Jack Moody

MASTER DRAINAGE REPORT
FOR
LITCHFIELD MASTER PLANNED COMMUNITY
CITY OF GOODYEAR, ARIZONA

March 1989
Revised September 1989

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MASTER DRAINAGE REPORT
FOR
LITCHFIELD MASTER PLANNED COMMUNITY
CITY OF GOODYEAR, ARIZONA

March 1989
Revised September 1989

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APPROVALS

This Conceptual Master Drainage Report for the Litchfield Park Development Master Plan (revised September, 1989) is approved by the City Council, City of Goodyear, Resolution No. 89-367 on this 12th day of December, 1989.

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1.0 INTRODUCTION

1.1 General Background:

SunCor Development Company is planning to develop a 9,000-acre Master Planned Community in the vicinity of Litchfield Park. The site is of an irregular shaped and is generally bounded by Interstate-10 to the south, Camelback Road to the north, Citrus Road to the west and Dysart Road to the east. Refer to Plate 1 for the vicinity and approximate boundary locations. The site falls within four different governmental jurisdictions: the City of Avondale, the City of Goodyear, the City of Litchfield Park, and Maricopa County. A majority of the site falls within the City of Goodyear and unincorporated areas of Maricopa County.

1.2 Purpose

The purpose of this report is to present a Conceptual Master Drainage Plan to be used for the zoning application. In addition, this report will study and set drainage parameters for the planning of this development. Within this report is presented a conceptual hydrologic and hydraulic analysis of the project drainage system. This includes a preliminary drainage plan showing general direction of stormwater runoff and how the onsite and offsite drainage will be handled. This Conceptual Master Drainage Report (CMDR) is intended to provide drainage information to satisfy the needs of all of the governmental agencies. CVL has made contacts with the agencies to solicit their input for the purpose of this report. In general, the Cities of Avondale, Goodyear, and Litchfield Park have their own drainage policies and requirements for the master development plans.

However, since their requirements are generally similar in addressing post-development flows and retention, this CMDR utilizes a HEC-1 computer program to calculate peak runoff rates. Additionally, retention basins are sized based on the 100-year, 6-hour storms to meet the more stringent City of Goodyear requirements.

1.3 Existing Reports

Numerous reports have been produced that are relevant to the study area. These reports include:

1. ADOT Drainage File for Interstate-10 (Ref. 12) from Perryville Road to 1/2 mile east of Reems Road [I-10-2(34)] prepared by ADOT 1974. This file indicates the tributary areas and corresponding 50-year flows impacting the subject portion of I-10. The 50-year flow for the wash between Reems Road and Bullard Avenue (hereafter referred to as Bullard Wash) is indicated to be 3400 cfs. This flow correlates closely to the results found in this CMDR.

2. ADOT Offsite Drainage Design Report (Ref. 13), Project No: I-IG-10-2(37)C, Highway: Ehrenberg-Phoenix Highway, Section: Bullard-Dysart Road, prepared by Dibble and Associates Consulting Engineers, January 1976. The report substantiates the design of the retention basins that are north of the subject highway. The retention basins were designed to hold the 50-year storm runoff generated on the entire future urbanized tributary. The tributary boundaries are approximately I-10 to Camelback Road and Bullard Avenue to 1/2 mile east of Dysart Road.

3. Hydrological Evaluation, Litchfield Park Dam, Maricopa County, Arizona (Ref. 14), For Litchfield Park Properties, prepared by Dames & Moore (D&M), January 1986. The reports evaluates the impact of a 100-year storm on the Litchfield Park Dam (also known as Murphy's Dam). The tributary area assumed in the D&M Reports differs from that area used in this CMDR. The new detailed topographic mapping used by this CMDR indicates a smaller tributary, and thus a smaller flow.

4. Flow Estimation to Camelback and Dysart Roads (Ref. 15) for SunCor Development Company, prepared by Boyle Engineering Corporation April 7, 1988, revised May 17, 1988. The report evaluates Litchfield Park Dam and the flow from this dam that impacts Camelback Road. This CMDR generally agrees with the conclusions drawn by the Boyle report.

5. Master Drainage Report for Litchfield Ridge (Ref. 16), prepared by Wood & Associates, November 1988. The report was developed for the Litchfield Ridge Development and generally agrees with the Boyle report.

6. Hydrology for Special Study of Luke Air Force Base, Arizona (Ref. 17), prepared by PRC Toups Corporation, January 1979. The report evaluates the effect of the 100-year storm on the two major channels that protect Luke Air Force Base. Even though the

tributary area boundaries differ slightly from the PRC report to this CMDR, the 100-year flows are reasonably close.

7. Draft Memo Regarding the Dysart Drain (Luke Air Force Base Channel) (Ref. 18), prepared by the Corps of Engineers. Undated. The memo evaluates other reports on the Dysart Drain. The memo reports that even though many reports show the Dysart Drain to be substantially undersized, flow across the base has only occurred once since the drain was complete, and that was because construction of a bridge temporarily blocked the drain.

8. Drainage Analysis for Goodyear Farms in Maricopa County, Arizona (Ref. 19), prepared by Ellis-Murphy, Inc., September 1984. The report delineated the offsite drainage areas that affect the property and estimated the 100-year flows. This CMDR utilized more detailed topographic mapping and field investigation to analyze the watershed, therefore the boundaries differ somewhat from the Ellis-Murphy report.

9. ADOT, Estrella Freeway Hydrologic Investigation Report (Ref. 20), prepared by Cella Barr Associates. The report is a hydrologic investigation for the Estrella Freeway route location. Peak discharge values for the 50-year storm were estimated for use as a basis for preliminary design assessments. The flow calculations were simplified due to the preliminary nature of the alignment study.

All of these reports provided valuable information. The results, however, vary from one report to another, due to the mapping that was available for each, the changing field conditions, and the methodology used. This CMDR considered all of the information available, along with detailed topographic mapping and field visits, to evaluate the hydrologic impact on this site.

2.0 DESCRIPTION OF WATERSHED

2.1 General

The terrain throughout the site and watershed is relatively flat, sloping southeasterly at an average slope of about 0.5 percent. The upper watershed extends to the Beardsley Canal and is cut off by McMicken Dam that is immediately upstream of the canal. Presently, the majority of the watershed is being used for agriculture. Small portions of the watershed have remained in their natural desert state, while other smaller areas have been urbanized. Luke Air Force Base and surrounding development lies within the watershed.

Typically the upstream land has been leveled and terraced for agricultural purposes. This leveling along with roads and irrigation ditches have caused some diversions from the natural flow patterns. Additionally, land subsidence, due to overpumping of ground water, has created some minor diversions to the natural flow paths.

2.2 Rainfall Seasons

There are two separate rainfall seasons. The first occurs during the winter months from November to March when the area is subjected to occasional storms from the Pacific Ocean. While this is classified as a rainfall season, there can be periods of a month or more in this or

any other season when practically no precipitation occurs. The second rainfall period occurs during July and August, when Arizona is subjected to widespread thunderstorm activity whose moisture supply originates both in the Gulf of Mexico and along Mexico's west coast. These thunderstorms are extremely variable intensity and location.

2.3 Runoff Characteristics

Generally, runoff occurs only during and immediately following heavy precipitation because arid climate and drainage characteristics are not conducive to continuous flow. The majority of the watershed consists of hydrologic Group B soils, although groups A,C, and D soils occur throughout the watershed in minor proportions (Ref. 9). Most of the watershed is farmland with recently tilled soil, irrigation ditches, berms, and tailwater ponds, all of which will reduce runoff. Generally, infiltration and transmission losses are expected to be high.

2.4 Upstream Modifications

The natural drainage basin affecting the study area extends to the white tank mountains. There have been however, a number of man-made improvements that affect runoff to the project site. These improvements include:

1. McMicken Dam and Beardsley Canal - These structures effectively eliminate runoff from the west of the Beardsley Canal.
2. Agricultural Reservoirs and Drains - A number of agricultural reservoirs are located on private property in the drainage basin upstream of the study area. These reservoirs and their collecting drains effectively reduce the volume of runoff to the project

site. However, to be conservative, the HEC-1 model within this CMDR does not account for the impact of these agricultural features.

3. Cotton Lane and AT&SF Railroad - Runoff from the west of Cotton Lane and north of Camelback Road is conveyed south by Cotton Lane and adjacent railroad. In some locations, the dike formed by the railroad is breached, or designed channels allow flow to cross.

4. Camelback Road Drain (West) - Starting west of Cotton Lane, the Camelback Road drain runs easterly along the north side of Camelback Road, collecting runoff from north of Camelback Road and diverting it east to the culverts on Camelback Road between Reems Road and Bullard Avenue. At this point it turns south in Bullard Wash and crosses the property.

5. Luke Air Force Perimeter Drain - This drain collects runoff along the western perimeter of the base and concentrates the flow in Bullard Wash north of Camelback Road.

6. Dysart Diversion Channel -Starting at Reems Road on Northern Avenue, this drain diverts about 1,000 cfs of upstream runoff to the Agua Fria River. Boyle Engineering (Ref. 15) performed a field survey and established the capacity of this drain to be about 1,000 cfs.

7. Paved and Unpaved Roads - Many roads throughout the watershed create channels that effectively convey flow throughout the watershed. These "channels" may not have the capacity to carry all of the flow that gets to them, thus creating a flow split. Many of these roads carry flow out of the watershed.

8. Roosevelt Irrigation District Canal - The Roosevelt Irrigation District (RID) Canal crosses the property, ponding water and diverting flow. The flow spills into the canal, but the canal does not have the capacity to carry it. The flow then spills out of the canal to continue flowing south in a natural drainage path.

3.0 HYDROLOGY

3.1 Methodology

The hydrologic methods to be used on this project were selected based on many discussions and input from the Flood Control District of Maricopa County (FCDMC). The Soil Conservation Service (SCS) method within the HEC-1 computer program was used to estimate the peak flows for the 10-, 50-, and 100-year frequency storms. The SCS Type II rainfall distribution was used for the 6-hour storm. Refer to Table 1 for precipitation data. Aerial reduction factor for the 6-hour storm on this watershed is in the vicinity of 93% to 97%. However, due to the complexity of the watershed, and the small local watershed sub-areas, this factor has been omitted.

A computerized rainfall/runoff model was developed for the watershed using the U.S. Army Corps of Engineers Flood Hydrograph package (HEC-1). HEC-1 uses numerical parameters to describe the amount of temporal distribution of rainfall, the runoff characteristics of the watershed, and the hydraulic properties of channels that collect and convey the direct runoff to concentration points. The computer output provides runoff hydrographs at user selected locations. These hydrographs can be used to design drainage channels,

retention basins, or to evaluate the capacity of existing drainage facilities.

The kinematic wave option was used to determine the hydrologic response of the sub-basin areas and for routing the resulting hydrographs through the tributary channels of the basin. This option was selected because runoff processes can be simulated using measurable geographic features such as overland flow elements and the shape, boundary roughness, length, and slope of channel elements. Unlike unit hydrograph techniques, the kinematic wave approach also provides for a non-linear response of runoff characteristics, i.e., peak discharge does not necessarily increase linearly with direct runoff when using the kinematic wave methodology.

A network of sub-basins and connecting channels was configured that simulates the natural drainage pattern in the basin. Plate 2 presents an illustration of the drainage patterns, sub-basin boundaries, concentration points used, and a schematic diagram of the model.

3.2 Modeling

The sub-basins were delineated based on USGS 7-1/2 minute quadrangle maps for the upper watershed, detailed topo in the vicinity of the site, and extensive field visits. Curve numbers were based on the SCS TR-55 for the appropriate land use. Refer to Table 2 for a list of the curve numbers used for this CMDR. At the request of the FCDMC, it is assumed that 40% of the farmland was no longer in production and reverted back to natural desert. Therefore, the curve number used for farmland was weighted 60% farmland and 40% desert. We feel this is a

very conservative assumption. Lag times were based on 60% the time of concentration (Lag = 0.6 Tc). Time of concentration was calculated based on the upland method. Flow velocities used in the upland method were based on estimated flows and field estimated cross sections. Similarly, the data for the kinematic wave routing method was based on field investigation.

There are many flow splits that occur in the upper watershed. These splits were modeled based on field investigation and the available topographic mapping.

4.0 EXISTING CONDITIONS

4.1 General

Many factors affect the flow that reaches the site. Numerous channels, roads, irrigation ditches, and berms direct and divert flow in the upper watershed. Existing channels help direct flow around Luke Air Force Base and its associated development. Litchfield Park Dam helps to control flow to the intersection of Camelback and Dysart Roads.

There is one major flow path (Bullard Wash) that crosses the site in a north-south direction. A channel north of Camelback Road intercepts sheet flow and routes it east. This flow combines with a Luke Air Force Base diversion channel at Bullard Wash (about 1/4 mile west of Bullard Avenue). This concentrated flow, herein identified as Bullard Wash, then runs southerly and crosses Camelback Road through a combination of multiple pipe culverts and dip section. The flow crosses the project and combines with local flow. At Thomas Road, this flow reaches the RID Canal, where a 60 ft. long siphon carries

the RID Canal below a storm water overshoot. The overshoot, however, does not have adequate capacity to convey the Bullard Wash 100-year flow across the RID Canal.

Flow enters the site at several other locations including: the intersections of Cotton Lane and Indian School Road, Cotton Lane and McDowell Road, Bullard Avenue and Indian School Road, RID canal and Litchfield Road, and Dysart Road and Indian School Road. At these locations, the flow is typically concentrated in the roads, with the excess breaking out into sheet flow across the farmland.

The RID canal crosses the site in a southwesterly direction. In many places, flow is backed up north of the canal until it overtops the banks. Since the canal has very limited capacity, the flow overtops the south canal bank and continues southerly.

Plate 5 depicts the estimated 100-year floodplain of Bullard Wash between Thomas Road and I-10. It should be noted that this estimate is in a general agreement with the ADOT's floodplain analysis of Bullard Wash.

Between Bullard Avenue and Dysart Road there is a system of retention basins immediately north of Interstate-10. These basins were designed to protect I-10 and to provide borrow material for the construction of the highway. The basins were designed to retain the 50-year runoff from the future developed tributary. The tributary for these basins extends as far north as Camelback Road, from just west of Bullard Avenue to just east of Dysart Road (Ref. 13).

Refer to Plate 2 for an overview of the existing drainage patterns and HEC-1 schematic.

4.2 Historical Data

There are no gauge stations within the watershed with any historical data. Therefore, verification of the HEC-1 results with historical data cannot be made. In order to understand how the watershed reacts to the rainfall pattern, however, contacts were made with the local residents living in the proximity of Bullard Wash. On January 11, 1989, CVL solicited input from Mr. Walter Burns, who has been farming near the Bullard Wash alignment at Lower Buckeye Road for over 37 years.

The wash, presently acting as a tailwater ditch, does not have very much capacity (about 65 cfs) within its banks. Even though this is the case, Mr. Burns only remembers having the wash getting out of the banks about 5 times in 37 years. The worst flooding he recalled was about 660 feet wide. Our estimate based on the U.S.G.S. quad map suggests that flow to be about 800 cfs (see Plate 6).

Another local resident, Mr. Bill Wade, also involved in farming near Bullard Wash for over 38 years, had given similar input. He has been living on the west side of Reems Road, immediately south of State Route 85.

Mr. Wade recalls the wash flowing out of its banks about 5 to 6 times. The worst that he recalled happened in late August, 1970, when he saw flooding about 450 feet wide in a sheet flow fashion (4" to 5" deep). The wash at that time was flowing about 4 feet deep and 6 feet wide. For the sake of comparison, Table 3 in the Appendix, summarizes the results of different methods for Bullard Wash in the vicinity of I-10.

4.3 Floodplain Maps

The Flood Insurance Rate Maps (FIRM) as published by the Federal Emergency Management Agency (FEMA) indicate certain upstream areas of the RID Canal as Floodplain Zone "A".

Zone "A", in accordance with FEMA, is the area of 100-year flooding. Base flood elevations or flood hazard factors are not determined for this flood zone.

In our opinion, Zone "A" is a result of ponding behind the canal bank. As the detailed grading and drainage plans are developed in conjunction with the future improvements, the ponding areas will either be eliminated or reduced in size. This measure in turn will remove or reduce the Zone "A" areas. By providing technical data and the detailed grading and drainage plans to FEMA, a Letter of Map Revision (LOMR) could be obtained.

5.0 POST-DEVELOPMENT CONDITION

5.1 General

The site is to be developed into a multi-use development consisting of single family housing, multi-family housing, commercial space, office space, schools, regional mall, industrial areas, and other uses (see Plate 7). Several amenities, including water features, greenbelts and golf courses are to be included in the project. With the development or this project, the offsite flows will be collected and channelized across the site. Local flows will be collected in street flow and storm drains, to outlet into the channel system. At strategic locations, retention basins are proposed and flow peaks are attenuated.

Siphoning the RID Canal is being considered at some locations where the channels need to cross the canal. By the use of siphon, overshoots can be provided to convey storm flows across the RID Canal. This has been discussed with RID. Their initial indications are very positive because it is realized by the RID that in the existing condition runoff from large storms overtop the canal bank and flow into the canal. This adds maintenance requirements following an intense storm. Our correspondence with RID, which shows a sketch of the siphon option, is included in the Appendix.

The northeast area of this project near Camelback and Dysart Roads is affected by a small watershed generally bounded by the Dysart Drain on the north and Dysart Road on the west. This watershed contains Litchfield Park Dam and because of its existence, the peak flows at Camelback Road near Dysart Road are impacted.

Boyle Engineering, in a report dated April 7, 1988 (Ref. 15), has done a significant amount of work addressing the flow conditions at Camelback and Dysart Roads. Boyle updated the report on May 17, 1988, subsequent to the FCDMC's technical comments. Results of this CMDR are in general agreement with the Boyle analysis as listed below. Variations in the flow volumes are a result of the difference in curve numbers and storm distributions used by Boyle and CVL.

Runoff at Camelback and Dysart Roads

	10-Year		100-Year	
	Boyle	CVL	Boyle	CVL
Without Dam	370 cfs	*	1003 cfs	*
With Dam	207 cfs	372 cfs**	717 cfs	1013 cfs**

* not analyzed
** 6-hour storm

CVL has prepared a report proposing to remove the Litchfield Park Dam and replace it with a detention basin (Ref. 22). This report has been approved by the FCDMC and the Arizona Department of Water Resources (ADWR). See the Appendix for ADWR Letter of Approval. CVL is currently in the process of designing the facility and producing grading plans.

5.2 Drainage Concept

A system of channels is proposed for this project to convey offsite and onsite stormwater runoff. The offsite runoff is to be collected and routed across the project, where it can be released at the downstream end in a manner similar to the existing condition. Local onsite stormwater runoff is to be collected and routed into retention basins, where it is to bleed off through ungated outlet pipes into the channel system. Typically, major offsite flows are not to be routed through the retention basins.

At the downstream end of the project, the post-development 100-year flow is not to exceed the pre-development 100-year flow. In the Bullard Wash case, however, due to channelization of existing sheet flow, flood peak attenuation is reduced, resulting in the increase in peak flow. This problem is corrected by diverting the top portion of the hydrograph into a retention basin, and reducing the 100-year outflow to less than the existing condition.

This project is anticipated to develop over the 25-year span. As the project improvements are progressing, the drainage outfall points will need further site specific detailed analysis. The analysis should consider the outfall and how it impacts on both the downstream

properties as well as within the project. Additionally, considerations will be required on the channel gradient, bleed off system, and retention basins, generally within the lower portion of the project along the south boundary.

5.3 Channels and Street Hydraulics

The streets will be designed to carry runoff from the 5-year storm between curbs. Additionally, the 50-year flow should be carried within the cross section between buildings, and the finished floor elevations should be above the 100-year storm, in accordance with the City of Goodyear requirements (Ref. 3). When the street capacities are exceeded, the excess flow is to be removed from the road and put in a storm drain or channel. This policy is being used in the City of Goodyear. If a portion of the project lies within another jurisdiction that has a more stringent policy, the more stringent policy will be used for that area.

A conceptual channel system has been designed based on the estimated flows. This system assumes that any 100-year flows less than about 200 cfs will be accommodated in a local system and will be addressed at the detailed design phase of the site specific development. Refer to Plate 3 for the conceptual channel system layout, and see the Appendix for channel calculations.

A detailed hydraulic analysis of channels, road crossings, siphons, street flows, retention facilities, and the final design of improvements around them, are beyond the scope of this report. When

evaluated for the final design, they will be based on generally accepted engineering practices and in accordance with local requirements.

5.4 Impact of Estrella Freeway

The Estrella Freeway, which generally follows the Cotton Lane alignment, will have a significant impact on this development. The preliminary drainage recommendations by Cella Barr Associates (CBA) suggest a pass-through system which consists of a collection channel along the west side of the freeway, a detention basin generally at the north side of McDowell, Thomas, Indian School, and Camelback Roads within the ADOT right-of-way, and culvert crossings along all East-West section line roads. The basins will control the outlet capacity of the pass-through system to match the existing conveyance of ditches at all outlet points.

This CMDR uses the pre-Estrella Freeway condition for the modeling purposes. However, depending upon the timing of the freeway construction and the on-site improvements of this project, a joint and mutually beneficial solution may be pursued with ADOT. It should be noted that ADOT has already studied a diversion channel option to direct all flow to the Gila River. The extent of diversion needs some further evaluations. We have included correspondence between ADOT and CVL for general information on the subject of diversion.

6.0 RETENTION

6.1 General

After many discussions with the FCDMC and the City of Goodyear, a retention concept was developed and agreed upon. Retention is to be provided in large regional retention basins. The basins will have the

capacity to handle the 100-year, 6-hour storm runoff generated from the onsite tributary area. The City of Goodyear requirements for the basins slightly differ from the Uniform Drainage Policy as summarized below:

1.	City of Goodyear:	100-year 6-hr. storm	3" precipitation
2.	Maricopa County : (Uniform Drainage Policy)	100-year 2-hr. storm	2.72" precipitation

To insure design adequacy, CMDR provides retention for the 100-year, 6-hour storm runoff.

These regional retention basins will be large and also function in cooperation with parks, schools, and other open space areas. The concept for these basins is to have them from 4 to 8 feet deep with a terraced or sloped bottom, to keep runoff from the smaller storm confined to a smaller area. The maximum side slope will be 4:1. The basins are to be drained in about 36 hours following the storm. This is to be done through the use of bleed off pipes where appropriate or through dry wells. Three conceptual park layouts have been analyzed for different sizes and depths of basins. Plate 4 in the appendix shows conceptual presentations of the retention facilities. Table 6 shows a summary of the retention basins including tributary area, volume required, depth, outlet pipe size, and time to drain.

The onsite area east of Dysart Road and south of the RID Canal will require onsite retention with the development of that area. This area drains away from Dysart Road toward the Agua Fria River, and does not impact the overall drainage system. This area will require 48.4 Acre-feet of onsite retention. Since this area has no impact on the

overall drainage system, and several small retention basins will be provided to meet the agency requirements, it is not modeled in HEC-1.

6.2 ADOT Retention Basins

The existing large ADOT retention basins between Bullard Avenue and Dysart Road have the capacity to handle the 100-year post development flows that are tributary to it. The basins were designed by Dibble Associates for ADOT to accept the post-development flow (Ref. 13), based on the previous master development plan for Goodyear Farms prepared by Gruen Associates. In our discussions with ADOT and previous correspondence in conjunction with Goodyear Farms Development, ADOT has indicated that the drainage flows from the historical contributing area will be acceptable to these basins as long as it is insured that the proposed condition creates no adverse impact on the functioning of these basins.

For convenience, a partial copy of the drainage report by Dibble Associates (Ref. 13) is included in the Appendix. The results of their analysis and this CMDR are summarized below:

	ADOT's Design (50-yr,24-hr)	CVL's Analysis (50-yr, 6-hr)	CVL's Analysis (100-yr, 6-hr)
Contributing Drainage Area	7.9 sq. mi.	8.1 sq. mi.	8.1 sq. mi.
Basin Size - Surface Area	139 acres	139 acres	139 acres
Basin Volume Provided	1020 ac. ft.	1020 ac. ft.	1020 ac. ft.
Basin Volume Required	856 ac. ft.	393 ac. ft.	513 ac. ft.
Highwater Elevation	**982.85 MSL**	**978.7 MSL**	**979.8 MSL**
Basin Bottom Elevation	971.0	971.0	971.0
Outlet (Ungated)	48" RCP	48" RCP	48" RCP

As can be seen above, the proposed development plan reduces the basin volume requirement. The highwater elevation in the basin is lowered from the ADOT 50-year, 24-hour design of 982.85 to CVL's 50-

year, 6-hour design of 978.7. Additionally, the proposed 100-year, 6-hour highwater elevation of 979.8 is below ADOT's 50-year design highwater elevation of 982.85. As a result, the overall hydraulic impact created is positive.

Presently, the ADOT basins accept sheet flow from the north by multiple spillways. The CMDR proposes acceptance of concentrated channelized flow into the basins and the elimination of the multiple spillways.

Correspondence, including an acceptance memo dated August 22, 1989, is included in the Appendix.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis of this CMDR, the following conclusions are drawn:

A. Based on discussions and input from FCDMC, the flood peaks were calculated by the use of SCS Method and the kinematic wave routing method within the HEC-1 computer program.

B. The off-site flow entering the development combined with the local on-site flow can safely be conveyed through the development. A conceptual channel system and retention system has been designed based on the estimated flows.

C. A detailed drainage system, to be comprised of streets, storm drains, channels and retention facilities, is beyond the scope of this report. When evaluated for final design, they will be based on generally accepted engineering practices and in accordance with local requirements.

D. Siphons are to be used to allow channels to cross the RID Canal.

E. Large regional retention basins are to be used to handle runoff from the 100-year, 6-hour storm. These basins are to be from 4' to 8' deep with sloped (maximum 4:1) or terraced bottoms to concentrate the nuisance ponding. The basins are to be drained through ungated bleed off pipes in about 36 hours following the storm. Drain time does not account for the percolation losses through the basin bottom.

F. The easterly watershed drains into the existing retention basins within the ADOT right-of-way. The basins have been designed and built to accept the post-development flow from the natural

watershed. The hydrologic/hydraulic analysis in this CMDR substantiate that the post-development condition will have no adverse impact on the basins. In fact, the analysis shows a reduction in the 100-year highwater in the basin.

G. The 100-year post-development flows leaving the project will not be greater than the existing 100-year flow, as shown on Plate 3.

It is recommended that the results of this CMDR be used as the guidelines in implementing local drainage from further development within the project. It is further recommended that:

A. Finished floor elevations be kept above the 100-year flood elevations.

B. Further development should conform to this conceptual Master Drainage Report.

C. As per this CMDR there are some areas where one parcel outlets to the adjoining parcel on the downstream side. In condition such as this, if the downstream parcel is developed first, it will be the responsibility of its developer to address any problems associated with the upstream undeveloped parcel.

D. Depending on the timing of the Estrella Freeway construction and the onsite improvements of this project, a joint and mutually beneficial flood control solution may be pursued with ADOT.

E. As the project improvements progress, the drainage outfall points should have further site specific detailed analysis. The analysis should consider the outfall and how it impacts on both the downstream properties as well as within the project.

Additionally, consideration will be required on the channel gradient, bleed off system, and retention basins generally with the lower portion of the project.

8.0 REFERENCES

1. Flood Control District of Maricopa County, "Uniform Drainage Policies and Standards for Maricopa County, Arizona", February 25, 1987.

2. Flood Control District of Maricopa County, "Drainage Regulation for the Unincorporated Area of Maricopa County, Arizona", September 16, 1988.

3. City of Goodyear, "Storm Drainage Collection and Retention Requirements for Subdivisions and Site Plans", July 1984.

4. Maricopa County Department of Planning and Development, "White Tanks - Agua Fria Technical Guide", January 1982.

5. Maricopa County Department of Planning and Development, "White Tanks - Agua Fria Policy & Development Guide", November 8, 1982.

6. U. S. Army Corps of Engineers, The Hydrologic Engineering Center, "HEC-1, Flood Hydrograph Package", September 1981.

7. Arizona Department of Transportation, "Hydrologic Design for Highway Drainage in Arizona", Phoenix, Arizona. December 1968.

8. U. S. Department of Agriculture, Soil Conservation Service, Technical Release 55, "Urban Hydrology for Small Watersheds", Washington, D.C., January 1975.

9. U. S. Department of Agriculture, Soil Conservation Service, in cooperation with University of Arizona Agricultural Experiment Station, "Soil Survey of Maricopa County, Arizona, Central Part", September 1977.

10. Chow Ven Te, "Handbook of Applied Hydrology", McGraw Hill, 1964.

11. Chow Ven Te, "Open Channel Hydraulics", McGraw Hill, 1959.

12. ADOT, Drainage File for Interstate 10, Project I-10-2(34), 1974.

13. Dibble and Associates Consulting Engineers, "Offsite Drainage Design Report Project No: I-IG-10-2(37)C, Highway: Ehrenberg-Phoenix Highway, Section: Bullard-Dysart Road", January 1976.

14. Dames & Moore, "Hydrologic Evaluation, Litchfield Park Dam, Maricopa County, Arizona", January 1986.

15. Boyle Engineering Corporation, "Flow Estimation to Camelback and Dysart Roads", April 7, 1988, revised May 17, 1988.

16. Wood & Associates, Inc. "Master Drainage Report for Litchfield Ridge", November 1988.

17. PRC Toups Corporation, "Hydrology for Special Study of Luke Air Force Base, Arizona", January 1979.

18. U. S. Army Corps of Engineers, "Draft Memo Regarding Dysart Drain", undated.

19. Ellis-Murphy, Inc., "Drainage Analysis for Goodyear Farms in Maricopa County, Arizona", September 1984.

20. Cella Barr Associates, "Estrella Freeway Hydrologic Investigation Report", June 14, 1987.

21. City of Phoenix, "Storm Drain Design manual, Subdivision.Drainage Design", September 1985.

22. Coe & Van Loo, "Conceptual Drainage Report for Litchfield Park Detention Facility," June, 1989.

TABLES

1. PRECIPITATION DATA

2. CURVE NUMBERS

3. BULLARD WASH AT I-10 FLOW COMPARISONS

4. TYPICAL CHANNEL SECTIONS

5. TYPICAL BULLARD WASH SECTION THROUGH PROJECT

6. RETENTION BASINS

TABLE 1

PRECIPITATION DATA

10-YEAR 6-HOUR	50-YEAR 6-HOUR	100-YEAR 6-HOUR
2.02"	2.78"	3.15"

TABLE 2

CURVE NUMBERS

LAND USE	SOIL TYPE A	B	C	D	
Farm Land	61	70	77	80	*
Desert	63	77	85	88	*
Single-Family Residential	--	82	87	90	+
Multi-Family Residential	--	86	89	91	+
Commercial	89	92	94	95	*
Industrial	81	88	91	93	*
Rural Farm Housing	54	70	80	85	*
Luke AFB (runway w/much graded area)	77	86	91	94	*
Golf Course & Park	49	69	79	84	*
Prison	--	87	92	94	
School	--	82	87	90	

* from TR-55 (Ref. 8)

+ from City of Phoenix Storm Drain Design Manual (Ref. 21)

TABLE 3

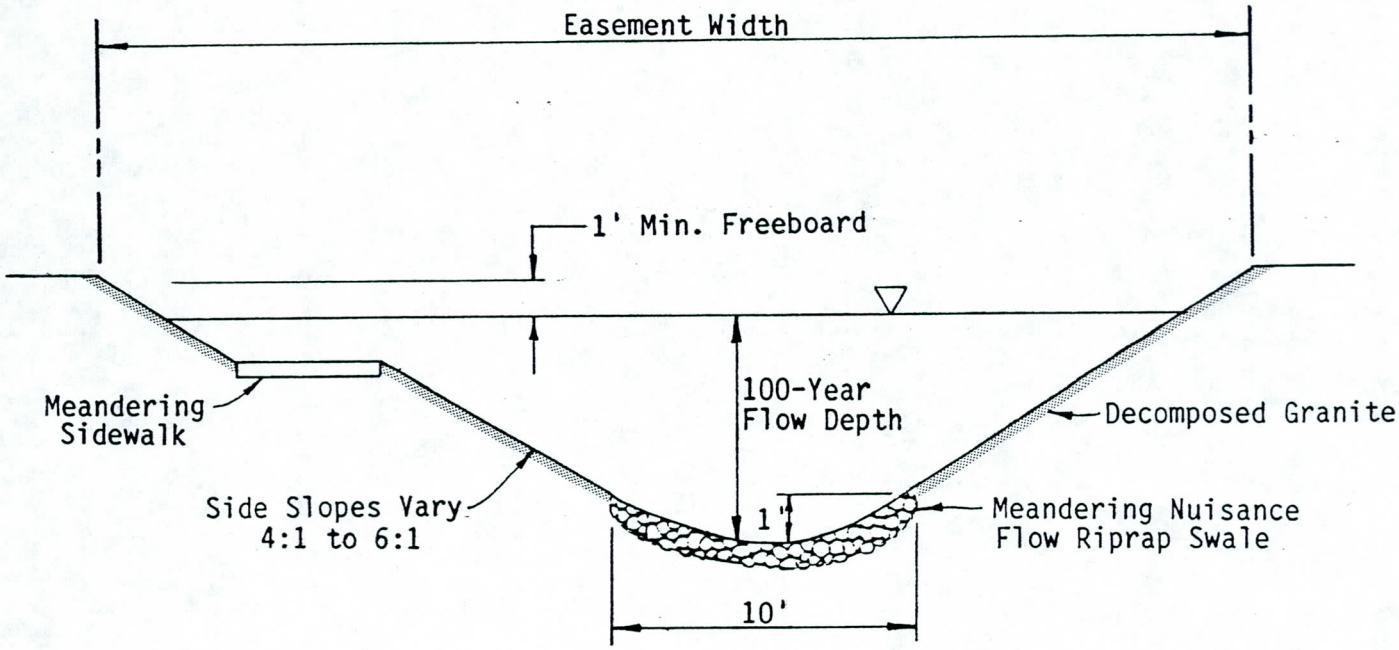
BULLARD WASH AT I-10
FLOW COMPARISONS
PEAK FLOWS IN CFS

	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Drainage Area
CMDR (a)	1517	---	3011	3572	38.5 sq.mi.
ADOT (Ref.9) (b)	---	---	3400	4200	32.8 sq.mi.
CBA (Ref.17) (c)	---	---	1500	---	38.5 sq.mi.
Historical Accounts (d)	---	800	---	---	43.0± sq.mi.

(a) At Thomas Road, 1.3 miles north of I-10
(b) At I-10
(c) At Thomas Road; Drainage Area - Runoff information from CBA (Ref. 20) used to develop flow for Bullard Wash.
(d) At Lower Buckeye Road; From Section 4.2, this information included for comparison purpose only.

TABLE 4

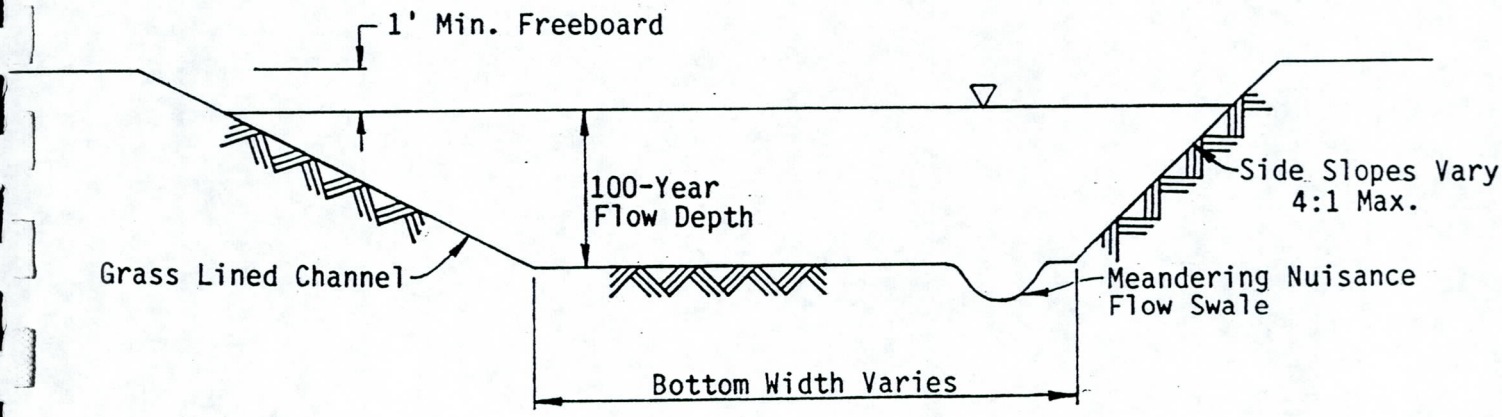
TYPICAL CHANNEL SECTIONS



Flow (cfs)	Slope (%)	Easement Width (ft.)	100-year Flow Depth (ft.)	Velocity (fps)
200	0.2	60'	3.2	2.8
200	0.5	60'	2.6	4.0
500	0.2	70'	4.7	3.6
500	0.5	70'	3.9	5.0
1000	0.2	85'	6.3	4.3
1000	0.5	85'	5.2	6.0

TABLE 5

TYPICAL BULLARD WASH SECTION THROUGH PROJECT



NORTH END OF PROJECT

Q = 3100 cfs
n = 0.035
100-year Depth = 3.1 ft.

Slope = 0.0050 ft./ft.
Bottom Width = 150 ft.
Velocity = 6.1 fps

SOUTH END OF PROJECT

Q = 3900 cfs
n = 0.035
100-year Depth = 5.5 ft.

Slope = 0.0025 ft./ft.
Bottom Width = 100 ft.
Velocity = 5.9 fps

TABLE 6

RETENTION BASINS

V = P x A x C
V - Volume requred in Acre-feet
P - Precipitation in feet
(100-year, 6-hour = 3" = 0.25')
C - Runoff coefficient

Retention Basin	Tributary Area (Ac)	Weighted C	Vol. Required (Ac ft)	Retention Depth (ft)	Surface Area (Ac)	Outlet Pipe Size	Average Outflow From Pipe* (CFS)	Flow Passing Thru Basin From Upstream Basin Bleed-off (CFS)	(Basin ID)	Net Average Outflow From Retained Volume (CFS)	Time To Drain** (hrs)	Flood Depth 10 yr	100 yr
RET1A	95	0.42	10.0	3.0	5.2	12"	3	---	---	3	40.3	1.7	2.9
RET1B	324	0.87	70.5	7.5	18.9	24"	25	---	---	25	34.1	3.0	5.1
RET1C	293	0.87	63.7	7.5	17.0	24"	25	---	---	25	30.8	3.0	5.3
RET1E	287	0.69	49.5	5.0	15.0	24"	16	---	---	16	37.4	2.4	4.1
RET1G	523	0.46	60.1	7.5	16.0	24"	25	---	---	25	29.1	3.6	6.9
RET1H	152	0.40	15.2	3.0	7.9	15"	5	---	---	5	36.8	1.6	2.9
RET1I	294	0.40	29.4	3.0	15.4	30"	10	---	---	10	35.6	1.5	2.7
RET1K	395	0.56	55.3	5.0	16.8	24"	16	---	---	16	41.8	2.6	4.5
RET1N	718	0.48	86.2	7.5	23.0	36"	46	16	RET1K	30	34.8	3.8	7.0
RET1O	111	0.47	13.0	3.0	6.8	15"	5	---	---	5	31.5	1.7	2.9
RET1P	98	0.51	12.5	3.0	6.6	15"	5	---	---	5	30.3	1.6	2.8
RET1R	85	0.44	9.4	3.0	4.9	12"	3	---	---	3	37.9	1.6	2.8
RET1T	315	0.71	55.9	5.0	5.4	30"	22	3	RET1R	14	35.6	3.7	5.3
RET2N	638	0.82	130.8	7.5	34.4	36"	46	---	---	46	34.4	3.5	5.8
RET2P	181	0.80	36.2	5.0	10.9	18"	11	---	---	11	39.8	2.8	4.3
RET2Q	60	0.83	12.5	3.0	6.6	15"	5	---	---	5	30.3	1.5	2.4
RET2S	368	0.50	46.0	5.0	13.9	24"	16	---	---	16	34.8	2.8	4.7
RET2T	250	0.55	34.4	5.0	10.5	36"	27	16	RET2S	11	37.8	2.6	4.3
RET2W	389	0.70	68.1	7.5	18.2	24"	25	---	---	25	33.0	3.7	6.3
RET2X	158	0.69	27.3	3.0	14.3	24"	8	---	---	8	41.3	1.6	2.6
RE2TZ	448	0.60	67.2	7.5	17.9	36"	46	35	RET2T & RET2X	11	73.9	4.0	7.0
East of Dysart Rd.	430	0.45	48.4	Multiple basins will be used									

Note: Retention volume depth and surface area values are approximate and subject to refinement with the design of the project.

* Based on 1/2 the average depth of retention

** Time to drain = $\frac{\text{(Vol Req.) (43560)}}{\text{(Net Ave. of Flow)(3600)}}$

CVL-4-1266

CORRESPONDENCE

1. R.I.D. CANAL SIPHON OPTIONS
2. ESTRELLA FREEWAY
3. ADOT RETENTION BASINS BY DIBBLE AND ASSOCIATES - AND APPROVAL LETTER
4. LITCHFIELD PARK DAM APPROVAL LETTER BY ADWR

CORRESPONDENCE 1

R.I.D. CANAL SIPHON OPTIONS

1100-270
CVL-4-1271

CVL

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Land Planning
Civil Engineering
Water Resources Engineering
Transportation Engineering
Computer Services
Landscape Architecture
Surveying

Founded in 1958 by
P.E. Coe, P.E. (1915-1977)
H.W. Van Loo, P.E.

John B. Nelson, P.E., R.L.S.
Ronald J. Mlnarik, R.L.A.
David L. Maguire, R.L.A.
Ashok C. Patel, P.E., R.L.S.
Karl Hirlinger, P.E.
Richard Alcocer, R.L.S.
Newell Roundy, R.L.A.
Michael G. Rhodes, P.E.
Richard R. Norton, P.E.
Paul W.R. Hoskin, P.E.
James D. Lemon, P.E., R.L.S.
Steven M. Verfurth, P.E.
Cathy Caris-Hart, R.L.A.
Earl Swetland, R.L.A.
James C. Spofford, P.E.

March 21, 1989

Roosevelt Irrigation District
P.O. Box 95
103 East Baseline Road
Buckeye, Arizona 85326

Attn: Mr. Stan Ashby

Re: RID Canal within SunCor Properties

Dear Mr. Ashby:

Per our recent phone conversations, I am herewith sending you a copy of the RID siphon option.

As you are aware, because of the large existing watershed, a considerable volume of flow would occur at certain key locations throughout the length of the RID Canal alignment between Cotton Lane and Litchfield Road. As discussed in the past, this flow needs to be routed from the north side of the canal to the south side, so that it provokes no adverse impact on the canal system. The attached schematic shows a method by which the canal will be siphoned for some distance so that the drainage can be allowed to travel at the ground elevation in a channelized condition. It is our intent to have this siphon designed following the basic RID requirements on hydraulic parameters.

RID Canal Parameters:

Design Flow Requirements:	386 cfs
Canal Average Velocities:	2.5 fps (existing condition)
Siphon Average Velocities:	5 fps (minimum) to insure better hydraulics through the siphon.

Please note that CVL will closely coordinate the siphon design with both the RID office and RID's design consultant, to insure that the design meets or exceeds the RID requirements.

Please review the sketch presented herein. Should you have any questions regarding the sketch, please do not hesitate to call. It is hoped that you will provide us with written input on this matter, so that the siphon details can be further refined.

Sincerely,

COE & VAN LOO
Consulting Engineers, Inc.

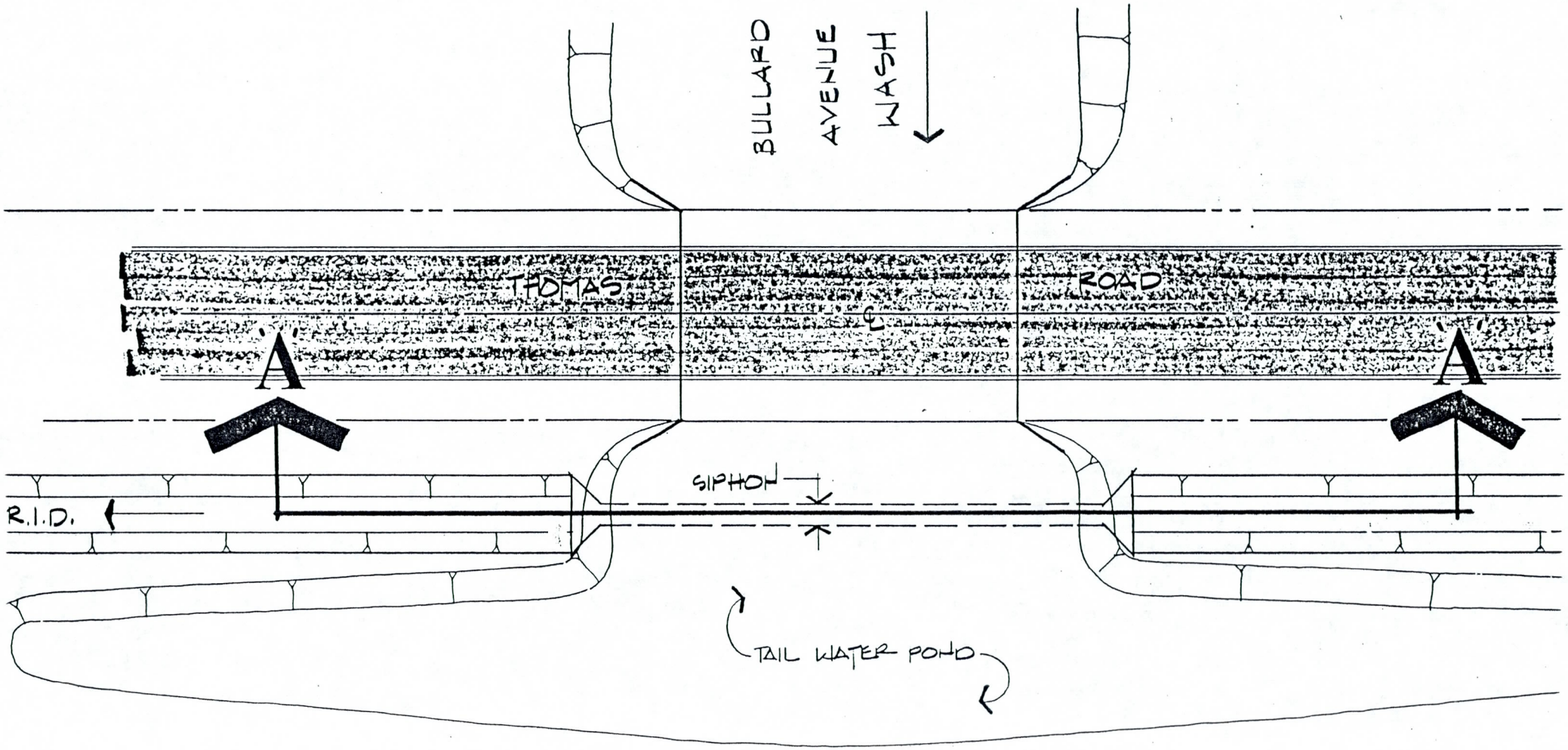
Ashok C. Patel, P.E., R.L.S.
Senior Vice President

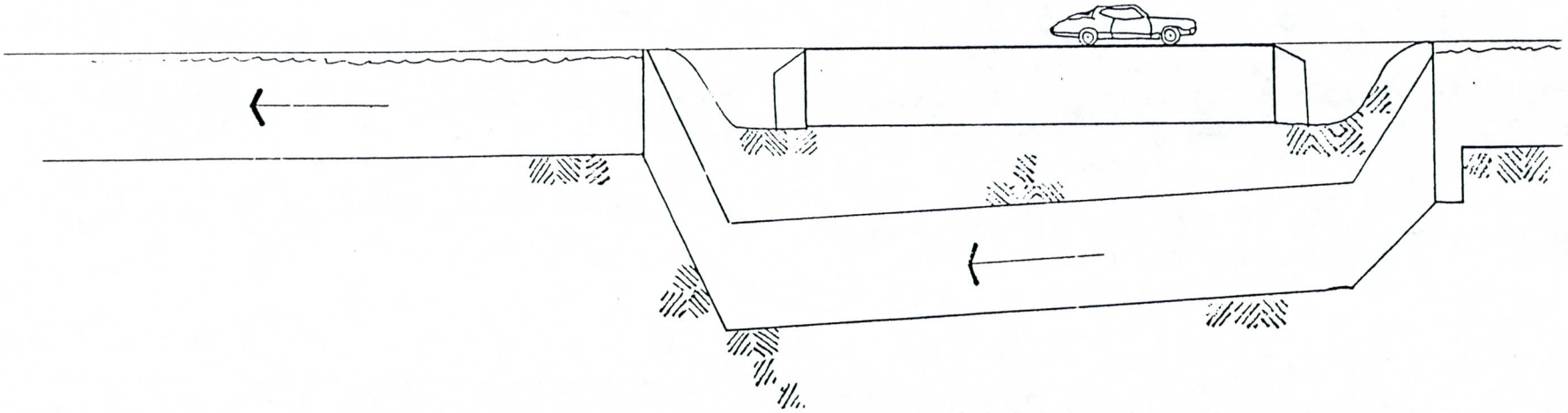
ACP:lps
CVL-2-1458

Enclosure

cc: Dan Haas, P.E. - SunCor
Dale Gardon - VSA

CVL


BULLARD
AVENUE
WASH
THOMAS
ROAD
A
A
SIPHON
R.I.D.
TAIL WATER POND



ELEVATION 'A'–'A'

CORRESPONDENCE 2

ESTRELLA FREEWAY

1100-270
CVL-4-1271

CVL

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Land Planning
Civil Engineering
Water Resources Engineering
Transportation Engineering
Computer Services
Landscape Architecture
Surveying

Founded in 1958 by
P.E. Coe, P.E. (1915-1977)
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Steven M. Verfurth, P.E.
Cathy Caris-Hart, R.L.A.
Earl Swetland, R.L.A.
James C. Spofford, P.E.

January 11, 1989

Arizona Department of Transportation
Urban Highways Division
205 South 17th Avenue
Room 216E
Phoenix, Arizona 85007

Attn: Mr. Art May

Re: Estrella Freeway Drainage Option Study

Dear Mr. May:

Thank you for meeting with us and Cella Barr Associates (CBA) at their office on January 4, 1989, to discuss the above referenced project. Since that time, we have had the opportunity to further review and discuss CBA's report as well as their memorandums.

We believe the simplified TR-55 approach adopted in the CBA report is appropriate for the scope and purpose of the study, and agree that a more detailed study will be needed in the future, during the final design phase of the Estrella Freeway. We also concur with a number of key conclusions made by CBA. However, we would like to recommend some further evaluations of other available options.

CBA's conclusion was that the "pass through" drainage option would be the least costly. However, we feel that more consideration could be given to a combination of pass through and storage options, which we believe may have economic benefits while satisfying other needs. In addition, the pass through option offers little benefit in solving an overall drainage problem and has potential for future liability for the downstream areas.

It is respectfully requested that additional options be evaluated.

We recommend the following considerations for the purpose of new evaluations:

A large drainage channel exists along Camelback Road on both the east and west side of the proposed Estrella Freeway alignment. Because of this channel, there seems a logical cutoff point for a "pass through" system immediately north of Camelback Road.

We suggest the use of a combination of channel and basin systems south of Camelback Road, with an ultimate outfall to the Gila River. This option may not significantly alter the drainage, while providing added benefits.

Additionally, we suggest:

1. The use of large basins where the land costs are comparatively low, and continued use of the "pass through" system where the land costs are high.

2. Increase basin depths to over 10 feet. By strategically locating such basins, borrow requirements for the roadway earthwork can be substantially reduced, with resultant cost savings. The preliminary road profile plot by CBA suggests that borrow areas would be needed. The large basins would be excellent sources of the needed dirt.

3. The use of overflow (diversion) basins should be further explored (see sketch for conceptual configuration). This concept has been successfully used on the Superstition Freeway and other ADOT projects.

Should you have any questions regarding this matter, please do not hesitate to call.

Sincerely,

COE & VAN LOO
Consulting Engineers, Inc.

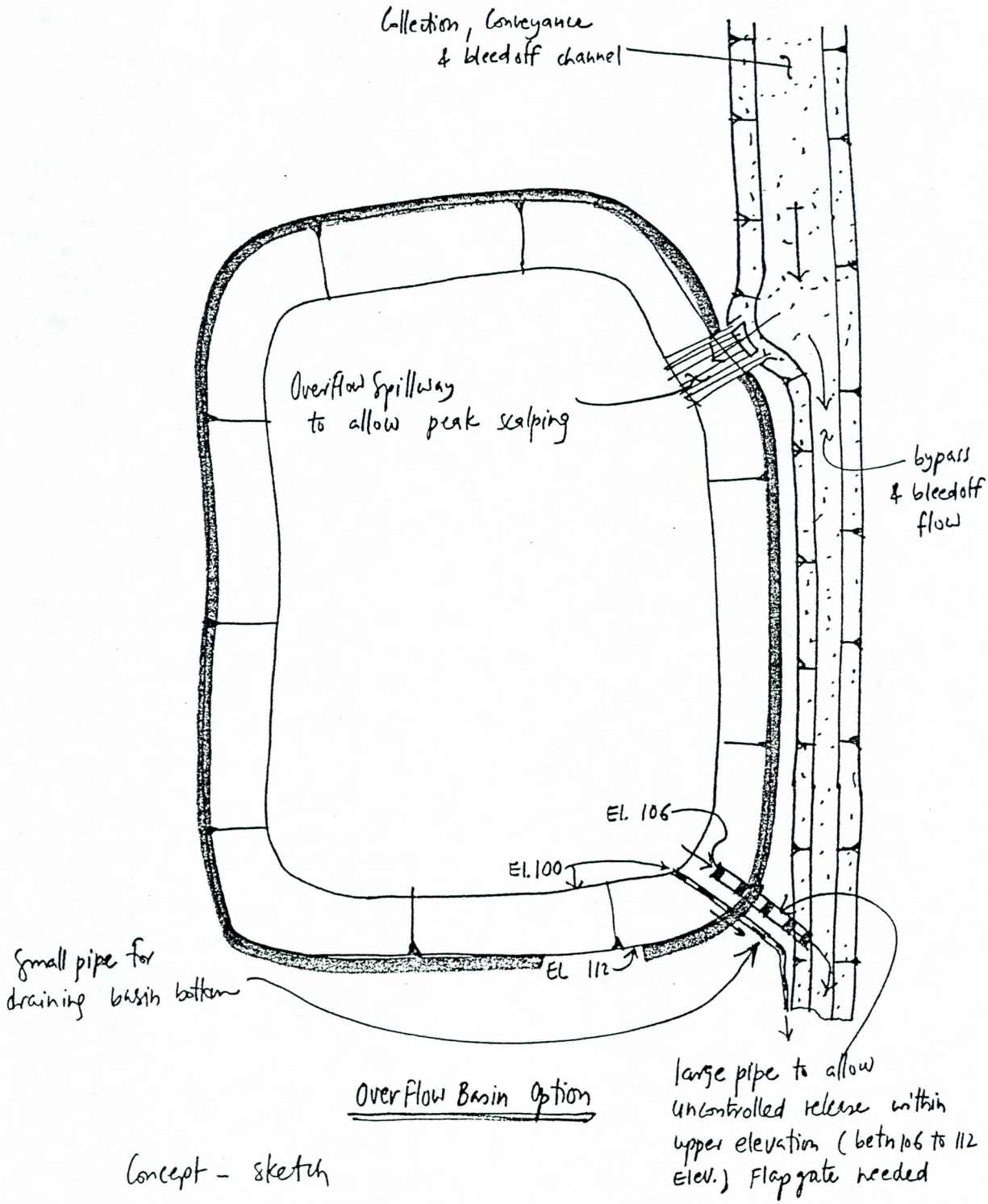
Ashok C. Patel, P.E., R.L.S.
Senior Vice President
Drainage Engineer for
SunCor Development Company

ACP:lps
CVL-2-1320

Enclosure

cc: Jim Nelson, P.E., CBA
Dan Haas, P.E., SunCor
Dale Gardon, VSA

CVL



Over Flow Basin Option

Concept - sketch

ARIZONA DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

206 South Seventeenth Avenue Phoenix, Arizona 85007

ROSE MOFFORD
Governor

CHARLES L. MILLER
Director

THOMAS A. BRYANT, II
State Engineer

February 3, 1989

RECEIVED
FEB 10 1989
COE & VAN LOO

Ashok C. Patel, Senior Vice President
Coe and Van Loo
4550 North 12th Street
Phoenix, Arizona 85014-4291

Re: Estrella Freeway Drainage Option Study H087701D

Dear Mr. Patel:

Thank you for your letter dated January 11, 1989. As we discussed on the telephone January 26, 1989, ADOT and Urban Highways have a continuing interest in development adjacent to our freeway right of ways.

As we have discussed, the Estrella Freeway has the lowest priority on the MAG transportation system with construction beginning after 2000. Our corridor location study was meant to: 1) investigate environmental issues within the corridor 2) identify the preferred alignment of the ultimate freeway and 3) identify right of way needs for future acquisition. As part of the study several possible drainage options were investigated to identify their impact on item 1-3 above. We did not address regional flood control issues since that is a problem that will need to be addressed by developers and the Maricopa County Flood Control District (FCD) as development occurs, years before the freeway is built.

You make several excellent suggestions for the development of a drainage system through property owned by Suncor Development Company. If we were 15 years closer to final design of the Estrella joint study your suggestion might be beneficial to all parties. However, the location study for the Estrella Freeway was completed in the spring of 1988. Only the final reports remain to be completed, therefor we will not be able to evaluate additional options.

Sincerely,

Arthur V. May

ARTHUR V. MAY
Corridor Engineer
Urban Highway Section

AVM/dlp

cc: Dick Perralt
Cella-Barr

TRANSPORTATION PLANNING

CORRESPONDENCE 3

ADOT RETENTION BASINS BY DIBBLE AND ASSOCIATES

Including: correspondence between A.D.O.T. and Litchfield Park Properties regarding the use of A.D.O.T. Retention Basins, and approval letter.

OFFSITE
DRAINAGE DESIGN REPORT

PROJECT NO.: I-IG-10-2(37)C
HIGHWAY: EHRENBERG-PHOENIX HIGHWAY
SECTION: BULLARD-DYSART ROAD

Registered Professional Engineer (Civil)
CERTIFICATE NO.
6207
JIT S.
PEGANY
Date Signed
ARIZONA, U.S.A.

Prepared by:

DIBBLE AND ASSOCIATES
CONSULTING ENGINEERS

Designed by: Nelson

Checked by: Pegany

January, 1976

III. DISCUSSION

A. Hydrology

1. Drainage Areas

The entire watershed north of the freeway consists of three drainage areas as approximately delineated on the drainage area map provided in Appendix VI-A.

2. Type of Flow

The existing terrain is primarily flat farmland with few scattered residential buildings. As a result, most of the storm water flows south to the freeway project as overland sheet flow, with a small amount concentrated in waste ditches along the crossroads and fields. The Roosevelt Irrigation District canal which crosses the watershed acts as a barrier but it is assumed that the canal will break during a 50-year storm and overland flow will continue south to the freeway. When the area is developed, most of the runoff will concentrate in collector streets and man-made swales and the rest will be carried in Litchfield Park Properties proposed two-year storm sewer system.

3. Land Use

a. Existing

At the present, most of the watershed consists of flat cultivated land.

III. DISCUSSION (continued)

b. Projected

Projected land use is planned by Litchfield Park Properties for three broad categories, "commercial, residential and parks", as shown on the drainage area map. Although the timing of these developments is uncertain, the hydrologic computations for this project are based on the projected land use.

4. SCS Curve Number and Rational "C" Values

SCS Curve No. 90 is based on projected land use; Rational "C" 0.59 is based on weighted projected land use.

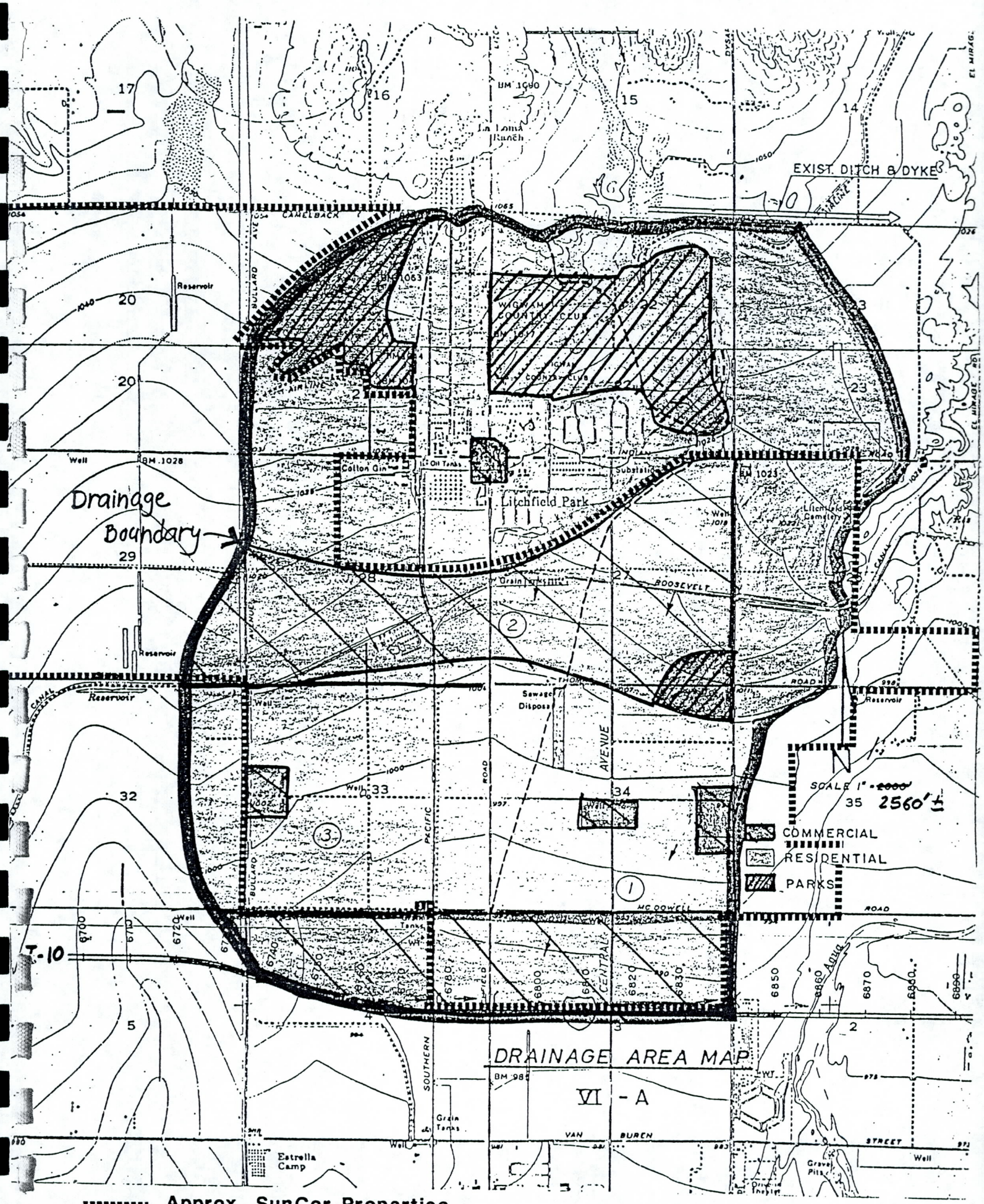
5. Precipitation Values

6 hour p = 2.8 inches

24 hour p = 3.3 inches.

6. Soil Groups

C.



Approx. SunCor Properties

Source: Dibble, for planned land use & drainage areas.

PLATE 1

ARIZONA DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION
District 1
2140 West Hilton Avenue, Phoenix, Arizona 85009

BRUCE BABBITT
Governor

WILLIAM A. ORDWAY
Director

OSCAR T. LYON, JR., P.E.
Assistant Director
and State Engineer

April 24, 1979

APR 1979
RECEIVED
ELLIS, MURPHY,
HOLGATE & JOHNSON

Mr. Charles Edman, Jr.
Project Manager
Ellis, Murphy & Holgate, Inc.
6601 N. Black Canyon Hwy.
Phoenix, Az. 85015

Re: Storm Drain Outfall Plan
Litchfield Park
LPP-D-8001-78
A.D.O.T. Case 1-128-9

Dear Mr. Edman:

The above noted project has been reviewed by the District One Office and A.D.O.T.'s Hydraulic Section. Both parties are in agreement on three (3) points.

1. This is a precedent setting item.

2. A.D.O.T. will require your company to obtain a letter from the governing authority, written toward the fact that no other subdivision will be allowed to drain into this channel, nor adapt to your drainage grades which would add more water to the retension pond.

3. A.D.O.T. also needs to know who will maintain the channel and the frequency of the cleanings.

I will hold this permit application in abeyance until the Department receives the requested information.

Sincerely,

Ronald E. Romley

Ronald E. Romley,
District One Permit
& Encroachment Supvr.

RER:ry

cc: John Unten

ARIZONA DEPARTMENT OF TRANSPORTATION

BRUCE BABBITT
Governor

LIAM A. ORDWAY
Director

HIGHWAYS DIVISION
District 1
2140 West Hilton Avenue, Phoenix, Arizona 85009

OSCAR T. LYON, JR., P.E.
Assistant Director
and State Engineer

May 15, 1979

Mr. Charles Edman, Jr.
Project Manager
Ellis, Murphy & Holgate, Inc.
6601 N. Black Canyon Hwy.
Phoenix, Az. 85015

Re: Storm Drain Outfall Plan
Litchfield Park
LPP-D-8001-78
A.D.O.T. Code 1-128-9

Dear Mr. Edman:

As per the meeting on May 10, 1979, A.D.O.T. will ammend Item No. 2, incorporated into our letter of April 24, 1979, to read that: 1. A signed document shall be submitted to this office from the developer assuring A.D.O.T. that no additional water from outside the planned area will be allowed to flow into the retension pond. 2. Any future developments within the planned area, which would increase the flow into the pond, a contact with A.D.O.T. must be made. This will help the Department keep up to date with the current flow projections.

Included in this letter I would appreciate an answer to Item #3 along with a name and phone number of who could be contacted in case contact is necessary.

The Department will start the processing of the permit application at this time, but the permit will not be issued until the information needed is on file.

Should you need further information please call.

Sincerely,

Ronald E. Romley

Ronald E. Romley,
District One Permit
& Encroachment Supvr.

MAY 1979
RECEIVED
ELLIS, MURPHY,
HOLGATE & JOHNSON

RER:ry

Litchfield Park

May 21, 1979

Mr Ronald E. Romley
District One Permit & Encroachment Supervisor
Arizona Department of Transportation
Highways Division
District 1
2140 West Hilton Avenue
Phoenix, Arizona 85009

Re: Storm Drain Outfall Plan
Litchfield Park

Dear Mr Romley,

Reference is made to your letter of May 15, 1979, addressed to Mr. Charles Edman, Jr, Ellis Murphy & Holgate, Inc., and to your letter to Mr Edman, dated April 24, 1979.

As the developer of Litchfield Park, Litchfield Park Properties does assure the Arizona Department of Transportation that,

1. No additional water from outside the planned area, as depicted on the Drainage Area Map VI-A, will be allowed to flow into the retention basins located on the North side of Highway I-10 in Sections 3 & 4 T1N, R1W Gila & Salt River Base & Meridian, Maricopa County, Arizona. A copy of the above referenced map is attached herewith. This map is from appendix VI-A of the Offsite Drainage Design Report, prepared by Dibble and Associates for ADOT.

2. Litchfield Park Properties as developer of Litchfield Park also assures the A.D.O.T. that a contact will be made with A.D.O.T. in case any future development within the planned area should cause the flow into the ponds to be increased.

3. Litchfield Park Properties will maintain the drainage channel in a manner which allows for the free unobstructed flow of water.

Litchfield Park Properties | *111 West Indian School Rd., Litchfield Park, Arizona 85340* | P. O. Box 747 | Phone 602/935-3836

onald E. Romley
trict One Permit & Encroachment Supervisor
izona Department of Transportation

Re: Storm Drain Outfall Plan
Litchfield Park

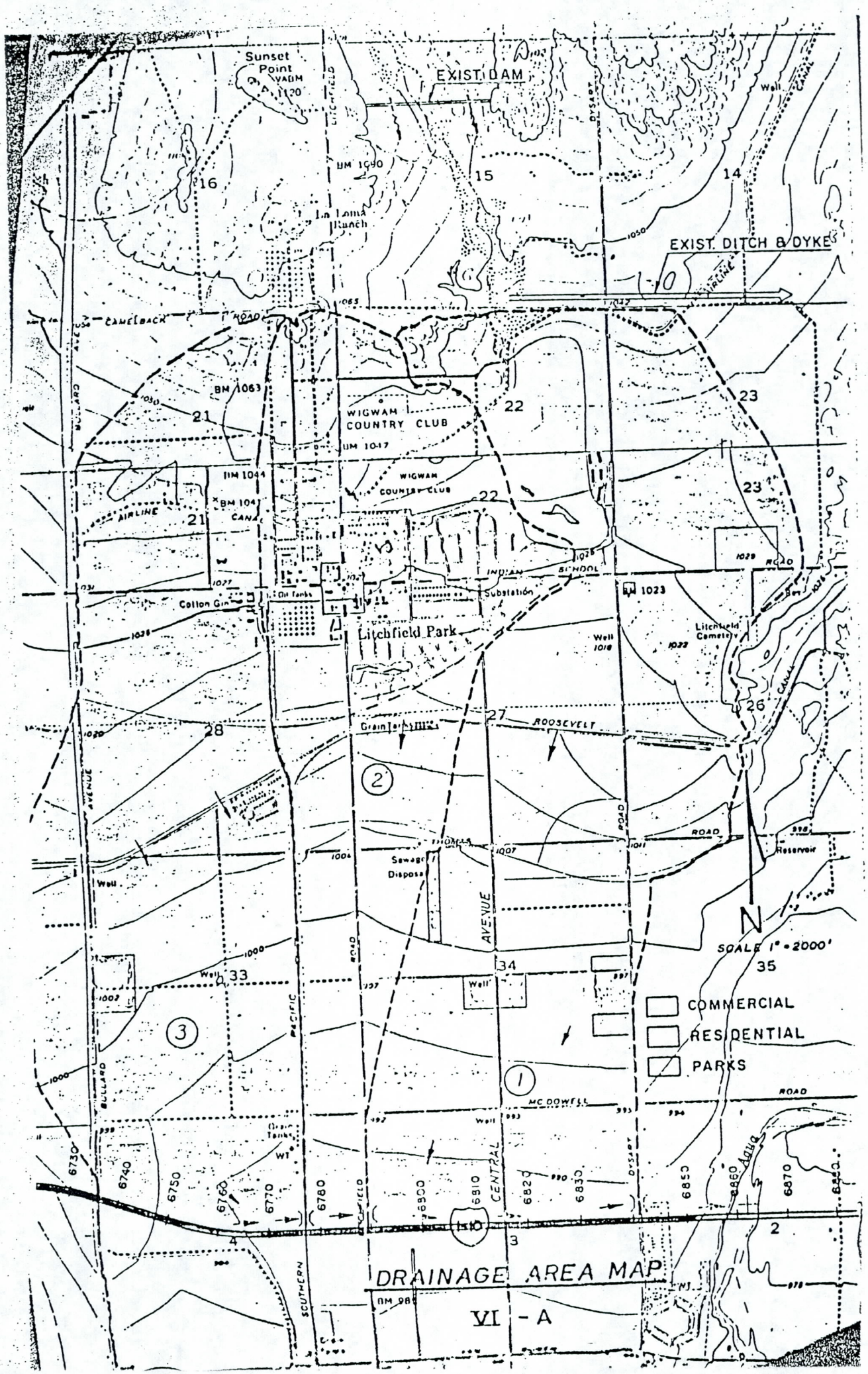
We trust that the above assurances as requested in your letters as cited, will satisfy the requirements necessary for the issurance of a permit.

Very truly yours,

G W Busey
Vice President

G W Busey
ces
encl.

cc: Charles Edman Jr.


Sunset Point
EXIST. DAM
EXIST. DITCH & DYKE
La Loma Ranch
CAMELBACK ROAD
WIGWAM COUNTRY CLUB
INDIAN SCHOOL
Litchfield Park
Cotton Gin
Substation
Litchfield Cemetery
Grain Elevators
ROOSEVELT
Sewage Disposal
Reservoir
AVENUE
ROAD
MC DOWELL
CENTRAL
PACIFIC
SOUTHERN
BULLARD
LITCHFIELD
DYSART
AIRLINE
CANAL
Agua
SCALE 1" = 2000'
COMMERCIAL
RESIDENTIAL
PARKS
DRAINAGE AREA MAP
VI - A

ARIZONA DEPARTMENT OF TRANSPORTATION
STRUCTURES SECTION

OFFICE MEMO

August 22, 1989

RECEIVED
AUG 24 1989
DISTRICT 1

TO: DAN POWELL, District Engineer
District 1

FROM: GEORGE LOPEZ-CEPERO, Bridge Drainage Engineer-Supervisor
Structures Section

RE: I-10 @ Dysart Road
Detention Basin

We have reviewed the Concept Master Drainage Report for Litchfield Park Development by SunCor which was prepared by Coe & Van Loo. The report was reviewed for the impact of the development on ADOT's property. The report concludes that the project will result in an improved performance for ADOT detention basins.

The report appears appropriate and should allow SunCor/Coe Van Loo to proceed further and submit the permit request. The request should include plans for any work to be performed on ADOT's R/W, including any channelization, bank protection or channel outlet measures needed to mitigate the effects of flow concentrations into the basins.

George Lopez-Cepero
GEORGE LOPEZ-CEPERO

GLC:mc

cc: Ashok C. Patel

CORRESPONDENCE 4

LITCHFIELD PARK DAM APPROVAL LETTER BY ADWR

JUN 22 1989

ARIZONA
DEPARTMENT
OF WATER
RESOURCES

Rose Mofford, Governor
N. W. Plummer
Director

15 South 15th Avenue
Phoenix, Arizona 85007

June 20, 1989

Mr. Dan Haas, P.E.
SunCor Development Company
Post Office Box 1800
Litchfield Park, Arizona 85340

Subject: Litchfield Park Dam (07.30)

Dear Mr. Haas:

We have reviewed the Conceptual Drainage Report for the Litchfield Park Detention Facility submitted to us by Ashok Patel of Coe & Van Loo on June 15, 1989. The Department believes that the proposed detention facility concept can be developed into a design which permits free passage of flood waters as required by the statutes.

The statutes also require the owner to file an application for removal of the dam. At our May 31 meeting we provided Coe & Van Loo with the necessary application forms and filing instructions. Included with the application should be the drawings, specifications and design reports necessary for removal of the dam. Construction may not begin until the application has been approved by the Department.

If you have any questions concerning the dam or the application requirements, please contact Chuck Hamstra at 542-1541. We look forward to resolving the safety problems that have persisted at this structure.

Thank you for your cooperation.

Sincerely,

William C. Jenkins, P.E.
Supervisor
Safety of Dams Section

WCJ/CEH/rh

cc: Ashok Patel, Coe & Van Loo
Steve Tucker, FCDMC

HEC-1 ANALYSIS

1. EXISTING CONDITION
2. POST-DEVELOPMENT CONDITION

HEC-1

EXISTING CONDITION

1100-270
CVL-4-1271

```
FLOOD HYDROGRAPH PACKAGE  (HEC-1)
      FEBRUARY 1981
    REVISED  4 NOV 81

WED, SEP 13 1989      TIME 09:34:35
```


```
U.S. ARMY CORPS OF ENGINEERS
THE HYDROLOGIC ENGINEERING CENTER
      609 SECOND STREET
     DAVIS, CALIFORNIA 95616
(916) 440-3285 OR (FTS) 448-3285
```


```
X     X  XXXXXXX  XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

```
                                                  1 I
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID        LITCHFIELD PARK DEVELOPMENT MASTER PLAN
  2           ID        SUNCOR DEVELOPMENT COMPANY
  3           ID        EXISTING HYDROLOGY
  4           ID        10-YEAR, 50-YEAR, & 100-YEAR, 6-HOUR STORM
  5           ID        COE & VAN LOO CONSULTING ENGINEERS INC.        SEPTEMBER 1989        JKM
              *DIAGRAM
  6           IT     10                          300
  7           IO      5        0
  8           JR     PREC     0.64     0.88     1.00

  9           KK     SUBA
 10           KM        RUNOFF FOR SUB BASIN A
 11           IN     15
 12           PB     3.15
 13           PC     0.000    0.036    0.071    0.111    0.151    0.196    0.249    0.315    0.395    0.489
 14           PC     0.604    1.066    2.293    2.488    2.612    2.715    2.795    2.861    2.919    2.968
 15           PC     3.012    3.052    3.088    3.119    3.150    3.150    3.150    3.150    3.150    3.150
 16           BA     6.43
 17           LS              74
 18           UD     2.5

 19           KK     DIV1
 20           KM        DIVERSION AT WADELL RD. & REEMS RD.
 21           DT     D1
 22           DI        0      100      300      500     1000     2000     3000     4000
 23           DQ        0      100      200      300      320      350      375      400

 24           KK     RO1
 25           KM        ROUTE DIV1 TO STATION1
 26           RK   17000    0.004    0.035                TRAP       50       20

 27           KK     SUBB
 28           KM        RUNOFF FROM SUBBASIN B
 29           BA     11.33
 30           LS              74
 31           UD     3.5

 32           KK     CO1
 33           KM        COMBINE RO1 & SUBB
 34           HC      2

 35           KK     DIV2
 36           KM        DIVERSION AT OLIVE & REEMS
 37           DT     D2
 38           DI        0      100      300      500     1000     2000     4000     8000
 39           DQ        0      100      200      300      500     1000     2000     4000

 40           KK     RO2
 41           KM        ROUTE DIV2 TO STATION 2
 42           RK    5000    0.004    0.035                TRAP       50       20
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  43          KK    DIV3
  44          KM        DIVERSION AT NORTHERN & REEMS
  45          DT      D3
  46          DI       0      100      300      500     1000     2000     4000     8000
  47          DQ       0      100      250      270      300      300      300      300

  48          KK    RO3
  49          KM        ROUTE DIV3 TO STATION 3
  50          RK   24000    0.003    0.040              TRAP      100       50

  51          KK    RD2
  52          KM        RETRIEVE D2
  53          DR      D2

  54          KK    RO4
  55          KM        ROUTE RD2 TO STATION 4
  56          RK   13000   0.0025    0.035              TRAP        5        6

  57          KK    RO3
  58          KM        RETRIEVE D3
  59          DR      D3

  60          KK    RO5
  61          KM        ROUTE RO3 TO STATION 5
  62          RK    8000    0.002    0.035              TRAP       10        3

  63          KK    SURC
  64          KM        RUNOFF FROM SUBBASIN C
  65          BA    3.29
  66          LS              73
  67          UD     2.2

  68          KK    CO2
  69          KM        COMBINE RO4, RO5, & SUBC
  70          HC       3

  71          KK    RO6
  72          KM        ROUTE CO2 TO STATION 6
  73          RK    9000    0.001    0.020              TRAP       20        2

  74          KK    SURD
  75          KM        RUNOFF FROM SUBBASIN D
  76          BA    1.00
  77          LS              73
  78          UD     1.6

  79          KK    DIV4
  80          KM        DIVERSION AT PEORIA & LITCHFIELD
  81          DT      D4
  82          DI       0      100      200      400     1000     2000
  83          DQ       0       50      100      150      200      250
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 84           KK     R07
 85           KM         ROUTE DIV4 TO STATION 7
 86           RK   15000   0.004   0.050              TRAP      500      100

 87           KK    SUBE
 88           KM         RUNOFF FROM SUBBASIN E
 89           BA    2.34
 90           LS               73
 91           UD     1.9

 92           KK     C03
 93           KM         COMBINE R06, R07, & SUBE
 94           HC       3

 95           KK    DIV5
 96           KM         DIVERSION FROM LUKE AFD CHANNEL
 97           DT      D5
 98           DI       0      100      500     1000     1500     2000     5000
 99           DQ       0      100      500     1000     1000     1000     1000

100           KK     R08
101           KM         ROUTE DIV5 TO STATION 8
102           RK    6000   0.001   0.040              TRAP      100      100

103           KK    DIV6
104           KM         DIVERSION THROUGH PIPE TO MURPHYS DAM
105           DT      D6
106           DI       0       60      200      500     1000     2000     5000
107           DQ       0       60       60       60       60       60       60

108           KK     R09
109           KM         ROUTE DIV6 TO STATION 9
110           RK   17000   0.002   0.035              TRAP       40        5

111           KK    SUBF
112           KM         RUNOFF FROM SUBBASIN F
113           BA    14.30
114           LS               76
115           UD     2.9

116           KK     C04
117           KM         COMBINE R03, R09, & SUBF
118           HC       3

119           KK    SUBG
120           KM         RUNOFF FROM SUBBASIN G
121           BA    2.36
122           LS               75
123           UD     1.4
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  124         KK    DIV7
  125         KM        DIVERSION AT CITRUS & CAMELBACK
  126         DT      D7
  127         DI       0      100      200      300      500     1000     2000
  128         DQ       0        0       50      145      330      800     1750

  129         KK    RO10
  130         KM        ROUTE DIV7 TO STATION 10
  131         RK    5000   0.005   0.035              TRAP       5       2

  132         KK    SUBH
  133         KM        RUNOFF FROM SUBBASIN H
  134         BA    7.30
  135         LS              73
  136         UD     3.1

  137         KK     C05
  138         KM        COMBINE RO10 & SUBH
  139         HC       2

  140         KK    DIV8
  141         KM        DIVERSION AT COTTON & CAMELBACK
  142         DT      D8
  143         DI       0      100      350      500     1000     2000     4000     6000
  144         DQ       0        0        0      100      550     1500     3500     5500

  145         KK    RO11
  146         KM        ROUTE DIV8 TO STATION 11
  147         RK   14000   0.003   0.035              TRAP      20       2

  148         KK    SUBI
  149         KM        RUNOFF FROM SUBBASIN I
  150         BA    2.14
  151         LS              74
  152         UD     1.5

  153         KK     C06
  154         KM        COMBINE RO11 & SUBI
  155         HC       2

  156         KK     C07
  157         KM        COMBINE C04 & C06
  158         HC       2

  159         KK    RO12
  160         KM        ROUTE C07 TO STATION 12
  161         RK   11000   0.003   0.045              TRAP      20     100

  162         KK     PD7
  163         KM        RETRIEVE D7
  164         DR      D7
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  165         KK    RO13
  166         KM        ROUTE RD7 TO STATION 13
  167         RK   10000   0.003   0.025              TRAP      30        4

  168         KK    SUBJ
  169         KM        RUNOFF FROM SUBBASIN J
  170         BA    0.99
  171         LS              73
  172         UD     1.2

  173         KK     COB
  174         KM        COMBINE RO13 & SUBJ
  175         HC       2

  176         KK    DIV9
  177         KM        DIVERSION AT COTTON & INDIAN SCHOOL
  178         DT      D9
  179         DI       0       50      100      200      500     1000     2000
  180         DQ       0        0       50      150      450      950     1950

  181         KK     RD8
  182         KM        RETRIEVE D8
  183         DR      D8

  184         KK    RO14
  185         KM        ROUTE RD8 TO STATION 14
  186         RK    5100   0.003   0.025              TRAP      30        4

  187         KK    SUBK
  188         KM        RUNOFF FROM SUBBASIN K
  189         BA    0.45
  190         LS              73
  191         UD     1.1

  192         KK     C09
  193         KM        COMBINE DIV9, RO14, & SUBK
  194         HC       3

  195         KK    RO15
  196         KM        ROUTE C09 TO STATION 15
  197         RK   15000   0.004   0.050              TRAP     500      100

  198         KK    SUBL
  199         KM        RUNOFF FROM SUBBASIN L
  200         BA    4.75
  201         LS              73
  202         UD     1.8

  203         KK    C010
  204         KM        COMBINE RO12, RO15, & SUBL
  205         HC       3
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  206         KK     RD6
  207         KM        RETRIEVE D6
  208         DR      D6

  209         KK     R016
  210         KM        ROUTE RD6 TO STATION 16
  211         RK     6000   0.002   0.035            TRAP      20        4

  212         KK     SUBM
  213         KM        RUNOFF FROM SUBBASIN M
  214         BA     1.23
  215         LS             82
  216         UD      1.6

  217         KK     C011
  218         KM        COMBINE R016 & SUBM
  219         HC       2

  220         KK     RET1
  221         KM        MURPHYS DAM RETENTION
  222         RS       1    ELEV    1062
  223         SA       7       9      23      39      65
  224         SQ       0      32      74     132     322
  225         SE    1062    1064    1066    1068    1070

  226         KK     R017
  227         KM        ROUTE RET1 TO STATION 17
  228         RK     4500   0.004   0.035            TRAP      20        4

  229         KK     SUBN
  230         KM        RUNOFF FROM SUBBASIN N
  231         BA     1.20
  232         LS             79
  233         UD      1.3

  234         KK     C012
  235         KM        COMBINE R017 & SUBN
  236         HC       2

  237         KK     SUBO
  238         KM        RUNOFF FROM SUBBASIN O
  239         BA     2.33
  240         LS             76
  241         UD      1.6

  242         KK     R019
  243         KM        ROUTE SUBO TO STATION 19
  244         RK    10000  0.0025   0.025            TRAP      30        4
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  245         KK    SUBP
  246         KM        RUNOFF FROM SUBBASIN P
  247         BA    1.40
  248         LS              74
  249         UD     1.2

  250         KK    R020
  251         KM        ROUTE SUBP TO STATION 20
  252         RK    8000  0.0025   0.050            TRAP     100     100

  253         KK    SUBQ
  254         KM        RUNOFF FROM SUBBASIN Q
  255         BA    3.73
  256         LS              73
  257         UD     1.5

  258         KK    C014
  259         KM        COMBINE R010, R020, & SUBQ
  260         HC       3

  261         KK    RET2
  262         KM        ADOT RETENTION AT LITCHFIELD RD & I10
  263         RS       1    ELEV     971
  264         SV       0     7.9    38.9   144.2   316.6   534.8   758.7   930.4  1103.9  1115.0
  265         SQ       0      11      28      36      43      49      53      57      62     500
  266         SE     971     972     974     976     978     980     982   983.5     985   985.1

  267         KK    SUBR
  268         KM        RUNOFF FROM SUBBASIN R
  269         BA    0.65
  270         LS              73
  271         UD     1.3

  272         KK    SUBS
  273         KM        RUNOFF FROM SUBBASIN S
  274         BA    1.03
  275         LS              73
  276         UD     1.4

  277         KK    R021
  278         KM        ROUTE SUBS TO STATION 21
  279         RK    8000   0.006   0.040            TRAP      50       6

  280         KK    SUBT
  281         KM        RUNOFF FROM SUBBASIN T
  282         BA    1.00
  283         LS              85
  284         UD     0.7
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  285         KK     C015
  286         KM         COMBINE R021 & SUBT
  287         HC       2

  288         KK     R022
  289         KM         ROUTE C015 TO STATION 22
  290         RK     5000    0.005    0.050              TRAP      100       20

  291         KK      RD9
  292         KM         RETRIEVE D9
  293         DR       D9

  294         KK     R023
  295         KM         ROUTE RD9 TO STATION 23
  296         RK    14000    0.005    0.050              TRAP       50       20

  297         KK     SUBU
  298         KM         RUNOFF FROM SUBBASIN U
  299         BA     3.74
  300         LS              73
  301         UD      2.2

  302         KK     C016
  303         KM         COMBINE R022, R023, & SUBU
  304         HC       3
  305         ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
OUT
LINE        (V) ROUTING          (--->) DIVERSION
NO.         (.) CONNECTOR        (<---) RETURN OF DIVERTED FLOW

 9          SUBA
                 .
                 .
21               .------->      D1
19          DIV1
                 V
                 V
24          RO1
                 .
                 .
27               .        SUBB
                 .          .
                 .          .
32          CO1.............
                 .
                 .
37               .------->      D2
35          DIV2
                 V
                 V
4.          RO2
                 .
                 .
45               .------->      D3
43          DIV3
                 V
                 V
48          RO3
                 .
                 .
53               .          .<-------      D2
51               .       PD2
                 .          V
                 .          V
54               .       RO4
                 .          .
                 .          .
59               .          .          .<-------      D3
57               .          .       RO3
                 .          .          V
                 .          .          V
61               .          .       RO5
                 .          .          .
                 .          .          .
63               .          .          .        SUBC
                 .          .          .          .
                 .          .          .          .
58               .       CO2.......................
                 .          V
                 .          V
71               .       RO6
                 .          .
                 .          .
74               .          .       SUBD
                 .          .          .
                 .          .          .
81               .          .          .------->      D4
79               .          .       DIV4
                 .          .          V
```

```
84                                  RD7
87                                          SUBE
92                      CO3.......................
97                      .-------->      D5
95                  DIV5
                        V
                        V
100                 RO8
                        .
105                     .-------->      D6
103                 DIV6
                        V
                        V
108                 RO9
                        .
111                                 SUBF
                                        .
116             CO4.......................
                        .
119                 SUBG
                        .
126                     .-------->      D7
124                 DIV7
                        V
                        V
129                 RO10
                        .
132                                 SUBH
                                        .
137                     CO5............
                        .
142                     .-------->      D6
140                 DIV8
                        V
                        V
145                 RO11
                        .
148                                 SUBI
                                        .
153                     CO6............
                        .
156             CO7............
                        V
                        V
159             RO12
                        .
164                     .<--------      D7
162                 RD7
```

```
                    V
                    V
165                 R013
                    .
                    .
168                 .          SUBJ
                    .          .
                    .          .
173                 C08........
                    .
                    .
178                 .--------> D9
176                 DIV9
                    .
                    .
183                 .<-------  D8
181                 .          RD8
                    .          V
                    .          V
184                 .          R014
                    .          .
                    .          .
187                 .          .          SUBK
                    .          .          .
                    .          .          .
192                 C09........................
                    V
                    V
195                 R015
                    .
                    .
198                 .          SUBL
                    .          .
                    .          .
203                 C013.......................
                    .
                    .
208                 .<-------  D6
210                 RD6
                    V
                    V
209                 R016
                    .
                    .
212                 .          SUBM
                    .          .
                    .          .
217                 C011.......
                    V
                    V
220                 RET1
                    V
                    V
226                 R017
                    .
                    .
229                 .          SUBN
                    .          .
                    .          .
234                 C012.......
                    .
                    .
237                 .          SUBO
                    .          V
                    .          V
```

```
242
245                    SUBP
                         V
                         V
250                    R020

253                                SUBQ

258                 C014.......................
                         V
                         V
261                 RET2

267                    SUBR

272                                SUBS
                                     V
                                     V
277                                R021

28                                         SUBT

285                                C015............
                                     V
                                     V
288                                R022

293                                                <-------- D9
291                                         RD9
                                             V
                                             V
294                                         R023

297                                                     SUBU

302                                C016......................
*** RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*********************************                    *********************************
*                                 *                    *                               *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*                    *  U.S. ARMY CORPS OF ENGINEERS *
*        FEBRUARY 1961            *                    *  THE HYDROLOGIC ENGINEERING CENTER *
*      REVISED 14 NOV 81          *                    *        609 SECOND STREET      *
*                                 *                    *      DAVIS, CALIFORNIA 95616  *
* ED, SEP 13 1989     TIME 09:34:35 *                    * (916) 440-3285 OR (FTS) 448-3285 *
*                                 *                    *                               *
*********************************                    *********************************
```

LITCHFIELD PARK DEVELOPMENT MASTER PLAN
SUNCOR DEVELOPMENT COMPANY
EXISTING HYDROLOGY
10-YEAR, 50-YEAR, & 100-YEAR, 6-HOUR STORM
CDE & VAN LOO CONSULTING ENGINEERS INC. SEPTEMBER 1989 JKM

```
 7 10        OUTPUT CONTROL VARIABLES
                IPRNT          5  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                NMIN          10  MINUTES IN COMPUTATION INTERVAL
               IDATE      1    0  STARTING DATE
               ITIME         0005  STARTING TIME
                  NQ         300  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE      3    0  ENDING DATE
              NDTIME         0155  ENDING TIME

          COMPUTATION INTERVAL     0.17 HOURS
               TOTAL TIME BASE    49.83 HOURS

      ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT

   JP        MULTI-PLAN OPTION
               NPLAN          1  NUMBER OF PLANS

   JR        MULTI-RATIO OPTION
            RATIOS OF PRECIPITATION
             0.64      0.88      1.00
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					10 YR 6 HR	50 YR 6 HR	100 YR 6 HR
					RATIOS APPLIED TO PRECIPITATION		
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3
					0.64	0.88	1.00
HYDROGRAPH AT	SUBA	6.43	1	FLOW	367.	805.	1063.
				TIME	5.83	5.67	5.67
DIVERSION TO	D1	6.43	1	FLOW	233.	312.	322.
				TIME	5.83	5.67	5.67
HYDROGRAPH AT	DIV1	6.43	1	FLOW	133.	493.	741.
				TIME	5.83	5.67	5.67
ROUTED TO	RO1	6.43	1	FLOW	112.	443.	646.
				TIME	7.67	6.83	6.67
HYDROGRAPH AT	SUBB	11.33	1	FLOW	483.	1045.	1373.
				TIME	7.17	7.00	7.00
2 COMBINED AT	CO1	17.76	1	FLOW	591.	1485.	2010.
				TIME	7.33	6.83	6.83
DIVERSION TO	D2	17.76	1	FLOW	337.	742.	1005.
				TIME	7.33	6.83	6.83
HYDROGRAPH AT	DIV2	17.76	1	FLOW	255.	742.	1005.
				TIME	7.33	6.83	6.83
ROUTED TO	RO2	17.76	1	FLOW	254.	738.	1001.
				TIME	7.67	7.17	7.00
DIVERSION TO	D3	17.76	1	FLOW	216.	284.	300.
				TIME	7.67	7.17	7.00
HYDROGRAPH AT	DIV3	17.76	1	FLOW	39.	454.	701.
				TIME	7.67	7.17	7.00
ROUTED TO	RO3	17.76	1	FLOW	19.	355.	589.
				TIME	14.17	10.17	9.50
HYDROGRAPH AT	RO2	0.00	1	FLOW	337.	742.	1005.
				TIME	14.17	10.17	9.50
ROUTED TO	RO4	0.00	1	FLOW	334.	737.	987.
				TIME	8.00	7.33	7.33
HYDROGRAPH AT	RO3	0.00	1	FLOW	216.	284.	300.
				TIME	8.00	7.33	7.33
ROUTED TO	RO5	0.00	1	FLOW	214.	284.	300.
				TIME	8.00	7.50	7.33
HYDROGRAPH AT	SUBC	5.29	1	FLOW	176.	398.	530.
				TIME	5.83	5.50	5.50
3 COMBINED AT	CO2	5.29	1	FLOW	638.	1271.	1632.
				TIME	7.67	7.17	6.83

)UTED TO	R06	3.29	1	FLOW	638.	1268.	1629.
				TIME	8.50	7.33	7.00
·YDROGRAPH AT	SUBD	1.00	1	FLOW	65.	150.	201.
				TIME	5.00	4.83	4.83
IVERSION TO	D4	1.00	1	FLOW	33.	75.	100.
				TIME	5.00	4.83	4.83
YDROGRAPH AT	DIV4	1.00	1	FLOW	33.	75.	101.
				TIME	5.00	4.83	4.83
-JUTED TO	R07	1.00	1	FLOW	18.	47.	65.
				TIME	12.17	10.17	9.67
YDROGRAPH AT	SUBE	2.34	1	FLOW	137.	313.	418.
				TIME	5.33	5.17	5.17
3 COMBINED AT	C03	6.63	1	FLOW	695.	1429.	1861.
				TIME	7.67	7.00	6.83
IVERSION TO	D5	6.63	1	FLOW	695.	1000.	1000.
				TIME	7.67	5.67	5.00
-YDROGRAPH AT	DIV5	6.63	1	FLOW	0.	429.	861.
				TIME	0.17	7.00	6.83
·JUTED TO	R08	6.63	1	FLOW	0.	395.	821.
				TIME	0.17	8.17	7.67
IVERSION TO	D6	6.63	1	FLOW	0.	60.	60.
				TIME	0.17	7.00	6.17
YDROGRAPH AT	DIV6	6.63	1	FLOW	0.	335.	761.
				TIME	0.17	8.17	7.67
JUTED TO	R09	6.63	1	FLOW	0.	243.	654.
				TIME	0.17	9.50	8.67
YDROGRAPH AT	SUBF	14.37	1	FLOW	828.	1719.	2231.
				TIME	6.50	6.33	6.33
3 COMBINED AT	C04	38.69	1	FLOW	828.	1719.	2231.
				TIME	6.50	6.33	6.33
YDROGRAPH AT	SUBG	2.36	1	FLOW	272.	444.	588.
				TIME	4.67	4.50	4.50
IVERSION TO	D7	2.36	1	FLOW	52.	279.	412.
				TIME	4.67	4.50	4.50
YDROGRAPH AT	DIV7	2.36	1	FLOW	150.	166.	175.
				TIME	4.67	4.50	4.50
-JUTED TO	R010	2.36	1	FLOW	150.	166.	175.
				TIME	4.83	4.67	4.67
YDROGRAPH AT	SUBH	7.35	1	FLOW	311.	692.	918.
				TIME	6.83	6.67	6.50
2 COMBINED AT	C05	9.66	1	FLOW	413.	841.	1071.
				TIME	6.50	6.50	6.50
IVERSION TO	D8	9.66	1	FLOW	42.	407.	617.
				TIME	6.50	6.50	6.50

YDROGRAPH AT	DIV8	9.66	1	FLOW	371.	434.	454.
				TIME	6.50	6.50	6.50
OUTED TO	RO11	9.66	1	FLOW	369.	433.	453.
				TIME	6.83	6.83	7.00
YDROGRAPH AT	SUB1	2.14	1	FLOW	160.	360.	478.
				TIME	4.83	4.67	4.67
2 COMBINED AT	CO6	11.80	1	FLOW	462.	711.	846.
				TIME	6.00	5.17	5.00
2 COMBINED AT	CO7	50.49	1	FLOW	1286.	2348.	2941.
				TIME	6.33	6.17	6.17
OUTED TO	RO12	50.49	1	FLOW	1277.	2326.	2919.
				TIME	7.33	7.00	6.83
YDROGRAPH AT	RD7	0.00	1	FLOW	52.	279.	412.
				TIME	7.33	7.00	6.83
OUTED TO	RO13	0.00	1	FLOW	38.	256.	389.
				TIME	5.50	5.00	5.00
YDROGRAPH AT	SUBJ	0.99	1	FLOW	77.	180.	242.
				TIME	4.50	4.33	4.33
2 COMBINED AT	CO8	0.99	1	FLOW	93.	400.	592.
				TIME	5.17	4.83	4.83
DIVERSION TO	D9	0.99	1	FLOW	43.	350.	542.
				TIME	5.17	4.83	4.33
YDROGRAPH AT	DIV9	0.99	1	FLOW	50.	50.	50.
				TIME	3.83	3.50	3.33
YDROGRAPH AT	RD8	0.00	1	FLOW	42.	407.	617.
				TIME	3.83	3.50	3.33
OUTED TO	RO14	0.00	1	FLOW	41.	405.	616.
				TIME	6.67	6.67	6.67
YDROGRAPH AT	SUBK	0.45	1	FLOW	37.	87.	117.
				TIME	4.33	4.17	4.17
3 COMBINED AT	CO9	1.44	1	FLOW	102.	481.	699.
				TIME	6.50	6.50	6.50
OUTED TO	RO15	1.44	1	FLOW	90.	469.	681.
				TIME	10.00	8.67	8.33
YDROGRAPH AT	SUBL	4.75	1	FLOW	288.	658.	880.
				TIME	5.33	5.00	5.00
3 COMBINED AT	CO11	56.68	1	FLOW	1428.	2694.	3585.
				TIME	7.17	6.67	7.67
YDROGRAPH AT	RD6	0.00	1	FLOW	0.	60.	60.
				TIME	7.17	6.67	7.67
ROUTED TO	RO16	0.00	1	FLOW	0.	60.	60.
				TIME	0.17	8.83	8.00
YDROGRAPH AT	SUBM	1.23	1	FLOW	330.	636.	804.
				TIME	3.50	3.50	3.50

2 CO[illegible] D A	C[illegible]			FL[illegible]	3[illegible].	636.	804.
				TIME	3.50	3.50	3.50
OUTED TO	RET1	1.23	1	FLOW	62.	83.	91.
				TIME	5.67	6.00	6.17
				** PEAK STAGES IN FEET **			
			1	STAGE	1065.41	1066.64	1067.18
				TIME	5.67	6.00	6.17
OUTED TO	R017	1.23	1	FLOW	62.	83.	91.
				TIME	5.83	6.33	6.50
YDROGRAPH AT	SUBN	1.20	1	FLOW	372.	781.	1012.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C012	2.43	1	FLOW	372.	782.	1013.
				TIME	3.17	3.17	3.17
YDROGRAPH AT	SUBO	2.93	1	FLOW	252.	537.	702.
				TIME	4.83	4.83	4.67
OUTED TO	R019	2.93	1	FLOW	247.	534.	688.
				TIME	5.33	5.00	5.00
YDROGRAPH AT	SUBP	1.40	1	FLOW	120.	274.	365.
				TIME	4.50	4.33	4.33
OUTED TO	R020	1.40	1	FLOW	102.	242.	314.
				TIME	6.33	5.83	5.67
YDROGRAPH AT	SUBQ	3.73	1	FLOW	253.	585.	785.
				TIME	4.83	4.67	4.67
3 COMBINED AT	C014	8.06	1	FLOW	491.	1190.	1620.
				TIME	5.17	5.33	5.17
OUTED TO	RET2	8.06	1	FLOW	35.	43.	46.
				TIME	10.50	10.67	10.83
				** PEAK STAGES IN FEET **			
			1	STAGE	975.83	977.90	978.84
				TIME	10.50	10.83	11.00
YDROGRAPH AT	SUBR	0.65	1	FLOW	48.	112.	150.
				TIME	4.67	4.50	4.50
YDROGRAPH AT	SUBS	1.03	1	FLOW	73.	169.	227.
				TIME	4.67	4.50	4.50
OUTED TO	R021	1.03	1	FLOW	65.	161.	220.
				TIME	5.50	5.00	5.00
YDROGRAPH AT	SUBT	1.00	1	FLOW	312.	556.	686.
				TIME	3.67	3.67	3.67
2 COMBINED AT	C015	2.03	1	FLOW	312.	559.	694.
				TIME	3.67	3.67	3.67
OUTED TO	R022	2.03	1	FLOW	313.	54[illegible].	670.
				TIME	4.00	3.83	3.83
YDROGRAPH AT	RD9	0.00	1	FLOW	43.	350.	542.
				TIME	4.00	3.83	3.83
OUTED TO	R023	0.00	1	FLOW	26.	258.	429.
				TIME	7.67	6.17	6.00

```
YDROGRAPH AT      SUBU      3.74     1   FLOW        200.      452.      602.
                                         TIME        5.83      5.50      5.50

3 COMBINED AT     C016      5.77     1   FLOW        402.      957.     1347.
                                         TIME        4.33      5.83      5.67

*** NORMAL END OF HEC-1 ***
```

HEC-1

POST-DEVELOPMENT CONDITION

1100-270
CVL-4-1271

CVL

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*           REVISED 4 NOV 81            *
*                                       *
*MON, SEP 11 1989      TIME 16:06:49    *
*                                       *
*****************************************
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*****************************************
*                                       *
*     U.S. ARMY CORPS OF ENGINEERS      *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*            609 SECOND STREET          *
*        DAVIS, CALIFORNIA 95616        *
*  (916) 440-3285 OR (FTS) 448-3285     *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID        LITCHFIELD PARK DEVELOPMENT MASTER PLAN
  2           ID        SUNCOR DEVELOPMENT COMPANY
  3           ID        POST-DEVELOPMENT HYDROLOGY
  4           ID        10-YEAR, 50-YEAR, & 100-YEAR, 6-HOUR STORMS
  5           ID        COE & VAN LOO CONSULTING ENGINEERS INC.      SEPTEMBER 1989       JKM
              *DIAGRAM
  6           IT      15                    300
  7           IO       5       0
  8           JR    PREC    0.64    0.88    1.00

  9           KK    SUBA
 10           KM        RUNOFF FOR SUB BASIN A
 11           IN      15
 12           PB    3.15
 13           PC    0.000   0.036   0.071   0.111   0.151   0.196   0.249   0.315   0.395   0.489
 14           PC    0.604   1.366   2.293   2.488   2.612   2.715   2.795   2.861   2.919   2.968
 15           PC    3.012   3.052   3.088   3.119   3.150   3.150   3.150   3.150   3.150   3.150
 16           BA    6.43
 17           LS              74
 18           UD     2.5

 19           KK    DIV1
 20           KM        DIVERSION AT WADELL RD. & REEMS RD.
 21           DT      D1
 22           DI       0     100     300     500    1000    2000    3000    4000
 23           DQ       0     100     200     300     320     350     375     400

 24           KK    RO1
 25           KM        ROUTE DIV1 TO STATION1
 26           RK   17000   0.004   0.035            TRAP      50      20

 27           KK    SUBB
 28           KM        RUNOFF FROM SUBBASIN B
 29           BA   11.33
 30           LS              74
 31           UD     3.5

 32           KK    CO1
 33           KM        COMBINE RO1 & SUBB
 34           HC      2

 35           KK    DIV2
 36           KM        DIVERSION AT OLIVE & REEMS
 37           DT      D2
 38           DI       0     100     300     500    1000    2000    4000    8000
 39           DQ       0     100     200     300     500    1000    2000    4000

 40           KK    RO2
 41           KM        ROUTE DIV2 TO STATION 2
 42           RK    5000   0.004   0.035            TRAP      50      20
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  43          KK    DIV3
  44          KM        DIVERSION AT NORTHERN & REEMS
  45          DT      D3
  46          DI       0      100      300      500     1000     2000     4000     8000
  47          DQ       0      100      250      270      300      300      300      300

  48          KK    RO3
  49          KM        ROUTE DIV3 TO STATION 3
  50          RK   24000   0.003   0.040             TRAP      100       50

  51          KK    RO2
  52          KM        RETRIEVE D2
  53          DR      D2

  54          KK    RO4
  55          KM        ROUTE RO2 TO STATION 4
  56          RK   13000   0.0025   0.035             TRAP        5        6

  57          KK    RO3
  58          KM        RETRIEVE D3
  59          DR      D3

  60          KK    RO5
  61          KM        ROUTE RO3 TO STATION 5
  62          RK    8000   0.002   0.035             TRAP       10        3

  63          KK    SUBC
  64          KM        RUNOFF FROM SUBBASIN C
  65          BA    3.29
  66          LS              73
  67          UD     2.2

  68          KK    CO2
  69          KM        COMBINE RO4, RO5, & SUBC
  70          HC       3

  71          KK    RO6
  72          KM        ROUTE CO2 TO STATION 6
  73          RK    9000   0.001   0.020             TRAP       20        2

  74          KK    SUBD
  75          KM        RUNOFF FROM SUBBASIN D
  76          BA    1.00
  77          LS              73
  78          UD     1.6

  79          KK    DIV4
  80          KM        DIVERSION AT PEORIA & LITCHFIELD
  81          DT      D4
  82          DI       0      100      200      400     1000     2000
  83          DQ       0       50      100      150      200      250
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  84          KK      R07
  85          KM          ROUTE DIV4 TO STATION 7
  86          RK    15000   0.034   0.050              TRAP      500      100

  87          KK     SUBE
  88          KM          RUNOFF FROM SUBBASIN E
  89          BA     2.34
  90          LS                73
  91          UD      1.9

  92          KK      C03
  93          KM          COMBINE R06, R07, & SUBE
  94          HC        3

  95          KK     DIV5
  96          KM          DIVERSION FROM LUKE AFB CHANNEL
  97          DT       D5
  98          DI        0      100      500     1000     1500     2000     5000
  99          DQ        0      100      500     1000     1000     1000     1000

 100          KK      R08
 101          KM          ROUTE DIV5 TO STATION 8
 102          RK     6000   0.031   0.040              TRAP      100      100

 103          KK     DIV6
 104          KM          DIVERSION THROUGH PIPE TO MURPHYS DAM
 105          DT       D6
 106          DI        0       60      200      500     1000     2000     5000
 107          DQ        0       60       60       60       60       60       60

 108          KK      R09
 109          KM          ROUTE DIV6 TO STATION 9
 110          RK    17000   0.002   0.035              TRAP       40        5

 111          KK     SUBF
 112          KM          RUNOFF FROM SUBBASIN F
 113          BA    14.30
 114          LS                76
 115          UD      2.9

 116          KK      C04
 117          KM          COMBINE R03, R09, & SUBF
 118          HC        3

 119          KK     SUBG
 120          KM          RUNOFF FROM SUBBASIN G
 121          BA     2.36
 122          LS                75
 123          UD      1.4
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 124          KK    DIV7
 125          KM        DIVERSION AT CITRUS & CAMELBACK
 126          DT      D7
 127          DI       0      100      200      300      500     1000     2000
 128          DQ       0        0       50      145      330      800     1750

 129          KK    R010
 130          KM        ROUTE DIV7 TO STATION 10
 131          RK    5000   0.005   0.035              TRAP       5        2

 132          KK    SUBH
 133          KM        RUNOFF FROM SUBBASIN H
 134          BA    7.30
 135          LS              73
 136          UD     3.1

 137          KK     C05
 138          KM        COMBINE R010 & SUBH
 139          HC       2

 140          KK    DIV8
 141          KM        DIVERSION AT COTTON & CAMELBACK
 142          DT      D8
 143          DI       0      100      350      500     1000     2000     4000     6000
 144          DQ       0        0        0      100      550     1500     3500     5500

 145          KK    R011
 146          KM        ROUTE DIV8 TO STATION 11
 147          RK   14000   0.003   0.035              TRAP      20        2

 148          KK    SUBI
 149          KM        RUNOFF FROM SUBBASIN I
 150          BA    2.14
 151          LS              74
 152          UD     1.5

 153          KK     C06
 154          KM        COMBINE R011 & SUBI
 155          HC       2

 156          KK     C07
 157          KM        COMBINE C04 & C06
 158          HC       2

 159          KK    R051
 160          KM        ROUTE C07 TO STATION 51
 161          RK    2000   0.005   0.035              TRAP     150        4

 162          KK   SUBIA
 163          KM        RUNOFF FROM SUBBASSIN 1A
 164          BA   0.148
 165          LS              81
 166          UD    0.35
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 167          KK   RET1A
 168          KM        RETENTION BASIN 1A
 169          RS       1    ELEV       0
 170          SV       0     2.0      5.0     10.0     13.0
 171          SQ       0     2.2      4.5      6.0      500
 172          SE       0       1        2        3      3.5

 173          KK   C051
 174          KM        COMBINE R051 & RET1A
 175          HC       2

 176          KK   R052
 177          KM        ROUTE C051 TO STATION 52
 178          RK   4600   0.004   0.035            TRAP     150       4

 179          KK    RD7
 180          KM        RETRIEVE D7
 181          DR      D7

 182          KK   R013
 183          KM        ROUTE RD7 TO STATION 13
 184          RK   1000   0.003   0.025            TRAP      30       4

 185          KK   SUBJ
 186          KM        RUNOFF FROM SUBBASIN J
 187          BA   0.39
 188          LS              73
 189          UD    1.2

 190          KK    C08
 191          KM        COMBINE R013 & SUBJ
 192          HC       2

 193          KK   DIV9
 194          KM        DIVERSION AT COTTON & INDIAN SCHOOL
 195          DT      D9
 196          DI       0      50     100     200     500    1000    2000
 197          DQ       0       0      50     150     450     950    1950

 198          KK    RD8
 199          KM        RETRIEVE D8
 200          DR      D8

 201          KK   R014
 202          KM        ROUTE RD8 TO STATION 14
 203          RK   5000   0.003   0.025            TRAP      30       4

 204          KK   SUBK
 205          KM        RUNOFF FROM SUBBASIN K
 206          BA   0.45
 207          LS              73
 208          UD    1.1
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 209          KK     C09
 210          KM        COMBINE DIV9, R014, & SUBK
 211          HC       3

 212          KK     R053
 213          KM        ROUTE C09 TO STATION 53
 214          RK     2000    0.004    0.035              TRAP       20        4

 215          KK    SUB1B
 216          KM        RUNOFF FROM SUBBASIN 1B
 217          BA    0.484
 218          LS                87
 219          UD    0.43

 220          KK    RET1B
 221          KM        RETENTION BASIN 1B
 222          RS       1     ELEV        0
 223          SV       0     10.6      28.2      49.4      70.5      84.6
 224          SQ       0     12.5        26        35        40       500
 225          SE       0        2         4         6       7.5         8

 226          KK     C052
 227          KM        COMBINE R053 & RET1B
 228          HC       2

 229          KK     R054
 230          KM        ROUTE C052 TO STATION 54
 231          RK     2400    0.004    0.035              TRAP       20        4

 232          KK    SUB1C
 233          KM        RUNOFF FROM SUBBASIN 1C
 234          BA    0.458
 235          LS                87
 236          UD    0.38

 237          KK    RET1C
 238          KM        RETENTION BASIN 1C
 239          RS       1     ELEV        0
 240          SV       0      9.6      25.4      44.5      63.7      76.4
 241          SQ       0     12.5        26        35        40       500
 242          SE       0        2         4         6       7.5         8

 243          KK     C053
 244          KM        COMBINE R054 & RET1C
 245          HC       2

 246          KK     R055
 247          KM        ROUTE C053 TO STATION 55
 248          RK     2800    0.003    0.035              TRAP       20        4
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  249         KK   SUB1D
  250         KM        RUNOFF FROM SUBBASIN 1D
  251         BA   0.208
  252         LS             88
  253         UD    0.25

  254         KK    R056
  255         KM        ROUTE SUB1D TO STATION 56
  256         RK    2500   0.004   0.035            TRAP      10        4

  257         KK   SUB1E
  258         KM        RUNOFF FROM SUBBASIN 1E
  259         BA   0.241
  260         LS             83
  261         UD    0.31

  262         KK    C054
  263         KM        COMBINE R056 & SUB1E
  264         HC       2

  265         KK   RET1E
  266         KM        RETENTION BASIN 1E
  267         RS       1    ELEV       0.
  268         SV       0     5.0    12.4    22.3    34.7    49.5    59.4
  269         SQ       0     4.2    12.5    20.2    26.0    31.0     500
  270         SE       0       1       2       3       4       5     5.5

  271         KK    C055
  272         KM        COMBINE R055 & RET1E
  273         HC       2

  274         KK    R057
  275         KM        ROUTE C055 TO STATION 56
  276         RK    4200   0.002   0.035            TRAP      20        4

  277         KK   SUB1F
  278         KM        RUNOFF FROM SUBBASIN 1F
  279         BA   0.323
  280         LS             84
  281         UD    0.26

  282         KK    R058
  283         KM        ROUTE SUB1F TO STATION 58
  284         RK    3200   0.004   0.035            TRAP      10        4

  285         KK   SUB1G
  286         KM        RUNOFF FROM SUBBASIN 1G
  287         BA   0.494
  288         LS             79
  289         UD    0.49
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  290         KK    C056
  291         KM        COMBINE R057 & SUB1G
  292         HC       2

  293         KK   RET1G
  294         KM        RETENTION BASIN 1G
  295         RS       1    ELEV       0
  296         SV       0     9.0     24.0     42.1     60.1     72.1
  297         SQ       0    12.5       26       35       40      500
  298         SE       0       2        4        6      7.5        8

  299         KK    C057
  300         KM        COMBINE R056 & RET1G
  301         HC       2

  302         KK    R059
  303         KM        ROUTE C057 TO STATION 59
  304         RK    1800   0.002   0.035              TRAP       20        4

  305         KK   SUB1H
  306         KM        RUNOFF FROM SUBBASIN 1H
  307         BA   0.238
  308         LS              79
  309         UD    0.31

  310         KK   RET1H
  311         KM        RETENTION BASIN        1H
  312         RS       1    ELEV       0
  313         SV       0     3.0      7.6     15.2     19.8
  314         SQ       0     2.8      7.0      9.0      500
  315         SE       0       1        2        3      3.5

  316         KK   SUB1I
  317         KM        RUNOFF FROM SUBBASIN 1I
  318         BA   0.459
  319         LS              79
  320         UD    0.49

  321         KK   RET1I
  322         KM        RETENTION BASIN 1I
  323         RS       1    ELEV       0
  324         SV       0     5.9     14.7     29.4     38.2
  325         SQ       0     5.0       16       28      500
  326         SE       0       1        2        3      3.5

  327         KK    C058
  328         KM        COMBINE R052, R059, RET1H, & RET1I
  329         HC       4
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

330           KK    DIVA
331           KM        DIVERT PEAK FLOW INTO RETENTION BASIN
332           DT      DA
333           DI       0     500    1000    1500    2000    2500    3000    3470    3500    4000
334           DQ       0       0       0       0       0       0       0       0      30     530

335           KK    R060
336           KM        ROUTE C058 TO STATION 60
337           RK    4400   0.002   0.035            TRAP     150       4

338           KK    SUB1J
339           KM        RUNOFF FROM SUBBASIN 1J
340           BA    0.273
341           LS              87
342           UD     0.21

343           KK    R061
344           KM        ROUTE SUB1J TO STATION 61
345           RK    4000  0.0025   0.035            TRAP      15       4

346           KK    SUB1K
347           KM        RUNOFF FROM SUBBASIN 1K
348           BA    0.344
349           LS              82
350           UD     0.33

351           KK    C059
352           KM        COMBINE R061 & SUB1K
353           HC       2

354           KK    RET1K
355           KM        RETENTION BASIN 1K
356           RS       1    ELEV       0
357           SV       0     5.5    13.8    24.9    38.7    55.3    66.4
358           SQ       0     4.2    12.5    20.2    26.0    31.0     500
359           SE       0       1       2       3       4       5     5.5

360           KK    R062
361           KM        ROUTE RET1K TO STATION 62
362           RK    1600  0.0025   0.035            TRAP       5       4

363           KK    SUB1L
364           KM        RUNOFF FROM SUBBASIN 1L
365           BA    0.255
366           LS              82
367           UD     0.39

368           KK    C060
369           KM        COMBINE R062 & SUB1L
370           HC       2
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 371          KK   R063
 372          KM        ROUTE C060 TO STATION 63
 373          RK   4400  0.0025   0.035              TRAP      15       4

 374          KK   SUB1M
 375          KM        RUNOFF FROM SUBBASIN 1M
 376          BA   0.570
 377          LS              83
 378          UD    0.52

 379          KK   SUB1N
 380          KM        RUNOFF FROM SUBBASIN 1N
 381          BA   0.297
 382          LS              81
 383          UD    0.40

 384          KK   C061
 385          KM        COMBINE R063, SUB1M, & SUB1N
 386          HC       3

 387          KK   RET1N
 388          KM        RETENTION BASIN 1N
 389          RS       1    ELEV       0
 390          SV       0    12.9     34.5     60.3     86.2    103.4
 391          SQ       0      18       50       70       82      500
 392          SE       0       2        4        6      7.5        8

 393          KK   SUB10
 394          KM        RUNOFF FROM SUBBASIN 10
 395          BA   0.173
 396          LS              83
 397          UD    0.31

 398          KK   RET10
 399          KM        RETENTION BASIN 10
 400          RS       1    ELEV       0
 401          SV       0     2.6      6.5     13.0     16.9
 402          SQ       0     2.8      7.0      9.0      500
 403          SE       0       1        2        3      3.5

 404          KK   SUB1P
 405          KM        RUNOFF FROM SUBBASIN 1P
 406          BA   0.153
 407          LS              84
 408          UD    0.27

 409          KK   RET1P
 410          KM        RETENTION BASIN 1P
 411          RS       1    ELEV       0
 412          SV       0     2.5      6.3     12.5     16.3
 413          SQ       0     2.8        7        9      500
 414          SE       0       1        2        3      3.5
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  415         KK     RDA
  416         KM         RETRIEVE DA
  417         DR       DA

  418         KK    RETDA
  419         KM         PEAK FLOW RETENTION
  420         RS       1     ELEV       0
  421         SV       0       10       20       30       40       50       60
  422         SQ       0        3        7        9       11      500     1000
  423         SE       0        1        2        3        4        5        6

  424         KK    C010
  425         KM         COMBINE RD60, RET1N, RET10, RET1P, & RETDA
  426         HC       5

  427         KK     RD6
  428         KM         RETRIEVE D6
  429         DR       D6

  430         KK    RO16
  431         KM         ROUTE RD6 TO STATION 16
  432         RK     6440    0.012    0.035              TRAP       20        4

  433         KK    SUBM
  434         KM         RUNOFF FROM SUBBASIN M
  435         BA    1.23
  436         LS              82
  437         UD      0.6

  438         KK    C011
  439         KM         COMBINE RO16 & SUBM
  440         HC       2

  441         KK    RET1
  442         KM         MURPHYS DAM RETENTION
  443         RS       1     ELEV    1062
  444         SA       0        9       23       39       65
  445         SQ       0       32       74      162      322
  446         SE    1062     1064     1066     1068     1070

  447         KK    RO17
  448         KM         ROUTE RET1 TO STATION 17
  449         RK     4540    0.004    0.035              TRAP       20        4

  450         KK    SUBN
  451         KM         RUNOFF FROM SUBBASIN N
  452         BA    1.20
  453         LS              79
  454         UD      0.3
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

455           KK    C012
456           KM        COMBINE R017 & SUBN
457           HC       2

458           KK   SUB1Q
459           KM        RUNOFF FROM SUBBASIN 1Q
460           BA   0.638
461           LS              75
462           UD    0.28

463           KK    R065
464           KM        ROUTE SUB1Q TO STATION 65
465           RK    1400   0.004   0.035            TRAP       20        4

466           KK   SUB1R
467           KM        RUNOFF FROM SUBBASIN 1R
468           BA   0.133
469           LS              81
470           UD    0.23

471           KK   RET1R
472           KM        RETENTION BASIN 1R
473           RS       1    ELEV       0
474           SV       0     1.9      4.7      9.4     12.2
475           SQ       0     2.2      4.5      6.0      500
476           SE       0       1        2        3      3.5

477           KK    C003
478           KM        COMBINE R065 & RET1R
479           HC       2

480           KK    R066
481           KM        ROUTE RET1R TO STATION 66
482           RK    5000   0.003   0.035            TRAP        5        4

483           KK   SUB1S
484           KM        RUNOFF FROM SUBBASIN 1S
485           BA   0.247
486           LS              73
487           UD    0.67

488           KK    R067
489           KM        ROUTE SUB1S TO STATION 67
490           RK    2000   0.003   0.035            TRAP        5        4

491           KK   SUB1T
492           KM        RUNOFF FROM SUBBASIN 1T
493           BA   0.492
494           LS              88
495           UD    0.36
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

496           KK    C064
497           KM        COMBINE R066, R067, & SUB1T
498           HC       3

499           KK   RET1T
500           KM        RETENTION BASIN 1T
501           RS       1    ELEV       0
502           SV       0      5.6     14.0     25.2     39.1     55.9     67.1
503           SQ       0        5       16       28       37       45      500
504           SE       0        1        2        3        4        5      5.5

505           KK    ROR1
506           KM        ROUTE RET1T TO STATION R1
507           RK    2100  0.0020   0.035              TRAP      10        4

508           KK   SUBRA
509           KM        RUNOFF FROM SUBBASIN RA
510           BA   0.216
511           LS              81
512           UD    0.31

513           KK    COR1
514           KM        COMBINE ROR1 & SUBRA
515           HC       2

516           KK    ROR2
517           KM        ROUTE COR1 TO STATION R2
518           RK    2200  0.0020   0.035              TRAP      20        4

519           KK   SUBRB
520           KM        RUNOFF FROM SUBBASIN RB
521           BA   0.270
522           LS              80
523           UD    0.34

524           KK   SUBRC
525           KM        RUNOFF FROM SUBBASIN RC
526           BA   0.108
527           LS              78
528           UD    0.27

529           KK    COR2
530           KM        COMBINE ROR2, ROR3, & SUBRC
531           HC       3

532           KK    ROR4
533           KM        ROUTE COR2 TO STATION R4
534           RK    3000  0.0030   0.035              TRAP      20        4
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

535           KK    SUBRD
536           KM          RUNOFF FROM SUBBASIN RD
537           BA    0.317
538           LS                82
539           UD     0.43

540           KK    SUBRE
541           KM          RUNOFF FROM SUBBASIN RE
542           BA    0.233
543           LS                80
544           UD     0.37

545           KK     COR3
546           KM          COMBINE ROR4, SUBRD, & SUBRE
547           HC        3

548           KK     ROR5
549           KM          ROUTE COR3 TO STATION R5
550           RK     1500    0.002    0.035              TRAP       20        4

551           KK    SUBRF
552           KM          RUNOFF FROM SUBBASIN RF
553           BA    0.183
554           LS                83
555           UD     0.18

556           KK    SUB2H
557           KM          RUNOFF FROM SUBBASIN 2H
558           BA    0.223
559           LS                73
560           UD     0.83

561           KK     R078
562           KM          ROUTE SUB2H TO STATION 78
563           RK     3000    0.002    0.035              TRAP       15        4

564           KK    SUB2I
565           KM          RUNOFF FROM SUBBASIN 2I
566           BA    0.281
567           LS                86
568           UD     0.22

569           KK     COR4
570           KM          COMBINE ROR5, R078, SUBRF, & SUB2I
571           HC        4

572           KK    SUB1V
573           KM          RUNOFF FROM SUBBASIN 1V
574           BA    0.698
575           LS                73
576           UD     1.00
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  577         KK    ROR6
  578         KM          ROUTE SUB1V TO STATION R6
  579         RK    3000  0.0015   0.035            TRAP      20        4

  580         KK    SUBRG
  581         KM          RUNOFF FROM SUBBASIN RG
  582         BA    0.277
  583         LS                82
  584         UD    0.42

  585         KK    COR5
  586         KM          COMBINE ROR6 & SUBRG
  587         HC        2

  588         KK    ROR7
  589         KM          ROUTE COR5 TO STATION R7
  590         RK    4400  0.0010   0.035            TRAP      20        4

  591         KK    SUBRH
  592         KM          RUNOFF FROM SUBBASIN RH
  593         BA    0.300
  594         LS                85
  595         UD    0.44

  596         KK    COR6
  597         KM          COMBINE ROR7 & SUBRH
  598         HC        2

  599         KK    SUB1Y
  600         KM          RUNOFF FROM SUBBASIN 1Y
  601         BA    1.558
  602         LS                79
  603         UD    0.46

  604         KK    COR7
  605         KM          COMBINE COR6 & SUB1Y
  606         HC        2

  607         KK    ROR8
  608         KM          ROUTE COR7 TO STATION R8
  609         RK    2600  0.003    0.035            TRAP      30        4

  610         KK    SUBRI
  611         KM          RUNOFF FROM SUBBASIN RI
  612         BA    0.313
  613         LS                79
  614         UD    0.31

  615         KK    COR8
  616         KM          COMBINE ROR8 & SUBRI
  617         HC        2
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  618         KK    ROR9
  619         KM          ROUTE COR8 TO STATION R9
  620         RK    3200  0.0020   0.035            TRAP      50        5

  621         KK    SUBRJ
  622         KM          RUNOFF FROM SUBBASIN RJ
  623         BA  0.2250
  624         LS                77
  625         UD    0.28

  626         KK    SUBRK
  627         KM          RUNOFF FROM SUBBASIN RK
  628         BA    0.214
  629         LS                87
  630         UD    0.21

  631         KK    ROR10
  632         KM          ROUTE SUBRK TO STATION R10
  633         RK    3400   0.002   0.035            TRAP      10        5

  634         KK    SUBRL
  635         KM          RUNOFF FROM SUBBASIN RL
  636         BA  0.1813
  637         LS                81
  638         UD    0.36

  639         KK    COR9
  640         KM          COMBINE ROR10 & SUBRL
  641         HC        2

  642         KK    COR10
  643         KM          COMBINE ROR9, COR9, & SUBRJ
  644         HC        3

  645         KK    ROR11
  646         KM          ROUTE COR10 TO STATION R11
  647         RK    1600  0.0020   0.035            TRAP      50        5

  648         KK    SUBRM
  649         KM          RUNOFF FROM SUBBASIN RM
  650         BA  0.0719
  651         LS                77
  652         UD    0.27

  653         KK    COR11
  654         KM          COMBINE ROR11 & SUBRM
  655         HC        2

  656         KK    ROR12
  657         KM          ROUTE COR11 TO STATION R12
  658         RK    1200  0.0020   0.035            TRAP      50        5
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

659           KK   SUBRN
660           KM        RUNOFF FROM SUBBASIN RN
661           BA  0.0781
662           LS              32
663           UD    0.28

664           KK   ROR13
665           KM        ROUTE SUBRN TO STATION R13
666           RK    3500   0.002   0.035            TRAP      20        5

667           KK   SUBRO
668           KM        RUNOFF FROM SUBBASIN RO
669           BA  0.2719
670           LS              78
671           UD    0.36

672           KK   COR12
673           KM        COMBINE  ROR13, & SUBRO
674           HC       2

675           KK   SUBRP
676           KM        RUNOFF FROM SUBBASIN RP
677           BA  0.1719
678           LS              80
679           UD    0.33

680           KK   COR13
681           KM        COMBINE COR12, ROR12, & SUBRO
682           HC       3

683           KK   ROR14
684           KM        ROUTE COR13 TO STATION R14
685           RK    1400   0.002   0.035            TRAP      50        5

686           KK   SUBRQ
687           KM        RUNOFF FROM SUBBASIN RQ
688           BA  0.2118
689           LS              83
690           UD    0.18

691           KK   SUBRR
692           KM        RUNOFF FROM SUBBASIN RR
693           BA  0.2393
694           LS              80
695           UD    0.18

696           KK   COR14
697           KM        COMBINE COR4, ROR14, SUBRQ, & SUBRR
698           HC       4
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 699          KK    RET2
 700          KM        ADOT RETENTION AT LITCHFIELD RD & I10
 701          RS       1    ELEV     971
 702          SV       0     0.9    38.9   144.2   316.6   534.8   758.7   930.4  1103.9  1115.0
 703          SQ       0      11      28      36      43      49      53      57      62     500
 704          SE     971     972     974     976     978     980     982   983.5     985   985.1

 705          KK    RD9
 706          KM        RETRIEVE D9
 707          DR     D9

 708          KK    RD79
 709          KM        ROUTE RD9 TO STATION 79
 710          RK    5200   0.003   0.035            TRAP      25       4

 711          KK    SUB2M
 712          KM        RUNOFF FROM SUBBASIN 2M
 713          BA    0.184
 714          LS              76
 715          UD     0.35

 716          KK    SUB2N
 717          KM        RUNOFF FROM SUBBASIN 2N
 718          BA    0.555
 719          LS              90
 720          UD     0.39

 721          KK    SUB20
 722          KM        RUNOFF FROM SUBBASIN 20
 723          BA    0.258
 724          LS              92
 725          UD     0.35

 726          KK    CO75
 727          KM        COMBINE  SUB2M, SUB2N, & SUB20
 728          HC       3

 729          KK    RET2N
 730          KM        RETENTION BASIN 2N
 731          RS       1    ELEV       0
 732          SV       0    19.6    52.3    91.6   130.8   157.0
 733          SQ       0      18      50      70      82     500
 734          SE       0       2       4       6     7.5       8

 735          KK    SUB2P
 736          KM        RUNOFF FROM SUBBASIN 2P
 737          BA    0.283
 738          LS              91
 739          UD     0.35
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  740         KK   RET2P
  741         KM        RETENTION BASIN 2P
  742         RS       1    ELEV       0
  743         SV       0     3.6     9.1    16.2    25.3    36.2    43.4
  744         SQ       0     3.4     8.8    12.2    15.1    18.5     500
  745         SE       0       1       2       3       4       5     5.5

  746         KK   CORA
  747         KM        COMBINE R079, RET2N, & RET2O
  748         HC       3

  749         KK   R080
  750         KM        ROUTE CORA TO STATION 80
  751         RK    3000   0.004   0.035              TRAP      25       4

  752         KK   SUB2Q
  753         KM        RUNOFF FROM SUBBASIN 2Q
  754         BA   0.094
  755         LS              90
  756         UD    0.20

  757         KK   RET2Q
  758         KM        RETENTION BASIN 2Q
  759         RS       1    ELEV       0
  760         SV       0     2.5     6.3    12.5    16.3
  761         SQ       0     2.8       7       9     500
  762         SE       0       1       2       3     3.5

  763         KK   CORB
  764         KM        COMBINE R080 & RET2Q
  765         HC       2

  766         KK   R081
  767         KM        ROUTE CORB TO STATION 81
  768         RK    2400   0.004   0.035              TRAP      25       4

  769         KK   SUBS
  770         KM        RUNOFF FROM SUBBASIN S
  771         BA    1.03
  772         LS              73
  773         UD     1.4

  774         KK   R021
  775         KM        ROUTE SUBS TO STATION 21
  776         RK    8000   0.006   0.040              TRAP      50       6

  777         KK   SUBT
  778         KM        RUNOFF FROM SUBBASIN T
  779         BA    1.00
  780         LS              85
  781         UD     0.7
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  782         KK    C015
  783         KM          COMBINE R021 & SUBT
  784         HC        2

  785         KK    CORC
  786         KM          COMBINE R081 & C015
  787         HC        2

  788         KK    R082
  789         KM          ROUTE CORC TO STATION 82
  790         RK    3000   0.004   0.035            TRAP      25        4

  791         KK    SUB2R
  792         KM          RUNOFF FROM SUBBASIN 2R
  793         BA    0.317
  794         LS                 86
  795         UD    0.44

  796         KK    SUB2S
  797         KM          RUNOFF FROM SUBBASIN 2S
  798         BA    0.258
  799         LS                 81
  800         UD    0.43

  801         KK    C077
  802         KM          COMBINE SUB2R & SUB2S
  803         HC        2

  804         KK    RET2S
  805         KM          RETENTION BASIN 2S
  806         RS        1     ELEV        0
  807         SV        0      4.6     11.5     20.7     32.2     46.0     55.2
  808         SQ        0      4.2     12.5     20.2     26.0     31.0      500
  809         SE        0        1        2        3        4        5      5.5

  810         KK    R083
  811         KM          ROUTE RET2S TO STATION 83
  812         RK    2800  0.0015   0.035            TRAP       5        4

  813         KK    SUB2T
  814         KM          RUNOFF FROM SUBBASIN 2T
  815         BA    0.391
  816         LS                 84
  817         UD    0.32

  818         KK    C078
  819         KM          COMBINE R083 & SUB2T
  820         HC        2
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

821           KK   RET2T
822           KM        RETENTION BASIN 2T
823           RS       1    ELEV       0
824           SV       0      3.4      8.6     15.5     24.8     34.4     41.3
825           SQ       0        2       18       35       50       61      500
826           SE       0        1        2        3        4        5      5.5

827           KK   R084
828           KM        ROUTE RET2T TO STATION 84
829           RK    1600  0.0045   0.035              TRAP        5        4

830           KK   SUB2X
831           KM        RUNOFF FROM SUBBASIN 2X
832           BA   0.247
833           LS              88
834           UD    0.32

835           KK   RET2X
836           KM        RETENTION BASIN 2X
837           RS       1    ELEV       0
838           SV       0      5.5     13.7     27.3     35.5
839           SQ       0      4.2     12.5     20.2      500
840           SE       0        1        2        3      3.5

841           KK   R087
842           KM        ROUTE CO80 TO STATION 87
843           RK    3200   0.001   0.035              TRAP       30        4

844           KK   SUB2Y
845           KM        RUNOFF FROM SUBBASIN 2Y
846           BA   0.300
847           LS              89
848           UD    0.31

849           KK   CO81
850           KM        COMBINE R087 & SUB2Y
851           HC       2

852           KK   SUB2Z
853           KM        RUNOFF FROM SUBBASIN 2Z
854           BA   0.400
855           LS              82
856           UD    0.30

857           KK   CO82
858           KM        COMBINE R084, CO81, & SUB2Z
859           HC       3

860           KK   RET2Z
861           KM        RETENTION BASIN 2Z
862           RS       1    ELEV       0
863           SV       0     10.1     26.9     47.0     67.2     80.6
864           SQ       0       18       50       70       82      500
865           SE       0        2        4        6      7.5        8
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  866         KK    CORD
  867         KM          COMBINE R082 & RET2Z
  868         HC        2

  869         KK    SUB2U
  870         KM          RUNOFF FROM SUBBASIN 2U
  871         BA    0.158
  872         LS                84
  873         UD     0.40

  874         KK    SUB2V
  875         KM          RUNOFF FROM SUBBASIN 2V
  876         BA    0.220
  877         LS                87
  878         UD     0.40

  879         KK    C079
  880         KM          COMBINE SUB2U & SUB2V
  881         HC        2

  882         KK    R085
  883         KM          ROUTE C079 TO STATION 85
  884         RK    2000    0.002    0.035            TRAP      10        4

  885         KK    SUB2W
  886         KM          RUNOFF FROM STATION 2W
  887         BA    0.230
  888         LS                90
  889         UD     0.30

  890         KK    C083
  891         KM          COMBINE R085 & SUB2W
  892         HC        2

  893         KK    RET2W
  894         KM          RETENTION BASIN 2W
  895         RS        1    ELEV        0
  896         SV        0    10.2     27.2     47.7     68.1     81.7
  897         SQ        0    12.5       26       35       40      500
  898         SE        0       2        4        6      7.5        8
  899         ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE        (V) ROUTING          (--->) DIVERSION
 NO.        (.) CONNECTOR        (<---) RETURN OF DIVERTED FLOW

 9          SUBA
                 .
                 .
21               .-------->      D1
19          DIV1
                 V
                 V
24          RO1
                 .
                 .
27               .        SUBB
                 .          .
                 .          .
32          CO1.............
                 .
                 .
37               .-------->      D2
35          DIV2
                 V
                 V
40          RO2
                 .
                 .
45               .-------->      D3
43          DIV3
                 V
                 V
48          RO3
                 .
                 .
53               .          .<-------      D2
51               .       RD2
                 .        V
                 .        V
54               .       RO4
                 .        .
                 .        .
59               .        .          .<-------      D3
57               .        .       RD3
                 .        .        V
                 .        .        V
60               .        .       RO5
                 .        .        .
                 .        .        .
63               .        .        .        SUBC
                 .        .        .          .
                 .        .        .          .
68               .       CO2.......................
                 .        V
                 .        V
71               .       RO6
                 .        .
                 .        .
74               .        .       SUBD
                 .        .        .
                 .        .        .
81               .        .        .-------->      D4
79               .        .       DIV4
                 .        .        V
```

```
                                  V
 84                            R07
                                  .
                                  .
 87                                     SUBE
                                  .       .
 92                        C03.......................
                                  .
 97                               .------->     D5
 95                        DIV5
                                  V
                                  V
100                        R08
                                  .
                                  .
105                               .------->     D6
103                        DIV6
                                  V
                                  V
108                        R09
                                  .
                                  .
111                            SUBF
                                  .
                                  .
116                   C04........................
                                  .
                                  .
119                        SUBG
                                  .
                                  .
126                               .-------->    D7
124                        DIV7
                                  V
                                  V
129                        R010
                                  .
                                  .
132                            SUBH
                                  .
                                  .
137                        C05............
                                  .
                                  .
142                               .------->     D8
140                        DIV8
                                  V
                                  V
145                        R011
                                  .
                                  .
148                            SUBI
                                  .
                                  .
153                        C06............
                                  .
                                  .
156                   C07............
                                  V
                                  V
159                   R051
                                  .
                                  .
```

```
162          UB1A
                V
                V
167          RET1A
                .
                .
173     C051............
        V
        V
176     R052
        .
        .
181     .<-------      D7
179     .      RD7
        .        V
        .        V
182     .      R013
        .        .
        .        .
185     .        .        SUBJ
        .        .          .
        .        .          .
190     .      C08..........
        .        .
        .        .
195     .        .-------->     D9
193     .      DIV9
        .        .
        .        .
200     .        .          .<-------      D8
198     .        .       RD8
        .        .         V
        .        .         V
201     .        .       R014
        .        .          .
        .        .          .
204     .        .          .        SUBK
        .        .          .          .
        .        .          .          .
209     .      C09.......................
        .        V
        .        V
212     .      R053
        .        .
        .        .
215     .        .       SUB1B
        .        .         V
        .        .         V
220     .        .       RET1B
        .        .          .
        .        .          .
226     .      C052..........
        .        V
        .        V
229     .      R054
        .        .
        .        .
232     .        .       SUB1C
        .        .         V
        .        .         V
237     .        .       RET1C
        .        .          .
        .        .          .
243     .      C053..........
        .        V
        .        V
246     .      R055
```

```
249                 SUB1D
                      V
                      V
254                 R056
                      .
257                 .       SUB1E
                    .         .
262                 C054.....
                      V
                      V
265                 RET1E
                      .
271           C055.....
                V
                V
274           R057
                .
277                 SUB1F
                      V
                      V
282                 R058
                      .
285                 .       SUB1G
                    .         .
290                 C056.....
                      V
                      V
293                 RET1G
                      .
299           C057.....
                V
                V
302           R059
                .
305                 SUB1H
                      V
                      V
310                 RET1H
                      .
316                 .       SUB1I
                    .         V
                    .         V
321                 .       RET1I
                    .         .
327     C058.....................
                .
332             ------->    DA
330     D1VA
          V
          V
335     R060
                .
```

```
338          SUB1J
                V
                V
343          R061
                .
                .
346                    SUB1K
                .          .
                .          .
351          C059..........
                V
                V
354          RET1K
                V
                V
363          R062
                .
                .
363                    SUB1L
                .          .
                .          .
368          C060..........
                V
                V
371          R063
                .
                .
374                    SUB1M
                .          .
                .          .
379                    .          SUB1N
                .          .          .
                .          .          .
384          C061......................
                V
                V
387          RET1N
                .
                .
393                    SUB1O
                .          V
                .          V
398                    RET1O
                .          .
                .          .
404                    .          SUB1P
                .          .          V
                .          .          V
409                    .          RET1P
                .          .          .
                .          .          .
417                    .          .          .<-------      DA
415                    .          .          .     RDA
                .          .          .          V
                .          .          .          V
418                    .          .          .     RETDA
                .          .          .          .
                .          .          .          .
424          C010.......................................
                .
                .
429                .<-------      D6
427          RD6
                V
                V
430          R016
```

433		SUBM		
438	C011			
441	RET1			
447	R017			
450		SUBN		
455	C012			
458		SUB1Q		
463		R065		
466			SUB1R	
471			RET1R	
477		C063		
480		R066		
483			SUB1S	
488			R067	
491				SUB1T
496		C064		
499		RET1T		
505		ROR1		
508			SUBRA	
513		COR1		
516		ROR2		
519			SUBRB	

524				SUBRC	
529		COR2			
532		ROR4			
535			SUBRD		
540				SUBRE	
545		COR3			
548		ROR5			
551			SUBRF		
556				SUB2H	
561				ROT8	
564					SUB2I
569		COR4			
572			SUB1V		
577			ROR6		
580				SUBRG	
585			COR5		
588			ROR7		
591				SUBRH	
596			COR6		
599				SUB1Y	
604			COR7		
607			ROR8		

```
610                                      SUBRI
                                           .
615                          COR8...........
                              V
                              V
618                          ROR9
                              .
621                           .          SUBRJ
                              .            .
626                           .            .        SUBRK
                              .            .          V
                              .            .          V
631                           .            .        ROR10
                              .            .          .
634                           .            .          .         SUBRL
                              .            .          .           .
639                           .            .        COR9...........
                              .            .          .
642                          COR10.............................
                              V
                              V
645                          ROR11
                              .
648                           .          SUBRM
                              .            .
653                          COR11..........
                              V
                              V
656                          ROR12
                              .
659                           .          SUBRN
                              .            V
                              .            V
664                           .          ROR13
                              .            .
667                           .            .        SUBRO
                              .            .          .
672                           .          COR12.........
                              .            .
675                           .            .        SUBRP
                              .            .          .
680                          COR13.............................
                              V
                              V
683                          ROR14
                              .
686                           .          SUBRQ
                              .            .
691                           .            .        SUBRR
```

```
696   COR14.................................
        V
        V
699   RET2

707                  .<-------      D9
705                RD9
                     V
                     V
708                RO79
                     .
                     .
711                        SUB2M
                             .
                             .
716                                  SUB2N
                                       .
                                       .
721                                              SUB2O
                                                     .
                                                     .
726                        CO75.......................
                             V
                             V
729                        RET2N
                             .
                             .
735                                  SUB2P
                                       V
                                       V
74                                   RET2P
                                       .
                                       .
746                CORA.......................
                     V
                     V
749                RO80
                     .
                     .
752                        SUB2Q
                             V
                             V
757                        RET2Q
                             .
                             .
763                CORB............
                     V
                     V
756                RO81
                     .
                     .
769                        SUBS
                             V
                             V
774                        RO21
                             .
                             .
777                                  SUBT
                                       .
                                       .
782                        CO15............
                             .
```

785				CORC													
				V													
788				R082													
791						SUB2R											
796								SUB2S									
801						C077											
						V											
804						RET2S											
						V											
810						R083											
813								SUB2T									
818						C078											
						V											
821						RET2T											
						V											
827						R084											
830								SUB2X									
								V									
835								RET2X									
								V									
841								R087									
844										SUB2Y							
849								C081									
852										SUB2Z							
857						C082											
						V											
860						RET2Z											
866				CORD													
869						SUB2U											
874								SUB2V									

```
879                    C079.............
                         V
                         V
882                    R085
                         .
                         .
885                      .          SUB2W
                         .            .
                         .            .
89                       .
                         .
                         .
                         .
                         .
893                      .
```

***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*          FEBRUARY 1981            *
*        REVISED 04 NOV 81          *
*                                   *
*MON, SEP 11 1989      TIME 16:06:49*
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
* THE HYDROLOGIC ENGINEERING CENTER *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
* (916) 440-3285 OR (FTS) 448-3285  *
*                                   *
*************************************
```

```
                    LITCHFIELD PARK DEVELOPMENT MASTER PLAN
                    SUNCOR DEVELOPMENT COMPANY
                    POST-DEVELOPMENT HYDROLOGY
                    10-YEAR, 50-YEAR, & 100-YEAR, 6-HOUR STORMS
                    COE & VAN LOO CONSULTING ENGINEERS INC.     SEPTEMBER 1989      JKM

  7 10        OUTPUT CONTROL VARIABLES
                IPRNT          5  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                NMIN          10  MINUTES IN COMPUTATION INTERVAL
                IDATE      1   8  STARTING DATE
                ITIME       0000  STARTING TIME
                  NQ        300  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE      3   0  ENDING DATE
              NDTIME       0150  ENDING TIME

            COMPUTATION INTERVAL     0.17 HOURS
                 TOTAL TIME BASE    49.83 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT

  JP          MULTI-PLAN OPTION
                NPLAN          1  NUMBER OF PLANS

  JR          MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
            0.64       0.88       1.00
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					10YR 6HR	50YR 6HR	100YR 6HR
					RATIOS APPLIED TO PRECIPITATION		
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3
					0.64	0.88	1.00
HYDROGRAPH AT	SUBA	6.43	1	FLOW	367.	805.	1063.
				TIME	5.83	5.67	5.67
DIVERSION TO	D1	6.43	1	FLOW	233.	312.	322.
				TIME	5.83	5.67	5.67
HYDROGRAPH AT	DIV1	6.43	1	FLOW	133.	493.	741.
				TIME	5.83	5.67	5.67
ROUTED TO	RO1	6.43	1	FLOW	112.	443.	646.
				TIME	7.67	6.83	6.67
HYDROGRAPH AT	SUBB	11.33	1	FLOW	483.	1045.	1373.
				TIME	7.17	7.00	7.00
2 COMBINED AT	CO1	17.76	1	FLOW	591.	1485.	2010.
				TIME	7.33	6.83	6.83
DIVERSION TO	D2	17.76	1	FLOW	337.	742.	1005.
				TIME	7.33	6.83	6.83
HYDROGRAPH AT	DIV2	17.76	1	FLOW	255.	742.	1005.
				TIME	7.33	6.83	6.83
ROUTED TO	RO2	17.76	1	FLOW	254.	738.	1001.
				TIME	7.67	7.17	7.00
DIVERSION TO	D3	17.76	1	FLOW	216.	284.	300.
				TIME	7.67	7.17	7.00
HYDROGRAPH AT	DIV3	17.76	1	FLOW	39.	454.	701.
				TIME	7.67	7.17	7.00
ROUTED TO	RO3	17.76	1	FLOW	19.	355.	589.
				TIME	14.17	10.17	9.50
HYDROGRAPH AT	RD2	0.00	1	FLOW	337.	742.	1005.
				TIME	14.17	10.17	9.50
ROUTED TO	RO4	0.00	1	FLOW	334.	737.	987.
				TIME	8.00	7.33	7.33
HYDROGRAPH AT	RD3	0.00	1	FLOW	216.	284.	300.
				TIME	8.00	7.33	7.33
ROUTED TO	RO5	0.00	1	FLOW	214.	284.	300.
				TIME	8.00	7.50	7.33
HYDROGRAPH AT	SUBC	3.29	1	FLOW	176.	398.	530.
				TIME	5.83	5.50	5.50
3 COMBINED AT	CO2	3.29	1	FLOW	638.	1271.	1632.
				TIME	7.67	7.17	6.83

ROUTED TO	R06	3.29	1	FLOW	638.	1268.	1629.
				TIME	8.00	7.33	7.00
HYDROGRAPH AT	SUBD	1.00	1	FLOW	65.	150.	201.
				TIME	5.00	4.83	4.83
DIVERSION TO	D4	1.00	1	FLOW	33.	75.	100.
				TIME	5.00	4.83	4.83
HYDROGRAPH AT	DIV4	1.00	1	FLOW	33.	75.	101.
				TIME	5.00	4.83	4.83
ROUTED TO	R07	1.00	1	FLOW	18.	47.	65.
				TIME	12.17	10.17	9.67
HYDROGRAPH AT	SUBE	2.34	1	FLOW	137.	313.	418.
				TIME	5.33	5.17	5.17
3 COMBINED AT	C03	6.63	1	FLOW	695.	1429.	1861.
				TIME	7.67	7.00	6.83
DIVERSION TO	D5	6.63	1	FLOW	695.	1000.	1000.
				TIME	7.67	5.67	5.00
HYDROGRAPH AT	DIV5	6.63	1	FLOW	0.	429.	861.
				TIME	0.17	7.00	6.83
ROUTED TO	R08	6.63	1	FLOW	0.	395.	821.
				TIME	0.17	8.17	7.67
DIVERSION TO	D6	6.63	1	FLOW	0.	60.	60.
				TIME	0.17	7.00	6.17
HYDROGRAPH AT	DIV6	6.63	1	FLOW	0.	335.	761.
				TIME	0.17	8.17	7.67
ROUTED TO	R09	6.63	1	FLOW	0.	243.	654.
				TIME	0.17	9.50	8.67
HYDROGRAPH AT	SUBF	14.30	1	FLOW	828.	1719.	2231.
				TIME	6.50	6.33	6.33
3 COMBINED AT	C04	38.69	1	FLOW	828.	1719.	2231.
				TIME	6.50	6.33	6.33
HYDROGRAPH AT	SUBG	2.36	1	FLOW	202.	444.	588.
				TIME	4.67	4.50	4.50
DIVERSION TO	D7	2.36	1	FLOW	52.	279.	412.
				TIME	4.67	4.50	4.50
HYDROGRAPH AT	DIV7	2.36	1	FLOW	150.	166.	175.
				TIME	4.67	4.50	4.50
ROUTED TO	R010	2.36	1	FLOW	150.	166.	175.
				TIME	4.83	4.67	4.67
HYDROGRAPH AT	SUBH	7.30	1	FLOW	311.	692.	918.
				TIME	6.83	6.67	6.50
2 COMBINED AT	C05	9.66	1	FLOW	413.	841.	1071.
				TIME	6.50	6.50	6.50
DIVERSION TO	D8	9.66	1	FLOW	42.	407.	617.
				TIME	6.50	6.50	6.50

HYDROGRAPH AT	DIV8	[illegible]	1	FLOW	271.	434.	454.
				TIME	6.50	6.50	6.50
ROUTED TO	R011	9.66	1	FLOW	369.	433.	453.
				TIME	6.83	6.83	7.00
HYDROGRAPH AT	SUB1	2.14	1	FLOW	160.	360.	478.
				TIME	4.83	4.67	4.67
2 COMBINED AT	C06	11.80	1	FLOW	462.	711.	846.
				TIME	6.00	5.17	5.00
2 COMBINED AT	C07	50.49	1	FLOW	1286.	2348.	2941.
				TIME	6.33	6.17	6.17
ROUTED TO	R051	50.49	1	FLOW	1285.	2343.	2938.
				TIME	6.50	6.17	6.17
HYDROGRAPH AT	SUB1A	0.15	1	FLOW	51.	98.	123.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1A	0.15	1	FLOW	4.	5.	6.
				TIME	6.33	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	1.65	2.52	2.94
				TIME	6.33	6.33	6.33
2 COMBINED AT	C051	50.64	1	FLOW	1289.	2348.	2944.
				TIME	6.50	6.17	6.17
ROUTED TO	R052	50.64	1	FLOW	1287.	2348.	2943.
				TIME	6.50	6.33	6.33
HYDROGRAPH AT	RD7	0.00	1	FLOW	52.	279.	412.
				TIME	6.50	6.33	6.33
ROUTED TO	R013	0.00	1	FLOW	38.	256.	389.
				TIME	5.50	5.00	5.00
HYDROGRAPH AT	SUBJ	0.99	1	FLOW	77.	180.	242.
				TIME	4.50	4.33	4.33
2 COMBINED AT	C08	0.99	1	FLOW	93.	400.	592.
				TIME	5.17	4.83	4.83
DIVERSION TO	D9	0.99	1	FLOW	43.	350.	542.
				TIME	5.17	4.83	4.83
HYDROGRAPH AT	DIV9	0.99	1	FLOW	50.	50.	50.
				TIME	3.83	3.50	3.33
HYDROGRAPH AT	RD8	0.00	1	FLOW	42.	407.	617.
				TIME	3.83	3.50	3.33
ROUTED TO	R014	0.00	1	FLOW	41.	405.	616.
				TIME	6.67	6.67	6.67
HYDROGRAPH AT	SUBK	0.45	1	FLOW	37.	87.	117.
				TIME	4.33	4.17	4.17
3 COMBINED AT	C09	1.44	1	FLOW	102.	481.	699.
				TIME	6.50	6.50	6.50
ROUTED TO	R053	1.44	1	FLOW	102.	480.	697.
				TIME	6.67	6.67	6.67

HYDROGRAPH AT	SUB1B	0.48	1	FLOW	239.	409.	498.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1B	0.48	1	FLOW	19.	28.	31.
				TIME	6.17	6.17	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	2.95	4.41	5.12
				TIME	6.17	6.17	6.33
2 COMBINED AT	C052	1.92	1	FLOW	121.	508.	728.
				TIME	6.67	6.67	6.67
ROUTED TO	R054	1.92	1	FLOW	120.	506.	728.
				TIME	6.83	6.67	6.67
HYDROGRAPH AT	SUB1C	0.46	1	FLOW	240.	408.	495.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1C	0.46	1	FLOW	19.	28.	32.
				TIME	6.00	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	3.01	4.52	5.25
				TIME	6.00	6.17	6.17
2 COMBINED AT	C053	2.38	1	FLOW	139.	534.	759.
				TIME	6.83	6.67	6.67
ROUTED TO	R055	2.38	1	FLOW	138.	534.	758.
				TIME	7.00	6.83	6.83
HYDROGRAPH AT	SUB1D	0.21	1	FLOW	149.	247.	298.
				TIME	3.17	3.17	3.17
ROUTED TO	R056	0.21	1	FLOW	145.	233.	277.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB1E	0.24	1	FLOW	104.	196.	246.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C054	0.45	1	FLOW	243.	411.	498.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1E	0.45	1	FLOW	16.	23.	26.
				TIME	6.17	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	2.41	3.52	4.06
				TIME	6.17	6.17	6.17
2 COMBINED AT	C055	2.83	1	FLOW	153.	557.	784.
				TIME	7.00	6.83	6.83
ROUTED TO	R057	2.83	1	FLOW	153.	556.	783.
				TIME	7.33	7.00	7.00
HYDROGRAPH AT	SUB1F	0.32	1	FLOW	171.	309.	383.
				TIME	3.17	3.17	3.17
ROUTED TO	R058	0.32	1	FLOW	155.	305.	372.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB1G	0.49	1	FLOW	118.	238.	306.
				TIME	3.50	3.50	3.50

2 COMBINED AT	C056	0.82	1	FLOW	266.	539.	677.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1G	0.82	1	FLOW	23.	35.	38.
				TIME	6.33	6.33	6.50
			** PEAK STAGES IN FEET **				
			1	STAGE	3.60	5.93	6.88
				TIME	6.33	6.33	6.50
2 COMBINED AT	C057	3.65	1	FLOW	176.	590.	820.
				TIME	7.33	7.00	7.00
ROUTED TO	R059	3.65	1	FLOW	175.	588.	820.
				TIME	7.33	7.00	7.00
HYDROGRAPH AT	SUB1H	0.24	1	FLOW	72.	151.	196.
				TIME	3.17	3.17	3.17
ROUTED TO	RET1H	0.24	1	FLOW	5.	8.	9.
				TIME	6.33	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	1.55	2.44	2.87
				TIME	6.33	6.33	6.33
HYDROGRAPH AT	SUB1I	0.46	1	FLOW	109.	221.	284.
				TIME	3.50	3.50	3.50
ROUTED TO	RET1I	0.46	1	FLOW	11.	20.	25.
				TIME	6.33	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	1.53	2.37	2.74
				TIME	6.33	6.33	6.33
4 COMBINED AT	C058	54.98	1	FLOW	1462.	2927.	3749.
				TIME	6.67	6.67	6.50
DIVERSION TO	DA	54.98	1	FLOW	0.	0.	279.
				TIME	0.17	0.17	6.50
HYDROGRAPH AT	DIVA	54.98	1	FLOW	1462.	2927.	3470.
				TIME	6.67	6.67	5.83
ROUTED TO	R060	54.98	1	FLOW	1461.	2925.	3470.
				TIME	7.00	6.67	6.00
HYDROGRAPH AT	SUB1J	0.27	1	FLOW	190.	318.	385.
				TIME	3.17	3.17	3.17
ROUTED TO	R061	0.27	1	FLOW	185.	275.	334.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB1K	0.34	1	FLOW	130.	250.	317.
				TIME	3.33	3.17	3.17
2 COMBINED AT	C059	0.62	1	FLOW	315.	517.	636.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1K	0.62	1	FLOW	17.	25.	28.
				TIME	6.33	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	2.64	3.90	4.47
				TIME	6.33	6.33	6.33

ROUTED TO	R062	0.62	1	FLOW	17.	25.	28.
				TIME	6.50	6.50	6.50
HYDROGRAPH AT	SUB1L	0.25	1	FLOW	91.	172.	217.
				TIME	3.33	3.33	3.33
2 COMBINED AT	C060	0.87	1	FLOW	92.	178.	225.
				TIME	3.33	3.33	3.33
ROUTED TO	R063	0.87	1	FLOW	83.	180.	216.
				TIME	3.67	3.50	3.67
HYDROGRAPH AT	SUB1M	0.57	1	FLOW	184.	342.	426.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUB1N	0.30	1	FLOW	96.	187.	237.
				TIME	3.33	3.33	3.33
3 COMBINED AT	C061	1.74	1	FLOW	347.	683.	857.
				TIME	3.50	3.50	3.33
ROUTED TO	RET1N	1.74	1	FLOW	47.	70.	78.
				TIME	6.50	6.50	6.50
			** PEAK STAGES IN FEET **				
			1	STAGE	3.79	6.05	7.00
				TIME	6.50	6.50	6.50
HYDROGRAPH AT	SUB1O	0.17	1	FLOW	75.	141.	177.
				TIME	3.17	3.17	3.17
ROUTED TO	RET1O	0.17	1	FLOW	6.	8.	9.
				TIME	6.17	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	1.66	2.48	2.87
				TIME	6.17	6.17	6.17
HYDROGRAPH AT	SUB1P	0.15	1	FLOW	79.	144.	178.
				TIME	3.17	3.17	3.17
ROUTED TO	RET1P	0.15	1	FLOW	5.	8.	9.
				TIME	6.00	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	1.62	2.41	2.78
				TIME	6.00	6.17	6.17
HYDROGRAPH AT	RDA	0.00	1	FLOW	0.	0.	279.
				TIME	6.00	6.17	6.17
ROUTED TO	RETDA	0.00	1	FLOW	0.	0.	8.
				TIME	0.17	0.17	7.67
			** PEAK STAGES IN FEET **				
			1	STAGE	0.00	0.00	2.51
				TIME	0.00	0.00	7.67
5 COMBINED AT	C011	57.05	1	FLOW	1517.	3011.	3572.
				TIME	7.00	6.67	7.17
HYDROGRAPH AT	RD6	0.00	1	FLOW	0.	60.	60.
				TIME	7.00	6.67	7.17

ROUTED TO	R016	0.00	1	FLOW	0.	60.	60.
				TIME	0.17	8.83	8.00
HYDROGRAPH AT	SUBM	1.23	1	FLOW	330.	636.	804.
				TIME	3.50	3.50	3.50
2 COMBINED AT	C011	1.23	1	FLOW	330.	636.	804.
				TIME	3.50	3.50	3.50
ROUTED TO	RET1	1.23	1	FLOW	62.	83.	91.
				TIME	5.67	6.00	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	1065.41	1066.64	1067.18
				TIME	5.67	6.00	6.17
ROUTED TO	R017	1.23	1	FLOW	62.	83.	91.
				TIME	5.83	6.33	6.50
HYDROGRAPH AT	SUBN	1.20	1	FLOW	372.	781.	1012.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C012	2.43	1	FLOW	372.	782.	1013.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	SUB1Q	0.64	1	FLOW	138.	331.	444.
				TIME	3.17	3.17	3.17
ROUTED TO	R065	0.64	1	FLOW	135.	309.	407.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB1R	0.13	1	FLOW	59.	113.	142.
				TIME	3.17	3.17	3.17
ROUTED TO	RET1R	0.13	1	FLOW	4.	5.	6.
				TIME	6.17	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	1.58	2.44	2.84
				TIME	6.17	6.17	6.17
2 COMBINED AT	C063	0.77	1	FLOW	137.	313.	412.
				TIME	3.33	3.33	3.33
ROUTED TO	R066	0.77	1	FLOW	125.	289.	415.
				TIME	3.50	3.67	3.33
HYDROGRAPH AT	SUB1S	0.25	1	FLOW	27.	66.	89.
				TIME	3.67	3.67	3.67
ROUTED TO	R067	0.25	1	FLOW	26.	66.	89.
				TIME	3.83	3.83	3.83
HYDROGRAPH AT	SUB1T	0.49	1	FLOW	280.	465.	563.
				TIME	3.33	3.33	3.17
3 COMBINED AT	C064	1.51	1	FLOW	360.	776.	1022.
				TIME	3.50	3.33	3.33
ROUTED TO	RET1T	1.51	1	FLOW	34.	157.	333.
				TIME	6.50	4.83	4.33
			** PEAK STAGES IN FEET **				
			1	STAGE	3.70	5.12	5.32
				TIME	6.50	4.83	4.33

ROUTED TO	ROR1	1.51	1	FLOW	34.	156.	329.
				TIME	6.67	5.00	4.33
HYDROGRAPH AT	SUBRA	0.22	1	FLOW	78.	156.	199.
				TIME	3.17	3.17	3.17
2 COMBINED AT	COR1	1.73	1	FLOW	79.	175.	365.
				TIME	3.17	5.00	4.33
ROUTED TO	ROR2	1.73	1	FLOW	72.	175.	364.
				TIME	3.50	5.17	4.50
HYDROGRAPH AT	SUBRB	0.27	1	FLOW	86.	169.	216.
				TIME	3.33	3.33	3.17
HYDROGRAPH AT	SUBRC	0.11	1	FLOW	33.	71.	92.
				TIME	3.17	3.17	3.17
3 COMBINED AT	COR2	2.10	1	FLOW	186.	382.	491.
				TIME	3.33	3.33	3.33
ROUTED TO	ROR4	2.10	1	FLOW	174.	376.	478.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUBRD	0.32	1	FLOW	106.	203.	256.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUBRE	0.23	1	FLOW	72.	143.	183.
				TIME	3.33	3.33	3.33
3 COMBINED AT	COR3	2.65	1	FLOW	334.	692.	904.
				TIME	3.50	3.33	3.33
ROUTED TO	ROR5	2.65	1	FLOW	326.	683.	874.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUBRF	0.10	1	FLOW	55.	98.	122.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	SUB2H	0.22	1	FLOW	21.	52.	70.
				TIME	4.00	3.83	3.83
ROUTED TO	ROT8	0.22	1	FLOW	21.	52.	69.
				TIME	4.33	4.00	4.17
HYDROGRAPH AT	SUB2I	0.28	1	FLOW	182.	312.	380.
				TIME	3.17	3.17	3.17
4 COMBINED AT	COR4	3.26	1	FLOW	425.	862.	1139.
				TIME	3.50	3.33	3.33
HYDROGRAPH AT	SUB1V	0.70	1	FLOW	69.	143.	193.
				TIME	4.17	4.17	4.00
ROUTED TO	ROR6	0.70	1	FLOW	60.	141.	190.
				TIME	4.33	4.33	4.17
HYDROGRAPH AT	SUBRG	0.28	1	FLOW	94.	180.	227.
				TIME	3.33	3.33	3.33
2 COMBINED AT	COR5	0.97	1	FLOW	95.	198.	265.
				TIME	3.33	4.00	4.00
ROUTED TO	ROR7	0.97	1	FLOW	92.	196.	264.
				TIME	4.50	4.50	4.17

YDROGRAPH AT	SUBRH	0.30	1	FLOW	125.	225.	278.
				TIME	3.33	3.33	3.33
2 COMBINED AT	COR6	1.27	1	FLOW	161.	358.	437.
				TIME	3.67	3.50	3.50
YDROGRAPH AT	SUBIY	1.56	1	FLOW	378.	784.	1017.
				TIME	3.50	3.33	3.33
2 COMBINED AT	COR7	2.83	1	FLOW	513.	1118.	1409.
				TIME	3.50	3.50	3.50
OUTED TO	ROR8	2.83	1	FLOW	505.	1062.	1395.
				TIME	3.67	3.50	3.50
YDROGRAPH AT	SUBRI	0.31	1	FLOW	94.	198.	257.
				TIME	3.17	3.17	3.17
2 COMBINED AT	COR8	3.15	1	FLOW	571.	1193.	1560.
				TIME	3.50	3.50	3.50
OUTED TO	ROR9	3.15	1	FLOW	551.	1154.	1495.
				TIME	3.83	3.67	3.67
YDROGRAPH AT	SUBRJ	0.22	1	FLOW	61.	135.	177.
				TIME	3.17	3.17	3.17
YDROGRAPH AT	SUBRK	0.21	1	FLOW	149.	250.	302.
				TIME	3.17	3.17	3.17
OUTED TO	ROR10	0.21	1	FLOW	135.	215.	262.
				TIME	3.50	3.33	3.33
YDROGRAPH AT	SUBRL	0.18	1	FLOW	62.	119.	150.
				TIME	3.33	3.33	3.33
2 COMBINED AT	COR9	0.40	1	FLOW	194.	335.	413.
				TIME	3.33	3.33	3.33
3 COMBINED AT	COR10	3.77	1	FLOW	699.	1389.	1788.
				TIME	3.67	3.67	3.50
OUTED TO	ROR11	3.77	1	FLOW	682.	1370.	1782.
				TIME	3.83	3.67	3.67
YDROGRAPH AT	SUBRM	0.07	1	FLOW	20.	44.	58.
				TIME	3.17	3.17	3.17
2 COMBINED AT	COR11	3.84	1	FLOW	692.	1388.	1805.
				TIME	3.67	3.67	3.67
OUTED TO	ROR12	3.84	1	FLOW	691.	1355.	1781.
				TIME	3.83	3.83	3.67
YDROGRAPH AT	SUBRN	0.08	1	FLOW	34.	64.	81.
				TIME	3.17	3.17	3.17
OUTED TO	ROR13	0.08	1	FLOW	22.	52.	67.
				TIME	3.67	3.50	3.50
YDROGRAPH AT	SUBRO	0.27	1	FLOW	71.	149.	193.
				TIME	3.33	3.33	3.33
2 COMBINED AT	COR12	0.35	1	FLOW	83.	190.	256.
				TIME	3.33	3.33	3.33

'DROGRAPH AT	SUBRP	0.17	1	FLOW	55.	110.	142.
				TIME	3.33	3.17	3.17
S COMBINED AT	COR13	4.36	1	FLOW	780.	1532.	2011.
				TIME	3.67	3.67	3.67
DUTED TO	ROR14	4.36	1	FLOW	774.	1509.	1997.
				TIME	3.83	3.83	3.67
'DROGRAPH AT	SUBRQ	0.21	1	FLOW	112.	202.	251.
				TIME	3.17	3.17	3.00
'DROGRAPH AT	SUBRR	0.24	1	FLOW	101.	195.	246.
				TIME	3.17	3.17	3.17
COMBINED AT	COR14	8.07	1	FLOW	1181.	2335.	3130.
				TIME	3.67	3.67	3.50
DUTED TO	RET2	8.07	1	FLOW	38.	45.	48.
				TIME	10.33	11.67	11.17
			** PEAK STAGES IN FEET **				
			1	STAGE	976.64	978.68	979.82
				TIME	10.50	11.67	11.17
'DROGRAPH AT	RD9	0.00	1	FLOW	43.	350.	542.
				TIME	10.33	11.67	11.17
DUTED TO	RO79	0.00	1	FLOW	41.	343.	535.
				TIME	5.50	5.17	5.00
'DROGRAPH AT	SUB2M	0.18	1	FLOW	40.	89.	117.
				TIME	3.33	3.33	3.33
'DROGRAPH AT	SUB2N	0.55	1	FLOW	352.	564.	672.
				TIME	3.33	3.33	3.33
'DROGRAPH AT	SUB2O	0.26	1	FLOW	194.	305.	361.
				TIME	3.17	3.17	3.17
S COMBINED AT	CO75	1.00	1	FLOW	580.	943.	1130.
				TIME	3.33	3.33	3.33
DUTED TO	RET2N	1.00	1	FLOW	42.	60.	68.
				TIME	6.17	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	3.49	5.02	5.80
				TIME	6.17	6.17	6.17
'DROGRAPH AT,	SUB2P	0.28	1	FLOW	199.	319.	380.
				TIME	3.17	3.17	3.17
DUTED TO	RET2P	0.28	1	FLOW	12.	15.	16.
				TIME	6.17	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	2.80	3.87	4.33
				TIME	6.17	6.33	6.33
S COMBINED AT	CORA	1.28	1	FLOW	94.	417.	618.
				TIME	5.67	5.17	5.00
DUTED TO	RO80	1.28	1	FLOW	94.	415.	613.
				TIME	5.67	5.33	5.17

'DROGRAPH AT	SUB2Q	0.09	1	FLOW	79.	124.	148.
				TIME	3.17	3.17	3.17
ɔUTED TO	RET2Q	0.09	1	FLOW	5.	7.	8.
				TIME	5.50	5.50	5.67
			** PEAK STAGES IN FEET **				
			1	STAGE	1.49	2.13	2.37
				TIME	5.67	5.50	5.67
! COMBINED AT	CORB	1.37	1	FLOW	98.	422.	621.
				TIME	5.67	5.33	5.17
ɔUTED TO	RO81	1.37	1	FLOW	98.	422.	621.
				TIME	5.83	5.33	5.17
'DROGRAPH AT	SUBS	1.03	1	FLOW	73.	169.	227.
				TIME	4.67	4.50	4.50
ɔUTED TO	RO21	1.03	1	FLOW	65.	161.	220.
				TIME	5.50	5.00	5.00
'DROGRAPH AT	SUBT	1.00	1	FLOW	312.	556.	686.
				TIME	3.67	3.67	3.67
! COMBINED AT	CO15	2.03	1	FLOW	312.	559.	694.
				TIME	3.67	3.67	3.67
! COMBINED AT	CORC	3.40	1	FLOW	323.	709.	1013.
				TIME	3.67	5.17	5.00
ɔUTED TO	RO82	3.40	1	FLOW	323.	707.	1009.
				TIME	3.83	5.33	5.17
'DROGRAPH AT	SUB2R	0.32	1	FLOW	143.	251.	308.
				TIME	3.33	3.33	3.33
'DROGRAPH AT	SUB2S	0.26	1	FLOW	79.	156.	198.
				TIME	3.33	3.33	3.33
! COMBINED AT	CO77	0.58	1	FLOW	222.	406.	505.
				TIME	3.33	3.33	3.33
ɔUTED TO	RET2S	0.58	1	FLOW	18.	27.	30.
				TIME	6.33	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	2.76	4.10	4.71
				TIME	6.33	6.33	6.33
ɔUTED TO	RO83	0.58	1	FLOW	18.	27.	30.
				TIME	6.50	6.50	6.50
'DROGRAPH AT	SUB2T	0.39	1	FLOW	178.	329.	410.
				TIME	3.17	3.17	3.17
! COMBINED AT	CO78	0.97	1	FLOW	178.	329.	410.
				TIME	3.17	3.17	3.17
ɔUTED TO	RET2T	0.97	1	FLOW	29.	46.	53.
				TIME	6.33	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	2.62	3.72	4.28
				TIME	6.33	6.17	6.17

UTED TO	R084	0.97	1	FLOW	29.	46.	53.
				TIME	6.33	6.33	6.33
DROGRAPH AT	SUB2X	0.25	1	FLOW	153.	258.	313.
				TIME	3.17	3.17	3.17
UTED TO	RET2X	0.25	1	FLOW	9.	15.	17.
				TIME	6.17	6.17	6.17
			** PEAK STAGES IN FEET **				
			1	STAGE	1.63	2.29	2.57
				TIME	6.17	6.17	6.17
UTED TO	R087	0.25	1	FLOW	9.	15.	17.
				TIME	6.83	6.67	6.50
DROGRAPH AT	SUB2Y	0.30	1	FLOW	204.	337.	406.
				TIME	3.17	3.17	3.17
COMBINED AT	C081	0.55	1	FLOW	204.	337.	406.
				TIME	3.17	3.17	3.17
DROGRAPH AT	SUB2Z	0.40	1	FLOW	163.	315.	397.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C082	1.91	1	FLOW	368.	654.	808.
				TIME	3.17	3.17	3.17
UTED TO	RET2Z	1.91	1	FLOW	50.	71.	78.
				TIME	6.33	6.50	6.67
			** PEAK STAGES IN FEET **				
			1	STAGE	3.97	6.10	7.00
				TIME	6.33	6.50	6.67
COMBINED AT	CORD	5.32	1	FLOW	358.	775.	1084.
				TIME	3.83	5.33	5.17
DROGRAPH AT	SUB2U	0.16	1	FLOW	65.	118.	147.
				TIME	3.33	3.33	3.33
DROGRAPH AT	SUB2V	0.22	1	FLOW	113.	192.	234.
				TIME	3.33	3.33	3.33
COMBINED AT	C079	0.38	1	FLOW	178.	311.	380.
				TIME	3.33	3.33	3.33
UTED TO	R085	0.38	1	FLOW	175.	298.	361.
				TIME	3.50	3.50	3.50
DROGRAPH AT	SUB2W	0.23	1	FLOW	172.	277.	331.
				TIME	3.17	3.17	3.17
COMBINED AT	C083	0.61	1	FLOW	305.	521.	634.
				TIME	3.33	3.33	3.33
UTED TO	RET2W	0.61	1	FLOW	24.	33.	36.
				TIME	6.17	6.33	6.33
			** PEAK STAGES IN FEET **				
			1	STAGE	3.72	5.49	6.34
				TIME	6.17	6.33	6.33

*** NORMAL END OF HEC-1 ***

PLATES

1. VICINITY MAP

2. OFFSITE DRAINAGE MAP & EXISTING HEC-1 SCHEMATIC

3. POST-DEVELOPMENT HEC-1 SCHEMATIC

4. CONCEPTUAL PARK RETENTION PLAN

5. BULLARD WASH EXISTING FLOODPLAIN FROM THOMAS ROAD TO I-10

6. HISTORICAL ACCOUNT BULLARD WASH

7. LANDUSE MAP

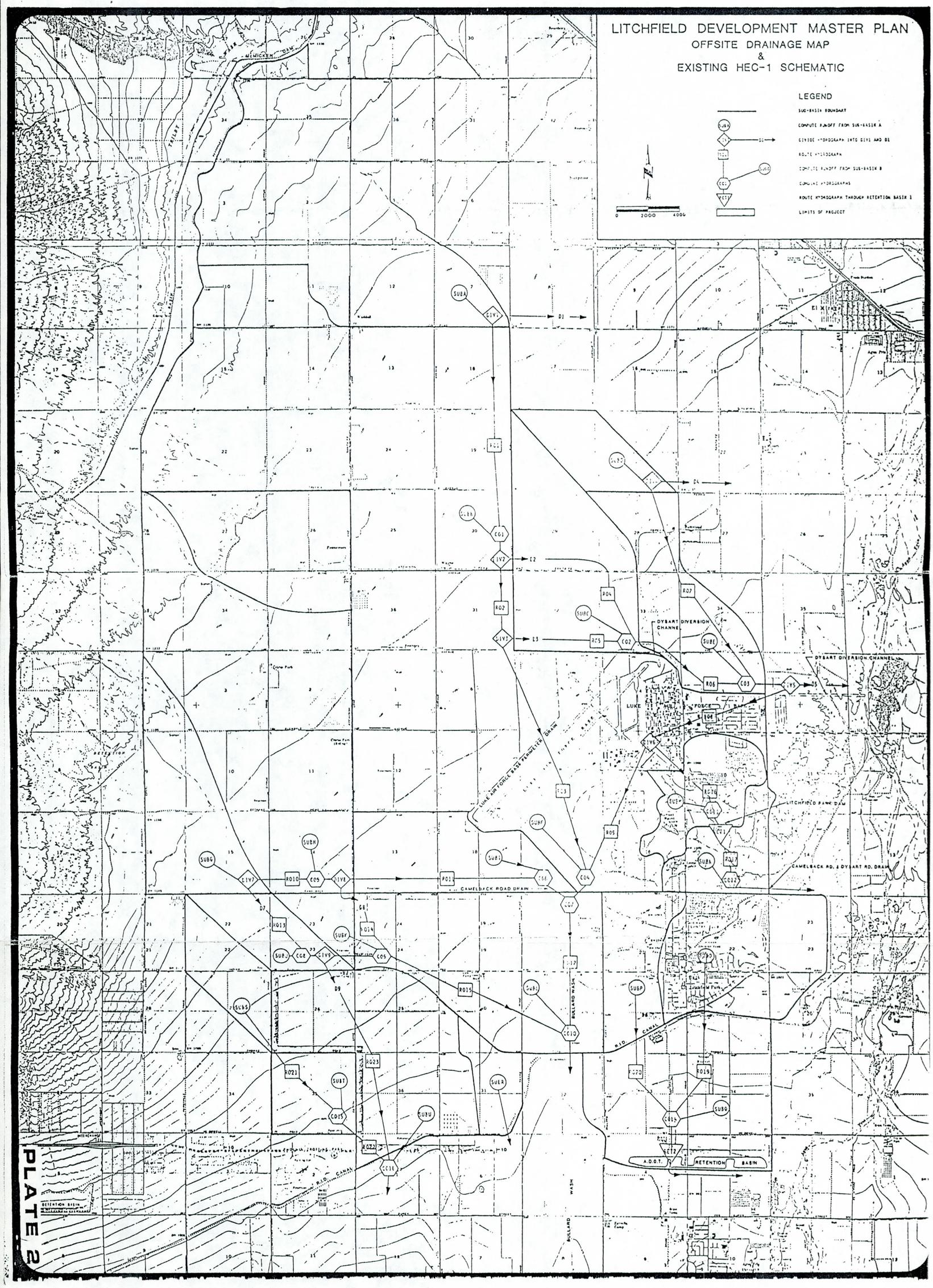

LITCHFIELD DEVELOPMENT MASTER PLAN
OFFSITE DRAINAGE MAP
&
EXISTING HEC-1 SCHEMATIC
LEGEND
SUB-BASIN BOUNDARY
COMPUTE RUNOFF FROM SUB-BASIN A
CENTOID HYDROGRAPH INTO DIV1 AND D1
ROUTE HYDROGRAPH
COMPUTE RUNOFF FROM SUB-BASIN B
COMBINE HYDROGRAPHS
ROUTE HYDROGRAPH THROUGH RETENTION BASIN 1
LIMITS OF PROJECT
0 2000 4000
MENICHEN DAM
DYSART DIVERSION CHANNEL
LUKE AIR FORCE BASE
LUKE AIR FORCE BASE PENNELLS DRAIN
LITCHFIELD PARK DRAIN
CAMELBACK ROAD DRAIN
CAMELBACK RD. & DYSART RD. DRAIN
BULLARD WASH
RIO CANAL
A.D.O.T.
RETENTION BASIN

PLATE 2

LITCHFIELD DEVELOPMENT MASTER PLAN

POST-DEVELOPMENT HEC-1 SCHEMATIC

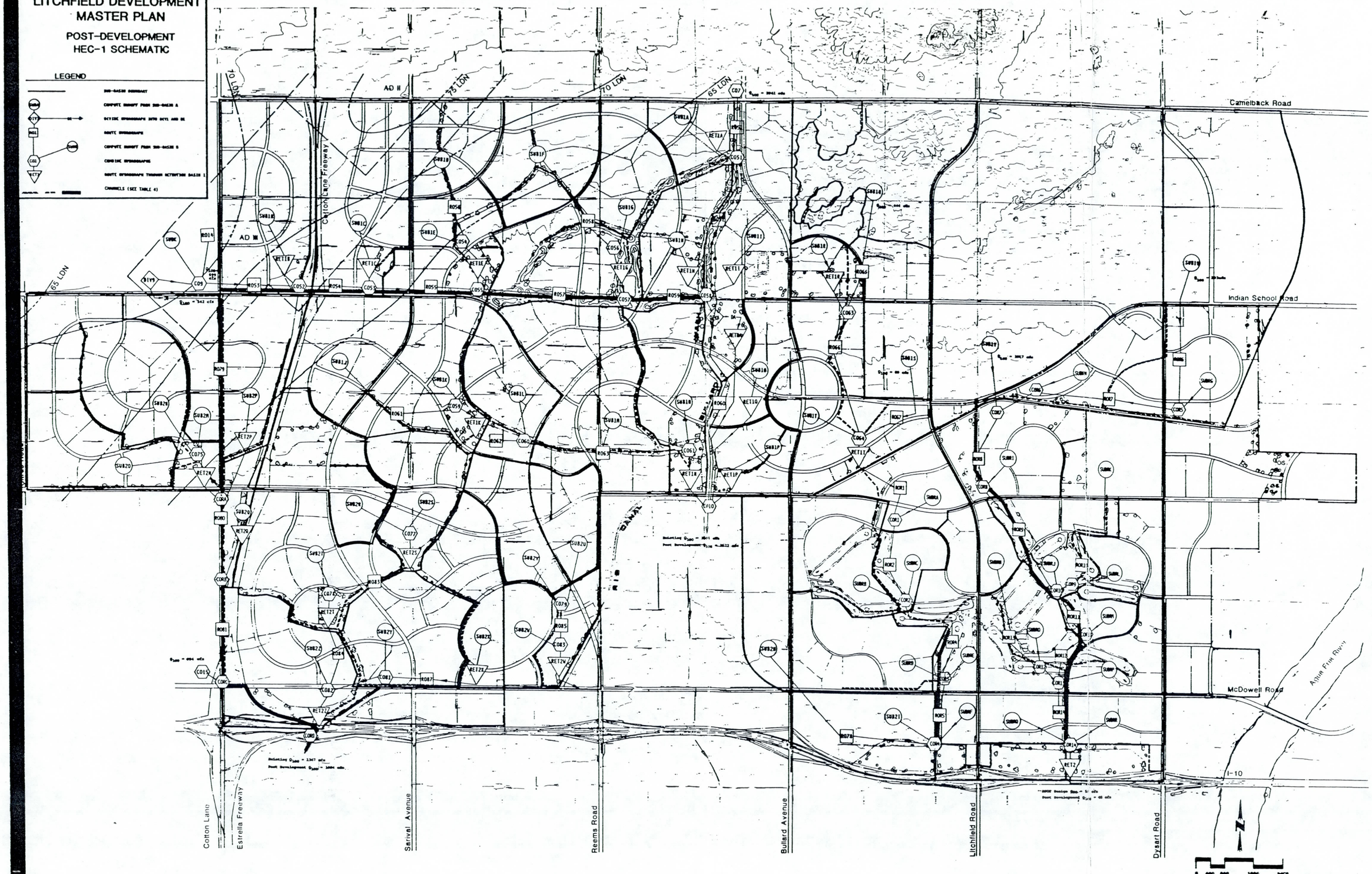


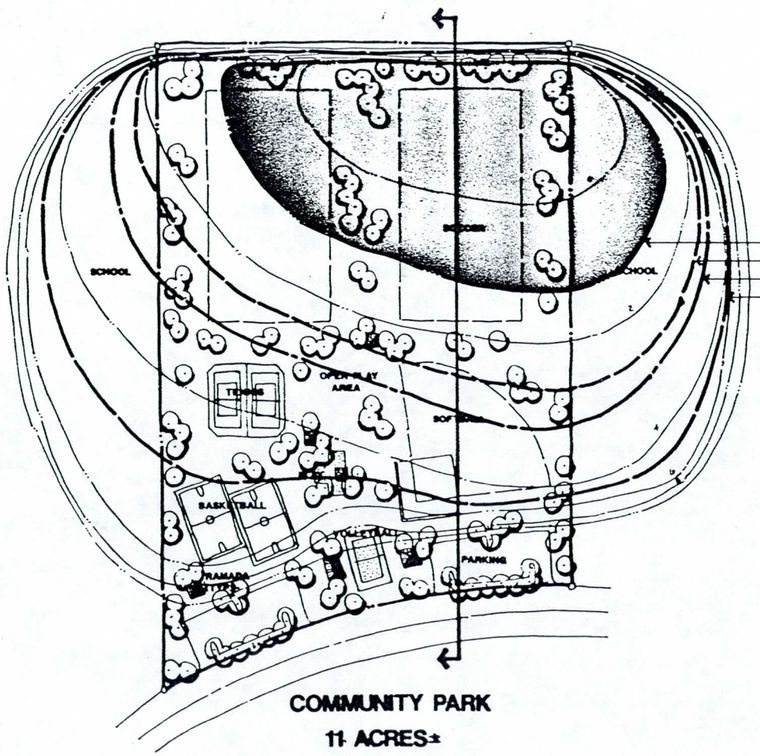
PLATE 3

1100-87

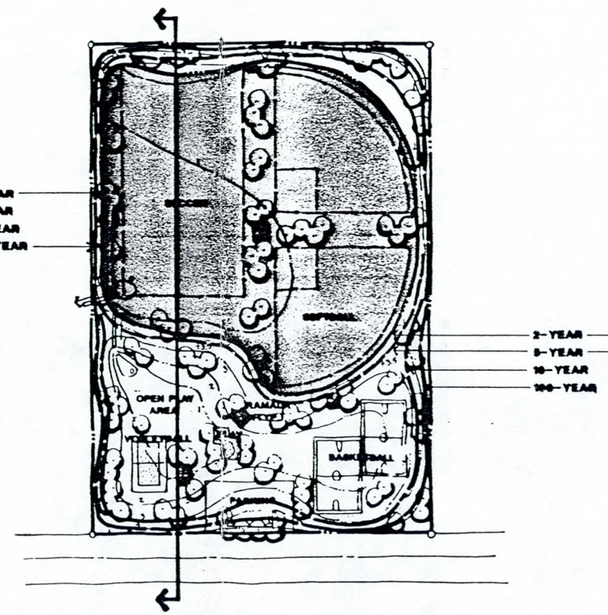
COE & VAN LOO PHOENIX
CONSULTING ENGINEERING INC. ARIZONA

LITCHFIELD

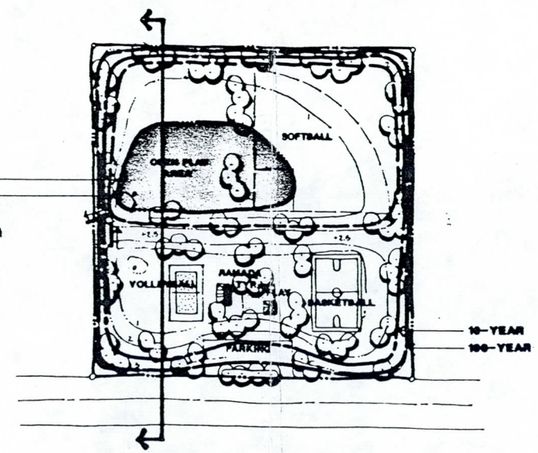
CONCEPTUAL
PARK/RETENTION PLANS



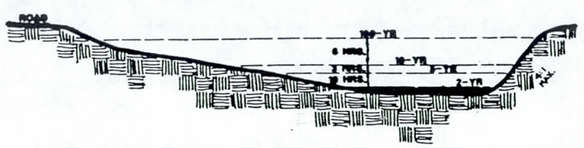
COMMUNITY PARK
11 ACRES±

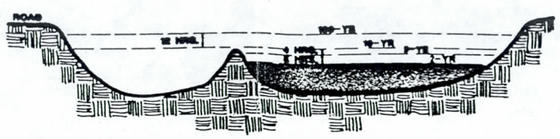


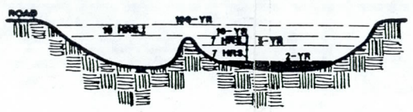
NEIGHBORHOOD PARK
8 ACRES ±

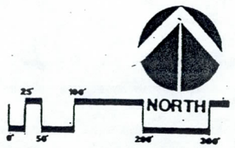


"VEST POCKET" PARK
5 ACRES±



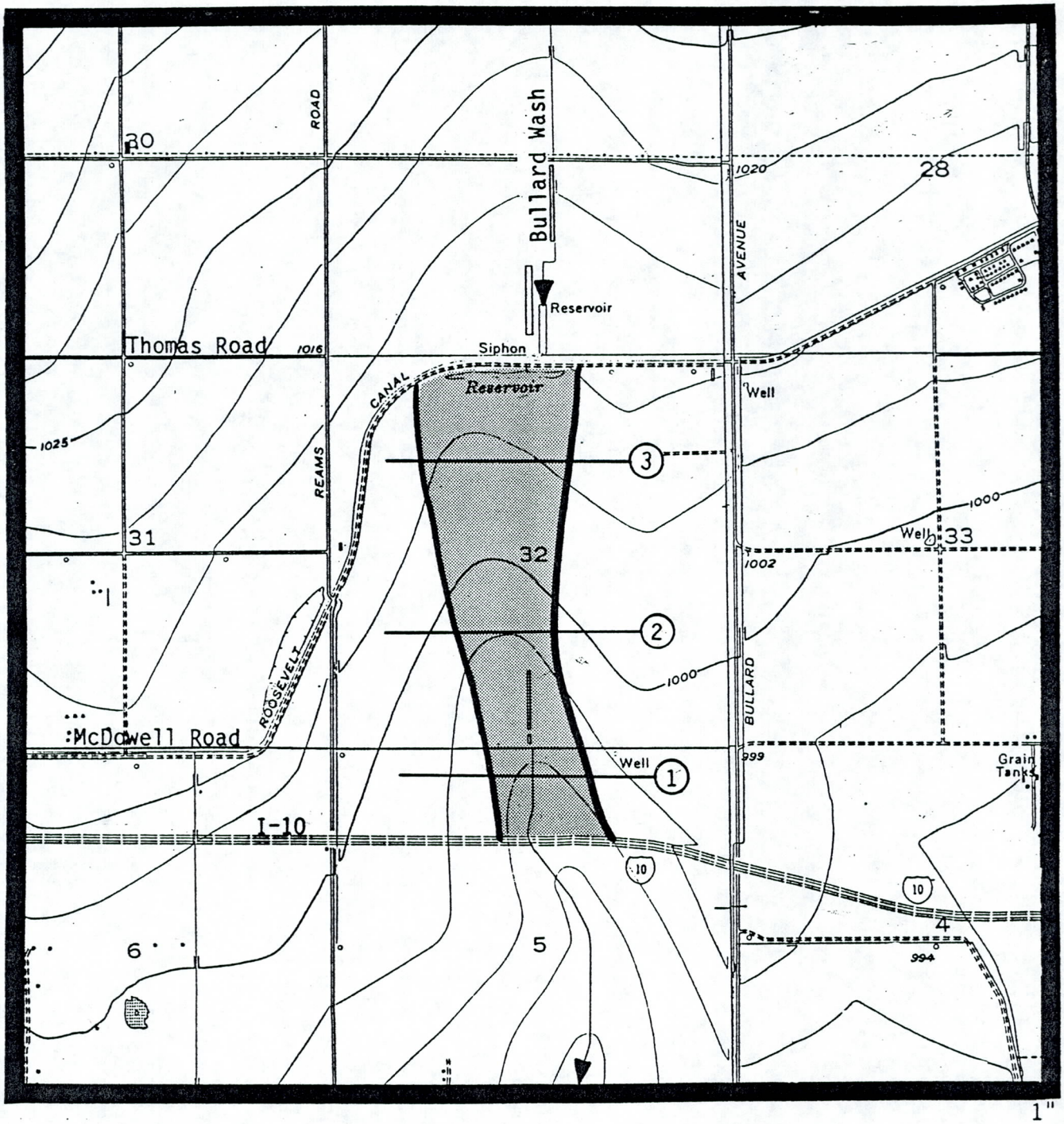






SCALE: 1"=100' HORIZ.
1"=5' VERT.
DATE: 9/13/89
CVL #1100-27

PLATE 4

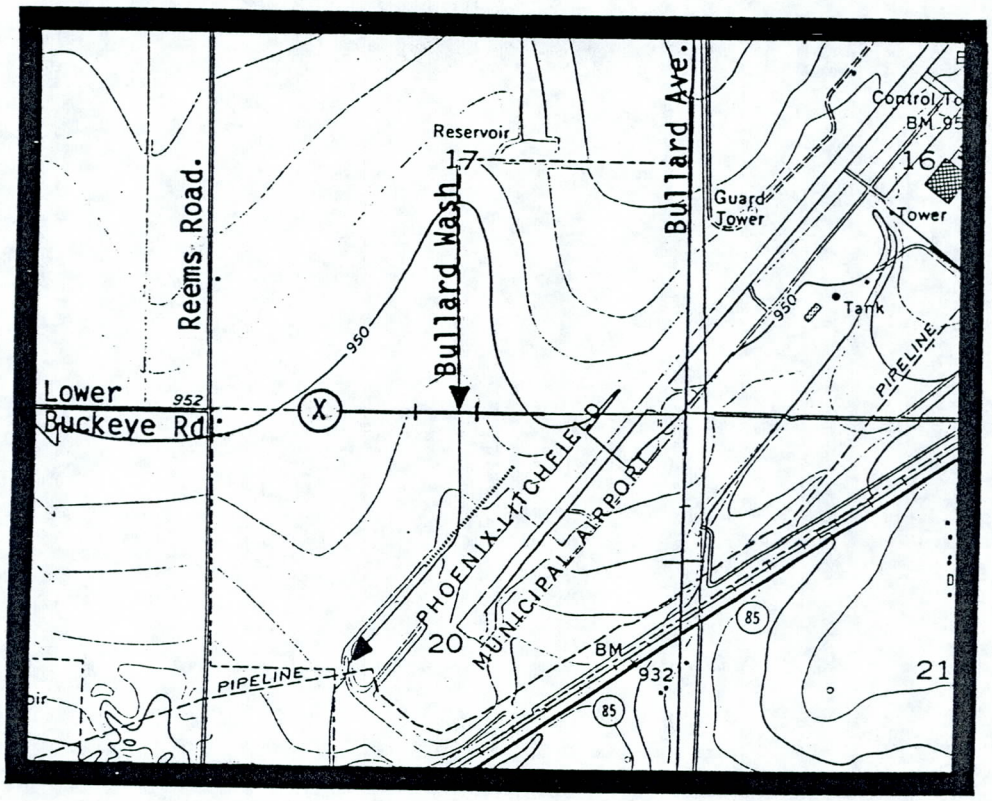


1" = 2000'

BULLARD WASH EXISTING FLOODPLAIN
FROM THOMAS ROAD TO I-10

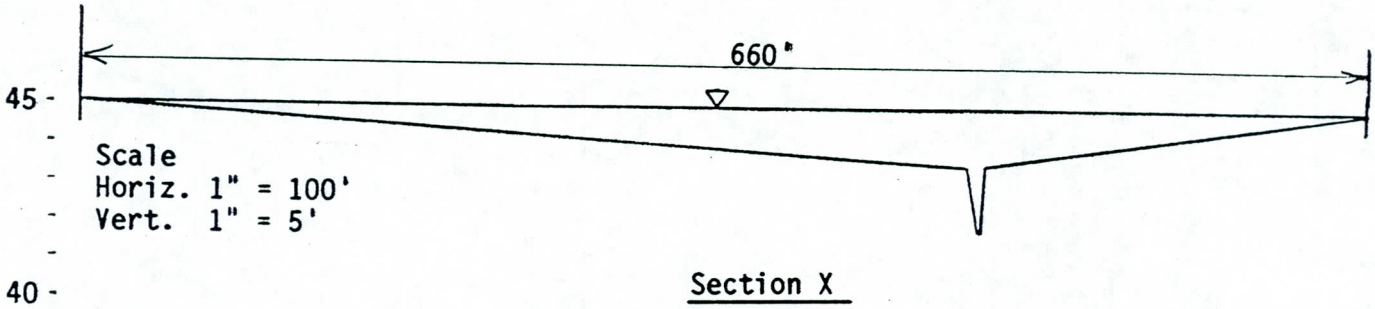
Q=4000 cfs (100 Yr.)

SECTION 1	SECTION 2	SECTION 3
n = 0.048	n = 0.048	n = 0.048
Slope = 0.0036	Slope = 0.0035	Slope = 0.0034
Depth = 3'	Depth = 3'	Depth = 2'
Width = 1200'	Width = 1200'	Width = 2000'
Velocity = 2.4 fps	Velocity = 2.3 fps	Velocity = 1.9 fps



1" = 2000'

HISTORICAL ACCOUNT- BULLARD WASH



Section X

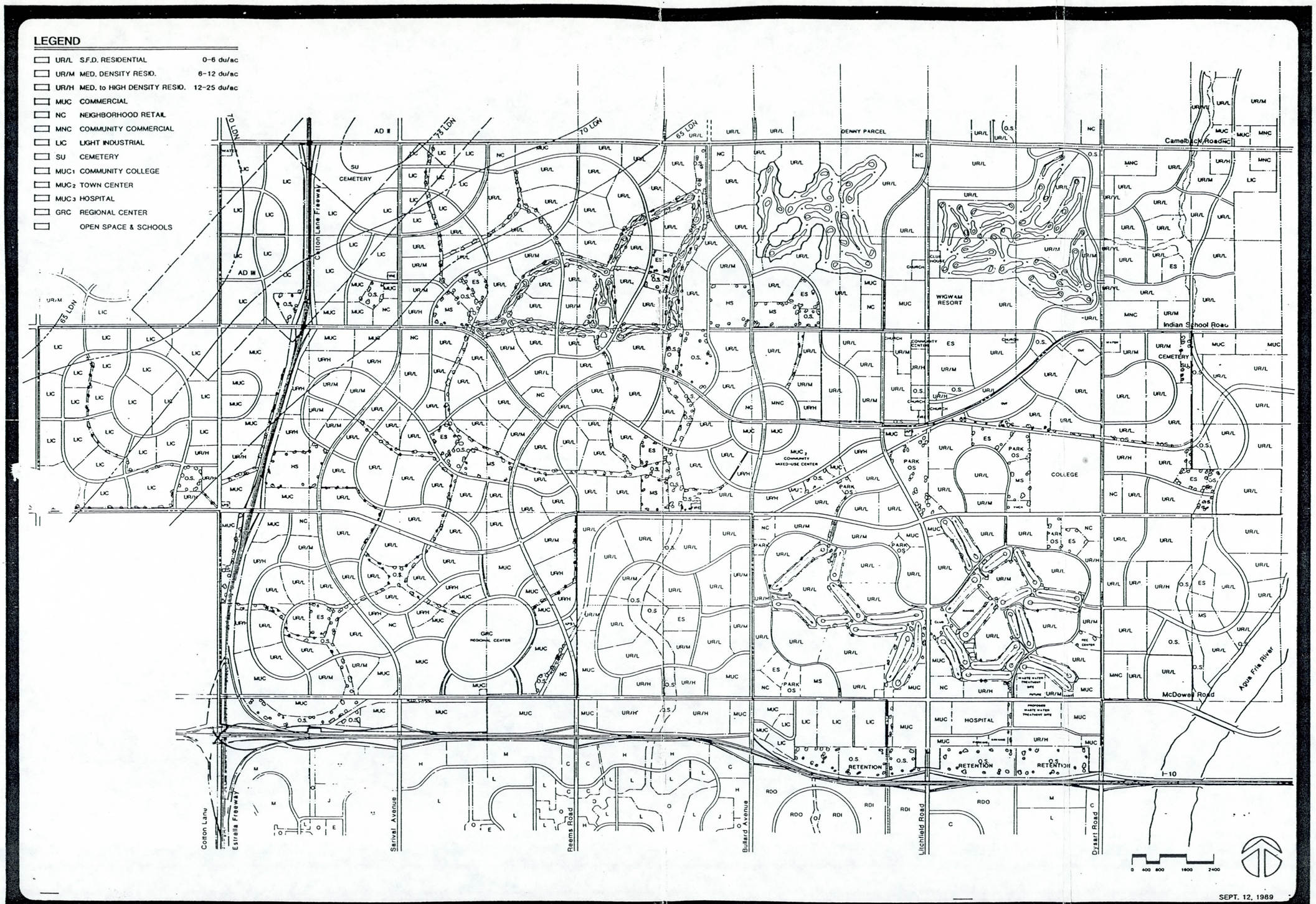
Capacity in Channel:

Slope = 0.0033 ft./ft.	n = 0.035
Side Slopes = 1:1	Depth = 3.5'
Bottom Width = 2'	Area = 12.3 S.F.
Q = 65 cfs	Velocity = 3.4 fps.

Capacity in Overbank:

Slope = 0.0033 ft./ft.	n = 0.048
Depth = 1.5'	Area = 495 S.F.
Wetted perimeter = 660'	
Q = 727 cfs	Velocity = 1.5 fps.

Total Capacity Q = 65 cfs + 727 cfs = 792 cfs



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7550 East McDonald Drive Scottsdale, Arizona 85253 (602) 991-6700

LITCHFIELD
City of Goodyear

Master Plan Program

PLATE 7