	-1.8
23	5.656	0.261	0.150	8.28	0.105	23.59	296	23	285.8
24	0.339	0.165	0.150	8.20	0.059	39.62	144	24	7.7
25	0.367	0.328	0.250	5.98	0.297	11.36	105	25	5.4
25A	0.221	0.453	0.250	3.66	0.499	2.06	37	25A	0.9
26	1.224	0.270	0.150	8.60	0.090	22.00	160	26	74.0
26A	0.121	0.170	0.150	8.40	0.070	33.00	70	26A	7.0
27	1.254	0.420	0.150	8.40	0.080	9.00	138	27	16.0
28	1.601	0.422	0.150	8.20	0.064	8.17	136	28	25.8
29	0.167	0.200	0.100	9.40	0.038	12.00	124	29	0.0
30	0.910	0.490	0.150	8.40	0.090	0.00	63	30	0.0
30A	0.108	0.500	0.170	7.32	0.195	0.00	30	30A	0.0
30B	0.661	0.460	0.150	8.05	0.140	7.00	55	30B	2.0
31	2.073	0.430	0.250	4.43	0.400	3.00	110	31	14.0
31A	1.637	0.470	0.250	5.05	0.310	0.00	87	31A	0.0
32	1.465	0.480	0.190	7.14	0.210	1.00	90	32	3.0
32A	0.677	0.390	0.170	6.29	0.290	5.00	79	32A	8.0
33	1.914	0.444	0.250	6.60	0.257	2.23	164	33	10.4
34	1.707	0.488	0.250	5.67	0.310	0.55	137	34	3.0
35	1.644	0.489	0.250	3.55	0.445	0.00	128	35	2.0
35A	0.784	0.393	0.250	3.82	0.520	4.10	193	35A	7.9
36	2.763	0.385	0.150	7.78	0.161	4.64	186	36	9.9
37	1.084	0.333	0.230	6.78	0.220	14.54	163	37	5.2
37A	0.023	0.200	0.250	5.67	0.338	12.00	60	37A	0.0
38	1.192	0.455	0.250	3.81	0.405	2.27	116	38	5.3
39	1.477	0.490	0.230	6.78	0.240	0.00	91	39	2.0
39A	1.471	0.480	0.250	3.71	0.510	1.00	123	39A	3.0
40	0.995	0.470	0.250	3.81	0.420	4.00	98	40	6.0
41	0.825	0.350	0.230	6.78	0.220	18.00	86	41	13.6
42	1.647	0.419	0.250	3.61	0.406	1.81	89	42	4.5
43	NON-CONTRIBUTING AREA							43	N-C

Table 4.6 Summary of MCUHP2 Input and Retention Volumes for Scenarios One and Two

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
44	0.268	0.500	0.250	3.55	0.460	0.00	41	44	0.0
45	0.372	0.495	0.250	3.50	0.436	0.00	67	45	0.0
46	1.018	0.461	0.190	7.14	0.201	1.17	67	46	2.2
47	0.580	0.440	0.250	6.29	0.250	2.00	57	47	0.0
48	0.719	0.380	0.250	3.82	0.550	7.00	101	48	14.0
48A	0.477	0.358	0.250	3.77	0.447	12.35	116	48A	9.0
49	1.896	0.353	0.170	7.32	0.172	13.93	112	49	20.1
49A	1.120	0.260	0.250	3.50	0.363	25.54	116	49A	36.6
50	1.178	0.287	0.250	6.29	0.218	18.73	108	50	33.8
51	NON-CONTRIBUTING AREA							51	N-C
52	0.497	0.439	0.190	7.14	0.175	0.00	66	52	0.0
53A	0.930	0.270	0.210	6.96	0.220	19.00	168	53A	35.0
53B	0.972	0.180	0.150	8.20	0.060	33.00	235	53B	57.0
53C	0.624	0.200	0.150	8.20	0.060	32.00	200	53C	34.0
53D	0.902	0.150	0.170	7.32	0.170	39.00	215	53D	61.0
53E	1.018	0.150	0.250	6.60	0.220	36.00	213	53E	66.0
53F	0.750	0.170	0.250	3.71	0.420	39.00	140	53F	52.0
53G	0.855	0.180	0.150	8.60	0.100	22.00	146	53G	23.0
54	NON-CONTRIBUTING AREA							54	N-C
55	3.371	0.207	0.150	8.28	0.112	22.98	296	55	275.0
55A	0.502	0.173	0.150	7.78	0.134	32.32	138	55A	55.0
56	NON-CONTRIBUTING AREA							56	N-C
57	NON-CONTRIBUTING AREA							57	N-C
57A	0.543	0.315	0.250	3.77	0.361	12.83	48	57A	14.1
58	0.853	0.308	0.250	3.77	0.402	14.55	67	58	29.9
58A	0.671	0.340	0.250	3.50	0.360	16.00	76	58A	22.0
59	0.408	0.216	0.250	4.30	0.484	30.28	86	59	19.7
59A	0.277	0.350	0.250	4.30	0.400	0.00	11	59A	0.0
60	1.462	0.223	0.150	7.50	0.144	31.66	205	60	52.7
61	1.169	0.237	0.250	3.87	0.406	21.58	138	61	43.7
62	0.793	0.144	0.250	3.50	0.377	50.30	192	62	4.1
63	1.034	0.156	0.250	3.81	0.349	37.07	153	63	1.4
64	0.505	0.151	0.250	3.66	0.431	37.26	250	64	18.7
65	1.423	0.290	0.250	3.71	0.427	16.28	117	65	43.7
66	2.756	0.342	0.250	3.82	0.448	11.37	158	66	46.6
67	1.704	0.207	0.190	7.14	0.173	24.66	217	67	126.1
68	2.030	0.324	0.250	4.14	0.543	16.39	210	68	55.3
69	1.119	0.340	0.210	6.96	0.190	15.00	158	69	32.0
69A	0.993	0.420	0.250	3.50	0.380	5.00	70	69A	9.0
69B	0.963	0.320	0.250	5.36	0.300	20.00	100	69B	32.0
70	0.080	0.478	0.250	3.61	0.480	2.25	24	70	0.6
71	1.154	0.410	0.250	3.50	0.400	9.00	113	71	19.0
71A	0.913	0.330	0.250	3.50	0.320	14.00	67	71A	24.0
72	1.277	0.330	0.250	3.81	0.360	15.00	92	72	33.0
72A	0.476	0.280	0.210	6.96	0.170	25.00	60	72A	25.0
72B	0.126	0.480	0.250	3.50	0.420	0.00	21	72B	0.0
72C	1.000	0.260	0.250	3.82	0.420	21.00	132	72C	23.0
73	0.337	0.400	0.250	3.50	0.360	8.00	24	73	4.0
74	0.239	0.490	0.250	4.14	0.650	0.00	51	74	0.0
74A	0.147	0.500	0.250	4.24	0.690	0.00	29	74A	0.0
74B	0.140	0.440	0.250	4.30	0.590	0.00	25	74B	0.0
74C	0.227	0.500	0.250	3.77	0.530	0.00	40	74C	0.0
74D	0.301	0.500	0.250	4.24	0.690	0.00	60	74D	0.0
75	2.753	0.460	0.250	4.30	0.640	2.00	74	75	13.0

Table 4.6 Summary of MCUHP2 Input and Retention Volumes for Scenarios One and Two

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
75A	1.262	0.377	0.250	6.60	0.262	10.48	98	75A	15.7
76	0.890	0.497	0.260	4.11	0.806	0.12	98	76	0.0
76A	0.629	0.500	0.250	6.60	0.266	0.00	63	76A	0.0
77	2.115	0.454	0.250	4.03	0.532	0.57	135	77	0.0
78	4.558	0.398	0.250	3.71	0.364	0.37	108	78	0.0
79	0.398	0.318	0.250	3.50	0.261	7.69	40	79	0.0
80	0.195	0.330	0.250	3.50	0.270	7.00	43	80	0.0
81	0.281	0.223	0.250	3.50	0.292	30.53	52	81	0.0
I-10WEST	2.020	0.423	0.250	3.92	0.546	7.22	67	I-10WEST	0.0

Table 4.7 Summary of MCUHP2 Input and Retention Volumes for Scenarios Three and Four

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
1	0.606	0.11	0.250	3.50	0.34	57	158	1	46.0
2	0.288	0.13	0.250	5.36	0.30	51	114	2	23.0
2A	0.115	0.08	0.170	7.32	0.20	70	56	2A	13.0
3	1.243	0.14	0.190	7.14	0.20	38	214	3	72.0
4	2.618	0.16	0.150	7.78	0.14	32	250	4	144.0
5	2.629	0.14	0.130	10.10	0.05	42	263	5	180.0
6	2.733	0.13	0.100	9.40	0.03	47	250	6	198.0
7	3.539	0.13	0.150	8.20	0.06	44	327	7	229.0
7A	0.897	0.16	0.100	9.40	0.03	32	116	7A	71.8
8	0.488	0.15	0.250	3.50	0.36	35	107	8	26.0
9	0.184	0.15	0.250	3.50	0.36	38	94	9	9.0
10	0.396	0.15	0.100	9.40	0.03	36	128	10	20.0
11	0.310	0.14	0.150	8.60	0.11	40	131	11	16.0
12	0.180	0.12	0.170	7.32	0.15	55	74	12	14.0
13	0.629	0.16	0.150	8.40	0.08	43	170	13	43.0
14A	0.840	0.15	0.150	7.50	0.16	38	194	14A	70.0
14B	0.093	0.17	0.150	8.20	0.07	31	92	14B	4.0
15	2.206	0.18	0.150	8.40	0.09	23	165	15	120.4
17	1.761	0.16	0.130	10.10	0.05	33	221	17	84.0
18	0.667	0.16	0.130	10.10	0.05	30	219	18	31.0
19	0.575	0.16	0.150	8.05	0.12	35	135	19	47.0
20	1.622	0.15	0.150	8.20	0.06	36	265	20	121.0
21	0.117	0.07	0.150	7.50	0.19	71	44	21	15.0
22	0.767	0.15	0.250	6.29	0.24	34	144	22	63.0
23	5.656	0.14	0.150	8.28	0.10	45	396	23	509.0
24	0.339	0.15	0.150	8.20	0.06	42	153	24	13.0
25	0.367	0.17	0.250	5.98	0.29	31	139	25	21.0
25A	0.221	0.16	0.250	3.66	0.42	33	69	25A	17.0
26	1.224	0.14	0.150	8.60	0.09	42	218	26	97.0
26A	0.121	0.14	0.150	8.40	0.08	42	75	26A	9.0
27	1.254	0.13	0.150	8.40	0.07	49	259	27	113.0
28	1.601	0.14	0.150	8.20	0.06	45	272	28	298.0
29	0.167	0.20	0.100	9.40	0.04	12	124	29	0.0
30	0.910	0.15	0.150	8.40	0.07	44	135	30	76.0
30A	0.108	0.15	0.170	7.32	0.16	44	64	30A	8.0
30B	0.661	0.14	0.150	8.05	0.12	40	103	30B	33.0
31	2.073	0.16	0.250	4.43	0.34	31	183	31	99.0
31A	1.637	0.15	0.250	5.05	0.29	44	218	31A	98.0
32	1.465	0.16	0.190	7.14	0.18	31	194	32	73.0
32A	0.677	0.15	0.170	6.29	0.26	36	119	32A	42.0
33	1.914	0.15	0.250	6.60	0.23	36	290	33	96.0
34	1.707	0.20	0.250	5.67	0.31	20	286	34	77.0
35	1.644	0.20	0.250	3.55	0.45	20	285	35	72.0
35A	0.784	0.20	0.250	3.82	0.55	17	302	35A	30.0
36	2.763	0.20	0.150	7.78	0.16	18	283	36	106.0
37	1.084	0.15	0.230	6.78	0.22	40	244	37	54.0
37A	0.023	0.20	0.250	5.67	0.34	12	60	37A	0.0
38	1.192	0.13	0.250	3.81	0.34	47	237	38	85.0
39	1.477	0.13	0.230	6.78	0.20	47	195	39	109.0
39A	1.471	0.13	0.250	3.71	0.41	45	231	39A	100.0
40	0.995	0.12	0.250	3.81	0.35	51	183	40	82.0

Table 4.7 Summary of MCUHP2 Input and Retention Volumes for Scenarios Three and Four

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
41	0.825	0.10	0.230	6.78	0.25	64	150	41	35.0
42	1.647	0.16	0.250	3.61	0.42	35	205	42	102.0
43	NON-CONTRIBUTING AREA							43	N-C
44	0.268	0.10	0.250	3.55	0.35	60	88	44	25.0
45	0.372	0.10	0.250	3.50	0.33	60	145	45	35.0
46	1.018	0.13	0.190	7.14	0.17	47	134	46	70.0
47	0.580	0.14	0.250	6.29	0.23	42	122	47	32.0
48	0.719	0.16	0.250	3.82	0.49	31	151	48	42.0
48A	0.477	0.14	0.250	3.77	0.46	43	210	48A	31.0
49	1.896	0.15	0.170	7.32	0.16	38	179	49	90.0
49A	1.120	0.15	0.250	3.50	0.36	42	154	49A	64.0
50	1.178	0.14	0.250	6.29	0.23	42	171	50	78.0
51	NON-CONTRIBUTING AREA							51	N-C
52	0.497	0.10	0.190	7.14	0.17	62	182	52	57.0
53A	0.930	0.10	0.210	6.96	0.19	60	210	53A	98.0
53B	0.972	0.16	0.150	8.20	0.06	37	253	53B	62.0
53C	0.624	0.16	0.150	8.20	0.06	35	216	53C	38.0
53D	0.902	0.13	0.170	7.32	0.18	45	230	53D	68.0
53E	1.018	0.14	0.250	6.60	0.23	39	228	53E	70.0
53F	0.750	0.14	0.250	3.71	0.42	44	150	53F	58.0
53G	0.855	0.18	0.150	8.60	0.10	22	146	53G	23.0
54	NON-CONTRIBUTING AREA							54	N-C
55	3.371	0.15	0.150	8.28	0.11	36	333	55	334.3
55A	0.502	0.15	0.150	7.78	0.13	41	145	55A	61.0
56	NON-CONTRIBUTING AREA							56	N-C
57	NON-CONTRIBUTING AREA							57	N-C
57A	0.543	0.10	0.250	3.77	0.45	61	122	57A	66.0
58	0.853	0.10	0.250	3.77	0.43	57	139	58	104.0
58A	0.671	0.10	0.250	3.50	0.35	61	145	58A	82.0
59	0.408	0.11	0.250	4.30	0.57	56	133	59	38.0
59A	0.277	0.11	0.250	4.30	0.53	57	53	59A	32.0
60	1.462	0.13	0.150	7.50	0.15	50	271	60	97.0
61	1.169	0.14	0.250	3.87	0.48	44	207	61	82.0
62	0.793	0.12	0.250	3.50	0.40	56	207	62	11.0
63	1.034	0.14	0.250	3.81	0.36	40	161	63	6.0
64	0.505	0.14	0.250	3.66	0.44	39	256	64	21.0
65	1.423	0.16	0.250	3.71	0.45	36	178	65	87.0
66	2.756	0.13	0.250	3.82	0.46	45	291	66	195.0
67	1.704	0.15	0.190	7.14	0.19	38	259	67	158.3
68	2.030	0.12	0.250	4.14	0.60	55	335	68	173.0
69	1.119	0.11	0.210	6.96	0.19	57	297	69	113.0
69A	0.993	0.13	0.250	3.50	0.36	47	150	69A	75.0
69B	0.963	0.12	0.250	5.36	0.32	52	150	69B	89.0
70	0.080	0.11	0.250	3.61	0.37	57	48	70	10.0
71	1.154	0.11	0.250	3.50	0.35	54	211	71	123.0
71A	0.913	0.11	0.250	3.50	0.36	59	134	71A	94.0
72	1.277	0.14	0.250	3.81	0.34	46	153	72	95.0
72A	0.476	0.10	0.210	6.96	0.17	60	100	72A	55.0
72B	0.126	0.10	0.250	3.50	0.33	60	46	72B	12.0
72C	1.000	0.12	0.250	3.82	0.51	50	220	72C	67.0
73	0.337	0.11	0.250	3.50	0.33	57	49	73	17.0

Table 4.7 Summary of MCUHP2 Input and Retention Volumes for Scenarios Three and Four

Basin ID	AREA (sq.mi.)	IA (inches)	DTHETA	PSIF	XKSAT adj.	RTIMP (%)	LAG (minutes)	Basin ID	Retention (acre-feet)
74	0.239	0.15	0.250	4.14	0.53	36	109	74	13.0
74A	0.147	0.15	0.250	4.24	0.56	36	63	74A	8.0
74B	0.140	0.15	0.250	4.30	0.58	36	62	74B	7.0
74C	0.227	0.13	0.250	3.77	0.43	46	86	74C	17.0
74D	0.301	0.14	0.250	4.24	0.57	41	128	74D	19.0
75	2.753	0.14	0.250	4.30	0.57	43	157	75	190.0
75A	1.262	0.15	0.250	6.60	0.24	39	147	75A	69.0
76	0.890	0.14	0.260	4.11	0.68	41	207	76	57.0
76A	0.629	0.14	0.250	6.60	0.22	43	136	76A	41.0
77	2.115	0.43	0.250	4.03	0.53	4	136	77	8.0
78	4.558	0.39	0.250	3.71	0.36	0	123	78	0.0
79	0.398	0.29	0.250	3.50	0.27	14	52	79	0.0
80	0.195	0.30	0.250	3.50	0.27	12	43	80	0.0
81	0.281	0.15	0.250	3.50	0.32	47	69	81	0.0
I-10WEST	2.020	0.15	0.250	3.92	0.48	40	120	I-10WEST	0.0

TABLE 4.8 Precipitation Depths by Model Component

		Point Rainfall[1]		Reduced Rainfall[2]	
HEC-1 Model Component	**Area (sq. mi.)**	**6-hour storm**	**24-hour storm**	**6-hour storm**	**24-hour storm**
North of US 60	29.6	3.0"	3.8"	2.67"	3.42"
Component #1	37.5*	3.0"	3.8"	2.63"	3.344"
Component #2	34.6*	3.0"	3.8"	2.65"	3.344"
Component #3	50	3.0"	3.8"	2.58"	3.31"

1 Precipitation depths from *NOAA Precipitation-Frequency Atlas for Arizona, 1973*

2 6-hour areal reduction from the FCDMC Drainage Design Manual, Vol. I (based on the Queen Creek storm of 8/19/54)

24-hour areal reduction from Figure 15 in *NOAA Technical Memorandum NWS HYDRO-40*

* These are the Vol. I component areas used in the areal reduction factor determination and as such do not reflect the movement of subbasins 30B and 31 from component 2 to 1.

4.8 Routing Parameters

The same hydrologic routing procedures were used in Volume II as in Volume I. Redelineation of subbasins required the addition, subtraction, or modification of some routings. The altered channel routings were primarily those changed by the new subbasins. In these instances, the previous cross sections and roughness values were used as much as possible. In other instances, reaches were changed from Muskingum-Cunge to kinematic wave routings or completely removed from the model in order to accommodate numerical instablities or program crashes. The only removed routing blocks were those with zero flow hydrographs and thus did not affect the results.

For the future land use condition, the universal assumption was made not to modify any of the channel routing reaches unless necessitated by numerical instabilities caused by the change in flows or the redelineation of subbasins. Although this is a far from perfect assumption, it was felt that it was at least as reasonable, and much more expedient, than arbitrary changes based on an uncertain future. Moreover, it was felt that the average routing lengths and roughness across the entire cross section and along its entire flow length would not be radically different. Reservoir routings for ponding areas were also not modified under the assumption of 1) vast uncertainies, and 2) that many of these areas are delineated flood hazard areas where the principle of "no net fill" will likely be adhered to thus not affecting the total storage available in these ponding locations. Also, several of the ponding areas directly adjacent to the Gila Drain were removed from the models due to the proposed Santan drainage facilities.

4.9 On-Site Retention

Retention volumes were calculated in the same manner in as described in Volume I using the common method required by the municipalities for the calculation of retention volume. Namely,

$$\text{Volume} = (\text{ "C" coefficient }) \times (\text{ Depth }) \times (\text{ Area })$$

where C is a runoff coefficient, the depth is rainfall depth in feet, the area is the drainage area in acres, and the volume is the retention volume in acre-feet. Table 4.9 summarizes the C factors for each land use type for each community and the resultant retention factors. All future development was considered to be developed with retention provided based upon the jurisdiction within which the land is presently located. This means that the County areas which sit within strip annexes of Gilbert and Chandler were considered to be developed under County retention

criteria. Since the retention factors for both Gilbert and Chandler are greater than those used for the County, this assumption considers less retention than may actually be built and as such is a conservative assumption with respect to runoff volumes. The retention factors used for future development in Mesa were updated to reflect their change in retention storm from the 50-year 24-hour storm to the 100-year 2-hour storm (Ref. 8)

TABLE 4.9 "C" Coefficients and Retention Factors for Retention Volume Estimation

C coefficients					
Land Use	County	Tempe	Gilbert	Chandler	Mesa
Agricultural	0.150	0.950	0.250	0.100	0.100
VLDR	0.220	0.950	0.350	0.350	0.255
LDR	0.325	0.950	0.410	0.350	0.352
MDR	0.400	0.950	0.540	0.400	0.465
MFR	0.550	0.950	0.670	0.550	0.605
COMM	0.800	0.950	0.835	0.800	0.708
IND	0.700	0.950	0.740	0.800	0.675
Rainfall Depth (inches)	2.5	2.4	3.0	3.0 1975 - 1987 2.5 1987 - present	3.0 1972 - 1990 2.5 1991 +

Retention Factors (multiply by area to get retention volume in acre-feet)							
				1975 - 1987	'87 - present	1972 -1990	1991 +
V L D R	0.046	0.190	0.088	0.088	0.073	0.064	0.053
L D R	0.068	0.190	0.103	0.088	0.073	0.081	0.073
M D R	0.083	0.190	0.135	0.100	0.083	0.116	0.097
M F R	0.115	0.190	0.168	0.138	0.115	0.151	0.126
Commercial	0.167	0.190	0.209	0.200	0.167	0.195	0.148
Industrial	0.146	0.190	0.185	0.200	0.167	0.169	0.141

The ARC/INFO system was then used to process the digital land use map, community map, and retention requirement map (i.e. development as of 1973, 1987, and 1991) to generate the total on-site retention volume for each subbasin. A summary of on-site retention volumes by subbasin is shown in Tables 4.6 and 4.7.

4.10 Detention Basins

All of the detention basins considered in the Volume I study were included in the Volume II analyses except for proposed ADOT basin H. Basin H is a temporary basin which will be removed upon completion of the Santan Collector Channel. Likewise, the proposed Basin G outlet to the Santan Channel was added. Proposed Basin B was also added per conversations with HDR Engineering and as reflected in their design concept report and plans for the Price Expressway and Southeast Loop Highway (Ref.s 2 & 26). For the modeling of Scenarios Two and Four which include the proposed Santan Freeway drainage facilities east of Dobson Road, the detention basins were taken and modeled after the assumptions in the Dames & Moore design concept report for ADOT, dated 1988 (Ref.s 3 & 15). Although this may no longer represent the latest concept about the nature of the future freeway drainage facilities, it is the best published information from ADOT describing these facilities.

4.11 Treatment of Storm Drains

Chandler

The Camp, Dresser, & McKee Stormwater Management Master Plan Update (Ref. 6) contains a description of future storm drains that are planned for draining downtown Chandler and areas of west Chandler. All of these new storm drains will eventually outlet to the proposed Santan Collector Channel. Storm drain locations and capacities were taken from the Master Plan Update and incorporated into the HEC-1 models for all four scenarios. Generally, the storm drains were modeled by simple diversions of the storm drain capacities from the runoff hydrographs at a given

concentration point.

Gilbert

A small portion of the old town of Gilbert and a short section of Gilbert Road south of the Phoenix Main Line are serviced by a storm drain system which feeds into the Gilbert Basin (i.e. Vaughn Street Basin). The capacity of the 48 inch (1.2 m) storm drain under Gilbert Road was estimated using the ground slope and the diameter as indicated by an official of the Town.

5.0 RESULTS AND CONCLUSIONS

The results of the hydrologic models for the 6- and 24-hour storms for selected locations are summarized in Tables 1.1 and 1.2 (pages 2 and 3 of this report). Complete lists of discharges for both storms are available in the HEC-1 output files in Appendix B.

5.1 Comparison with Volume I

Scenarios One and Two

The results for Scenarios One and Two remain the same as those in the Volume I models for those areas unaffected by the redelineation of subbasins or the addition of drainage facilities associated with the Price Expressway, the Santan Freeway, or the proposed City of Chandler storm drains because the models are exactly the same. Small differences (less than ten percent) in a few locations, such as the inflow to Crossroads Park and the over/throughflow of the Chandler Branch of the SPRR south of Germann Road, occur as a result of changes in subbasin loss parameters due to the different way in which the area was subdivided. Such differences primarily affect runoff volumes. Since these changes affect hydrographs, some channel routings also became unstable and necessitated adjustment. These adjustments also resulted in

small changes in discharge at a few locations.

Other differences one notices comparing the Volume I and Scenario One and Two results are seen at Outlet H. This results in part due to the change in contributing area from subbasins 74 - 74c as well as the addition of the Pecos Road storm drain. Likewise, many other locations in the third model component have changed due to the inclusion of the proposed drainage facilities. Total flows in the Gila Drain especially are notably higher due to the removal of several large ponding areas adjacent to the drain (RR72, RR72A, and RR73) and more efficient routing of runoff within the watershed (i.e. in the Santan Collector Channel).

The addition of the Santan Freeway facilities east of Dobson Road has two noteworthy effects on the regional drainage picture. First, flows to Crossroads Park are drastically reduced due to the inclusion of a 350 acre-foot (43.2 ha-m) Basin Q near the intersection of Ray and Greenfield Roads. The storage volume plus the four foot diameter (1.2 m) outlet pipe allow only 23 acre-feet (2.84 ha-m) to continue on to Crossroads Park. Nevertheless, the 540 acre-feet (66.6 ha-m) of total inflow still exceeds the 456 acre-feet (56.2 ha-m) of design capacity and flows still overtop the Eastern Canal toward the west. The second change of interest is the increase in volume on the falling limb of the Gila Drain eastern inflows. These inflows reflect the cummulative effect of collecting runoff in detention basins along the freeway and slowly bleeding it off. Of course, the exact nature and extent of this effect will depend entirely on the exact configuration and operation of the detention basins, their outlets and the collector channel decided upon for the freeway drainage system east of Dobson Road.

The same patterns can generally be observed in both the 6- and 24-hour models with the six hour statistics generally lower in both peak discharge and volume.

Scenarios Three and Four

The full urbanization of the watershed has a dramatic impact on runoff for both Scenarios Three and Four for both the 6- and 24-hour events.

Inflows from north of US 60 at the Eastern Canal are greatly impacted by the additional retention which accompanies development. The peak discharge passing under the freeway at this location drops almost in half. At the Consolidated Canal crossing, on the other hand, the effect is not nearly as pronounced. This likely results from the fact that most of the area of Mesa west (downstream) of the Eastern Canal is already urbanized and the assumption of full development has little effect on the runoff characteristics of that portion of the watershed.

In general the retention which accompanies new development has the effect of reducing both peak discharges and runoff volumes by as much as half. The impact of retention is more dramatic on the 6-hour event than the 24-hour event. Reductions in runoff volumes range between 30 to 40 percent for the 24-hour storm and 40 to 60 percent for the 6-hour storm. Runoff volumes to Crossroads Park decrease from 790 acre-feet (97.4 ha-m) to 570 acre-feet (70.3 ha-m) for the 24-hour event and from 740 acre-feet (91.3 ha-m) to 370 acre-feet (45.6 ha-m) for the 6-hour event. Subbasin 30 shows even greater effects. Runoff volumes for the future condition decrease from 61 acre-feet (7.5 ha-m) to 36 acre-feet (4.4 ha-m) and from 59 acre-feet (7.3 ha-m) to 21 acre-feet (2.6 ha-m) for the 24-hour and 6-hour events respectively. Peak discharges show similar trends. Inflows to Crossroads Park drop from 2900 cfs (82 cms) to 1520 cfs (43 cms) while eastern inflows to the Gila Drain drop from 1390 cfs (39 cms) to 820 cfs (23 cms).

The effects of the addition of proposed Santan Freeway facilities east of Dobson Road under future land use assumptions parallel those seen in with the current land uses.

Peak flows are not greatly affected except at those locations immediately adjacent to new detention basins (such as Crossroads Park) while total runoff volumes delivered to the Gila Drain dramatically increase.

5.2 Comparison with HDR

Table 5.3 shows a comparison of the HDR hydrology (Ref. 27) and the Volume II study results for the 24-hour storm for selected locations. The most noteworthy differences between the HDR results and the Volume II work can be seen in the eastern inflows to the Gila Drain which also affect the total Gila Drain inflows north of the Santan Freeway, and the inflows to Basin B. The HDR study shows much larger peak discharges and volumes at the Gila Drain. These differences likely result from a combination of factors including the design storms, routing methods, and consideration of on-site drainage from the freeway itself. A comparative study of District and ADOT methods by HDR for the Champion Drain area showed that the differences in rainfall and routing methods can explain the most of the variation in the results between the two approaches (Ref. 25). Another important difference between the studies is in the consideration of flows from south of the proposed freeway alignment. The extremely flat nature of this area creates considerable unaccounted storage in this area, especially in the western half of the GRIC area within the ADMS study boundary. Because of the lack of topographic data for this area this storage was not evaluated. Consequently, the inflows at HC78 are probably grossly overestimated. Nevertheless, no known attempt has been made in the ADOT studies to examine these contributions to the Gila Drain or their impact on its crossing under Interstate 10.

Additionally, it should be noted that HDR is presently preparing a reevaluation of their 1989 hydrology study. The updated study will incorporate hydrologic methodologies as reflected in the new ADOT Hydrology Manual as well the inclusion

Table 5.1 Comparison of Discharges: HDR (Ref. 26) and ADMS 24-Hour Model Scenarios

Location	HDR (Ref. 26)		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)	Peak Q (cfs)	Volume (ac-ft)
SPRR over/throughflow near Commonwealth Ave	260	385	350	240	350	240	180	200	180	200
Outlet E	298	132	650	290	650	290	480	250	480	250
Outlet F	149	32	300	42	300	42	170	36	170	36
HC60 (Ray and Arrowhead)	348	80	410	90	410	90	290	80	290	80
ADOT Basin G Inflow	975	219	500	205	500	205	340	180	340	180
Flow at Outlet H	805	732	650	510	690	1370	390	440	430	1180
Pecos and McClintock (HC68)	1200	813	850	780	890	1630	660	680	680	1420
Gila Drain eastern inflows in the Santan Collector	2221	2502	1390	1020	1430	1880	820	840	840	1590
Outlet C	670	134	510	100	510	100	70	30	70	30
Gila Drain western inflows in the Santan Collector	759	216	660	120	660	120	80	50	80	50
Total Gila Drain Inflows, North of Santan Fwy	2847	2718	1810	2180	1850	3030	970	1930	990	2670
Basin B inflows	1237	127	240	10	290	12	0	0	0	0
HC78 (I-10 near Germann Rd. alignment)	NA	NA	1490	1080	1490	710	1360	870	1360	460
Total Gila Drain Inflows, South of Santan Fwy	NA	NA	1040	1090	1040	720	970	860	970	440
Total Gila Drain flows at I-10	1610	2691	2600	3260	2610	3740	1040	2780	1050	3110

of analysis of the freeway system east of Dobson Road. Cooperation between ADOT and the FCDMC is ongoing with the hope that no opportunities are lost and that the interests of the State, District, municipalities, and their citizens are well served.

5.3 Conclusions

This study and the resulting HEC-1 models should be viewed as tools for the consideration and evaluation of alternatives for regional drainage systems in the area and their impact on one another. This study presents the impacts of four possible future conditions. Although none of them may predict the actual future, they may serve as an excellent basis for the evaluation of refined projections as they become available or necessitated.

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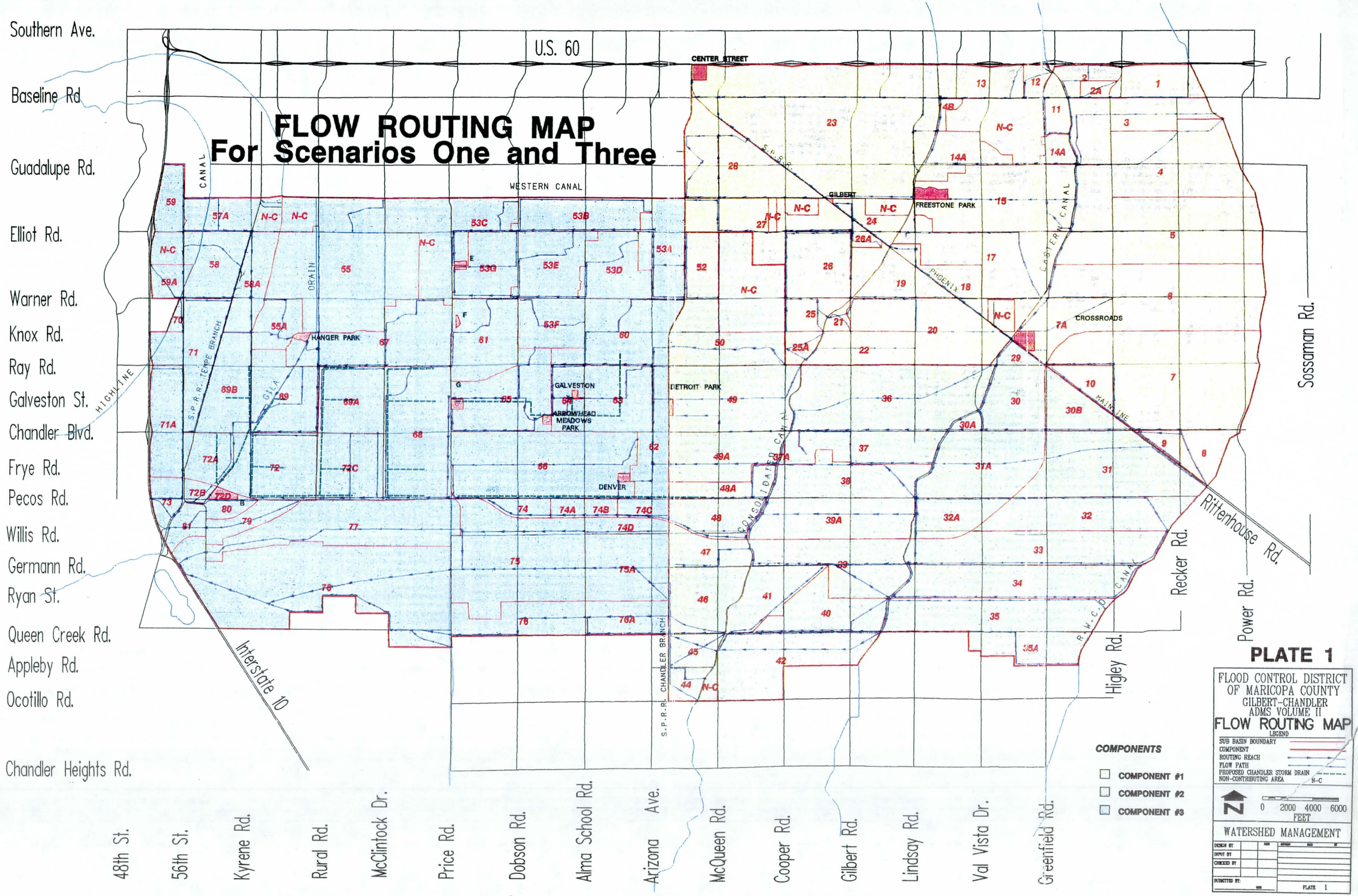
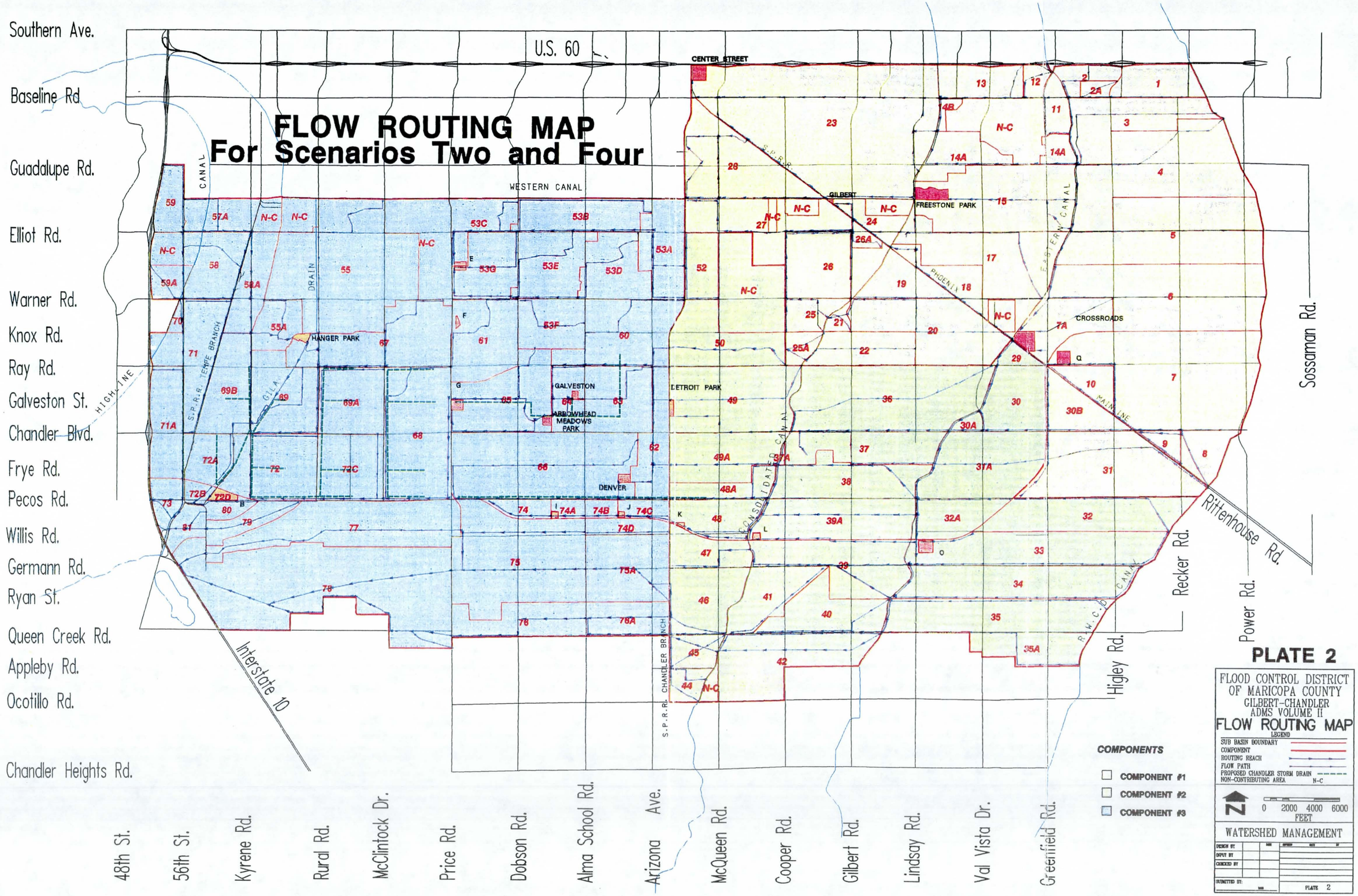
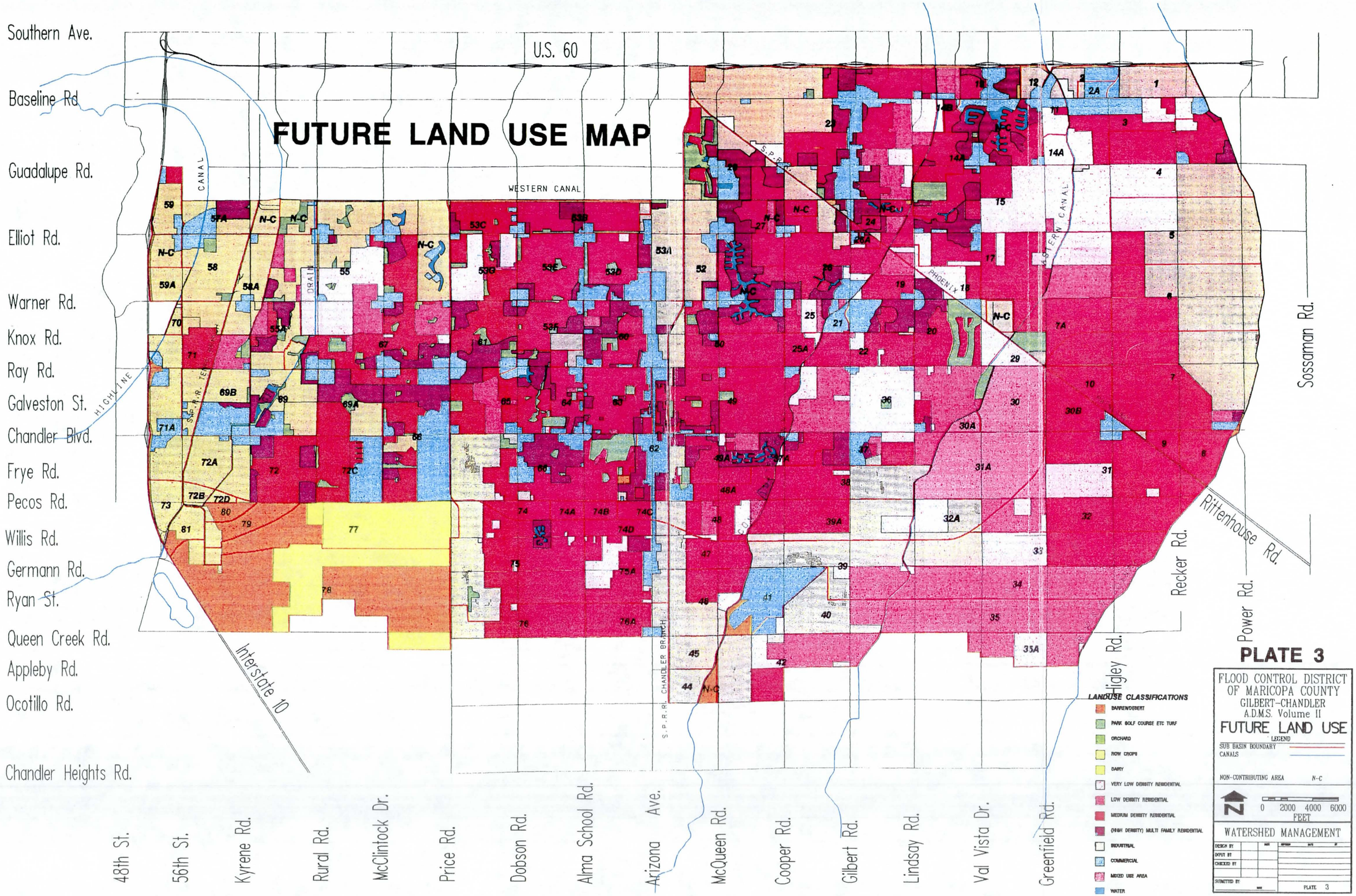
Appendix A

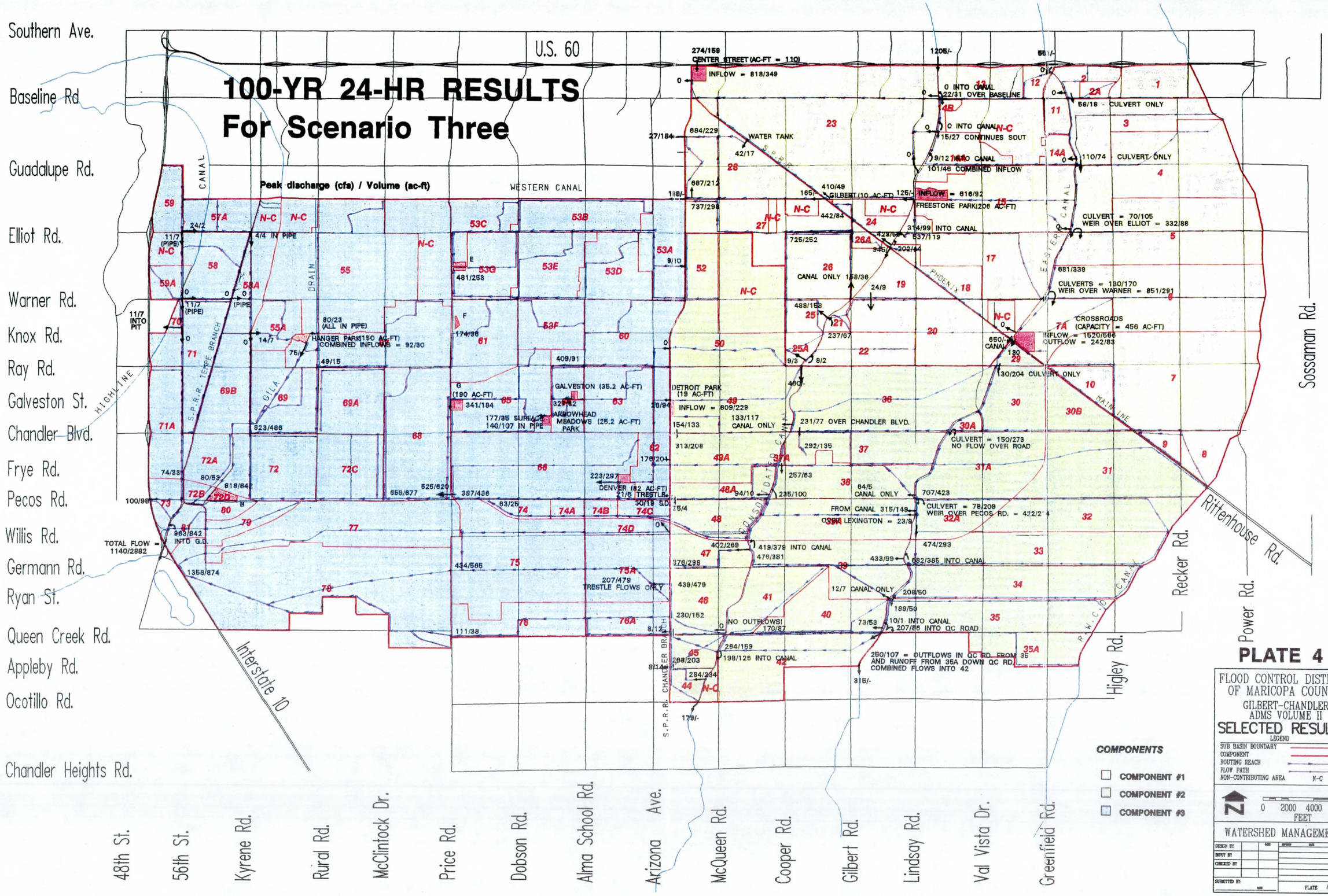
Plates

FLOW ROUTING MAP
For Scenarios One and Three




FLOW ROUTING MAP
For Scenarios Two and Four
U.S. 60
CENTER STREET
WESTERN CANAL
GILBERT
FREESTONE PARK
CROSSROADS
HANGER PARK
GALVESTON
ARROWHEAD MEADOWS PARK
DETROIT PARK
DENVER
S.P.R.R.
PHOENIX
EASTERN CANAL
CONSOLIDATED CANAL
R.W.C.D. CANAL
S.P.R.R. TEMPE BRANCH
S.P.R.R. CHANDLER BRANCH
GILA
DRAIN
CANAL
HIGHLINE
MAINLINE
N-C
Southern Ave.
Baseline Rd.
Guadalupe Rd.
Elliot Rd.
Warner Rd.
Knox Rd.
Ray Rd.
Galveston St.
Chandler Blvd.
Frye Rd.
Pecos Rd.
Willis Rd.
Germann Rd.
Ryan St.
Queen Creek Rd.
Appleby Rd.
Ocotillo Rd.
Chandler Heights Rd.
Interstate 10
Sossaman Rd.
Rittenhouse Rd.
Power Rd.
Recker Rd.
Higley Rd.
48th St.
56th St.
Kyrene Rd.
Rural Rd.
McClintock Dr.
Price Rd.
Dobson Rd.
Alma School Rd.
Arizona Ave.
McQueen Rd.
Cooper Rd.
Gilbert Rd.
Lindsay Rd.
Val Vista Dr.
Greenfield Rd.
COMPONENTS
COMPONENT #1
COMPONENT #2
COMPONENT #3
PLATE 2
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
GILBERT-CHANDLER
ADMS VOLUME II
FLOW ROUTING MAP
LEGEND
SUB BASIN BOUNDARY
COMPONENT
ROUTING REACH
FLOW PATH
PROPOSED CHANDLER STORM DRAIN
NON-CONTRIBUTING AREA
N-C
0 2000 4000 6000
FEET
WATERSHED MANAGEMENT
DESIGN BY
INPUT BY
CHECKED BY
SUBMITTED BY:
PLATE 2


FUTURE LAND USE MAP
Southern Ave.
Baseline Rd.
Guadalupe Rd.
Elliot Rd.
Warner Rd.
Knox Rd.
Ray Rd.
Galveston St.
Chandler Blvd.
Frye Rd.
Pecos Rd.
Willis Rd.
Germann Rd.
Ryan St.
Queen Creek Rd.
Appleby Rd.
Ocotillo Rd.
Chandler Heights Rd.
U.S. 60
WESTERN CANAL
EASTERN CANAL
CANAL
DRAIN
HIGHLINE
S.P.R.R.
PHOENIX
CHANDLER BRANCH
Interstate 10
48th St.
56th St.
Kyrene Rd.
Rural Rd.
McClintock Dr.
Price Rd.
Dobson Rd.
Alma School Rd.
Arizona Ave.
McQueen Rd.
Cooper Rd.
Gilbert Rd.
Lindsay Rd.
Val Vista Dr.
Greenfield Rd.
Higley Rd.
Recker Rd.
Power Rd.
Ritenhouse Rd.
Sossaman Rd.
LANDUSE CLASSIFICATIONS
BARREN/DESERT
PARK GOLF COURSE ETC TURF
ORCHARD
ROW CROPS
DAIRY
VERY LOW DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
(HIGH DENSITY) MULTI FAMILY RESIDENTIAL
INDUSTRIAL
COMMERCIAL
MIXED USE AREA
WATER
PLATE 3
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
GILBERT-CHANDLER
A.D.M.S. Volume II
FUTURE LAND USE
LEGEND
SUB BASIN BOUNDARY
CANALS
NON-CONTRIBUTING AREA N-C
0 2000 4000 6000
FEET
WATERSHED MANAGEMENT
DESIGN BY
INPUT BY
CHECKED BY
SUBMITTED BY
PLATE 3


100-YR 24-HR RESULTS
For Scenario Three
Peak discharge (cfs) / Volume (ac-ft)
Southern Ave.
Baseline Rd.
Guadalupe Rd.
Elliot Rd.
Warner Rd.
Knox Rd.
Ray Rd.
Galveston St.
Chandler Blvd.
Frye Rd.
Pecos Rd.
Willis Rd.
Germann Rd.
Ryan St.
Queen Creek Rd.
Appleby Rd.
Ocotillo Rd.
Chandler Heights Rd.
48th St.
56th St.
Kyrene Rd.
Rural Rd.
McClintock Dr.
Price Rd.
Dobson Rd.
Alma School Rd.
Arizona Ave.
McQueen Rd.
Cooper Rd.
Gilbert Rd.
Lindsay Rd.
Val Vista Dr.
Greenfield Rd.
Higley Rd.
Recker Rd.
Power Rd.
Sossaman Rd.
Rittenhouse Rd.
Interstate 10
U.S. 60
WESTERN CANAL
EASTERN CANAL
CONSOLIDATED CANAL
R.W.C.D. CANAL
S.P.R.R. TEMPE BRANCH
S.P.R.R. CHANDLER BRANCH
GILA RIVER
HIGHLINE CANAL
PHOENIX MAINLINE
TOTAL FLOW = 1140/2882
COMPONENTS
COMPONENT #1
COMPONENT #2
COMPONENT #3
PLATE 4
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
GILBERT-CHANDLER ADMS VOLUME II
SELECTED RESULTS
LEGEND
SUB BASIN BOUNDARY
COMPONENT
ROUTING REACH
FLOW PATH
NON-CONTRIBUTING AREA
N-C
0 2000 4000 6000 FEET
WATERSHED MANAGEMENT
DESIGN BY
INPUT BY
CHECKED BY
SUBMITTED BY:
PLATE 4

Appendix B

Floppy diskettes containing HEC-1 Model input and level 3 output and DSS file