ARCADIA AREA DRAINAGE PROJECT

PROJECT NO. 94-21
EXISTING HYDROLOGY

VOLUME I

FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY, ARIZONA
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009

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I. INTRODUCTION

The purpose of the Arcadia Area Drainage Project study is to evaluate and recommend design alternates for storm drainage collection systems to alleviate lower frequency storm flooding problems in the Arcadia area north of the Arizona Canal, from 40th Street to 64th Street, and to reduce or eliminate the limits of the "A" Zone floodplain along the north side of the canal. The storm drainage collection systems (SYSTEMS) can outlet into the improved Old Cross Cut Canal (OCCC) system via an undercrossing of the Arizona Canal at Arcadia Drive (48th Street). The project is a cooperative project between the Flood Control District of Maricopa County (DISTRICT) and the City of Phoenix (COP), with participation from the Salt River Project (SRP).

The project is located in the metropolitan Phoenix area, within the central area of Township 2 North and the westerly region of Range 4 East. The project limits are bounded by Camelback Mountain on the north, 64th Street on the east, 40th Street on the west and the Arizona Canal to the south and is shown on the Watershed Boundary Map (Figure 1). This report presents the existing hydrological conditions for examination of alternate storm drainage collection systems.

Hydrology Criteria.

The following is the scope for the hydrologic investigation. The 1991 U.S. Army Corps of Engineers computer program HEC-1, 4.01 Version was used to develop hydrologic models for the Arcadia area watershed. The methods and procedures in the Drainage Design Manual for Maricopa County, Arizona: Volume I - Hydrology (Dated June 1, 1992) shall be the basis for all hydrology calculations.

All special procedures or parameters needed to model special watershed conditions, such as the flood irrigated lots near the canal, has been discussed with the DISTRICT.

A base outlet direct discharge from the SYSTEMS alternates into the OCCC has been determined by the DISTRICT and Greiner, Inc. to be 990 cfs.

The maximum outlet direct discharge from the SYSTEMS alternates into the OCCC has been determined by the DISTRICT and Greiner, Inc. to be 1,990 cfs. This maximum discharge assumes no SRP releases (up to a maximum of 1,000 cfs) from the Arizona Canal into the OCCC. The corresponding storm frequency for this maximum outlet direct discharge shall be determined.

Project hydrology is for the return frequency equivalent to the maximum outlet discharge for the SYSTEMS as described in the above paragraph, and for the 100, 50, 25 and 10-year, 6-hour events under the existing conditions. This hydrology shall be used to develop and recommend alternates.

The hydrologic base maps were prepared using the topographic mapping developed for this project (Survey and Mapping).

Subbasins were identified to provide reasonable depiction of the watershed condition. Subbasins were established with sufficient detail to provide reasonable estimates of runoff for each subbasin.

Huitt-Zollars shall obtain approval from the District at each of the following steps:

1. Watershed boundary maps
2. HEC-1 parameter estimation
3. HEC-1 results

Huitt-Zollars shall review the hydrologic models' results for accuracy and reasonableness. Adjustments to input for obtaining the most realistic results is normal to the scope.

Huitt-Zollars shall submit maps of the subbasin delineations, HEC-1 input parameters, the HEC-1 flow diagram, the HEC-1 models and their results, maps, calculation sheets, etc. Computer files of the hydrologic modelling information shall be submitted on 3.5" or 5.25" diskettes.

Previous Investigations.

Because of the severe flooding problem in the developed area north of the Arizona Canal, there have been several studies previously performed in this area. They are:

Draft report: "ARCADIA AREA MASTER DRAINAGE STUDY" written by Arthur Beard Engineers, Inc., November 1985. (Ref. No. 1).

"OLD CROSS CUT PHOENIX ARIZONA" written by the U.S. Army Corp. of Engineers, June 1987. (Ref. No. 24).

"OLD CROSS CUT CANAL/LAFAYETTE DRAIN" written by the Flood Control District of Maricopa County, September 1993. (Ref. No. 8).

II. BACKGROUND DATA

A. Historical Information

The Arizona Canal was constructed in the late 1800's to transmit irrigation water from the Granite Reef Diversion Dam to farm lands in the west. At the time of its construction, there was very little development in what is now Phoenix and there was certainly no concern with regional flooding.

The construction of the canal itself has not increased runoff in the study area. However, the canal is raised and it blocks the runoff flow from Camelback Mountain and the surrounding area.

Originally, this was not a concern relative to flooding problems, due to the fact that the land north of the Arizona Canal was irrigated farm land. As the Phoenix city limits began to grow in the mid-1900's the area north of the Arizona Canal began to transform into prime developed real estate including many affluential homes built adjacent to the north bank of the Arizona Canal. During this time period there was little concern for detaining or conveying the stormwater runoff produced by the newly developed area. Some of the rainfall that percolated into the ground or runoff in small slow moving rivulets, is now collected in streets, storm channels, and ponding areas north of the Arizona Canal which drain through small drainage pipes into the Arizona Canal. Combined with the increase in development and the encroachment of development adjacent to the north bank levee, there has been significant flooding and property damage.

In recognition of this continuing flooding potential, the Federal Emergency Management Agency (FEMA) has designated approximately 125 acres of 100-year floodplain adjacent to the north bank canal levee between the study limits of 40th and 64th Streets. The area of this floodplain is shown on Figure 1, (Watershed Boundary Map).

B. Basin Characteristics

The study area watershed is approximately four square miles in size. The hydrologic properties of the basin are based on physiographic characteristics and land use. Its physiographical characteristics change from a rugged mountainous outcrop, peak El. 2707 feet and steep side slopes up to 60 percent, to a relatively flat developed residential neighborhood (avg. elevation 1260 feet). Camelback Mountain is undeveloped and accounts for approximately 22 percent of the drainage area. The hill slopes (2% to 15%) from the area adjacent to Camelback Mountain, to Camelback Road are naturally desert landscape with medium density vegetative cover. The land use for this area can be classified as very light density residential development.

The area south of Camelback Road and north of the Arizona Canal varies from medium density residences to multi-family residential homes with a few business developments along Camelback Road. Most residences in this area utilize flood irrigation watering. Land usage in the watershed area are shown on Figure 3, (Land Use).

C. Typical Storms & Flooding History

The following storm descriptions for the Phoenix area come from the OLD CROSS CUT report (Ref. No. 24).

General Winter Storms

Storms of this type normally move inland from the north Pacific Ocean, spreading general light to moderate precipitation over large areas. Although they occur any time from late October through May, they are most common and generally heaviest from December through early March. These storms frequently last several days and may occur in series with only slight breaks between storms.

They usually reflect orographic effects to a great degree, so the mountains of central Arizona often receive from four to ten times as much precipitation from winter storms as do the desert areas near Phoenix. Snow frequently falls in the mountains above 6,000 feet and occasionally falls at elevations below 3,000 feet (not a factor in this drainage area). Despite the normal low intensities of precipitation during general winter storms, the large areal extent and the relatively long duration of these storms, can produce substantial volumes of runoff and high peak discharges on the larger rivers of the region.

General Summer Storms

Storms of this type normally result from a flow of warm and very moist tropical air into the region from the southeast or south, including the Gulf of California (Sea of Cortez), the tropical Pacific Ocean south of Baja California, and, to a slight extent, the Gulf of Mexico. Such storms over Arizona are often associated with tropical storms or hurricanes. General summer storms can occur any time from late June through mid-October, but are most frequent from August through early October. They usually last from 1 to 3 days and generally consist of numerous locally heavy storm cells embedded in more widespread, general light to moderate rain. Like their general winter counterparts they usually reflect orographic influence, with higher mountains often receiving from three to eight times as much precipitation as do most of the desert areas. Some of the late September and October general storms can show characteristics of both the summer and winter types. The areal extent and duration of general summer storms are usually somewhat less than those of general winter storms, but intensities may be higher. Because infiltration rates are normally higher during summer than during winter, runoff volumes are usually lower than from winter events, but the peak flows on intermediate-sized streams may be higher.

Local Storms

Local storms consist of heavy downpours of rain over relatively small areas (up to about 300 square miles) for short periods of time (up to about 7 hours). They are usually accompanied by lightning and thunder, and are often referred to as thunderstorms or cloudbursts. They can occur any time of the year, but are most prevalent and most intense during the summer months, July to September, when tropical moisture frequently invades Arizona from out of the south or southeast. During the latter part of the summer season they are often larger, of longer duration, and more apt to be associated with general summer storms. Runoff from local storms is usually of a high-peak, low-volume type, affecting mostly the smaller creeks and washes, and is characterized by a rapidly rising and receding hydrograph. They can result in serious flash flood, sometime with loss of life and serious local property damage.

Storm runoff begins at the top of Camelback Mountain and flows southwardly in numerous gullies opposed to well defined water courses. Runoff flow is then picked up by small washes and streets in the hill slope areas and primarily flows as sheet flow along and across Camelback Road. This virtually occurs at every intersecting street along Camelback Road. South of Camelback Road the interconnecting streets channel runoff to the north bank of the Arizona Canal where the water collects. The profile along the north bank is relatively flat (slopes less than .15%) with no defined water course (except for the Arcadia Channel between 56th Street and 64th Street). The lower frequency storm runoff tends to pond behind the canal and then enter the canal at the various locations where the drainage pipes run under the north bank. (When the water ponds it tends to back up into the low lying residences adjacent to the north canal bank). For the larger storms, stormwater runoff overtops the north canal bank and discharges into the Arizona Canal and flows very slowly in a northwesterly direction. Occasionally, the depth of runoff in the Arizona Canal overtops the south bank and water spills out of the canal to the south.

The following flood reports describe the historical flooding characteristics of the Arcadia area.

Desert flood of 1943

On August 3rd, 1943 rainfall began at 3:30 am and continued until 11:00 am releasing an average precipitation of 2.12 inches for the Phoenix area. The Arcadia area at this time was primarily farmlands and there are no reports of inundation north of the Arizona Canal. There are however, reports of very heavy inflow (no estimates of the flow are given) to the Arizona Canal at Camelback around 100' east of 40th street which today is occupied by the Camelback Castile Condominiums. A point of interest in this report is that the author observed impounded water on the north bank of the Arizona Canal and recommended that culverts be put in the north bank to "relieve the pressure on the north bank" (Ref. No. 13)."

Flood of September 4-6, 1970

"On September 4th, 1970 a storm hit the Phoenix area with the precipitation depths exceeding the 100-year 24-hour storm in Scottsdale while West Phoenix was experiencing the 5-year 24-hour recurrence interval. Flooding in the Arcadia area was along the north bank of the Arizona Canal between 56th and 72nd Streets. The runoff "flowed westerly to the Falls Substation where part of the flow drained into the Canal with the rest crossing the Canal over the 56th street bridge and causing damage to the south". According to a Flood Damage Report by the City of Phoenix eyewitness accounts reported the Arizona Canal's north bank was overtopped northeast of 64th Street" (Ref. No. 2).

Report of Flood on June 22, 1972

"The flood that occurred on June 22, 1972 lasted 18 hours with the greatest intensity recorded in a two hour span. The unofficial depth recorded at 24th Street and Camelback was 5.25 inches. From 64th street to Cave Creek approximately 500 acres of property area, north of the Arizona Canal, was inundated costing an estimated $608,000.00 in damages. The south bank of the Arizona Canal at 40th street failed flooding homes south of the Arizona Canal. Together, with the break at 38th Street, an additional 2800 acres was flooded causing an estimated $3.7 million in damages." (Ref. No. 9).

D. Existing Drainage & Flood Control Structures

Two drainage collector systems have been built along the north side of the Arizona Canal both east and west of the study area, and a third is under construction along the Old Cross Cut Canal south of Indian School Road. The Arcadia Area north of the canal bank has been left unprotected with the exception of a few drainage structures. These existing drainage structures are shown on Figure 2, Existing Drainage Systems.

Arizona Canal Diversion Channel (ACDC).

One of the collector systems is the Arizona Canal Diversion Channel at Cudia City Wash west of 40th Street constructed in 1993. The ACDC is designed to collect the 100-yr runoff from the Cudia City Wash basin northwest of the Arcadia Area, therefore diverting stormwater runoff from entering the Arizona Canal. The ACDC drainage study was prepared by the U.S. Army Corps of Engineers.

Indian Bend Wash Side Channel System (IBW).

The other collector system, Indian Bend Wash Side Channel System, drains the 25-yr runoff to the east from 64th Street into the Indian Bend Wash. The Indian Bend Wash Side Channel System drainage study was prepared by the U.S. Army Corps of Engineers.

This system involves a 54-inch RCP at Lafayette Boulevard and 64th Street. The entrance to the pipe is in the center of the 64th Street facing north. Then it curves to the east running along the center of Lafayette Boulevard. The catch basin and inlet grate for the pipe is three feet wide and it spans the entire width of 64th Street. The depth of the catch is 10-feet deep at the center and tapers to 4-feet at the curb (Ref. No. 45). It then connects into a detention pond west of

68th street. From the detention pond the stormwater runoff drains to the Indian Bend Wash Side Channel System. Due to the size of the catch basin inlet and the storm drain, a sizeable amount of runoff is intercepted and diverted from the Arcadia study area. This structure was constructed in 1986 and designed to collect water from a 25-year storm. However, since the construction of this drainage structure, The Phoenician Resort has been constructed, altering the tributary drainage area. The methods and assumptions for this situation will be discussed in more detail under the Special Procedures Section of this report (Section III.E.).

Old Cross Cut Canal.

There is a recessed channel (Old Cross Cut Canal) along 48th Street just north of Indian School Road which Salt River Project uses to transfer water from the Arizona Canal to the Grand Canal and to waste excess stormwater from the Arizona Canal to the Salt River. Its current carrying capacity is 1000 cfs which is the flow SRP has the legal right to spill. A drainage study of the channel prepared by Greiner, Inc. estimates that future improvements to this channel will increase its carrying capacity to 1990 cfs which correlates to the 25 year event (Ref. No. 11). However, SRP still reserves the right to spill up to 1000 cfs into the Old Cross Cut Canal under any given conditions.

Arcadia Drainage Channel.

The Arcadia Drainage Channel from 56th Street to 64th Street was constructed in 1975 along the north bank of the Arizona Canal. (Ref. No. 53). The Arcadia drainage channel is a lined trapezoidal channel with a 5-foot wide bottom and side slopes of 1-¼:1. This channel connects to a 6' x 12' box culvert then discharges to an open channel which then connects to the Arizona Canal just east of 56th Street by two 48-inch diameter CMP culverts. The design capacity for the channel was 300 cfs from 56th Street to Jokake Drive and 200 cfs from Jokake Drive to 64th Street which is in excess of the 25 year event. The channel, particularly east of Jokake Drive appears to have deteriorated and the actual capacity may be reduced.

North Bank Ponding Area Drains.

From 56th Street to Cudia City Wash there are numerous pipes that drain ponding areas adjacent to the north bank of the canal. These pipes range in size from 3-inches to 48-inches in diameter as shown on Figure No. 2, (Existing Drainage Systems), and Table A-0 (Canal Storm Drain Lines). The drains throughthe north bank do not adequately drain the ponding areas for the larger return period storms because they were not designed to transfer peak runoff into the canal. The capacity of many of the pipes are further reduced because of silting and debris clogging the pipes. Additionally, the Arizona Canal has a limited capacity to carry stormwater runoff because its primary use is to transport irrigation waters. Runoff that does get into the canal reduces its freeboard capacity and, in turn, reduces the inlet capacities of the north bank inlets (due to backwater conditions). There is a culvert that runs from Tuberia, south of 46th Street to the Arizona Canal. There are two small culverts that act as inlets to the Arizona Canal both east and west of 44th Street and 56th Street at the Arizona Canal intersection, and approximately two dozen other small drainage pipes and structures which relieve ponding areas behind the canal. Most of the miscellaneous drain were not designed for a storm frequency and discharge less than 1 cfs each.

Camelback Road Storm Drain.
Approximately 600 feet east of 44th Street along Camelback Road there is an 18-inch RCP storm drain. At 44th Street this pipe connects into a 36-inch RCP and runs along the roadway alignment undercrossing the Arizona Canal just east of 40th Street and connecting to the 40th Street storm drain with a Salt River Outfall. This storm drain system, designed for the 2 year storm and constructed with Camelback Road improvements in 1986 can discharge approximately 55 cfs from the watershed.

A second storm drain system in Camelback Road includes a 24-inch pipe, that connects to two 24-inch pipes then to a 36-inch pipe which collects flows tributary to the north side of Camelback Road and east of 44th Street and then southwesterly to the Arizona Canal. This second storm drain system was installed by Maricopa County in the 1960's and was designed for an unknown storm event to relieve ponding in the intersection of 44th Street and Camelback Road and to operate under pressure in the low area behind the bank of the Arizona Canal. The discharge capacity of this 36-inch line is approximately 60 cfs to the Arizona Canal. The Camelback Road East Apartments 4255 Camelback Road and Camelback Horizon Estate developments (located east of Camelback Castille Condominiums) constructed catch basins in the south corner of their parcels connecting them to the 36-inch Maricopa County storm drain.

Water discharging out of these inlets has been reported by local residents; water discharging from these inlets is caused by a surcharged line operating under pressure.

Pipe culverts cross Camelback Road at various intersections to convey water that is ponding on the north side of the road across the street. Pipe sizes ranging from 18-inches to 36-inches are found at the following locations: Arcadia Drive, 54th Street, 56th Street, Camino Allenada, Jokake Drive and 64th Street.

Drainage Easements.
There are numerous drainage easements within the study area. Nearly all of them are located in the residential areas just north of the Arizona Canal. Most are paved valley gutters in easements between lots or alleys that drain the runoff from the residential streets to the inlets along the north bank.

Recent historical records show that there are six places along the canal where water exits the watershed. They are: Lafayette Drive at 64th Street, 56th Street bridge, the Old Cross Cut Canal, Camelback Road Storm Drain at 40th Street, the low spot in the south bank of the Arizona Canal west of 40th Street and where the Arizona Canal flows past the western boundary of the watershed.

III. METHOD OF ANALYSIS

A. Standards Used

The hydrologic modeling techniques used for this study are consistent with the policies, procedures and practices outlined in the 1992 version of "Drainage Design Manual for Maricopa County, Arizona" Volume 1 Hydrology. HEC-1, version 4.0.1E, was used for the hydrological computations. Table A-1, provides a detailed list of all of the hydrologic computer programs used for this study.

B. Rainfall

There is one rain gage located within the study area but it has not been in service long enough to generate accurate return-year precipitation depths. Therefore, the return-year rainfall depths were estimated using the NOAA ATLAS II 6-hour isopluvial maps from the Hydrology Manual.

The 6-hour rainfall precipitation frequency distribution pattern (No. 2.20) was calculated by the DRAINAGE DESIGN MENU SYSTEM (DDMS ver. 1.0 1994) program based on a drainage area of 4.2 square miles. PREFRE from the DDMS program calculated HEC-1 Parameter defaults and precipitation depths for various storm durations and frequencies (Table A-2).

C. HEC-1 Parameters

The rainfall losses were estimated using the Green and Ampt infiltration equation instead of the Initial Loss Plus Uniform Loss Rate because it is the more accurate of the two methods and the most preferred method of estimation by the FCDMC. The Clark Unit Hydrogaph method will be used since the subbasins are less than five square miles.

The hydrologic land use types as shown in Figure 3, (Land Use Map), were derived from the Land Use Type table menu (HEC-1 parameter defaults provided by DDMS software). Table 4.3a, from the Drainage Design Manual for Maricopa County, Vol. 1, was used to correlate city zoning maps with hydrologic land use types for the Arcadia Area. Note that two different land use types were used for the areas north and south of Camelback Road even though the zoning is primarily the same. This was done to represent the differences in landscaping type (i.e. differences in percent vegetative cover and imperviousness) found north (desert landscaping) and south (flood irrigated lawns) of Camelback Road. Two additional Land Use Types were added to Table A-3, namely Mountainous and Hill Slopes. This was done to lower the percent impervious (RTIMP) values associated with the land development in these areas. A more in depth discussion of this process is presented in the Special Procedures section of this report.

The land use areas that utilize flood irrigation create a unique situation for the hydrograph generation. This is because for lower frequency storms a portion of the rainfall will be captured and retained thus not contributing to the peak flows. But, for larger frequency storms the irrigated lawns will eventually fill, overtop and begin to contribute to the runoff. A more detailed discussion of this situation and how it is handled is provided in the Special Procedure Section of this report (Section III.E.).

Soil types, as shown in Figure 4, General Soils Map, were identified by using the Eastern Maricopa County soils map (Ref. No. 34). These types of soils and the corresponding loss rate parameters are identified within the DDMS software and determined from default lookup tables included with the software (see Table A-4 Eastern Maricopa County Soils Types). The percent impervious (RTIMP) values for the soil type RO (Rock Land) was reduced to 40% from 65%. This was done to reflect the actual inner-connecting portion that is impervious and contributing directly to runoff. The breakup of the subbasin soils type is found in Table A-6 and the related DDMS calculated loss rate parameters in Table A-7.

D. Watershed Delineation

The watershed limits, shown on Figure 1, (Watershed Boundary Map), are bound by the peaks of Camelback Mountain on the north, 64th Street on the east, 40th Street on the west (including the area immediately south of the ACDC entrance) and the Arizona Canal to the south. These limits closely reflect the watershed boundaries in the previous reports written by the U.S. Army Corps of Engineers (Ref. No. 19, 23 & 24) and the Flood Control District of Maricopa County (Ref. No. 8).

The watershed basin was subdivided into 42 separate subbasins as shown in Figure 5, (Drainage Area Map), with an average area of 64 acres the largest being 161.3 acres and the smallest 23.7 acres. From the Eastern boundary of the watershed (64th Street) to 48th Street, runoff primarily flows from north to south and drains into the Arizona Canal at various locations. West of 48th Street the flow transitions from southerly to westerly. The subbasins are subdivided at the roadways where the proposed alternate storm drainage systems will be located, Camelback Road, Exeter Road, and Lafayette Boulevard. This will facilitate rerouting the subbasin flows for the alternative storm drainage system solutions.

The runoff flow paths for existing conditions, shown in Figure 5 (Drainage Area Map), present a difficult situation because there are no well defined water courses. In all practicality, the numerous gullies and interconnecting streets found in this watershed will all contribute to conveying runoff. However, a single water course flow path has to be assumed so that time of concentrations can be determined. The flow paths shown on Figure 5 were determined by factoring in all of the variables, such as longest flow path that affect the time of concentrations, the flow paths that appear to carry the majority of runoff flow (determined from the contour maps), and historical records and reports of flooding in certain areas.

On the eastern end of the watershed boundary there is an overlap between the previous report written by the U.S. Army Corps of Engineers (Ref. No. 23) for the Indian Bend Wash and the proposed boundary for the Arcadia Area study. The main reason being that since the previous report was written (June 1981), the Phoenician Resort has been constructed which has changed the drainage flow patterns for the upper part of the subbasin. Some of the flow that has historically drained to 64th Street is redirected and flows down 62nd Street which will miss the interceptor drain at Lafayette Boulevard and 64th Street. The process describing the amount of flow to be intercepted will be explained in the next section of this report.

E. Special Procedures

This section describes and discusses the unique situations encountered within this watershed and the special procedures developed to address these situations. Table A-5 Special Procedures, provides a brief synopsis of all the special procedures used in this model.

Diversion

As shown in Table A-5 there are three different types of diversion procedures used in this model for the existing conditions. One type of diversion is for the on-site retention due to the flood irrigation lots. The second type of diversion is for existing storm drainage systems that exit the watershed. There are five cases where storm runoff exits the watershed which require use of the diversion procedure. And finally, there are diversions for split flow situations. A split flow situation occurs when the flow path changes due to higher runoff volumes. There are three split flow situations in this model.

As discussed earlier in the Land Use Type section of this report, there is a need to address the on-site retention for the flood irrigated lawns south of Camelback Road. A special procedure using diversion hydrographs is used in this model to account for the capture and retention of rainfall due to flood irrigation lawn watering. This special procedure was developed by determining that the maximum amount of rainfall to be diverted is the excess precipitation generated from the 10-year storm. Aerial photographs were then used to estimate the percentage of on-site retention for the subbasin area (i.e. the percentage of the area that is irrigated lawns). The diversion card in HEC-1 was then used to subtract the irrigated lawn retention out of subbasin hydrographs. This process continues until the maximum volume is diverted (i.e. when the irrigated lawns are filled). These values are tabulated in Table A-6 (Subbasin Data Input Parameter Estimates).

Five of the six locations where stormwater exits the Arcadia Area watershed, required different approaches unique to the individual conditions in calculating the amount of runoff to be diverted. The following paragraphs discuss the procedures used in calculating the diversions at each of the five subject locations.

The interceptor drain at Lafayette Boulevard and 64th Street

The existing storm drain at Lafayette Boulevard and 64th Street conveys runoff to the east and drains into an existing detention facility. From the detention pond, runoff then drains to the Indian Bend Wash out of the Arcadia Area watershed. The storm drain pipe in Lafayette Boulevard is a 54-inch RCP with a capacity of 125 cfs. This capacity was calculated assuming a worse case scenario with the outlet submerged. The inlet grate for the catch basin, 3-feet wide by 44-feet long, is capable of intercepting the maximum capacity of the pipe. Although runoff flow from subbasin 1 to subbasin 4 crosses the interceptor drain, there will be some runoff produced by these subbasins that will be conveyed in adjacent streets or areas which bypass the interceptor drain. Therefore, a conservative approach was used to anticipate that the Lafayette drain will intercept approximately half of the flow coming from subbasins 1 through 4. The HEC-1 DI and DQ cards respectively, represent the amount of flow generated and intercepted by the 2-year through the 100-year events. For the 100-year event the inlet capacity of the grate is greatly reduced due to the high velocities which will increase grate bypass flows.

56th Street Bridge

East of 56th Street, the north canal bank is much higher (four to nine feet) than the adjacent residential area, and storm water tributary to this area discharges into two 48-inch pipes, which enter the canal, westerly crossing 56th Street to the residential area, and southerly over the 56th Street Bridge. The flow diverted out of the watershed over the 56th Street Bridge was determined to be the excess capacity of the two 48-inch pipes. The conveyance capacity of the 56th Street bridge was also calculated to determine the amount of excess flows being conveyed by the bridge which would overtop the curbs and enter the Canal and remain within the watershed.

The Old Cross Cut Canal

At the Old Cross Cut Canal a maximum diversion of 1000 cfs is used and it is based solely on Salt River Project's option to outlet up to 1000 cfs from the Canal at any time.

Camelback Road 18-inch to 36-inch Storm Drain

At Camelback Road the 18-inch to 36-inch storm drain system was found to have a carrying capacity of 55 cfs. This system runs under the Arizona Canal and connects to the storm drain along 40th Street where it leaves the watershed. The maximum of 55 cfs will be diverted from subbasin 39 after it has been combined with the preceding contributing subbasins.

Low spot on South Canal Bank at 40th Street

There is a spillway section along the south bank of the Arizona Canal east of 40th Street that allows for certain overflows from the Arizona Canal. When the water surface in the canal exceeds the spillway elevation, the excess stormwater will leave the Arcadia Area watershed. The HEC-2 model created for the Arizona Canal indicated that runoff in excess of 10 cfs over maximum normal operating flows of 700 cfs will be diverted out of the canal at the spillway. The model is based on the maximum normal operating water surface elevations provided by

SRP, which utilized a Mannings co-efficient of 0.030.

Split Flow

The last type of diversions encountered in the watershed are for the split flow situations previously described. The first diversion encountered of this type is located between subbasin 30 and subbasin 38. The main flow path from subbasin 38 to subbasin 30 is in the gully along Dromedary Road. However, there is a small channel along Rockridge Road where it intersects with Dromedary Road, which will intercept low flows and route them to subbasin 39.

The last two split flow diversions both occur on Camelback Road in subbasin 39. The first one is for the 24-inch pipes that connects to two 24-inch pipes and then to a 36-inch pipe which has a capacity of 60 cfs. The 36-inch pipe discharges into the Arizona Canal in subbasin 36. The other split flow diversion comes from the flow path from subbasin 37 to the concentration point of subbasin 39 on Camelback Road. The maximum flow that can travel this route is 160 cfs. Flow exceeding 160 cfs will over top the crown of Camelback Road and flow south eventually finding its way to subbasin 36. Flows exceeding 160 cfs will be diverted and combined with subbasin 36.

Time of Concentration

Another problem encountered was the time of concentration being too high for the mountainous rock outcropping areas. DDMS adjusted the slopes to a maximum of 315'/ft, based on Figure 5.4 (Slope Adjustment for Steep Water Courses) in the Hydrology Manual. However this figure was intended for grass lined channels built using the (Denver) Urban Drainage and Flood Control District Criteria (Ref. No. 48) and therefore the true slopes were used to calculate the times of concentrations for this project.

Percent Imperviousness

DDMS calculates the percent imperviousness (RTIMP) by adding the RTIMP values for the Soils Types to the RTIMP values for the hydrologic Land Use Types. In specific combinations of Ro (Rock Land) Soils type and certain Land Use types this process can lead to a RTIMP value greater than 100%. The Landiscor aerial maps show that Camelback Mountain is zoned

RE-35. When this zoning is converted to the land use type of V.L.D.R. (RTIMP value of 5%) and added with the RTIMP of the soil type, 65%, the total value of 70% imperviousness appeared to be too high. Since there is a construction moratorium on Camelback Mountain for elevations greater than 1400 feet, two Land Use Types were created to reflect the actual percent of imperviousness. These are Mountainous and Hill Slopes. They were given zero and three percent of imperviousness respectively, which represents the actual conditions since there is very little to no development in these areas. Also, the RTIMP Value for Soil Type Ro was reduced to 40% from the DDMS default value of 65%.

F. Routing

There are two routing methods being used in this model for hydrograph routing. The Kinematic Wave method utilizing channel flow principles is used for all of the subbasins up to the Arizona Canal. This was done because the subbasins are fairly small and the Kinematic Wave method will minimize the hydrograph attenuation. Once the runoff reaches the north bank of the Arizona Canal, a Modified Puls Storage Routing was used. This method best represents the condition of stormwater routing within the Arizona Canal. A HEC-2 analysis of the Arizona Canal is used to generate a storage - discharge rating curve. This rating curve is used as input for the Modified Puls storage routing. The complete routing parameter estimates can be seen in Table A-8 (Subbasin Routing Parameter Estimates).

G. HEC-1 Data Input

The HEC-1 data input was created by the DDMS program and its sub-programs. Data input into the DDMS program is found in Table A-6 (Subbasin Data Input Parameter Estimate) which was created from topographical maps created specifically for this study, zoning maps from 1994 Landiscor aerial photographs and a CADD drawing referenced to the State Plane Coordinate System for the soils information. The soils drawing was then merged with the topographical map and the areas of the soils type for the subbasins are calculated by using the CADD software. The Land Use Types map was created by identifying the zoning boundaries as they correlate to the Land Use Types and overlaying them on the Subbasin map. These areas were calculated by using CADD software. Once Table A-6 was created, the data was entered into the required DDMS sub-programs. DDMS then calculates the loss rate parameters for each subbasin by using weighted area methods, the average area weighted logarithms (adj. XKSAT), or from the default look up menus that are provided with the software. Table A-3 and A-4 provide the DDMS defaults for the Land Use Types and the Soil Types, respectively. Table A-7 provides the breakdown of the DDMS calculated loss rates for the subbasin data input parameter estimates. Table A-8 gives the subbasin parameter estimates for Kinematic Wave and Modified Puls routing.

A Manning's coefficient of n = 0.016 was used for the Kinematic Wave Routing in the streets and it increases for the upper subbasins where the flow drains through natural washes and gullies. The flow through the streets is described as trapezoidal flow due to the fact that the rolled curbs act as a wide shallow trapezoidal channel.

IV. RESULTS

The HEC-1 data files for the 10, 25, 50 and 100-year storms for the existing conditions were prepared under the assumptions discussed previously and the input data listed in the "A" tables were used to generate the output data files and attached summary report. Table B-1, (Peak Flows Along The Arizona Canal), summarizes flows from the HEC-1 output reports.

The analysis assumes that Salt River Project (SRP) will operate the canal system during flooding periods in a manner which will minimize overtopping of the south canal bank. Table B-1 also indicates diversions of peak flows from the watershed which will provide relief to the water ponding behind the north canal bank and from excess flood waters within the canal system.

Areas where stormwater exits the watershed as noted in Table B-1 occur at Lafayette Drive and 64th Street where water exits to the Indian Bend Wash Side Channel System; at 56th Street where water exits over the 56th Street Canal Bridge and floods downstream properties; Old Cross Cut Canal where SRP is assumed to divert up to 1,000 cfs; and the low bank of the canal just west of 40th Street where flooding of down stream properties will occur.

A. Comparison of Results With Other Studies

Comparison of this HEC-1 model with the previous models for the area is shown for discussion purposes. However, this HEC-1 model for the existing conditions produces different results because of several factors. This model:

- Uses a rainfall pattern of 2.20 vs. the FCDMC pattern of 2.0.
- Uses smaller and more uniformly sized subbasins.
- Diverts flow into storage to account for stormwater retained on irrigated lots or in retention basins.
- Did not divert flows out of the watershed by overtopping canal banks at Spur Circle (CP501), at 47th Street (CP504), and south of Calle Redonda (CP505).
- Used Kinematic Wave routing within the watershed instead of the Muskingum method used by the District.
- Utilized the existing freeboard capacity of the canal in storage and routing the existing storm water flows.

Comparison of Subbasin Input Parameters

Table B-2 (Comparison of Subbasin Data Input Parameters) compares several subbasin loss rate parameters prepared for this study to parameters in the Flood Control District's "Old Cross Cut Canal/Lafayette Drain" report.

The subbasins used for comparison in Table B-2 have been chosen so that they are similar in location and size. Due to the differences between the way the watershed was subdivided and the FCDMC's subdivisions, only four subbasins were close enough in size and location to compare. The following paragraphs explain the difference in values for the loss rate parameters.

Subbasins being compared are similar in size, but there are still differences in the areas. This alone will lead to differences in the loss rate values because the loss rate parameters are calculated by taking the area weighted average. This study uses the same methodologies and practices to determine the loss rate used by the FCDMC with the exception of computing the percent imperviousness (RTIMP) and the adjusted hydraulic conductivities (XKSAT).

For the percent impervious (RTIMP) values, the only significant differences are between the mountainous subbasins (subbasins 38 and 40 found in this report, and the FCDMC's sub3 and sub1 respectively). This can be explained by the fact that the value of percent imperviousness (RTIMP) for the Eastern Maricopa County Soil Type Ro (Rock Land) was reduced to 40% from 65%. This was done to reflect the estimated inner-connecting portion that is impervious and contributing directly to runoff.

With the exception of subbasin 40 and FCDMC subbasin 1 (same XKSAT values), the differences in the XKSAT values can be explained by the fact that XKSAT was calculated by using the LOG weighted average (new prescribed procedure) opposed to FCDMC's area weighted average. The wetting front capillary suction (PSIF) and the volumetric soil moisture deficit (DTHETA) values differ because they are found graphically by using the adjusted XKSAT values. The differences with the surface retention losses (IA) come from the differences in subbasin area, soil types and the land use types.

Comparison of Peak Discharges

There are three points in the watershed with significant differences between this report and the FCDMC's results. These points are located at 56th Street, 48th Street, and 44th Street. Initially, there appeared to be large discrepancies between the two models, however, the large differences in peak flows can be easily explained. First the FCDMC's model assumes that all runoff enters the canal. This report model assumes runoff flows along the north levee of the canal until the water surface elevation exceeds that of the canal bank.

Location Area 56th Street Bridge

At the first point of analysis, 56th Street, the FCDMC model diverts flow from the Arizona Canal north of Spur Circle and at 56th Street. This investigation reveals the flow will only exit the watershed at 56th Street, thus the report model has greater peak flow value at 56th Street.

Location Area 47th Street

Next at 47th Street the FCDMC reservoir routes the flow assuming the runoff is ponding along the north bank of the canal at 48th Street. The model generated by this report routes all of the flow in the Arizona Canal and assumes that SRP is spilling all of the storm runoff at the OCCC up to the maximum of 1,000 cfs.

Location Area Calle Redonda east of 44th Street

At the third point of analysis the FCDMC's model diverts flow at Calle Redonda. Thus the remaining peak flows are very small. The model generated by this report assumes the storm runoff is carried in the canal, due to the wasting of 1,000 cfs at 48th Street, and continues down the canal through subbasin 42 where the excess spills at the low spot on the south bank of the canal west of 40th Street. This difference in routing schemes between the two models accounts for the large discrepancies.

Table B-3 (Subbasin Comparison of the 25-Year Peak Flow), gives an overview of the flow for the three different studies in the Arcadia/Old Cross Cut Canal area.

Table B-4 (Subbasin Comparison of 25-Year Peak Flow by CFS per Square Mile) sorts the same data by ordering peak subbasin discharge per square mile. It can be seen that subbasins south of the Arizona Canal, in the more intensely developed areas, have relatively higher discharges per square mile than the ones north of the canal. The relative discharges from subbasins in the mountainous area for both this report and the FCDMC report are quite similar. However, the relative discharges from the subbasins where diversions are used for flood irrigation, are less than the discharges estimated by the FCDMC.

Table B-5 (Subbasin Comparison of 25-Year Peak Flow by Size of Subbasin) and Table B-6 (Subbasin Comparison of 25-Year Peak Flow by Size of Peak Flow), present other opportunities for identifying extreme conditions within the subbasins for comparison and evaluation.

TABLE A-0

CANAL STORM DRAIN LINES

NO.	STATION	SIZE (in.)	FLOWLINE (ft.)
1	858+13	12	1247.41
2	858+51	8	1247.83
3	859+71	3	1247.27
4	868+96	18	1247.32
5	876+31	36	1245.13
6	884+02	18	1247.95
7	886+10	12	1247.61
8	893+61	12	1247.96
9	894+78	12	1247.75
10	901+53	12	1247.85
11	902+27	12	1247.16
12	915+64	18	1248.87
13	924+39	12	1249.34
14	924+92	12	1249.06
15	934+59	18	1249.65
16	936+46	30	1248.25
17	936+74	24	1250.91
18	941+10	12	1250.13
19	948+02	15	1250.64
20	954+79	12	1251.11
21	961+68	12	1249.95
22	965+18	12	1251.51
23	965+25	15	1250.34
24	968+32	12	1251.31
25	976+63	12	1251.23
26	977+38	8	1250.13
27	978+27	18	1250.40
28	993+96	48	1249.82
29	997+68	48	1249.24

TABLE A-1

HYDROLGICAL COMPUTER PROGRAMS USED

PROGRAM NAME	VERSION	DATE	DEVELOPED BY:
DDMS	1.0	10-94	FCDMC
PREFRE		06-88	BUREC
LAND TYPES		10-94	FCDMC
SUBBASIN PREP		10-94	FCDMC
MCUHP1		10-94	FCDMC
HEC-1	4.0.1E	05-91	US ARMY CORP OF ENGINEERS
DODSON HEC-1 EDITOR	4.0	04-91	DODSON & ASSOCIATES

TABLE A-2

HEC-1 PARAMETER DEFUALTS

PRECIPITATION DEPTH (IN.) FROM ISOPLUVIAL MAPS						
STORM DURATION	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
6-HOUR	1.15	1.65	2.00	2.50	2.80	3.20
24-HOUR	1.40	1.90	2.40	3.00	3.40	3.80
PRECIPITATION DEPTHS (IN.) CALCULATED FROM PREFRE						
5-MIN.	0.31	0.42	0.49	0.59	0.67	0.75
10-MIN.	0.46	0.63	0.75	0.90	1.03	1.15
30-MIN.	0.56	0.79	0.94	1.15	1.32	1.47
5-MIN.	0.74	1.05	1.27	1.56	1.78	2.00
1-HOUR	0.90	1.30	1.57	1.94	2.22	2.50
2-HOUR	0.98	1.42	1.72	2.21	2.43	2.74
3-HOUR	1.04	1.51	1.82	2.24	2.57	2.89
6-HOUR	1.15	1.65	1.99	2.47	2.80	3.19
12-HOUR	1.25	1.82	2.20	2.71	3.11	3.51
24-HOUR	1.36	1.90	2.39	2.95	3.39	3.80

TABLE A-3

HEC-1 PARAMETER DEFUALTS

LAND USE TYPES					
LAND USE TYPE	DTHETA CONDITION	% VEG. COVER	RTIMP %	IA 2.50	KB ROUGHNESS TYPE
* DESERT	DRY	25.00	0.0	0.35	LOW
* OPEN	DRY	10.00	0.0	0.10	MIN
V.L.D.R.	NORMAL	30.00	5.0	0.30	LOW
L.D.R.	NORMAL	50.00	15.0	0.30	LOW
M.D.R.	NORMAL	50.00	30.0	0.25	LOW
M.F.R.	NORMAL	50.00	45.0	0.25	LOW
* INDUSTRIAL	NORMAL	60.00	55.0	0.15	MIN
COMMERCIAL	NORMAL	75.00	80.0	0.10	MIN
* PARK	NORMAL	90.00	0.0	0.20	HIGH
* ROW CROP	NORMAL	85.00	0.0	0.50	HIGH
GOLF COURSE	NORMAL	95	0.0	0.40	MIN
HILL SLOPES	DRY	10	3.0	0.15	HIGH
MOUNTAINHOUS	DRY	2	0.0	0.1	HIGH

* NOT PRESENT IN THE WATERSHED BOUNDARIES.

TABLE A-4

HEC-1 PARAMETER DEFAULTS

EASTERN MARICOPA COUNTY SOIL TYPES						
MAP SYMBO	MAP UNIT	XKSAT	DTHETA DRY	DTHETA NORMAL	PSIF	RTIMP %
AoB	Antho Gravelly Sandy Loam	0.40	0.35	0.25	3.95	0
CeC	Calvelt Gravelly Loam	0.40	0.35	0.25	3.95	0
Es	Estrella Loam	0.25	0.35	0.25	4.80	0
LaA	Laveen Loam	0.25	0.35	0.25	4.80	0
Mv	Mohall Loam	0.25	0.35	0.25	4.80	0
PvC	Pinamt Very Gravelly Loam	0.40	0.35	0.25	3.95	0
TrB	Tremant/Gravelly Sandy Clay Loa	0.10	0.35	0.15	7.00	0
Ro	Rock Land/Gravelly/Sandy Loam	0.25	0.35	0.25	4.80	40
Ru	Rough Broken Land	0.40	0.35	0.25	3.95	10
Va	Valencia Sandy Loam	0.40	0.35	0.25	3.95	0

TABLE A-5

SPECIAL PROCEDURES

Operational Procedure	Modeling Problems	Modeling Solutions
Runoff Hydrograph Generation	HEC1 program does not allow for on-site retention. Specifically for the irrigated lawns in the Arcadia Area of the project.	Diversion cards will be programmed into the model for the irrigated areas. Max vol. to be diverted is the excess sub-basin precipitation from the 10 year - 6 hour storm.
Runoff Hydrograph Generation	There are several pipes and channels that intercept runoff and discharge outside the watershed.	Diversion cards will be used to divert a portion of the runoff that is intercepted by these pipes and channels.
Runoff Hydrograph Generation	There are several cases where the flow path changes due to higher runoff values i.e. split flow situations.	Diversion cards will be used to divert the portion of runoff that splits from the main flow path.
Runoff Hydrograph Generation	The time of concentration was too long for the mountainous rock outcrop areas because of the adjusted slopes.	The true slope for these sub-basins was used instead of the slope adjustment factors provided by DDMS Ver. 1.0. Research indicated that the adjusted slopes were intended for grass lined channels (ref. #47)
Runoff Hydrograph Generation	RTIMP value for mountainous sub-basins exceeded 100%, due to RTIMP from soils map being added to RTIMP from land use table.	Two new land use types: mountainous and hill were created and given low RTIMP values so that when added to the soils map RTIMP it more accuratety reflects the RTIMP for the sub-basin.

TABLE A-6 (1 of 5)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUB BASIN SOILS MAP UNIT AND LAND USE TYPE ESTIMATES																		DIVERSION DATA					
																		DT		DI		DQ	
SUB #	CP #	TOTAL AREA SQ. MI.	SOILS MAP UNIT	MAP AREA AC.	MAP AREA SQ. MI.	LAND USE TYPE	LAND AREA AC.	LAND AREA SQ. MI.	FLOW LENGTH MILES	ELEV. HIGH FT.	ELEV. LOW FT.	STORM SIZE SQ. MI.	UA RECORD #	% ONSITE RETEN. 4	ADJ. % RETEN.	10YR 6HR EXCESS PREC. (IN)	ROUTING & DIVERSION NOTES	FIELD1 ISTAD D#	FIELD2 DSTRMX AC-FT	FIELD1 DINFLO T=0	FIELD2 DINFLO UNIT Qp	FIELD1 DIVFLO T=0	FIELD2 DIVFLO UNIT Qp
1	1	0.037	Ro	17.13	0.027	MOUNT.	17.13	0.027	0.280	1950.0	1356.3	0.7	2	0	0.0	1.20	KINEMATIC WAVE	D1	0.00	0	0.00	0	0.000
			Ru	6.73	0.011	MFR	6.73	0.011						0			ROUTE SUB1 TO SUB2						
																	NO DIVERSION						
2	2	0.119	Ru	3.82	0.006	GOLF	37.52	0.059	0.603	1356.3	1303.3	0.7	1	70	38.2	0.33	KINEMATIC WAVE	D2	0.80	0	1.00	0	0.382
			TrB	18.20	0.028	VLDR	27.37	0.043						10			ROUTE SUB2 TO SUB3						
			Va	43.8	0.068	MFR	11.04	0.017									DIVERT FLOW SUB2						
			LaA	10.11	0.016																		
3	3	0.067	Va	30.26	0.047	MFR	1.91	0.003	0.259	1303.3	1291.0	0.7	1	0	57.3	0.43	KINEMATIC WAVE	D3	0.88	0	1.00	0	0.573
			LaA	12.58	0.020	LDR	41.15	0.064						60			ROUTE SUB3 TO SUB4						
			Mv	0.22	0.0003												DIVERT FLOW SUB3						
4	4	0.065	Mv	27.13	0.042	LDR	41.32	0.065	0.250	1291.0	1280.4	0.7	1	55	55.0	0.53	KINEMATIC WAVE	D4	1.00	0	1.00	0	0.550
			LaA	14.19	0.022												ROUTE SUB4 TO SUB5						
																	DIVERT FLOW SUB4						
5	5	0.067	Mv	39.40	0.062	LDR	42.63	0.067	0.437	1280.4	1269.7	0.7	1	50	50.0	0.53	STORAGE ROUTE	D5	0.94	0	1.00	0	0.500
			LaA	3.23	0.005												DIVERT FLOW SUB5						
6	6	0.090	Ro	52.71	0.082	MOUNT.	52.71	0.082	0.263	1974.5	1359.0	0.7	2	0	0.0	1.19	KINEMATIC WAVE	D6	0.00	0	0.00	0	0.000
			Ru	5.07	0.008	MFR	5.07	0.008									ROUTE SUB6 TO SUB7						
																	NO DIVERSION						
7	7	0.153	Ro	1.66	0.003	MFR	27.07	0.042	0.563	1359.0	1319.2	0.7	1	70	43.6	0.66	KINEMATIC WAVE	D7	2.35	0	1.00	0	0.436
			Ru	35.49	0.055	VLDR	25.29	0.040						20			ROUTE SUB7 TO SUB8						
			TrB	53.08	0.083	MOUNT.	1.66	0.003						0			DIVERT FLOW SUB7						
			Va	7.71	0.012	HILL	12.80	0.020						0									
						GOLF	31.12	0.049						60									
8	8	0.068	TrB	6.16	0.010	LDR	43.80	0.068	0.436	1319.2	1296.4	0.7	1	60	60.0	0.45	KINEMATIC WAVE	D8	0.99	0	1.00	0	0.600
			Va	37.64	0.059												ROUTE SUB8 TO SUB9						
																	DIVERT FLOW SUB8						
9	9	0.065	Va	15.00	0.023	LDR	41.67	0.065	0.249	1296.4	1282.7	0.7	1	60	60.0	0.45	KINEMATIC WAVE	D9	0.94	0	1.00	0	0.600
			LaA	14.67	0.023												ROUTE SUB9 TO SUB10						
			Mv	12.00	0.019												DIVERT FLOW SUB9						

TABLE A-6 (2 of 5)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUB BASIN SOILS MAP UNIT AND LAND USE TYPE ESTIMATES																		DIVERSION DATA					
																		DT		DI		DQ	
SUB. #	CP #	TOTAL AREA SQ. MI.	SOILS MAP UNIT	MAP AREA AC.	MAP AREA SQ. MI.	LAND USE TYPE	LAND AREA AC.	LAND AREA SQ. MI.	FLOW LENGTH MILES	ELEV. HIGH FT.	ELEV. LOW FT.	STORM SIZE SQ. MI.	UA RECORD #	% ONSITE RETEN. 4	ADJ. % RETEN.	10YR 6HR EXCESS PREC. (IN)	ROUTING & DIVERSION NOTES	FIELD1 ISTAD D#	FIELD2 DSTRMX AC-FT	FIELD1 DINFLO T=0	FIELD2 DINFLO UNIT Qp	FIELD1 DIVFLO T=0	FIELD2 DIVFLO UNIT Qp
10	10	0.093	LaA	49.10	0.077	LDR	58.97	0.092	0.338	1282.7	1270.0	1.0	1	45	44.5	0.53	STORAGE ROUTE	D10	1.17	0	1.00	0	0.445
			Mv	10.55	0.016	MDR	0.68	0.001						0			DIVERT FLOW SUB10						
11	11	0.093	Ro	41.55	0.065	MOUNT.	41.55	0.065	0.557	2391.0	1416.6	1.0	2	0	0.0	1.01	KINEMATIC WAVE	D11	0.00	0	0.00	0	0.000
			Ru	17.68	0.028	HILL	17.68	0.028						0			ROUTE SUB11 TO SUB12						
																	NO DIVERSION						
12	12	0.120	Ru	30.04	0.047	VLDR	60.84	0.095	0.309	1416.6	1322.3	1.0	1	10	7.9	0.60	KINEMATIC WAVE	D12	0.30	0	1.00	0	0.079
			TrB	46.68	0.073	HILL	15.88	0.025									ROUTE SUB12 TO SUB13						
																	DIVERT FLOW SUB12						
13	13	0.129	TrB	63.26	0.099	LDR	82.48	0.129	0.258	1322.3	1294.5	1.0	1	20	20.0	0.71	KINEMATIC WAVE	D13	0.98	0	1.00	0	0.200
			Va	19.22	0.030												ROUTE SUB13 TO SUB14						
																	DIVERT FLOW SUB13						
14	14	0.126	TrB	1.09	0.002	LDR	80.49	0.126	0.249	1294.5	1275.9	1.0	1	60	60.0	0.39	KINEMATIC WAVE	D14	1.57	0	1.00	0	0.600
			Va	71.99	0.112												ROUTE SUB14 TO SUB15						
			LaA	7.41	0.012												DIVERT FLOW SUB14						
15	15	0.126	Va	10.52	0.016	LDR	75.49	0.118	0.376	1275.9	1254.8	1.0	1	60	58.8	0.52	STORAGE ROUTE	D15	2.05	0	1.00	0	0.588
			Mv	39.40	0.062	MDR	4.97	0.008						40			DIVERT FLOW SUB15						
			LaA	30.54	0.048																		
16	16	0.129	Ro	75.56	0.118	MOUNT.	75.56	0.118	0.653	2706.0	1371.6	1.0	2	0	0.0	1.16	KINEMATIC WAVE	D16	0.00	0	0.00	0	0.000
			Ru	7.23	0.011	HILL	7.23	0.011									ROUTE SUB16 TO SUB17						
																	NO DIVERSION						
17	17	0.073	Ru	24.62	0.038	VLDR	45.93	0.072	0.316	1371.6	1313.1	1.0	1	7.5	7.4	0.39	KINEMATIC WAVE	D17	0.11	0	1.00	0	0.074
			Va	15.15	0.024	HILL	0.70	0.001									ROUTE SUB17 TO SUB18						
			TrB	6.86	0.011												DIVERT FLOW SUB17						
18	18	0.067	Va	40.43	0.063	LDR	42.63	0.067	0.261	1313.1	1286.5	1.0	1	60	60.0	0.38	KINEMATIC WAVE	D18	0.81	0	1.00	0	0.600
			TrB	2.20	0.003												ROUTE SUB18 TO SUB19						
																	DIVERT FLOW SUB18						
19	19	0.075	Va	48.00	0.075	LDR	48.00	0.075	0.253	1286.5	1267.2	1.0	1	60	60.0	0.38	KINEMATIC WAVE	D19	0.91	0	1.00	0	0.600
																	ROUTE SUB19 TO SUB20						
																	DIVERT FLOW SUB19						

TABLE A-6 (3 of 5)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUB BASIN SOILS MAP UNIT AND LAND USE TYPE ESTIMATES																		DIVERSION DATA					
																		DT		DI		DQ	
SUB. #	CP #	TOTAL AREA SQ. MI.	SOILS MAP UNIT	MAP AREA AC.	MAP AREA SQ. MI.	LAND USE TYPE	LAND AREA AC.	LAND AREA SQ. MI.	FLOW LENGTH MILES	ELEV. HIGH FT.	ELEV. LOW FT.	STORM SIZE SQ. MI.	UA RECORD #	% ONSITE RETEN. 4	ADJ. % RETEN.	10YR-6HR EXCESS PREC. (IN)	ROUTING & DIVERSION NOTES	FIELD1 ISTAD D#	FIELD2 DSTRMX AC-FT	FIELD1 DINFLO T=0	FIELD2 DINFLO UNIT Qp	FIELD1 DIVFLO T=0	FIELD2 DIVFLO UNIT Qp
20	20	0.129	Va	35.37	0.055	LDR	82.47	0.129	0.279	1267.2	1252	0.8	1	60	60.0	0.45	STORAGE ROUTNG	D20	1.86	0	1.00	0	0.600
			Es	9.22	0.014												DIVERT FLOW SUB20						
			Mv	37.88	0.059																		
21	21	0.124	Ro	72.65	0.114	MOUNT.	72.65	0.114	0.565	2706.0	1388.7	0.8	2	0	0.0	1.14	KINEMATIC WAVE	D21	0.00	0	0.00	0	0.000
			Ru	7.03	0.011	HILL	7.03	0.011									ROUTE SUB21 TO SUB22						
																	NO DIVERSION						
22	22	0.112	Ro	4.28	0.007	MOUNT	4.28	0.007	0.517	1388.7	1318.8	0.8	1	0	6.3	0.33	KINEMATIC WAVE	D22	0.12	0	1.00	0	0.063
			Ru	25.84	0.040	HILL	7.06	0.011						0			ROUTE SUB22 TO SUB23						
			Va	41.27	0.064	VLDR	54.45	0.085						0			DIVERT FLOW SUB22						
						GOLF	5.60	0.009						80									
23	23	0.060	Va	38.55	0.060	LDR	38.07	0.059	0.235	1318.8	1288.4	0.8	1	60	59.3	0.38	KINEMATIC WAVE	D23	0.72	0	1.00	0	0.593
						VLDR	0.48	0.001									ROUTE SUB23 TO SUB24						
																	DIVERT FLOW SUB23						
24	24	0.077	Va	49.18	0.077	LDR	49.18	0.077	0.282	1288.4	1266.5	0.8	1	60	60.0	0.38	KINEMATIC WAVE	D24	0.93	0	1.00	0	0.600
																	ROUTE SUB24 TO SUB25						
																	DIVERT FLOW SUB24						
25	25	0.076	Va	48.81	0.076	LDR	48.81	0.076	0.255	1266.5	1255.0	0.8	1	60	60.0	0.38	STORAGE ROUTE	D25	0.93	0	1.00	0	0.600
																	DIVERT FLOW SUB25						
26	26	0.053	Ro	9.23	0.014	MOUNT.	9.23	0.014	0.517	1756.0	1319.0	0.8	1	0	31.2	0.35	KINEMATIC WAVE	D26	0.31	0	1.00	0	0.312
			Ru	8.00	0.013	HILL	6.02	0.009						0			ROUTE SUB26 TO SUB27						
			Va	16.92	0.026	VLDR	1.16	0.002						0			DIVERT SUB 26						
						GOLF	17.74	0.028						60									
27	27	0.061	Va	38.82	0.061	LDR	38.82	0.061	0.245	1319.0	1288.6	0.8	1	60	60.0	0.38	KINEMATIC WAVE	D27	0.74	0	1.00	0	0.600
																	ROUTE SUB27 TO SUB28						
																	DIVERT FLOW SUB27						
28	28	0.078	Va	49.74	0.078	LDR	49.74	0.078	0.272	1288.6	1264.5	0.8	1	60	60.0	0.38	KINEMATIC WAVE	D28	0.95	0	1.00	0	0.600
																	ROUTE SUB28 TO SUB29						
																	DIVERT FLOW SUB28						
29	29	0.058	Va	37.44	0.058	LDR	36.60	0.057	0.220	1264.5	1254.2	0.8	1	60	58.7	0.38	STORAGE ROUTE	D29	0.70	0	1.00	0	0.587
						MDR	0.84	0.001						0			DIVERT FLOW SUB29						

TABLE A-6 (4 of 5)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUB BASIN SOILS MAP UNIT AND LAND USE TYPE ESTIMATES																		DIVERSION DATA					
																		DT		DI		DQ	
SUB #	CP #	TOTAL AREA SQ. MI.	SOILS MAP UNIT	MAP AREA AC.	MAP AREA SQ. MI.	LAND USE TYPE	LAND AREA AC.	LAND AREA SQ. MI.	FLOW LENGTH MILES	ELEV. HIGH FT.	ELEV. LOW FT.	STORM SIZE SQ. MI.	UA RECORD #	% ONSITE RETEN. 4	ADJ. % RETEN.	10YR-6HR EXCESS PREC. (IN)	ROUTING & DIVERSION NOTES	FIELD1 ISTAD D#	FIELD2 DSTRMX AC-FT	FIELD1 DINFLO T=0	FIELD2 DINFLO UNIT Qp	FIELD1 DIVFLO T=0	FIELD2 DIVFLO UNIT Qp
30	30	0.065	Ro	2.23	0.003	MOUNT.	2.23	0.003	0.481	1590.3	1316.4	0.9	1	0	0.0	0.33	KINEMATIC WAVE	D30	0.00	0	1.00	0	0.000
			Ru	11.23	0.018	HILL	4.67	0.007						0			ROUTE SUB30 TO SUB31						
			Va	27.82	0.043	VLDR	34.38	0.054						0			NO DIVERSION						
31	31	0.061	Va	39.34	0.061	LDR	39.34	0.061	0.247	1316.4	1287.0	0.9	1	40	40.0	0.34	KINEMATIC WAVE	D31	0.45	0	1.00	0	0.400
																	ROUTE SUB31 TO SUB32						
																	DIVERT FLOW SUB31						
32	32	0.065	Va	41.44	0.065	LDR	41.44	0.065	0.274	1287.0	1266.2	0.9	1	60	60.0	0.38	KINEMATIC WAVE	D32	0.79	0	1.00	0	0.600
																	ROUTE SUB32 TO SUB33						
																	DIVERT FLOW SUB31						
33	33	0.062	Va	39.56	0.062	LDR	21.42	0.033	0.216	1266.2	1252.0	0.9	1	60	37.0	0.51	STORAGE ROUTE	D33	0.62	0	1.00	0	0.370
						MDR	17.98	0.028						10			DIVERT FLOW SUB33						
						MFR	0.16	0.000															
34	34	0.167	Va	106.65	0.167	LDR	97.50	0.152	0.571	1314.7	1264.8	0.9	1	40	36.6	0.47	KINEMATIC WAVE	D34	1.53	0	1.00	0	0.366
						MDR	1.03	0.002						0			ROUTE SUB 34 TO SUB35						
						COMM.	8.12	0.013									DIVERT FLOW SUB34						
35	35	0.128	Va	81.63	0.128	LDR	2.85	0.00445	0.290	1264.8	1250.0	0.9	1	50	9.5	0.82	STORAGE ROUTE	D35	0.53	0	1.00	0	0.095
						MDR	63.07	0.09856						10			DIVERT FLOW SUB35						
						COMM.	15.47	0.02417															
						MFR	0.24	0.00038															
36	36	0.089	Va	40.45	0.063	MFR	20.11	0.03142	0.275	1255.0	1251.0	0.9	1	20	15.0	0.86	STORAGE ROUTE	D36	0.61	0	1.00	0	0.150
			AoB	16.51	0.026	MDR	30.18	0.047						15			DIVERT FLOW SUB36						
						COMM.	6.67																
37	37	0.049	PvC	10.00	0.016	VLDR	31.28	0.04888	0.299	1385.0	1310.9	0.9	1	0	0.0	0.27	KINEMATIC WAVE	D37	0.00	0	1.00	0	0.000
			Va	21.28	0.033												ROUTE SUB37 TO SUB39						
																	NO DIVERSION LAWNS						
38	38	0.252	Ro	107.74	0.168	MOUNT.	107.74	0.16834	1.284	2706.0	1325.5	0.9	2	0	0.0	0.95	KINEMATIC WAVE	D38	0.00	0	1.00	0	0.000
			Ru	45.32	0.071	HILL	37.62	0.05878									ROUTE SUB38 TO SUB39						
			Va	4.72	0.007	VLDR	15.68	0.0245									NO DIVERSION						
			PvC	3.26	0.005																		

TABLE A-6 (5 of 5)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUB BASIN SOILS MAP UNIT AND LAND USE TYPE ESTIMATES																		DIVERSION DATA					
																		DT		DI		DQ	
SUB #	CP #	TOTAL AREA SQ. MI.	SOILS MAP UNIT	MAP AREA AC.	MAP AREA SQ. MI.	LAND USE TYPE	LAND AREA AC.	LAND AREA SQ. MI.	FLOW LENGTH MILES	ELEV. HIGH FT.	ELEV. LOW FT.	STORM SIZE SQ. MI.	UA RECORD #	% ONSITE RETEN. 4	ADJ. % RETEN.	10YR-6HR EXCESS PREC. (IN)	ROUTING & DIVERSION NOTES	FIELD1 ISTAD D#	FIELD2 DSTRMX AC-FT	FIELD1 DINFLO T=0	FIELD2 DINFLO UNIT Qp	FIELD1 DIVFLO T=0	FIELD2 DIVFLO UNIT Qp
39	39	0.224	Ro	5.86	0.009	MOUNT.	5.87	0.009	* .662	1325.5	1259.4	0.7	1	0	4.8	0.76	KINEMATIC WAVE	D39	0.44	0	0.00	0	0.000
			Ru	18.52	0.029	HILL	7.49	0.012	** .367								ROUTE SUB39 TO SUB36						
			PvC	29.95	0.047	VLDR	79.64	0.124									NO DIVERSION						
			Va	73.46	0.115	MFR	18.72	0.029															
			TrB	15.48	0.024	COMM.	31.55	0.049															
40	40	0.074	Ro	1.54	0.002	MOUNT.	1.54	0.002	0.306	1893.0	1328.2	0.7	2	0	0.0	0.67	KINEMATIC WAVE	D40	0.00	0	0.00	0	0.000
			Ru	25.78	0.040	VLDR	17.10	0.027									ROUTE SUB40 TO SUB41						
			CeC	19.91	0.031	HILL	28.59	0.045									NO DIVERSION						
41	41	0.156	CeC	13.56	0.021	MFR	26.75	0.042	0.541	1328.2	1269.0	0.7	1	0	0.0	0.58	KINEMATIC WAVE	D41	0.00	0	0.00	0	0.000
			Ru	4.03	0.006	VLDR	69.91	0.109									ROUTE SUB41 TO SUB39						
			Va	26.13	0.041	HILL	2.03	0.003									NO DIVERSION						
			PvC	41.81	0.065	COMM.	1.00	0.002															
			TrB	14.16	0.022																		
42	42	0.206	TrB	75.63	0.118	LDR	23.14	0.036	0.511	1273.7	1259.0	0.7	1	50	8.8	0.78	STORAGE ROUTE	D42	0.75	0	1.00	0	0.088
			AoB	28.60	0.045	VLDR	73.43	0.115									DIVERT FLOW SUB42						
			Va	27.36	0.043	COMM.	35.02	0.055															

* Flow length for Routing for sub37.

** Flow length for routing subbasin 41.

TABLE A-7 (1 of 2)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUBBASIN #	AREA sq. mi.	IA (in.)	DTHETA WEIGHTED	PSIF (in.)	adj. XKSAT	RTIMP %	LENGTH MILES	EL. (ft.) HIGH	EL. (ft.) LOW	SLOPE ft/mi
1	0.037	0.142	0.322	4.55	0.310	52.0	0.280	1950.0	1356.3	2120.4
2	0.119	0.342	0.250	4.65	0.440	9.0	0.603	1356.3	1303.3	87.9
3	0.067	0.298	0.250	4.25	0.510	16.0	0.259	1303.3	1291.0	47.5
4	0.065	0.300	0.250	4.80	0.360	15.0	0.250	1291.0	1280.4	42.4
5	0.067	0.300	0.250	4.80	0.360	15.0	0.437	1280.4	1269.7	24.5
6	0.090	0.113	0.341	4.70	0.250	50.0	0.263	1974.5	1359.0	2340.3
7	0.153	0.295	0.269	5.40	0.280	18.0	0.563	1359.0	1319.2	70.7
8	0.068	0.300	0.250	4.35	0.480	15.0	0.436	1319.2	1296.4	52.3
9	0.065	0.300	0.250	4.50	0.430	15.0	0.249	1296.4	1282.7	55.0
10	0.093	0.299	0.250	4.80	0.360	15.0	0.338	1282.7	1270.0	37.6
11	0.093	0.115	0.350	4.55	0.270	39.0	0.557	2391.0	1416.6	1749.4
12	0.120	0.269	0.279	5.70	0.200	9.0	0.309	1416.6	1322.3	305.2
13	0.129	0.300	0.230	6.20	0.200	15.0	0.258	1322.3	1294.5	107.8
14	0.126	0.300	0.250	4.10	0.550	15.0	0.249	1294.5	1275.9	74.7
15	0.126	0.297	0.250	4.65	0.390	16.0	0.376	1275.9	1254.8	56.1
16	0.129	0.104	0.350	4.70	0.240	47.0	0.653	2706.0	1371.6	2043.5
17	0.073	0.298	0.252	4.35	0.400	10.0	0.316	1371.6	1313.1	185.1
18	0.067	0.300	0.250	4.15	0.530	15.0	0.261	1313.1	1286.5	101.9
19	0.075	0.300	0.250	3.95	0.580	15.0	0.253	1286.5	1267.2	76.3
20	0.129	0.300	0.250	4.45	0.450	15.0	0.279	1267.2	1252	54.5
21	0.124	0.104	0.350	4.70	0.240	46.0	0.565	2706.0	1388.7	2331.5

TABLE A-7 (2 of 2)

SUB BASIN DATA INPUT PARAMETER ESTIMATES

SUBBASIN #	AREA sq. mi.	IA (in.)	DTHETA WEIGHTED	PSIF (in.)	adj. XKSAT	RTIMP %	LENGTH MILES	EL. (ft.) HIGH	EL. (ft.) LOW	SLOPE ft/mi
22	0.112	0.281	0.266	4.00	0.480	11.0	0.517	1388.7	1318.8	135.2
23	0.060	0.300	0.250	3.95	0.580	15.0	0.235	1318.8	1288.4	129.4
24	0.077	0.300	0.250	3.95	0.580	15.0	0.282	1288.4	1266.5	77.7
25	0.076	0.300	0.250	3.95	0.580	15.0	0.255	1266.5	1255.0	45.1
26	0.053	0.272	0.295	4.25	0.520	17.0	0.517	1756.0	1319.0	845.3
27	0.061	0.300	0.250	3.95	0.580	15.0	0.245	1319.0	1288.6	124.1
28	0.078	0.300	0.250	3.95	0.580	15.0	0.272	1288.6	1264.5	88.6
29	0.058	0.299	0.250	3.95	0.580	15.0	0.220	1264.5	1254.2	46.8
30	0.065	0.272	0.267	4.00	0.460	10.0	0.481	1590.3	1316.4	569.4
31	0.061	0.300	0.260	3.67	0.690	15.0	0.247	1316.4	1287.0	119.0
32	0.065	0.300	0.250	3.95	0.580	15.0	0.274	1287.0	1266.2	75.9
33	0.062	0.277	0.250	3.95	0.580	22.0	0.216	1266.2	1252.0	65.7
34	0.167	0.284	0.250	3.95	0.590	20.0	0.571	1314.7	1264.8	87.4
35	0.128	0.223	0.250	3.95	0.600	39.0	0.290	1264.8	1250.0	51.0
36	0.089	0.232	0.250	3.95	0.590	41.0	0.275	1255.0	1251.0	14.5
37	0.049	0.300	0.250	3.95	0.490	5.0	0.299	1385.0	1310.9	247.8
38	0.252	0.131	0.340	4.55	0.280	37.0	1.284	2706.0	1325.5	1075.2
39	0.224	0.233	0.259	4.30	0.450	29.0	0.662	1325.5	1259.4	99.8
40	0.074	0.203	0.314	4.00	0.420	11.0	0.306	1893.0	1328.2	1845.8
41	0.156	0.281	0.252	4.35	0.420	16.0	0.541	1328.2	1269.0	109.4
42	0.206	0.247	0.250	5.60	0.250	27.0	0.511	1273.7	1259.0	28.8

TABLE A-8 (1 of 3)

SUBBASIN ROUTING PARAMETER ESTIMATES

		KINEMATIC WAVE ROUTING										COMBINE HYDROGRAPH	
		KK	RK									KM	HC
SUB. #	CP #	FIELD1	FIELD1 L	FIELD2 S	FIELD3 N	FIELD4 CA	FIELD5 SHAPE	FIELD6 WD	FIELD7 Z	FIELD8 UPSTQ	FIELD9 NDXMIN	COMENTS	FIELD1 #
1	1												
		R1-2	3183.8	0.0166	0.07		TRAP	0	3	YES			
2	2											Combine sub1 & sub2 at cp2	2
		R2-3	1367.5	0.009	0.016		TRAP	60	1	YES			
3	3											Combine sub2 & sub3 at cp3	2
		R3-4	1320.0	0.008	0.016		TRAP	44	1	YES			
4	4											Combine sub3 & sub4 at cp4	2
		R4-5	2307.4	0.005	0.016		TRAP	44	1	YES			
5	5	Storage Route using Modified Puls to Sub10										Combine sub4 & sub5 at cp5	2
6	6												
		R6-7	2972.0	0.013	0.07		TRAP	0	3	YES			
7	7											Combine sub6 & sub7 at cp7	2
		R7-8	2302.1	0.001	0.016		TRAP	40	1	YES			
8	8											Combine sub7 & sub8 at cp8	2
		R8-9	1314.7	0.010	0.016		TRAP	20	1	YES			
9	9											Combine sub8 & sub9 at cp9	2
		R9-10	1784.7	0.007	0.016		TRAP	40	1	YES			
10	10	Storage Route using Modified Puls to Sub15										Combine sub9,sub5 & sub10 at cp10	3
11	11												
		R11-12	1632.0	0.058	0.07		TRAP	0	3	YES			
12	12											Combine sub11 & sub12 at cp12	2
		R12-13	1362.2	0.020	0.016		TRAP	60	1	YES			
13	13											Combine sub12 & sub13 at cp13	2
		R13-14	1314.7	0.014	0.016		TRAP	60	1	YES			
14	14											Combine sub13 & sub14 at cp14	2
		R14-15	1985.3	0.011	0.016		TRAP	60	1	YES			
15	15	Storage Route using Modified Puls to Sub20										Combine sub14, sub10 & sub15 at cp1	3
16	16												
		R16-17	1668.0	0.035	0.07		TRAP	0	3	YES			
17	17											Combine sub16 & sub17 at cp17	2
		R17-18	1378.1	0.019	0.016		TRAP	40	1	YES			
18	18											Combine sub17 & sub18 at cp18	2
		R18-19	1335.8	0.014	0.016		TRAP	40	1	YES			
19	19											Combine sub18 & sub19 at cp19	2
		R19-20	1473.1	0.010	0.016		TRAP	30	1	YES			
20	20	Storage Route using Modified Puls to Sub25										Combine sub19, sub15 & sub20 at cp2	3
21	21												
		R21-22	2735.0	0.026	0.07		TRAP	0	3	YES			
22	22											Combine sub21 & sub22 at cp22	2

TABLE A-8 (2 of 3)

SUBBASIN ROUTING PARAMETER ESTIMATES

		KINEMATIC WAVE ROUTING										COMBINE HYDROGRAPH	
		KK	RK									KM	HC
SUB. #	CP #	FIELD1	FIELD1 L	FIELD2 S	FIELD3 N	FIELD4 CA	FIELD5 SHAPE	FIELD6 WD	FIELD7 Z	FIELD8 UPSTQ	FIELD9 NDXMIN	COMENTS	FIELD1 #
22	22												
		R22-23	1240.8	0.025	0.016		TRAP	20	1	YES			
23	23											Combine sub22 & sub23 at cp23	2
		R23-24	1488.9	0.015	0.016		TRAP	35	1	YES			
24	24											Combine sub23 & sub24 at cp24	2
		R24-25	1346.4	0.009	0.016		TRAP	40	1	YES			
25	25	Storage Route using Modified Puls to Sub29										Combine sub24, sub20 & sub25 at cp2	3
26	26												
		R26-27	1293.6	0.024	0.016		TRAP	35	1	YES			
27	27											Combine sub26 & sub27 at cp27	2
		R27-28	1436.2	0.017	0.016		TRAP	35	1	YES			
28	28											Combine sub27 & sub28 at cp28	2
		R28-29	1161.6	0.009	0.016		TRAP	35	1	YES			
29	29	Storage Route using Modified Puls to Sub33										Combine sub28, sub25 & sub29 at cp2	3
30	30											Combine sub38 & sub30 at cp30	2
		R30-31	1304.0	0.023	0.05		TRAP	20	1	YES			
31	31											Combine sub30 & sub31 at cp31	2
		R31-32	1260.0	0.019	0.016		TRAP	30	1	YES			
32	32											Combine sub31 & sub32 at cp32	2
		R32-33	1447.0	0.0144	0.07		TRAP	0	1	YES			
33	33	Storage Route using Modified Puls to Sub35										Combine sub32, sub29 & sub33 at cp3	3
34	34												
		R34-35	1531.2	0.018	0.016		TRAP	40	1	YES			
35	35	Storage Route using Modified Puls to Sub36										Combine sub34, sub33 & sub35 at cp3	3
36	36	Storage Route using Modified Puls to Sub42										Combine sub39, sub35, 2 recalled	5
												Diversions and sub36 at cp36	
37	37												
		R37-39	3500.0	0.018	0.016		TRAP	70	1	YES			
38	38												
		R38-39	1141.0	0.0149	0.032		TRAP	15	2	YES			
39	39											Combine sub37, recalled diversion,	
		R39-36	1250.0	0.006	0.016		TRAP	26	1	YES		sub41 and sub39 at cp39	4
40	40												
		R40-41	1452.0	0.0221	0.05		TRAP	6	2	YES			
41	41											Combine sub40 & sub41 at cp41	2
		R41-39	2865.0	0.0341	0.05		TRAP	4	3	YES			
42	42											Combine sub36 & sub42 at cp42	

TABLE A-8 (3 of 3)

SUBBASIN ROUTING PARAMETER ESTIMATES

MODIFIED PULS ROUTING																					
	KK	RS				SV							SQ								
SUB. #	FIELD1	FIELD1 NSTPS	FIELD2 ITYP	FIELD3 RSVRIC	FIELD4 X	FIELD1 AC-FT	FIELD2 AC-FT	FIELD3 AC-FT	FIELD4 AC-FT	FIELD5 AC-FT	FIELD6 AC-FT	FIELD7 AC-FT	FIELD1 CFS	FIELD2 CFS	FIELD3 CFS	FIELD4 CFS	FIELD5 CFS	FIELD6 CFS	FIELD7 CFS
5																			
	R5-10	1	FLOW	-1	0	0	1	3	13	50	110	162	0	75	250	500	1200	2400	4000
10																			
10																			
	R10-15	1	FLOW	-1	0	0	2	5	8	46	156	247	0	75	250	500	1200	2400	4000
15																			
15																			
	R15-20	1	FLOW	-1	0	0	14	18	25	35	72	111	0	75	250	500	1200	2400	4000
20																			
20																			
	R20-25	1	FLOW	-1	0	0	23	27	35	37	84	122	0	75	250	500	1200	2400	4000
29																			
25																			
	R25-29	1	FLOW	-1.0	0.00	0	2	6	13	23	35	36	0	75	250	500	1200	2400	4000
29																			
29																			
	R29-33	1	FLOW	-1.0	0.00	0	2	4	7	18	36	60	0	75	250	500	1200	2400	4000
33																			
33																			
	R33-35	1	FLOW	-1.0	0.00	0	5	10	22	50	93	142	0	75	250	500	1200	2400	4000
35																			
35																			
	R35-36	1	FLOW	-1.0	0.00	0	4	9	28	67	131	179	0	75	250	500	1200	2400	4000
36																			
36																			
	R36-42	1	FLOW	-1.0	0.00	0	3	6	10	34	60	130	0	75	250	500	1200	2400	4000
42																			

TABLE B-1

PEAK FLOWS (CFS) ALONG THE ARIZONA CANAL

LOCATION	10-YR STORM	25-YR STORM	50-YR STORM	100-YR STORM
DIBW	30	57	87	120
C9-5	152	241	326	442
C5-10	151	264	329	406
C15-10	257	466	645	821
D56ST	0	0	235	328
C20-15	191	443	552	713
C25-20	158	329	442	630
C29-25	147	310	430	622
DOCCC	147	310	430	622
C33-29	150	260	355	445
C35-33	117	258	371	481
DCBR1	55	55	55	55
C36-35	211	388	551	708
D40ST	201	378	541	698
C42-36	106	150	180	215

Concentration point location (i.e. C9-5) and diversion locations (i.e. DIBW) are shown on Figure 6.

TABLE B-2

COMPARISON OF SUBBASIN DATA INPUT PARAMETERS

EQUIVALENT SUBASINS		DRAINAGE AREA (SQ.MI.)		% RTIMP		IA		XKSAT		DTHETA		PSIF	
HZI	FCD	HZI	FCD	HZI	FCD	HZI	FCD	HZI	FCD	HZI	FCD	HZI	FCD
12,13,14	13	.375	.395	12	20	.29	.2	.258	.37	.258	.25	5.2	4.4
38	3	.252	.227	37	61	.131	.15	.28	.42	.34	.35	4.5	4.3
29,25, 50%-20	16	.199	.181	15	20	.30	.20	.56	.65	.25	.25	4.0	4.0
40	1	.074	.0623	11	69	.203	.15	.42	.42	.314	.35	4.3	4.3

TABLE B-3

SUBBASIN COMPARISONS OF 25-YEAR PEAK FLOWS

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
1	0.037	40	1081.1
2	0.119	37	310.9
3	0.067	25	373.1
4	0.065	33	507.7
5	0.067	17	253.7
6	0.090	107	1188.9
7	0.153	62	405.2
8	0.068	17	250.0
9	0.065	32	492.3
10	0.093	40	430.1
11	0.093	89	957.0
12	0.120	103	858.3
13	0.129	101	782.9
14	0.126	61	484.1
15	0.126	56	444.4
16	0.129	134	1038.8
17	0.073	46	630.1
18	0.067	31	462.7
19	0.075	33	440.0
20	0.129	68	527.1
21	0.124	135	1088.7
22	0.112	45	401.8
23	0.060	29	483.3
24	0.077	30	389.6
25	0.076	30	394.7
26	0.053	22	415.1
27	0.061	26	426.2
28	0.078	34	435.9
29	0.058	23	396.6
30	0.064	35	546.9
31	0.061	19	311.5
32	0.065	25	384.6
33	0.062	30	483.9
34	0.167	56	335.3
35	0.128	89	695.3
36	0.089	46	516.9
37	0.049	26	530.6
38	0.252	186	738.1
39	0.224	114	508.9
40	0.074	58	783.8
41	0.156	87	557.7
42	0.206	140	679.6
TOTAL	4.19	2417	
AVERAGE	0.10	57.55	557.71

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
F1	0.062	64	1027.3
F2	0.073	78	1062.7
F3	0.227	221	973.6
F4	0.142	140	985.9
F5	0.113	112	991.2
F6	0.179	176	983.2
F7	0.096	98	1025.1
F8	0.108	90	833.3
F9	0.207	105	507.2
F10	0.298	122	409.4
F11	0.260	106	407.7
F12	0.365	174	476.7
F13	0.395	290	734.2
F14	0.380	196	515.8
F15	0.082	53	647.1
F15A	0.049	30	611.0
F15B	0.033	19	575.8
F16	0.181	111	613.3
F16A	0.054	30	555.6
F17	0.198	176	888.9
F17A	0.072	43	597.2
TOTAL	3.57	2434.00	
AVERAGE	0.17	115.90	734.39

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
GA0	0.013	24	1846.2
G1A1	0.062	71	1145.2
G1A2	0.008	9	1125.0
G1A3	0.227	196	863.4
G1B1	0.030	33	1100.0
G1B2	1.125	802	712.9
G1C1	0.018	19	1055.6
G1C2	0.150	129	860.0
G2A1	0.047	56	1191.5
G2A2	0.005	7	1400.0
G2A3	0.276	300	1087.0
G2B	0.505	917	1815.8
G2C1	0.053	88	1660.4
G2C2	0.057	81	1421.1
G2C3	0.175	322	1840.0
TOTAL	2.75	3054.00	
AVERAGE	0.18	203.60	1274.93

Note: Subbasins 1 to 42 are shown in Figure 6 oF this report

Subbasins F1 to F17 are shown on Figure 1 of FCD Old Cross Cut Canal Hydrology Report (Sept. 21, 1993).

Subbasins G1A1 to G2C3 are shown on Figure 2.21 of Griener Old Cross Cut Canal Drainage Improvements Hydrology Report (May 24, 1991).

TABLE B-4

SUBBASIN COMPARISONS OF 25-YEAR PEAK FLOWS BY CFS PER SQ. MI.

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
8	0.068	17	250.0
5	0.067	17	253.7
2	0.119	37	310.9
31	0.061	19	311.5
34	0.167	56	335.3
3	0.067	25	373.1
32	0.065	25	384.6
24	0.077	30	389.6
25	0.076	30	394.7
29	0.058	23	396.6
22	0.112	45	401.8
7	0.153	62	405.2
F11	0.260	106	407.7
F10	0.298	122	409.4
26	0.053	22	415.1
27	0.061	26	426.2
10	0.093	40	430.1
28	0.078	34	435.9
19	0.075	33	440.0
15	0.126	56	444.4
18	0.067	31	462.7
F12	0.365	174	476.7
23	0.060	29	483.3
33	0.062	30	483.9
14	0.126	61	484.1
9	0.065	32	492.3
F9	0.207	105	507.2
4	0.065	33	507.7
39	0.224	114	508.9
F14	0.380	196	515.8
36	0.089	46	516.9
20	0.129	68	527.1
37	0.049	26	530.6
30	0.064	35	546.9
F16A	0.054	30	555.6
41	0.156	87	557.7
F15B	0.033	19	575.8
F17A	0.072	43	597.2
F15A	0.049	30	611.0

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
F16	0.181	111	613.3
17	0.073	46	630.1
F15	0.082	53	647.1
42	0.206	140	679.6
35	0.128	89	695.3
G1B2	1.125	802	712.9
F13	0.395	290	734.2
38	0.252	186	738.1
13	0.129	101	782.9
40	0.074	58	783.8
F8	0.108	90	833.3
12	0.120	103	858.3
G1C2	0.150	129	860.0
G1A3	0.227	196	863.4
F17	0.198	176	888.9
11	0.093	89	957.0
F3	0.227	221	973.6
F6	0.179	176	983.2
F4	0.142	140	985.9
F5	0.113	112	991.2
F7	0.096	98	1025.1
F1	0.062	64	1027.3
16	0.129	134	1038.8
G1C1	0.018	19	1055.6
F2	0.073	78	1062.7
1	0.037	40	1081.1
G2A3	0.276	300	1087.0
21	0.124	135	1088.7
G1B1	0.030	33	1100.0
G1A2	0.008	9	1125.0
G1A1	0.062	71	1145.2
6	0.090	107	1188.9
G2A1	0.047	56	1191.5
G2A2	0.005	7	1400.0
G2C2	0.057	81	1421.1
G2C1	0.053	88	1660.4
G2B	0.505	917	1815.8
G2C3	0.175	322	1840.0
GA0	0.013	24	1846.2

Note: Subbasins 1 to 42 are shown in Figure 6 of this report
Subbasins F1 to F17 are shown on Figure 1 of FCD Old Cross Cut Canal Hydrology Report (Sept. 21, 1993).
Subbasins G1A1 to G2C3 are shown on Figure 2.21 of Griener Old Cross Cut Canal Drainage Improvements Hydrology Report (May 24, 1991).

TABLE B-5

SUBBASIN COMPARISONS OF 25-YEAR PEAK FLOWS BY SIZE OF SUBBASIN AREA

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
G2A2	0.005	7	1400.0
G1A2	0.008	9	1125.0
GA0	0.013	24	1846.2
G1C1	0.018	19	1055.6
G1B1	0.030	33	1100.0
F15B	0.033	19	575.8
1	0.037	40	1081.1
G2A1	0.047	56	1191.5
37	0.049	26	530.6
F15A	0.049	30	611.0
26	0.053	22	415.1
G2C1	0.053	88	1660.4
F16A	0.054	30	555.6
G2C2	0.057	81	1421.1
29	0.058	23	396.6
23	0.060	29	483.3
31	0.061	19	311.5
27	0.061	26	426.2
33	0.062	30	483.9
G1A1	0.062	71	1145.2
F1	0.062	64	1027.3
30	0.064	35	546.9
32	0.065	25	384.6
9	0.065	32	492.3
4	0.065	33	507.7
5	0.067	17	253.7
3	0.067	25	373.1
18	0.067	31	462.7
8	0.068	17	250.0
F17A	0.072	43	597.2
17	0.073	46	630.1
F2	0.073	78	1062.7
40	0.074	58	783.8
19	0.075	33	440.0
25	0.076	30	394.7
24	0.077	30	389.6
28	0.078	34	435.9
F15	0.082	53	647.1
36	0.089	46	516.9

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
6	0.090	107	1188.9
10	0.093	40	430.1
11	0.093	89	957.0
F7	0.096	98	1025.1
F8	0.108	90	833.3
22	0.112	45	401.8
F5	0.113	112	991.2
2	0.119	37	310.9
12	0.120	103	858.3
21	0.124	135	1088.7
15	0.126	56	444.4
14	0.126	61	484.1
35	0.128	89	695.3
20	0.129	68	527.1
13	0.129	101	782.9
16	0.129	134	1038.8
F4	0.142	140	985.9
G1C2	0.150	129	860.0
7	0.153	62	405.2
41	0.156	87	557.7
34	0.167	56	335.3
G2C3	0.175	322	1840.0
F6	0.179	176	983.2
F16	0.181	111	613.3
F17	0.198	176	888.9
42	0.206	140	679.6
F9	0.207	105	507.2
39	0.224	114	508.9
G1A3	0.227	196	863.4
F3	0.227	221	973.6
38	0.252	186	738.1
F11	0.260	106	407.7
G2A3	0.276	300	1087.0
F10	0.298	122	409.4
F12	0.365	174	476.7
F14	0.380	196	515.8
F13	0.395	290	734.2
G2B	0.505	917	1815.8
G1B2	1.125	802	712.9

Note: Subbasins 1 to 42 are shown in Figure 6 of this report
Subbasins F1 to F17 are shown on Figure 1 of FCD Old Cross Cut Canal Hydrology Report (Sept. 21, 1993).
Subbasins G1A1 to G2C3 are shown on Figure 2.21 of Griener Old Cross Cut Canal Drainage Improvements Hydrology Report (May 24, 1991).

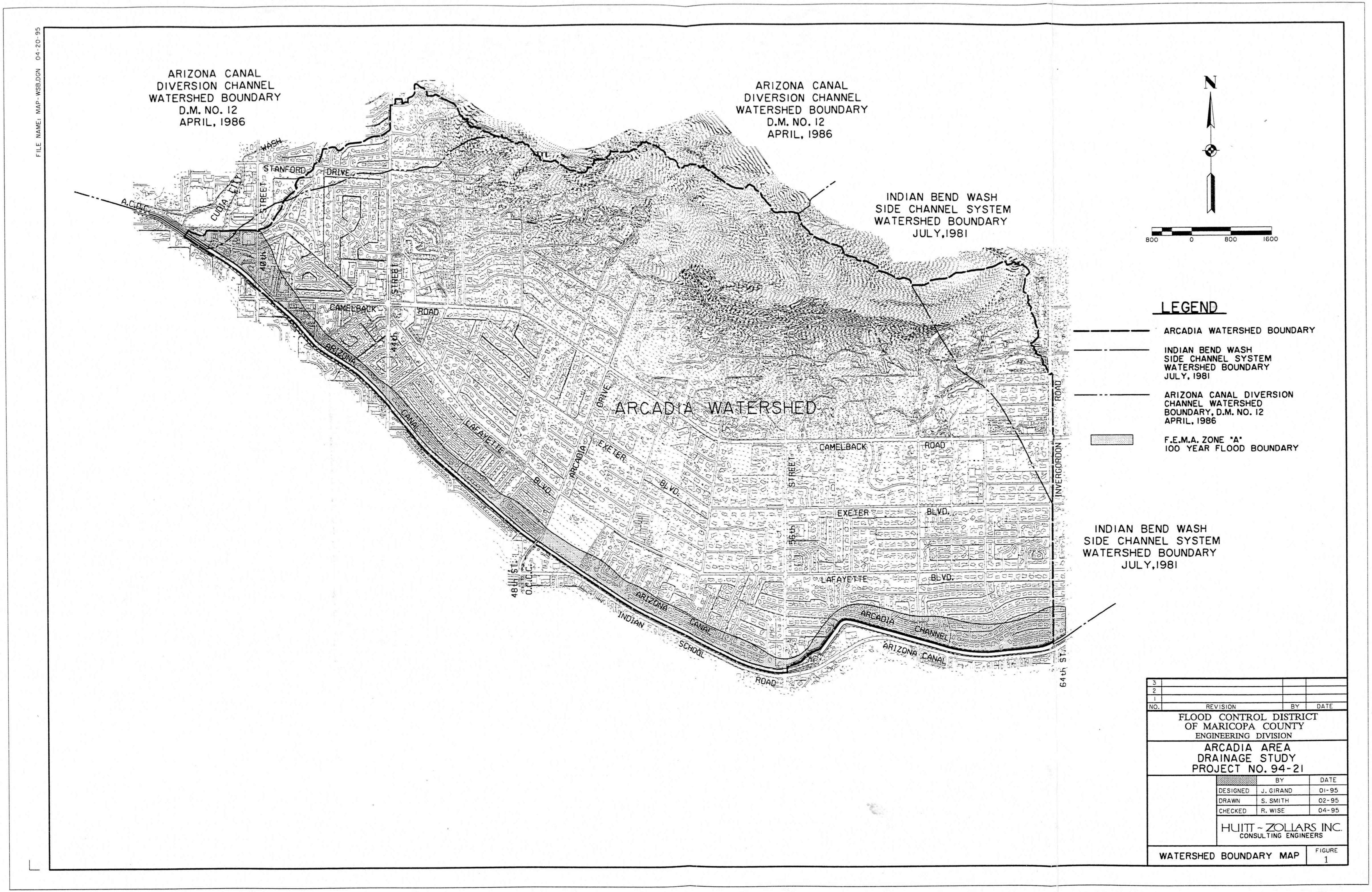
TABLE B-6

SUBBASIN COMPARISONS OF 25-YEAR PEAK FLOWS SIZE OF PEAK FLOWS

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
G2A2	0.005	7	1400.0
G1A2	0.008	9	1125.0
8	0.068	17	250.0
5	0.067	17	253.7
31	0.061	19	311.5
F15B	0.033	19	575.8
G1C1	0.018	19	1055.6
26	0.053	22	415.1
29	0.058	23	396.6
GA0	0.013	24	1846.2
3	0.067	25	373.1
32	0.065	25	384.6
27	0.061	26	426.2
37	0.049	26	530.6
23	0.060	29	483.3
24	0.077	30	389.6
25	0.076	30	394.7
33	0.062	30	483.9
F16A	0.054	30	555.6
F15A	0.049	30	611.0
18	0.067	31	462.7
9	0.065	32	492.3
19	0.075	33	440.0
4	0.065	33	507.7
G1B1	0.030	33	1100.0
28	0.078	34	435.9
30	0.064	35	546.9
2	0.119	37	310.9
10	0.093	40	430.1
1	0.037	40	1081.1
F17A	0.072	43	597.2
22	0.112	45	401.8
36	0.089	46	516.9
17	0.073	46	630.1
F15	0.082	53	647.1
34	0.167	56	335.3
15	0.126	56	444.4
G2A1	0.047	56	1191.5
40	0.074	58	783.8

HEC-1 SUBBASIN	AREA SQ. MI.	PEAK FLOW CFS	CFS/SQ. MI.
14	0.126	61	484.1
7	0.153	62	405.2
F1	0.062	64	1027.3
20	0.129	68	527.1
G1A1	0.062	71	1145.2
F2	0.073	78	1062.7
G2C2	0.057	81	1421.1
41	0.156	87	557.7
G2C1	0.053	88	1660.4
35	0.128	89	695.3
11	0.093	89	957.0
F8	0.108	90	833.3
F7	0.096	98	1025.1
13	0.129	101	782.9
12	0.120	103	858.3
F9	0.207	105	507.2
F11	0.260	106	407.7
6	0.090	107	1188.9
F16	0.181	111	613.3
F5	0.113	112	991.2
39	0.224	114	508.9
F10	0.298	122	409.4
G1C2	0.150	129	860.0
16	0.129	134	1038.8
21	0.124	135	1088.7
42	0.206	140	679.6
F4	0.142	140	985.9
F12	0.365	174	476.7
F17	0.198	176	888.9
F6	0.179	176	983.2
38	0.252	186	738.1
F14	0.380	196	515.8
G1A3	0.227	196	863.4
F3	0.227	221	973.6
F13	0.395	290	734.2
G2A3	0.276	300	1087.0
G2C3	0.175	322	1840.0
G1B2	1.125	802	712.9
G2B	0.505	917	1815.8

Note: Subbasins 1 to 42 are shown in Figure 6 of this report
Subbasins F1 to F17 are shown on Figure 1 of FCD Old Cross Cut Canal Hydrology Report (Sept. 21, 1993).
Subbasins G1A1 to G2C3 are shown on Figure 2.21 of Griener Old Cross Cut Canal Drainage Improvements Hydrology Report (May 24, 1991).



FILE NAME: MAP-WSB.DGN 04-20-95
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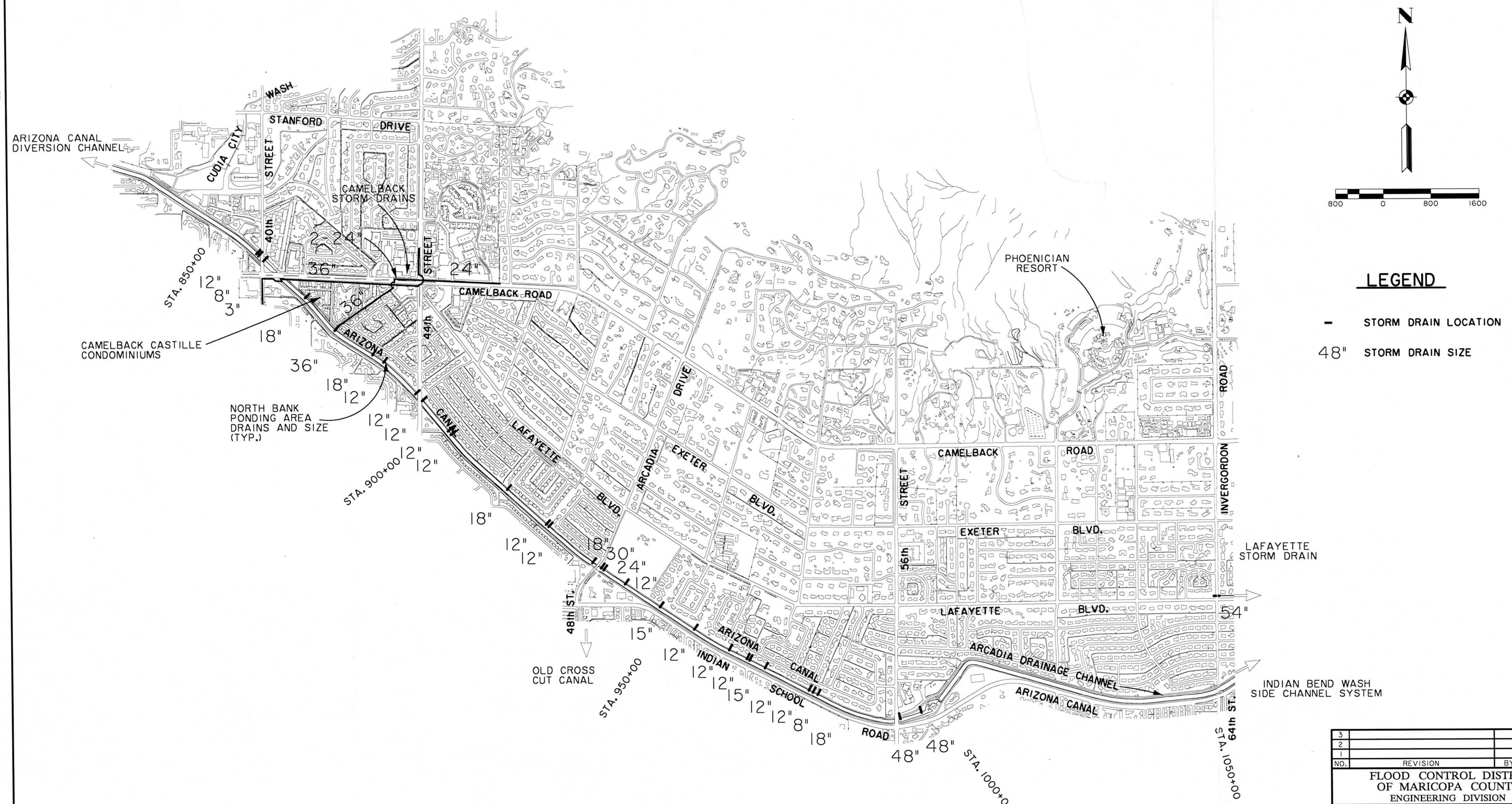
ARIZONA CANAL DIVERSION CHANNEL WATERSHED BOUNDARY D.M. NO. 12 APRIL, 1986
INDIAN BEND WASH SIDE CHANNEL SYSTEM WATERSHED BOUNDARY JULY, 1981
INDIAN BEND WASH SIDE CHANNEL SYSTEM WATERSHED BOUNDARY JULY, 1981
N
800 0 800 1600
ARCADIA WATERSHED
A.C.D.C.
CUDIA CITY WASH
STANFORD DRIVE
40th STREET
44th STREET
CAMELBACK ROAD
ARIZONA CANAL
LAFAYETTE BLVD.
ARCADIA DRIVE
EXETER BLVD.
56th STREET
CAMELBACK ROAD
EXETER BLVD.
LAFAYETTE BLVD.
INVERGORDON ROAD
48th ST. O.C.D.C.
ARIZONA CANAL
INDIAN SCHOOL ROAD
ARCADIA CHANNEL
ARIZONA CANAL
64th ST.
LEGEND
ARCADIA WATERSHED BOUNDARY
INDIAN BEND WASH SIDE CHANNEL SYSTEM WATERSHED BOUNDARY JULY, 1981
ARIZONA CANAL DIVERSION CHANNEL WATERSHED BOUNDARY, D.M. NO. 12 APRIL, 1986
F.E.M.A. ZONE "A" 100 YEAR FLOOD BOUNDARY
NO. REVISION BY DATE
3
2
1
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION
ARCADIA AREA DRAINAGE STUDY PROJECT NO. 94-21
BY DATE
DESIGNED J. GIRAND 01-95
DRAWN S. SMITH 02-95
CHECKED R. WISE 04-95
HUITT-ZOLLARS INC.
CONSULTING ENGINEERS
WATERSHED BOUNDARY MAP
FIGURE 1

FILE NAME: MAP-PIPE.DGN 04-20-95



NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ARCADIA AREA
DRAINAGE STUDY
PROJECT NO. 94-21

	BY	DATE
DESIGNED	J. GIRAND	09-95
DRAWN	S. SMITH	02-95
CHECKED	R. WISE	09-95

HUITT-ZOLLARS INC.
CONSULTING ENGINEERS

EXISTING DRAINAGE SYSTEMS — FIGURE 2

FILE NAME: MAP-LAND.DGN 04-20-95

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ARCADIA AREA
DRAINAGE STUDY
PROJECT NO. 94-21

	BY	DATE
DESIGNED	J. GIRAND	01-95
DRAWN	S. SMITH	02-95
CHECKED	R. WISE	04-95

HUITT-ZOLLARS INC.
CONSULTING ENGINEERS

LAND USE MAP

FIGURE 3

FILE NAME: MAP-SOIL.DGN 04-20-95

LEGEND

— — — — —	SUBBASIN BOUNDARY
————	SOILS BOUNDARY
2	SUBBASIN IDENTIFICATION NUMBER
AoB	ANTHO GRAVELLY SANDY LOAM
CeC	CALVELT GRAVELLY LOAM
Es	ESTRELLA LOAM
LaA	LAVEEN LOAM
Mv	MOHALL LOAM
PvC	PINAMT VERY GRAVELLY LOAM
TrB	TREMANT/GRAVELLY SANDY CLAY LOAM
Ro	ROCK LAND/GRAVELLY/SANDY LOAM
Ru	ROUGH BROKEN LAND
Va	VALENCIA SANDY LOAM

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ARCADIA AREA
DRAINAGE STUDY
PROJECT NO. 94-21

	BY	DATE
DESIGNED	J. GIRAND	01-95
DRAWN	S. SMITH	02-95
CHECKED	R. WISE	04-95

HUITT-ZOLLARS INC.
CONSULTING ENGINEERS

GENERAL SOILS MAP

FIGURE 4

FILE NAME: MAP-DRA.DGN 04-20-95

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ARCADIA AREA
DRAINAGE STUDY
PROJECT NO. 94-21

	BY	DATE
DESIGNED	J. GIRAND	01-95
DRAWN	S. SMITH	02-95
CHECKED	R. WISE	04-95

HUITT-ZOLLARS INC.
CONSULTING ENGINEERS

DRAINAGE AREA MAP — FIGURE 5

FILE NAME: MAP-HEC.DGN 04-20-95

LEGEND

Symbol	Description
———	WATERSHED BOUNDARY
———	SUBBASIN BOUNDARY
—·—►—	ROUTING REACH
•	CONCENTRATION POINT
SUB 4 / 0.06	SUBBASIN IDENTIFICATION / SUBBASIN AREA (SQ. MI.)
C1-2	COMBINATION OF HYDROGRAPHS
R1-2	ROUTED HYDROGRAPH
D38-39	DIVERSION HYDROGRAPH
D4	DIVERSION HYDROGRAPH (IRRIGATED LOTS)
DIBW	DIVERSION HYDROGRAPH (FROM WATERSHED)
RD38-39	RECALLED DIVERSION HYDROGRAPH

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

ARCADIA AREA
DRAINAGE STUDY
PROJECT NO. 94-21

	BY	DATE
DESIGNED	J. GIRAND	04-95
DRAWN	S. SMITH	04-95
CHECKED	R. WISE	04-95

HUITT-ZOLLARS INC.
CONSULTING ENGINEERS

HEC-1 FLOW DIAGRAM (EXIST.) FIGURE 6

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CITY OF PHOENIX STORM DRAIN AS-BUILTS

	AS-BUILT #	PROJECT #	DESCRIPTION
53.	43390	ST72164.00	Arcadia Drainage Channel 56th St. to 64th St.
54.	6-92-11		Improvement Plans 64th St. & AZ Canal
55.	36928	W70141.00	Water Main AZ Canal & Jokake Dr.
56.	1006		Devel Plans Villa Arcadia Lafayette & 52nd St.
57.	16254		Improvement Plans Lafayette & Arcadia
58.	94375	M503-7(4)	Paving Plans Indian Sch. Rd. 32nd St. to 48th St.
59.	26975	P64186.00	Paving Plans 44th St. Indian Sch. to AZ Canal
60.	22587	S63208	Improvement Plans 46th Pl. & Turney
61.	101369	P87442.0	Lafayette Blvd. 50th St. to 54th St.
62.	19243		Drain Plans Lot 11 Del Ray Estates 12 Amended
63.	45670	14010	NE Corner 44th St. & Camelback Rd.
64.	88717	P76007.03	(FMS-P-769091) Camelback 40th St. to 44th St.
65.	16809	60-C-13A	Intersection Drainage Camelback Rd. & 44th St.
66.	36696		Development Plans for 4255 E. Camelback Rd.
67.	65994	P76007.00	Drainage Plans Camelback Rd. 32nd St. to 40th St.
68.	67145	ST76043.02	Drain Plans 40th St. Thomas to Camelback Rd.
69.	63937	NP7618302(ID)	Improvement District Arcadia Vista
70.	42685	P14128	Grade & Drain NW Cor Camelback Rd. & 44th St.
71.	64737	P76007.00	Camelback Rd. 32nd St. to 40th St.
72.	30038		Paving Plans NW Cor Camelback Rd. & 44th St.
73.	22757	P63111	Improvement Plans 43rd St. & Minnezona Ave.