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MASTER DRAINAGE REPORT
FOR
LITCHFIELD PHASE 1

October 1989

Prepared for:
SunCor Development Company
555 East Plaza Circle
Litchfield Park, Arizona 85340
(602) 935-2700

Prepared by:
Coe & Van Loo Consulting Engineers, Inc.
4550 N. 12th Street
Phoenix, Arizona 85014
(602) 264-6831

Registered Professional Engineer (Civil)
CERTIFICATE NO. 10512
ASHOK C. PATEL
Date Signed 10/3/89
ARIZONA, U.S.A.

1200-05
CVL-4-1276

CVL
COE & VAN LOO

Land Planning
Civil Engineering
Water Resources Engineering
Transportation Engineering
Computer Services
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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.
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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.

October 2, 1989

City of Goodyear
119 North Litchfield Road
Goodyear, Arizona 85338

Attn: Mr. Paul Walker
City Planner

Re: Litchfield, Phase I
Master Drainage Report

Dear Mr. Walker:

We are herewith submitting two copies of Master Drainage Report for Litchfield, Phase I (800 Acres) for your review and approval.

The report is prepared in accordance with the recommendations and guidelines previously established in the Conceptual Master Drainage Report for the entire Litchfield project (9000 acres).

Litchfield Phase I will be designed in several segments. For example, we are submitting the Litchfield Road paving plans first and therefore we have included detailed hydraulic calculations for the Litchfield Road improvements. To facilitate your review, the report includes a concept grading plan to give you an overall "big picture" of all the infrastructures.

The second submittal, on Thomas Road, will follow in about two weeks. At that time, a supplemental data on hydraulic calculation for Thomas Road will be provided.

Similarly, we intend to provide supplemental hydraulic calculations with the Dysart Road, and Collector Road submittals.

Please note that the Collector Road alignments are now being set within Phase I by the planners and Golf Course Architect. Once the alignment and parcel layouts are finalized, we will refine the grading plans. At that point, a detailed channel hydraulics as well culvert details will be submitted for your review.

Should you need any clarification regarding this report, please do not hesitate to call.

Sincerely,

COE & VAN LOO
Consulting Engineers, Inc.

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

ACP:mm
CVL-2-1857

cc: Duane Black, SunCor
Dan Haas, SunCor

CVL

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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, known as Litchfield, is of an irregular shape 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. The overall project is anticipated to develop over a 25-year span, with the initial development, Litchfield Phase 1, to be developed at this time. Phase 1 consists of approximately 800 acres and is rectangular in shape. It is generally bounded by Interstate-10 to the south, Thomas Road to the north, Litchfield Road to the west, and Dysart Road to the east. Refer to Plate 1 for the vicinity and approximate boundary location. Phase 1 is under the governmental jurisdiction of the City of Goodyear.

1.2 Purpose

The purpose of this report is to provide detailed hydraulic analysis to substantiate the design of drainage facilities for the development of Litchfield Phase 1. This report will address local hydrology, channel hydraulics, culvert crossings, street hydraulics and storm drain for the major streets to be improved within Phase 1. The roads include Litchfield Road, Dysart Road, Thomas Road, and the interior collectors.

1.3 Previous Report

Coe and Van Loo prepared a Conceptual Master Drainage Report for Litchfield Park Development Master Plan (CMDR) in March 1989 and

revised it in September, 1989 (ref. 16). The report contains extensive background on the overall project, including a conceptual hydrologic and hydraulic analysis of the project drainage system. The CMDR contains brief descriptions of numerous reports that are relevant to the overall study area. Additionally, it goes into great detail about the offsite and onsite watershed to the overall development, and the man-made improvements that affect runoff to the project site. Refer to the CMDR for an extensive overview of the project. Based on discussions and meetings with the City of Goodyear, the CMDR is in general conformance with the City requirements. It is anticipated to be approved by a resolution by the City Council in the month of October, 1989.

2.0 DESCRIPTION OF WATERSHED

2.1 General

The terrain throughout Phase 1 and its watershed is relatively flat, sloping southerly at an average slope of about 0.25 percent. Presently, the majority of the onsite watershed is being used for agriculture purposes, while the offsite watershed consists of agriculture and urban uses. Typically the agricultural land has been leveled and terraced, this leveling along with roads and irrigation ditches have caused some diversions from the natural flow patterns.

The hydrology within this report is based on the assumption that the offsite watershed extends to Camelback Road. The 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.

The CMDR addresses other reports and the computed flows to this area. It is in general agreement that the existing channel along Camelback Road, that carries this flow to the Agua Fria River, is not adequate. Additionally, recent flooding of the urbanized area south of Camelback Road, confirms the need for increased flood control protection. It is assumed that this concern is being resolved by the Flood Control District of Maricopa County and the County Highway Department.

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 watershed consists of hydrologic Group B soils (Ref. 9). Much 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.

3.0 HYDROLOGY

3.1 Methodology

Two hydrologic methods were used on this project. Hydrology for channels, culverts, and other features with large tributaries was based on the HEC-1 method used in the CMDR. However, the rational method was used for small tributary areas such as right-of-way.

For the rational method, C-values were based on the Goodyear requirements (Ref. 3). Intensities were based on the ADOT method outlined in Reference 5, and times of concentration were based on overland and street flow.

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 subareas, 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

For the CMDR, 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.

For Phase 1, a detailed HEC-1 model has been produced and incorporated into the overall HEC-1 model. Input parameters for this area were based on the proposed land use and anticipated mass grading. Concentration points were chosen such that sufficient hydrology was available to adequately design the required hydraulic structures.

4.0 EXISTING CONDITIONS

4.1 General

The tributary area that impacts Phase 1 is generally bounded on the west by Litchfield Road, on the east south of the RID canal by Dysart Road, on the east north of the RID canal by approximately one-half mile east of Dysart Road, and on the north by Camelback Road. The delineation of Camelback Road as the northern boundary of the watershed, is based on the assumption that the existing flooding concern along the Camelback Road, is currently being resolved.

Many factors affect the flow that reaches the site. Numerous streets, channels, irrigation ditches, and berms direct and divert

flow in the watershed. Flow from the urbanized area (bounded by Camelback Road, Indian School Road, Litchfield Road, and Dysart Road) flows onto Indian School Road where a small portion is collected in a large (54") storm drain. The storm drain outlets into a sump south of the RID canal and west of Litchfield Road. The flow not collected in the storm drain continues south across Indian School Road where it combines with runoff from tributary farmland. This flow is backed up north of the RID canal until it overtops the banks. Since the canal has very limited capacity, the flow overtops the south canal bank and continues southerly as sheet flow across the farmland. This flow continues across the site.

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 Floodplain Maps

The Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas, Map number 04013C2080D, effective date: April 15, 1988, as published by the Federal Emergency Management Agency (FEMA), indicate the area of Phase 1 to be in Zone "B".

Zone "B" as defined by FEMA is:

Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.

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, and other uses (see Plate 4). Several amenities, including greenbelts and a golf course 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. Within the scope of this report, a hydraulic design of major elements of the drainage system is included in the appendix. The system is designed base on generally accepted engineering practices and in accordance with local requirements.

5.2 Drainage Concept

A system of channels is proposed to convey offsite and onsite storm water runoff. Sheet flow from north of Phase 1 impacts the site at Thomas Road. This flow is to be collected and concentrated in temporary collection channels, just north of Thomas Road. The concentrated flow crosses Thomas Road through culverts at two locations, 900' east of Litchfield Road and 1800' west of Dysart Road. As

the land north of Thomas Road is developed, and the drainage system proposed in the CMDR is completed, these temporary collection channels can be abandoned.

The offsite concentrated flow combines with local onsite runoff while it is conveyed across the site through a system of channels. The channels are located within the golf course where applicable, and cross the streets through culverts, dip sections or a combination. The concentrated flow then outlets into the ADOT retention basins at the south end of the property.

5.3 Channels

The channels within the project are designed to convey the expected 100-year flow with 1 foot of freeboard. The channels are to be earthen, grass lined, riprap lined, decomposed granite, or a combination. Channel hydraulics are based on Manning's normal depth computations and culvert headwater where applicable. Refer to the appendix for channel hydraulics calculations.

5.4 Culverts

Concrete box culverts or pipe culverts are used where the channels cross the roads. The culverts are designed for 100-year dry crossings of the arterial streets, collector streets and primary parcel access. The secondary parcel access roads are designed to a lesser standard such as a dip section with low flow pipes. The culvert sizes and types have been designed based on "Hydraulic Charts for the Selection of Highway Culverts, HEC 5" (Ref 7). Refer to the Appendix for culvert hydraulics calculations.

5.5 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 per the City of Goodyear requirements.

Curb opening type catch basins are being used to take flow from the streets into storm drains. The catch basins have been designed based on the "City of Phoenix Storm Drain Design Manual" (Ref. 10). Storm drain pipes have been designed to be in partial flow, full flow, or pressure flow. The Manning equation and the Bernoulli equation have been used to evaluate the capacity and hydraulic grade of the storm drains. Catch basin and storm drain calculations have been computerized on a spread sheet program.

Storm drain and catch basins have been designed for Litchfield Road, Thomas Road, Dysart Road, and the interior collector street. The hydrologic and hydraulic analyses of these streets and storm drains are included in the Appendix, Calculations 1 through 4.

5.6 Grading Concept

A mass grading concept plan is included in the appendix of this report (Plate 5). This plan is preliminary in nature and is subject to refinement as the golf course plan is completed. This plan is

included to help give an overall understanding of how the drainage and mass grading contours might look.

6.0 RETENTION

6.1 General

The City of Goodyear retention requirement is to retain stormwater runoff produced by the 100-year 6-hour storm (approximately 3"). Based on approval from ADOT, retention for Phase 1 is provided within the large ADOT retention basis.

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.

A comparison of the results of the ADOT analysis and this MDR - Phase 1 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 MDR - Phase 1 proposes acceptance of concentrated channelized flow into the basins and the elimination of the multiple spillways.

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

As indicated above, the existing ADOT basin is adequate to provide retention for the proposed development. However, grading modifications may be made to the basin to convert it into a joint use park and retention facility. These grading changes will not affect the ability of the retention basin to contain the design storm.

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

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

6. U. S. Department of Transportation, Federal Highway Administration, "Drainage of Highway Pavements, HEC-12", McLean, Virginia, March 1984.

7. U.S. Department of Transportation, Federal Highway Administration, "Hydraulic Charts for the Selection of Highway Culvert, HEC-5," Washington, D.C., December, 1965.

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. City of Phoenix, "Storm Drain Design Manual, Storm Drains with Paving of Major Streets", August 1975.

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

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

16. Coe & Van Loo, "Conceptual Master Drainage Report for Litchfield Park Development Master Plan," March 1989, Revised September 198

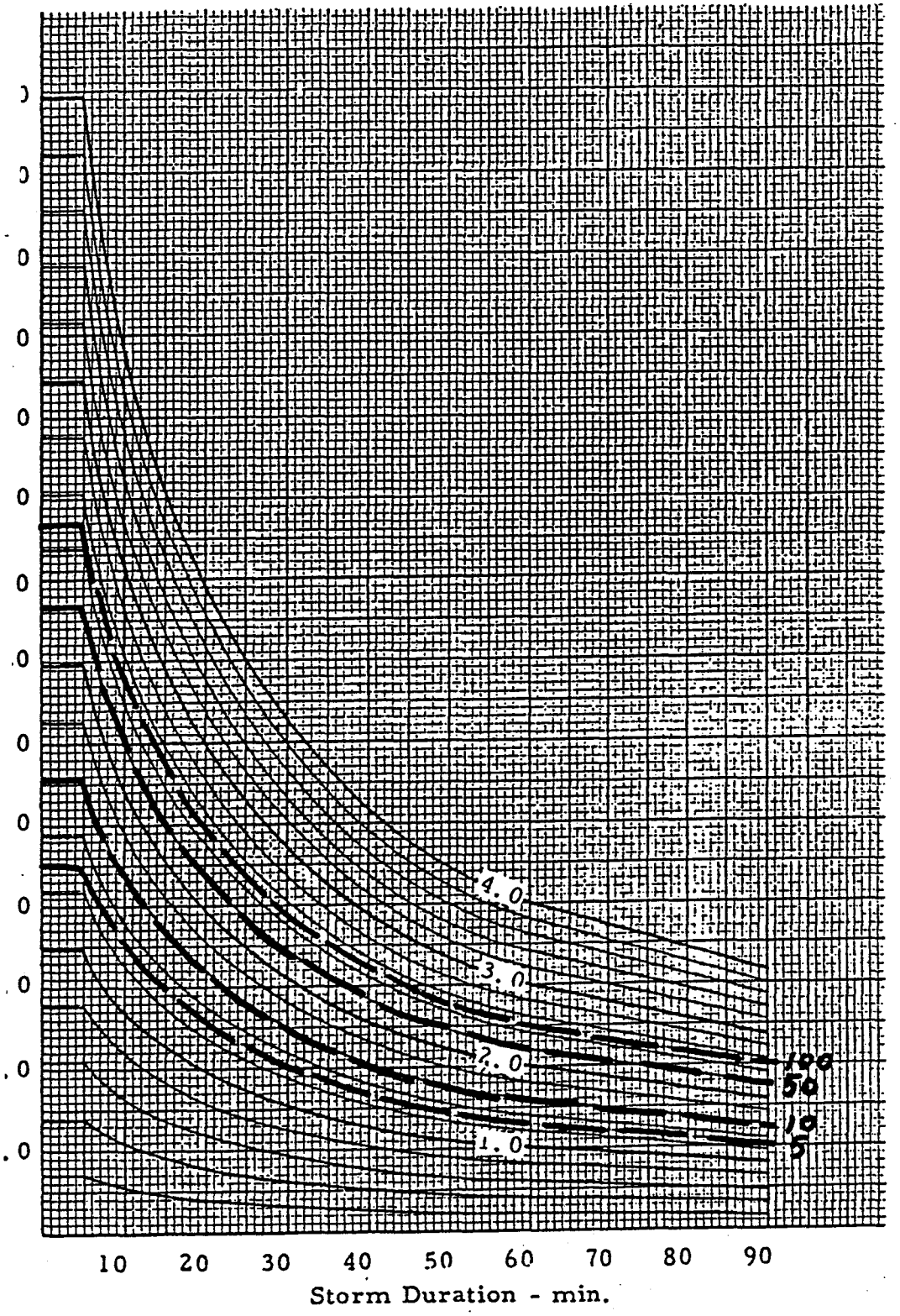

Fig. 3-2

STANDARD DURATION RAINFALL - INTENSITY CURVES

hr

1hr.

Based on:
Weather Bureau
Technical Paper No. 40

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	
Community College	--	85	89	92	
Right-of-Way	--	91	93	94	

* from TR-55 (Ref. 8)

+ from City of Phoenix Storm Drain Design Manual (Ref. 14)

Project No. LITCHFIELD Station _____

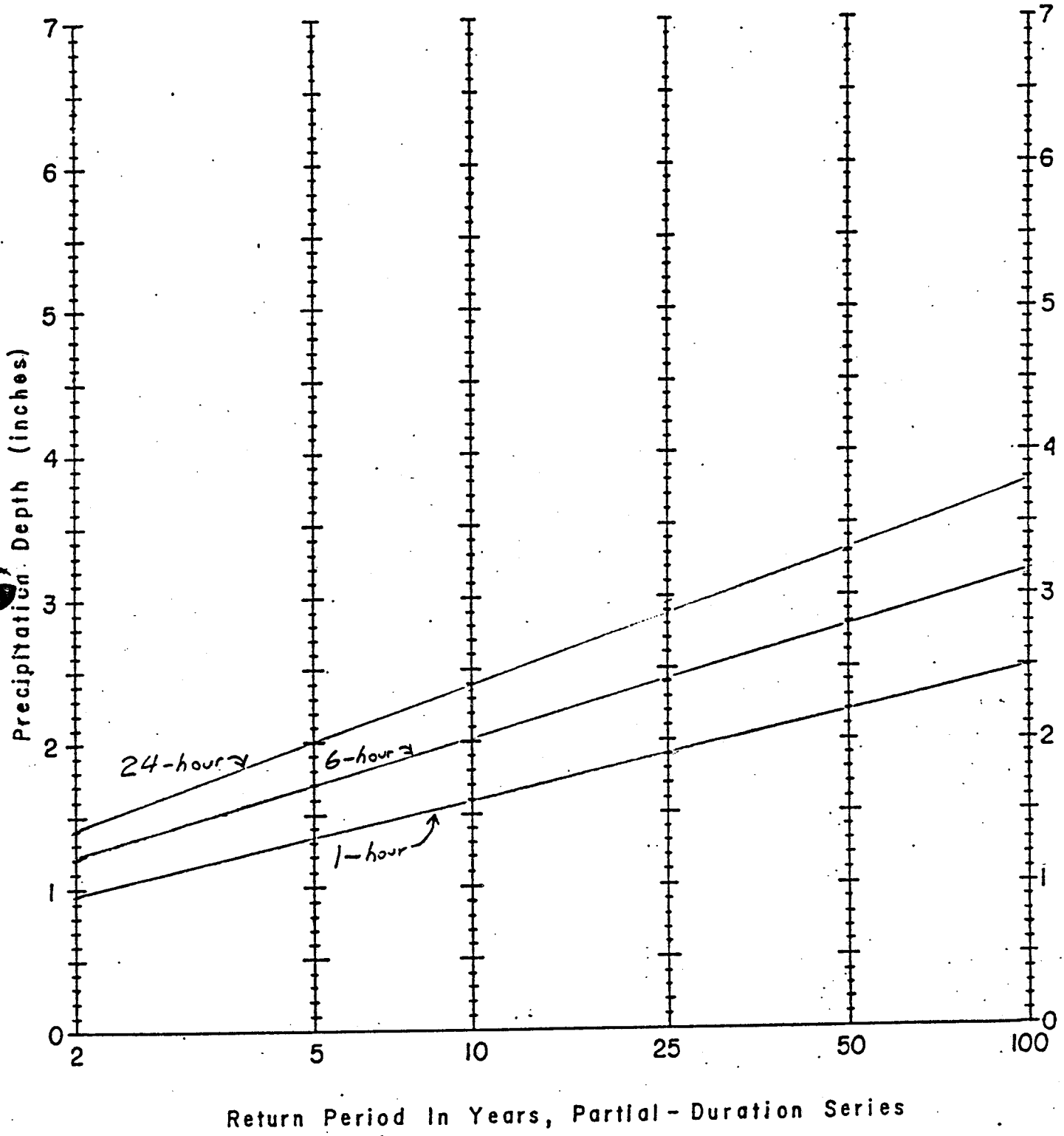

Figure 1 Precipitation Depth Versus Return Period for Partial-Duration Series

LITCHFIELD

ADDENDUM to "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN ARIZONA" April 1975

Steps to be used to determine precipitation values for various durations and return periods.

STEP 1. From the precipitation maps in the manual "Hydrologic Design for Highway Drainage in Arizona", determine the precipitation values for the 6 and 24 hour duration storms for return periods of 2, 5, 10, 25, 50 and 100 years. Tabulate these values in Table 1 in the column headed 'Map Values'

TABLE 1

Return Period (Years)	Precipitation Values (inches)			
	6 hour duration		24 hour duration	
	Map Value	Corrected Value	Map Value	Corrected Value
2	1.2	1.20	1.4	1.40
5	1.7	1.70	2.0	2.00
10	2.0	2.02	2.36	2.40
25	2.4	2.42	2.95	2.88
50	2.8	2.78	3.3	3.32
100	3.12	3.15	3.8	3.75

NOTE: There is a possibility of making an error while reading the maps because, (1) a site is not easy to locate precisely on a series of 12 maps, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. In order to minimize any errors in reading the maps, these values should be plotted on the diagram "Precipitation Depth versus Return Period" Fig. 1.

$Y_2 = -0.011 + 0.942\,(X_1^2/X_2)$ $\quad Y_2 = 0.96''$ 2yr-1hr

$Y_{100} = 0.494 + 0.755\,(X_3^2/X_4)$ $\quad Y_{100} = 2.49''$ 100yr-[illegible]

100-yr, 2-hr $= 0.341(3.15) + 0.659(2.49) = 2.72''$

CORRESPONDENCE

1. ADOT RETENTION BASIN APPROVAL LETTER
2. LITCHFIELD PARK DAM APPROVAL LETTER BY ADWR

CORRESPONDENCE 1

ADOT RETENTION BASIN APPROVAL LETTER

ARIZONA DEPARTMENT OF TRANSPORTATION
STRUCTURES SECTION

OFFICE MEMO

August 22, 1989

RECEIVED
AUG 24 1989

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 2

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

1200-05
CVL-4-1276

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*********************************
*                               *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)
*        FEBRUARY 1981          *
*       REVISED  4 NOV 81       *
*                               *
*ED, SEP 13 1989      TIME 09:34:35
*                               *
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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
*                               *
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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
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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        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   17300   0.004   0.035            TRAP      50      20

 27           KK    SUBB
 28           KM        RUNOFF FROM SUBBASIN B
 29           BA   11.53
 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    5700   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     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    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    15300   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 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    6100   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
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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    7.31
 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    R012
 160          KM        ROUTE C07 TO STATION 12
 161          RK   11000   0.003   0.045             TRAP      20     100

 162          KK     P07
 163          KM        RETRIEVE D7
 164          DR      D7
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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     CO8
 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     CO9
 193          KM        COMBINE DIV9, RO14, & SUBK
 194          HC       3

 195          KK    RO15
 196          KM        ROUTE CO9 TO STATION 15
 197          RK   15100   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    CO10
 204          KM        COMBINE RO12, RO15, & SUBL
 205          HC       3
```

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

206           KK     RD6
207           KM        RETRIEVE D6
208           DR      D6

209           KK     RO16
210           KM        ROUTE RD6 TO STATION 16
211           RK     6100   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      1.5

217           KK     CO11
218           KM        COMBINE RO16 & SUBM
219           HC       2

220           KK     RET1
221           KM        MURPHYS DAM RETENTION
222           RS       1    ELEV    1062
223           SA       0       9       23       39       65
224           SQ       0      32       74      152      322
225           SE    1062    1064    1066    1068    1070

226           KK     RO17
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     CO12
235           KM        COMBINE RO17 & SUBN
236           HC       2

237           KK     SUBO
238           KM        RUNOFF FROM SUBBASIN O
239           BA     2.93
240           LS              76
241           UD      1.6

242           KK     RO19
243           KM        ROUTE SUBO TO STATION 19
244           RK    10000  0.0025   0.025            TRAP      30        4
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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    RO20
 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    CO14
 259          KM        COMBINE RO10, RO20, & 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    1.13
 275          LS              73
 276          UD     1.4

 277          KK    RO21
 278          KM        ROUTE SUBS TO STATION 21
 279          RK    8100   0.036   0.040            TRAP      50       6

 280          KK    SUBT
 281          KM        RUNOFF FROM SUBBASIN T
 282          BA    1.70
 283          LS              85
 284          UD     1.7
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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

```
PUT
INE      (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[illegible]  RO2
          .
          .
45        .-------->      D3
43       DIV3
          V
          V
48        RO3
          .
53        .          .<-------      D2
51        .        RD2
          .          V
          .          V
54        .        RO4
          .          .
          .          .
59        .          .          .<-------      D3
57        .          .        RD3
          .          .          V
          .          .          V
6[illegible]  .          .        RO5
          .          .          .
          .          .          .
63        .          .          .          SUBC
          .          .          .            .
          .          .          .            .
68        .        CO2.......................
          .          V
          .          V
71        .        RO6
          .          .
          .          .
79        .          .        SUBD
          .          .          .
          .          .          .
81        .          .          .-------->      D4
79        .          .        DIV4
          .          .          V
```

```
                                  V
 84                               R07
                                   .
                                   .
 87                                .          SUBE
                                   .           .
 92                          C03.....................
                                   .
                                   .
 97                                .------->    D5
 95                          DIV5
                                   V
                                   V
130                          R08
                                   .
                                   .
135                                .------->    D6
133                          DIV6
                                   V
                                   V
136                          R09
                                   .
                                   .
141                                .          SUBF
                                   .           .
146                     C04.........................
                                   .
                                   .
149                          SUBG
                                   .
                                   .
155                                .-------->   D7
154                          DIV7
                                   V
                                   V
159                          R01
                                   .
                                   .
162                                .          SUBH
                                   .           .
167                          C05.............
                                   .
                                   .
172                                .------->    D8
170                          DIV8
                                   V
                                   V
175                          R011
                                   .
                                   .
178                                .          SUBI
                                   .           .
183                          C06.............
                                   .
                                   .
186                     C07.............
                        V
                        V
189                     R012
                        .
                        .
194                                .<-------    D7
 2                                 7
```

```
                    V
                    V
165                 R013
                    .
                    .
158                 .        SUBJ
                    .        .
                    .        .
173                 CO8.............
                    .
                    .
178                 .-------->     D9
176                 DIV9
                    .
                    .
183                 .        .<-------     D8
181                 .        RD8
                    .        V
                    .        V
184                 .        R014
                    .        .
                    .        .
187                 .        .        SUBK
                    .        .        .
                    .        .        .
192                 CO9......................
                    V
                    V
195                 R015
                    .
                    .
198                 .        SUBL
                    .        .
                    .        .
203         CO10......................
                    .
                    .
208                 .<-------     D6
206                 RD6
                    V
                    V
209                 R016
                    .
                    .
212                 .        SUBM
                    .        .
                    .        .
217                 CO11............
                    V
                    V
220                 RET1
                    V
                    V
226                 R017
                    .
                    .
229                 .        SUBN
                    .        .
                    .        .
234                 CO12............
                    .
                    .
237                 .        SUBO
                    .        V
                    .        V
```

```
242                 R019
245                          SUBP
                                V
                                V
250                          R020
253                                        SUBQ
258                 C014.......................
                        V
                        V
261                 PET2
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 1981            *                                    *  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
                                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    0  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
                     .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

OPERATION	STATION	AREA	PLAN		RATIO 1 0.64 (10 YR 6 HR)	RATIO 2 0.88 (50 YR 6 HR)	RATIO 3 1.00 (100 YR 6 HR)
					RATIOS APPLIED TO PRECIPITATION		
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
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	6.00	1	FLOW	337.	742.	1005.
				TIME	14.17	10.17	9.50
ROUTED TO	RO4	6.00	1	FLOW	334.	737.	987.
				TIME	8.00	7.33	7.33
HYDROGRAPH AT	RO3	6.00	1	FLOW	216.	284.	300.
				TIME	8.00	7.33	7.33
ROUTED TO	RO5	6.00	1	FLOW	214.	284.	300.
				TIME	8.30	7.50	7.33
HYDROGRAPH AT	SUBC	3.29	1	FLOW	176.	398.	530.
				TIME	5.83	5.50	5.50
3 COMBINE	CO2	9.29	1	FLOW	638.	1271.	32.
				I		7	8

DUTED 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
DUTED 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
5 COMBINED AT	CO3	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
DUTED 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
DUTED 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	CO4	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
DUTED 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	CO5	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

2 COMBINE.	C011	1.23	1	FLOW	330.	636.	04.
YDROGRAPH AT	DIVR	9.66	1	FLOW	3150	3350	3550
				TIME	6.50	6.50	6.50
OUTED TO	RET1	1.23	1	FLOW	62.	83.	91.
OUTED TO	R011	9.66	1	FLOW	3487	4330	4537
				TIME	6.83	6.83	7.00
				** PEAK STAGES IN FEET **			
YDROGRAPH AT	SUP1	2.14	1	STAGE	1065481	1068664	1069788
				TIME	5.83	6.08	6.67
DUTED TO	RO08	11.83	1	FLOW	462.	783.	846.
				TIME	6.80	5.33	5.60
YDROGRAPH AT	SUBW	50.99	1	FLOW	1388.	2368.	2912.
				TIME	6.33	6.17	6.17
DUTED TO	RM12	52.43	1	FLOW	1372.	2380.	2919.
				TIME	6.33	6.00	6.83
YDROGRAPH AT	SUBD	2.05	1	FLOW	252.	539.	702.
				TIME	7.83	7.88	8.83
OUTED TO	R013	2.05	1	FLOW	238.	856.	889.
				TIME	5.50	5.00	5.00
YDROGRAPH AT	SUB0	0.99	1	FLOW	120.	280.	368.
				TIME	4.50	4.33	4.33
DUTED TO	RO20	1.92	1	FLOW	192.	282.	528.
				TIME	5.33	5.83	5.83
YDROGRAPH AT	SUBW	3.99	1	FLOW	263.	580.	582.
				TIME	5.83	4.83	4.83
YDROGRAPH AT	D014	8.99	1	FLOW	491.	1190.	1680.
				TIME	5.83	5.58	5.33
YDROGRAPH AT	RED8	8.65	1	FLOW	45.	403.	610.
				TIME	13.83	13.68	13.83
OUTED TO	RO14	[illegible]	1	** PEAK STAGES IN FEET **	405.		616.
			1	STAGE	976.83	978.00	978.83
				TIME	10.50	10.83	11.00
YDROGRAPH AT	SUBK	1.45	1	FLOW	37.	87.	117.
YDROGRAPH AT	SUBR	0.65	1	FLOW	4083	4127	4507
				TIME	4.67	4.50	4.50
3 COMBINED AT	CO9	1.44	1	FLOW	102.	481.	699.
YDROGRAPH AT	SUBS	1.03	1	FLOW	6750	6690	8230
				TIME	4.67	4.50	4.50
OUTED TO	R015	1.44	1	FLOW	90.	469.	681.
OUTED TO	R021	1.03	1	FLOW	10650	8687	8283
				TIME	5.50	5.00	5.00
YDROGRAPH AT	SUBL	4.75	1	FLOW	298.	658.	880.
YDROGRAPH AT	SUBT	1.00	1	FLOW	5133	5500	6800
				TIME	3.67	3.67	3.67
3 COMBINED AT	C01T	56.68	1	FLOW	1428.	2694.	3585.
2 COMBINED AT	C015	2.03	1	FLOW	3127	5587	6967
				TIME	3.67	3.67	3.67
YDROGRAPH AT	RD6	[illegible]	1	FLOW	0.	60.	60.
OUTED TO	RO22	2.03	1	FLOW	3137	5487	6787
				TIME	4.00	3.83	3.83
OUTED TO	RO16	0.00	1	FLOW	0.	60.	60.
YDROGRAPH AT	RD9	0.00	1	FLOW	0437	8583	8420
				TIME	4.00	3.83	3.83
YDROGRAPH	SUPM	1.23	1	FLOW	330.	636.	04.
TEI	RO1			FLOW	[illegible]	[illegible]	[illegible]
				TIME	7.67	6.17	6.00

2 COMBINED AT	C056	.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	139.	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	R061	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	3.50	4.47
				TIME	3	33	.33

HYDROGRAPH AT	SUB1B	0.49	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	3.11	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	.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	1.49	1	FLOW	118.	238.	306.
				TIME	3.50	3.50	3.50

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	14.34	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	R014	2.36	1	FLOW	150.	166.	175.
				TIME	4.83	4.67	4.67
HYDROGRAPH 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
DIVERSION TO	D8	9.66	1	FLOW	42.	407.	617.
				TIME	6.50	6.50	6.50

HYDROGRAPH AT	DIV8	9.66	1	FLOW	371.	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	163.	360.	478.
				TIME	4.83	4.67	4.67
2 COMBINED AT	C06	11.62	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	1.16	1	FLOW	51.	98.	123.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1A	1.15	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	51.64	1	FLOW	1289.	2348.	2944.
				TIME	6.50	6.17	6.17
ROUTED TO	R052	51.64	1	FLOW	1287.	2348.	2943.
				TIME	6.50	6.33	6.33
HYDROGRAPH AT	R07	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	SUB3	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	XD8	0.35	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	SUB4	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	[illegible]	67	[illegible].67

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

 658          KK      C4
 659          HC       2

 660          KK      C5
 661          HC       3

 662          KK      R5
 663          RK    1300   .0033    .030          TRAP      10        5

 664          KK      S8
 665          BA   .0181
 666          LS              69
 667          UD     .15

 668          KK      S9
 669          BA   .0272
 670          LS              92
 671          UD     .1

 672          KK      R6
 673          RK     6 3   .0050    .015          TRAP      40        0

 674          KK      S1
 675          BA   .12 3
 676          LS              82
 677          UD     .18

 678          KK      C6
 679          HC       2

 680          KK      R7
 681          RK    12    .0040    .015          TRAP      40        0

 682          KK      S11
 683          BA   .0338
 684          LS              86
 685          UD     .19

 686          KK      C7
 687          HC       2

 688          KK      S12
 689          BA   .0364
 690          LS              91
 691          UD     .50

 692          KK      C8
 693          HC       2
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 694          KK      S8
 695          RK    14[illegible]0   .0019    .030            TRAP      10       5

 696          KK      S13
 697          BA    .0286
 698          LS                 69
 699          UD      .19

 700          KK      S14
 701          BA    .0541
 702          LS                 82
 703          UD      .36

 704          KK      C9
 705          HC       3

 706          KK      C1[illegible]
 707          HC       3

 708          KK      R5
 709          RK      5[illegible]    .0050    .030            TRAP      10       5

 71           KK      S15
 711          BA    .0[illegible]
 712          LS                 69
 713          UD      .15

 714          KK      S16
 715          BA    .0319
 716          LS                 82
 717          UD      .21

 718          KK      C11
 719          HC       4

 72[illegible]          KK      S1[illegible]
 721          RK    13[illegible]0   .0020    .30             TRAP      10       5

 722          KK      S17
 723          BA    .0248
 724          LS                 69
 725          UD      .14

 726          KK      S18
 727          BA    .0495
 728          LS                 82
 729          UD      .25

 73           KK      C12
 731          HC       3
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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    44[illegible]  [illegible].10   0.035            TRAP      20        4

 591          KK    SUBRH
 592          KM        RUNOFF FROM SUBBASIN PH
 593          BA    [illegible]
 594          LS              85
 595          UD    [illegible].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    2610  0.033   0.035            TRAP      30        4

 610          KK    SUBRI
 611          KM        RUNOFF FROM SUBBASIN RI
 612          BA    0.268
 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

              KK       C1
              BA    .0068
              LS              92
              UD      .11

              KK       C1
              HC        2

              KK       P1
              RK     15.0   .0020    .033            TRAP      10        5

              KK       S2
              BA    .1314
              LS              69
              UD      .14

              KK       S3
              BA    .0364
              LS              80
              UD      .22

              KK       C2
              HC        3

              KK       R2
              RK     16.0   .0025    .036            TRAP      10        5

              KK       S4
              BA    .0161
              LS              69
              UD      .19

              KK       S5
              BA    .0245
              LS              79
              UD      .38

              KK       R3
              RK     9.0    .0038    .012            CIRC       3

              KK       S6
              BA    .1678
              LS              85
              UD      .24

              KK       R4
              RK     16.0   .0038    .036            TRAP      10        5

              KK       S7
              BA    .0541
              LS              78
              UD      .23
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 496          KK    COR4
 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    2.70  0.0020   0.035            TRAP      10        4

 508          KK    SUBRA
 509          KM         RUNOFF FROM SUBBASIN R4
 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    22.0  0.0033   0.035            TRAP      20        4

 519          KK    SUBRB
 520          KM         RUNOFF FROM SUBBASIN RB
 521          BA    0.270
 522          LS              83
 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    31.0  0.0030   0.035            TRAP      20        4
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

              KK   SUBRD
              KM        RUNOFF FROM SUBBASIN RD
              BA   0.317
              LS                R2
              UD    0.43

              KK   SUBRE
              KM        RUNOFF FROM SUBBASIN RE
              BA   0.233
              LS                R4
              UD    0.37

              KK   COR3
              KM        COMBINE ROR4, SUBRD, & SUBRE
              HC       3

              KK   ROR5
              KM        ROUTE COR3 TO STATION R5
              RK   15[illegible]   0.242   0.035          TRAP      20       4

              KK   SUBRF
              KM        RUNOFF FROM SUBBASIN RF
              BA   [illegible] 3
              LS                R3
              UD   1.16

              KK   SUB2H
              KM        RUNOFF FROM SUBBASIN 2H
              BA   0.223
              LS                73
              UD   0.[illegible]

              KK   ROR78
              KM        ROUTE SUB2H TO STATION 78
              RK   3[illegible]0   0.242   0.035          TRAP      15       4

              KK   SUB2I
              KM        RUNOFF FROM SUBBASIN 2I
              BA   0.281
              LS                96
              UD    0.22

              KK   COR4
              KM        COMBINE ROR5, ROR78, SUBRF, & SUB2I
              HC       4

              KK   SUB1V
              KM        RUNOFF FROM SUBBASIN 1V
              BA   0.698
              LS                73
              UD    1.[illegible]
```

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

 415          KK     RO4
 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    CO1[illegible]
 425          KM        COMBINE RO6C, RET1N, RET1O, RET1P, & RETDA
 426          HC       5

 427          KK     RO6
 428          KM        RETRIEVE D6
 429          DR      D6

 430          KK    RO16
 431          KM        ROUTE RD6 TO STATION 16
 432          RK    6.[illegible]   0.[illegible]2   0.035          TRAP      20       4

 433          KK    SUBY
 434          KM        RUNOFF FROM SUBBASIN Y
 435          BA    1.23
 436          LS              82
 437          UD      1.6

 438          KK    CO11
 439          KM        COMBINE RO16 & SUBY
 440          HC       2

 441          KK    RET1
 442          KM        MURPHYS DAM RETENTION
 443          SS       1    ELEV    1162
 444          SE       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    45.[illegible]   0.[illegible]4   0.035          TRAP      20       4

 450          KK    SUBN
 451          KM        RUNOFF FROM SUBBASIN N
 452          BA    1.20
 453          LS              79
 454          UD      1.3
```

```
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    14.0    0.324    0.035             TRAP        25         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
474           SV                1.9      4.7      9.4     12.2
475           SQ                2.2      4.5      6.0      500
476           SE                  1        2        3      3.5

477           KK    C063
478           KM          COMBINE R065 & RET1R
479           HC        2

480           KK    R066
481           KM          ROUTE RET1R TO STATION 66
482           RK    5100    0.203    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    2100    0.303    0.035             TRAP         5         4

491           KK    SUB1T
492           KM          RUNOFF FROM SUBBASIN 1T
493           BA    0.452
494           LS                88
495           UD     0.36
```

```
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        1     5.0    1000    1500    2000    2500    3000    3470    3500    4000
334       DQ        0       0       0       0       0       0       0      30     530

335       KK    R062
336       KM        ROUTE C058 TO STATION 60
337       RK    4410   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    4410   0.025   0.035            TRAP      15       4

346       KK    SUB1K
347       KM        RUNOFF FROM SUBBASIN 1K
348       BA    0.144
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       SO      1     4.2    12.5    20.2    26.0    31.0     530
359       SE      0       1       2       3       4       5     5.5

360       KK    R062
361       KM        ROUTE RET1K TO STATION 62
362       RK    1610   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
```

```
KK     C09
KM        COMBINE DIV9, R014, & SUBK
HC       3

KK    R053
KM        ROUTE C09 TO STATION 53
RK    2[illegible]0   0.004   0.035            TRAP      20        4

KK    SUB1B
KM        RUNOFF FROM SUBBASIN 1B
BA    0.484
LS              87
UD    0.43

KK    RET1B
KM        RETENTION BASIN 1B
RS       1    ELEV        0
SV                11.6     28.2     49.4     74.5     84.6
SQ                12.5       26       35       40      500
SE                   2        4        6      7.5        8

KK    C052
KM        COMBINE R053 & RET1B
HC       2

KK    R054
KM        ROUTE C052 TO STATION 54
RK    24 0   0.004   0.035            TRAP      20        4

KK    SUB1C
KM        RUNOFF FROM SUBBASIN 1C
BA    0.438
LS              87
UD    0.38

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

KK    C053
KM        COMBINE R054 & RET1C
HC       2

KK    R055
KM        ROUTE C053 TO STATION 55
RK    28 0   0.003   0.035            TRAP      20        4
```

```
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   0.074   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     8       1   0.46              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      50      60      60      60      60      60

108           KK    R09
109           KM         ROUTE DIV6 TO STATION 9
110           RK   17100   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            100     210     310     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    7.31
 135          LS              73
 136          UD     2.1

 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    14[illegible]0   0.[illegible]3   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    2[illegible]0   0.005   0.035             TRAP     150       4

 162          KK    SUB1A
 163          KM        RUNOFF FROM SUBBASSIN 1A
 164          BA    1.148
 165          LS              81
 166          UD     0.35
```

```
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     1                          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      2.3

 19           KK    DIV1
 20           KM        DIVERSION AT WADELL RD. & REEMS RD.
 21           DT       D1
 22           DI              100      300      500     1000     2000     3000     4000
 23           DQ              100      200      300      325      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

              1
```

```
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     RD3
 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     RD4
 55           KM        ROUTE RD2 TO STATION 4
 56           RK   13100    0.025    0.035              TRAP        5        6

 57           KK     RD3
 58           KM        RETRIEVE D3
 59           DR      D3

 60           KK     RD5
 61           KM        ROUTE RD3 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      0.2

 68           KK     CO2
 69           KM        COMBINE RD4, RD5, & SUBC
 70           HC        3

 71           KK     RD6
 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     1.6
 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                50      100      150      200      250
```

```
*****************************************************************************
*                                                                           *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)                                        *
*            FEBRUARY 1981                                                  *
*          REVISED  4 NOV 81                                                *
*                                                                           *
*SAT, SEP 23 1989       TIME 13:35:02                                       *
*                                                                           *
*****************************************************************************
```


```
*****************************************************************************
*                                                                           *
*  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 -ATSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

HEC-1

POST-DEVELOPMENT CONDITION

1200-05
CVL-4-1276

CVL

2 COMBINE.	C011	1.23	1	FLOW	33[illegible].	636.	[illegible]4.
				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	1.43	1	FLOW	120.	274.	365.
				TIME	4.50	4.33	4.33
OUTED TO	R02[illegible]	1.43	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.	1193.	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	[illegible]	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	CO16	5.77	1	FLOW	402.	957.	1347.
				TIME	4.33	5.83	5.67

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

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

  768         KK      S24
  769         BA    .0448
  770         LS              82
  771         UD      .28

  772         KK      R16
  773         RK      9.2    .0017    .030            TRAP      10        5

  774         KK      S25
  775         BA    .0397
  776         LS              69
  777         UD      .19

  778         KK      C16
  779         HC        3

  780         KK      C17
  781         HC        2

  782         KK      S26
  783         BA    .0328
  784         LS              91
  785         UD      .4

  786         KK      R17
  787         RK      7.5    .0045    .030            TRAP      10        5

  788         KK      S27
  789         BA    .0631
  790         LS              82
  791         UD      .25

  792         KK      R18
  793         RK     11.0    .0020    .030            TRAP      10        5

  794         KK      S28
  795         BA    .1678
  796         LS              73
  797         UD      .33

  798         KK      C18
  799         HC        3

  800         KK      R19
  801         RK     1.00    .0020    .030            TRAP      10        5

  802         KK      S29
  803         BA    .0175
  804         LS              92
  805         UD      .17
```

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

  732         KK      R11
  733         RK      9.0    .0033    .030            TRAP      10        5

  734         KK      S19
  735         BA    .0206
  736         LS              82
  737         UD      .18

  738         KK      R12
  739         RK      3.0    .0033    .015            TRAP      40        0

  740         KK      S20
  741         BA    .0167
  742         LS              92
  743         UD      .10

  744         KK      C13
  745         HC        2

  746         KK      R13
  747         RK     22.0    .0020    .015            TRAP      40        0

  748         KK      S21
  749         BA    .0103
  750         LS              51
  751         UD      .13

  752         KK      C14
  753         HC        2

  754         KK      S22
  755         BA    .0118
  756         LS              91
  757         UD      .28

  758         KK      R14
  759         RK      8.0    .0033    .031            TRAP      10        5

  760         KK      S23
  761         BA    .0175
  762         LS              92
  763         UD      .18

  764         KK      C15
  765         HC        2

  766         KK      R15
  767         RK     18.0    .0020    .030            TRAP      10        5
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 844          KK    COR2
 845          HC       3

 846          KK   ROR14
 847          KM         ROUTE COR13 TO STATION R14
 848          RK    14.0   0.032   0.035            TRAP      50       5

 849          KK   SUBRQ
 850          KM         RUNOFF FROM SUBBASIN RQ
 851          BA   0.2118
 852          LS              83
 853          UD    0.18

 854          KK   SUBPR
 855          KM         RUNOFF FROM SUBBASIN RR
 856          BA   0.2593
 857          LS              80
 858          UD    0.18

 859          KK   COR14
 860          KM         COMBINE COR4, ROR14, SUBRQ, & SUBPR
 861          HC       4

 862          KK    RET2
 863          KM         ADOT RETENTION AT LITCHFIELD RD & I10
 864          RS       1     ELEV     971
 865          SV       0      0.9     38.9    144.2    316.6    534.8    758.7    930.4   1103.9   1115.0
 866          SQ                11       28       36       43       49       53       57       62      500
 867          SE     971     972     974     976     978     980     982   983.5     985    985.1

 868          KK    RD9
 869          KM         RETRIEVE D9
 870          OR      D9

 871          KK    RD79
 872          KM         ROUTE RD9 TO STATION 79
 873          RK    52.0   0.033   0.035            TRAP      25       4

 874          KK   SUB2M
 875          KM         RUNOFF FROM SUBBASIN 2M
 876          BA   0.184
 877          LS              76
 878          UD    0.35

 879          KK   SUB2N
 880          KM         RUNOFF FROM SUBBASIN 2N
 881          BA   0.455
 882          LS              90
 883          UD    0.39
```

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

806         KK      S30
807         BA    .0225
808         LS              92
809         UD      .16

810         KK      S31
811         BA    .0223
812         LS              89
813         UD      .17

814         KK      C19
815         HC        4

816         KK      R20
817         RK      1200  .0025    .030          TRAP      10        5

818         KK      S32
819         BA    .0184
820         LS              82
821         UD      .25

822         KK      S33
823         BA    .0247
824         LS              84
825         UD      .23

826         KK      S34
827         BA    .0259
828         LS              69
829         UD      .16

830         KK      C20
831         HC        4

832         KK      C21
833         HC        3

834         KK      R21
835         RK      700   .0033    .030          TRAP      10        5

836         KK      S35
837         BA    .0128
838         LS              29
839         UD      .17

840         KK      S36
841         BA    .0322
842         LS              69
843         UD      .15
```

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

              KK    CORB
              KM        COMBINE R080 & RET2Q
              HC       2

              KK    R061
              KM        ROUTE CORB TO STATION 81
              RK    24.0   0.204   0.035            TRAP      25        4

              KK    SUBS
              KM        RUNOFF FROM SUBBASIN S
              BA    1.03
              LS              73
              UD    1.4

              KK    R021
              KM        ROUTE SUBS TO STATION 21
              RK    8.0    1.065   0.045            TRAP      50        6

              KK    SUBT
              KM        RUNOFF FROM SUBBASIN T
              BA    1.02
              LS              85
              UD      .7

              KK    C015
              KM        COMBINE R021 & SUBT
              HC       2

              KK    CORC
              KM        COMBINE R081 & C015
              HC       2

              KK    R082
              KM        ROUTE CORC TO STATION 82
              RK    3.00   0.204   0.035            TRAP      25        4

              KK    SUB2R
              KM        RUNOFF FROM SUBBASIN 2R
              BA    0.317
              LS              86
              UD    0.44

              KK    SUB2S
              KM        RUNOFF FROM SUBBASIN 2S
              BA    0.258
              LS              81
              UD    0.43

              KK    C077
              KM        COMBINE SUB2R & SUB2S
              HC       2
```

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

 884          KK   SUB20
 885          KM        RUNOFF FROM SUBBASIN 20
 886          BA   0.258
 887          LS             92
 888          UD    0.35

 889          KK   CO75
 890          KM        COMBINE  SUB2M, SUB2N, & SUB20
 891          HC       3

 892          KK   RET2N
 893          KM        RETENTION BASIN 2N
 894          RS       1    ELEV       0
 895          SV       0    15.6     52.3     91.6    131.8    157.0
 896          SQ       0      18       50       70       82      500
 897          SE       0       2        4        6      7.5        8

 898          KK   SUB2P
 899          KM        RUNOFF FROM SUBBASIN 2P
 900          BA   0.283
 901          LS             91
 902          UD   0.25

 903          KK   RET.P
 904          KM        RETENTION BASIN 2P
 905          RS       1    ELEV       0
 906          SV       0     3.6      9.1     16.2     25.3     36.2     43.4
 907          SQ             3.4      6.8     12.2     15.1     18.5     50.0
 908          SE               1        2        3        4        5      5.5

 909          KK   CORA
 910          KM        COMBINE R079, RET2N, & RET20
 911          HC       3

 912          KK   R080
 913          KM        ROUTE CORA TO STATION 80
 914          RK   3000   0.004   0.035              TRAP      25        4

 915          KK   SUB2Q
 916          KM        RUNOFF FROM SUBBASIN 2Q
 917          BA   0.094
 918          LS             90
 919          UD    0.20

 920          KK   RET2Q
 921          KM        RETENTION BASIN 2Q
 922          RS       1    ELEV       0
 923          SV       0     2.5      6.3     12.5     16.3
 924          SQ       0     2.8        7        9      500
 925          SE       0       1        2        3      3.5
```

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

1007          KK   SUB2Y
1008          KM        RUNOFF FROM SUBBASIN 2Y
1009          BA   0.300
1010          LS             99
1011          UD    0.31

1012          KK   COB1
1013          KM        COMBINE R087 & SUB2Y
1014          HC       2

1015          KK   SUB2Z
1016          KM        RUNOFF FROM SUBBASIN 2Z
1017          BA   0.40
1018          LS             82
1019          UD    0.30

1020          KK   COB2
1021          KM        COMBINE R084, COB1, & SUB2Z
1022          HC       3

1023          KK   RET2Z
1024          KM        RETENTION BASIN 2Z
1025          RS       1    ELEV
1026          SV            10.1    26.9    47.0    67.2    87.6
1027          SQ            18      50      74      82      500
1028          SE       1     2       4       6      7.5      8

1029          KK   COB3
1030          KM        COMBINE R082 & RET2Z
1031          HC       2

1032          KK   SUB2U
1033          KM        RUNOFF FROM SUBBASIN 2U
1034          BA   0.158
1035          LS             84
1036          UD    0.40

1037          KK   SUB2V
1038          KM        RUNOFF FROM SUBBASIN 2V
1039          BA   0.220
1040          LS             87
1041          UD    0.40

1042          KK   C079
1043          KM        COMBINE SUB2U & SUB2V
1044          HC       2

1045          KK   R095
1046          KM        ROUTE C079 TO STATION 95
1047          RK   2.50   0.062   0.035            TRAP      15       4
```

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

  967         KK   RET2S
  968         KM        RETENTION BASIN 2S
  969         RS       1    ELEV       0
  970         SV                 4.6     11.5     23.7     32.2     46.3     55.2
  971         SQ                 4.2     12.5     23.2     26.0     31.0     50.0
  972         SE                   1        2        3        4        5      5.5

  973         KK   R083
  974         KM        ROUTE RET2S TO STATION 83
  975         RK    28.0   0.0015    0.035            TRAP       5        4

  976         KK   SUB2T
  977         KM        RUNOFF FROM SUBBASIN 2T
  978         BA   0.391
  979         LS                 64
  980         UD    0.32

  981         KK   C078
  982         KM        COMBINE R083 & SUB2T
  983         HC       2

  984         KK   RET2T
  985         KM        RETENTION BASIN 2T
  986         RS       1    ELEV       0
  987         SV                 3.4      8.6     15.5     24.8     34.4     41.3
  988         SQ                   2       18       35       50       61     50.0
  989         SE                   1        2        3        4        5      5.5

  990         KK   R084
  991         KM        ROUTE RET2T TO STATION 84
  992         RK    16.0   0.0145    0.035            TRAP       5        4

  993         KK   SUB2X
  994         KM        RUNOFF FROM SUBBASIN 2X
  995         BA   0.247
  996         LS                 38
  997         UD    0.32

  998         KK   RET2X
  999         KM        RETENTION BASIN 2X
 1000         RS       1    ELEV       0
 1001         SV                 5.5     13.7     27.3     35.5
 1002         SQ                 4.2     12.5     23.2     50.0
 1003         SE                   1        2        3      3.5

 1004         KK   R087
 1005         KM        ROUTE C08  TO STATION 87
 1006         RK    32.0   0.0031    0.035            TRAP      30        4
```

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

1048          KK   SUB2W
1049          KM        RUNOFF FROM STATION 2W
1050          BA   0.233
1051          LS          90
1052          UD    0.50

1053          KK   COB3
1054          KM        COMBINE RO85 & SUB2W
1055          HC        2

1056          KK   RET2W
1057          KM        RETENTION BASIN 2W
1058          RS        1    ELEV
1059          SV        0    10.2    27.2    47.7    68.1    81.7
1060          SQ        0    12.5      26      35      40     500
1061          SE        4       2       4       6     7.5       8
1062          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
-------------------------------------------------------------------------------
 4           RO2
                 .
                 .
-------------------------------------------------------------------------------
 45              .-------->      D3
 43          DIV3
                 V
                 V
-------------------------------------------------------------------------------
 42          RO3
                 .
-------------------------------------------------------------------------------
 53              .        .<-------      D2
 51              .      RO2
                 .        V
                 .        V
-------------------------------------------------------------------------------
 54              .      RO4
                 .        .
-------------------------------------------------------------------------------
 59              .        .          .<-------      D3
 57              .        .        RO3
                 .        .          V
                 .        .          V
-------------------------------------------------------------------------------
 6               .        .        RO5
                 .        .          .
                 .        .          .
-------------------------------------------------------------------------------
 65              .        .          .        SUBC
                 .        .          .          .
                 .        .          .          .
-------------------------------------------------------------------------------
 68              .      CO2..........................
                 .        V
                 .        V
-------------------------------------------------------------------------------
 71              .      RO6
                 .        .
                 .        .
-------------------------------------------------------------------------------
 74              .        .        SUBD
                 .        .          .
                 .        .          .
-------------------------------------------------------------------------------
 81              .        .          .-------->      D4
 79              .        .        DIV4
                 .        .          V
```

```
167          RET1A

173     C051.............
                V
                V
176     R052

181                <-------      D7
179          R07
                V
                V
182          R013

185                     SUBJ

19           C06.............

155                <-------->    D9
193          DIV9

2                       <-------      D8
19                  R06
                        V
                        V
2 1                 R014

2 4                         SUPK

2 9          C09........................
                V
                V
212          R053

215                 SUB1B
                        V
                        V
22                  RET1B

226          C052.............
                V
                V
229          R054

232                 SUB1C
                        V
                        V
237                 RET1C

243          C053.............
                V
                V
245          R055
```

```
84                          RC7
                             .
87                           .          SUBE
                             .            .
92                  C03.......................
                             .
97                           .-------->   D5
95                  DIV5
                             V
                             V
1[illegible]                R08
                             .
                             .
1[illegible]5                .-------->   D6
1[illegible]3               DIV6
                             V
                             V
1[illegible]8               R09
                             .
                             .
111                                 SUBF
                             .        .
11[illegible]       C04.......................
                             .
                             .
11[illegible]               SUBG
                             .
                             .
126                          .-------->   D7
124                 DIV7
                             V
                             V
12[illegible]               RC1
                             .
                             .
132                                 SUBH
                             .        .
137                 C05............
                             .
142                          .-------->   D8
14[illegible]       DIV8
                             V
                             V
145                 R011
                             .
                             .
148                                 SUBI
                             .        .
153                 C06............
                             .
156         C07............
                             V
                             V
153         R051
                             .
152                 SUB1A
                             V
```

```
        V
      RD61
        .
        .
        .        SUB1K
        .          .
        .          .
      CC59 ............
        V
        V
     RET1K
        V
        V
      RD62
        .
        .
        .        SUB1L
        .          .
        .          .
      CC6 .............
        V
        V
      RD63
        .
        .
        .        SUB1M
        .          .
        .          .
        .                SUB1N
        .          .       .
        .          .       .
      CC61 ......................
        V
        V
     RET1M
        .
        .
        .        SUB1O
        .          V
        .          V
        .        RET1O
        .          .
        .          .
        .                SUB1P
        .          .       V
        .          .       V
        .          .     RET1P
        .          .       .
        .          .       .
        .          .       .        .<-------      DA
        .          .       .      RDA
        .          .       .        V
        .          .       .        V
        .          .       .      RETDA
        .          .       .        .
..........................................
        .<-------      D6
      RD6
        V
        V
      RD15
        .
```

```
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
29                  C056............
                      V
                      V
293                 RET1G
299           C057............
                      V
                      V
3 2           R059
3 5                 SUB1H
                      V
                      V
31                  RET1H
316                              SUB1I
                                   V
                                   V
321                              RET1I
327         C05P.................................
332                 -------->   D1
33          DIV2
                      V
                      V
335         R06
```

524								SUBRC									
529				COR2													
532				ROR4													
535						SUBRD											
54								SUBRE									
545				COR3													
548				ROR5													
551						SUBRF											
556								SUB2H									
561								ROR8									
564										SUB2I							
569				COR4													
572						SUB1V											
577						ROR6											
585								SUBRG									
585						COR5											
588						ROR7											
591								SUBRH									
596						COR6											
599								SUB1Y									
6 4						COR7											
6 7						RCR8											

```
433                 SUBM
                      .
438          C011.........
                     V
                     V
441          RET1
                     V
                     V
447          R017
                      .
450                 SUBN
                      .
455          C012.........
                      .
459                 SUB10
                     V
                     V
463                 R065
                      .
466                       SUB1R
                                V
                                V
471                       RET1R
                                .
477                 C063.........
                     V
                     V
48                  R066
                      .
483                       SUB1S
                                V
                                V
488                       R067
                                .
491                             .      SUB1T
                                .        .
496                 C064.......................
                     V
                     V
499                 RET1T
                     V
                     V
5 5                 RGR1
                      .
5 3                       SUBRA
                                .
515                 CGR1.........
                     V
                     V
516                 RGR2
                      .
519                       SUBRB
```

742							S20									
744						C13										
746						R13										
748							S21									
752						C14										
754							S22									
756							R14									
76									S23							
764							C15									
766							R15									
768									S24							
772									R16							
774											S25					
778							C16									
780						C17										
782							S26									
786							R17									
788									S27							
792									R18							
794											S28					
798							C18									
800							R19									

61[illegible]				SUBRI				
615			CORE					
618				S1				
622			C1					
624			V R1					
626				S2				
63[illegible]					S3			
634			C2					
636			V R2					
63[illegible]				S4				
642					S5			
646					V R3			
648						S6		
652						V R4		
654							S7	
65[illegible]						C4		
66[illegible]				C5				
662				V R5				
664					S8			
66[illegible]						S9		
672						V R6		
674							S10	

973				R083	
978					SUB2T
981				C078	
984				RET2T	
990				R084	
993					SUB2X
998					RET2X
1004					R087
1007					SUB2Y
1012					C081
1015					SUB2Z
1020				C082	
1023				RET2Z	
1029			CORD		
1032				SUB2U	
1037					SUB2V
1042				C079	
1045				R085	
1048					SUB2W
1053				C083	
1056				RET2W	

(***) PUNOF ALSO COMPUTED AT THIS LOCATION

879 SUB2N

884 SUB2O

889 CO75

892 RET2N

898 SUB2P

903 RET2P

909 CORA

912 RO8

915 SUB2O

920 RET2O

926 CORB

929 RO81

932 SUBS

937 RO21

943 SUBT

945 CO15

948 CORC

951 RO82

954 SUB2R

959 SUB2S

964 CO77

967 RET2

```
*********************************                                    ********************************
*                                 *                                    *                              *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*                                    *  U.S. ARMY CORPS OF ENGINEERS*
*        FEBRUARY 1981            *                                    * THE HYDROLOGIC ENGINEERING CENTER*
*        REVISED  4 NOV 81        *                                    *        609 SECOND STREET     *
*                                 *                                    *      DAVIS, CALIFORNIA 95616 *
*SAT, SEP 23 1999      TIME 13:35:02*                                    * (916) 440-3285 OR (FTS) 448-3285*
*                                 *                                    *                              *
*********************************                                    ********************************
```

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

```
 7 IO        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         0  STARTING TIME
                   NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     3   0  ENDING DATE
                 NDTIME      2150  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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 0.64 10-YR	RATIO 2 0.88 50-YR.	RATIO 3 1.00 100-YR.
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.	1145.	1373.
				TIME	7.17	7.00	7.00
2 COMBINED AT	CO1	17.76	1	FLOW	591.	1485.	2019.
				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	5.29	1	FLOW	337.	742.	1005.
				TIME	14.17	10.17	9.50
ROUTED TO	RO4	3.59	1	FLOW	334.	737.	987.
				TIME	8.30	7.33	7.33
HYDROGRAPH AT	RO3	5.3	1	FLOW	216.	284.	300.
				TIME	8.30	7.33	7.33
ROUTED TO	RO5	5.56	1	FLOW	214.	284.	300.
				TIME	8.00	7.50	7.33
HYDROGRAPH AT	SUBC	3.23	1	FLOW	176.	398.	530.
				TIME	5.83	5.50	5.50
3-COMBINED AT	CO2	3.29	1	FLOW	638.	1271.	1732.
				TIME	[illegible]	[illegible]	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	14.34	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	7.35	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
DIVERSION TO	D8	9.66	1	FLOW	42.	407.	617.
				TIME	6.50	6.50	6.50

HYDROGRAPH AT	DIV8	9.66	1	FLOW	371.	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	SUE1	2.14	1	FLOW	163.	360.	478.
				TIME	4.83	4.67	4.67
2 COMBINED AT	C06	11.8[illegible]	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	[illegible]	1	FLOW	51.	98.	123.
				TIME	3.33	3.33	3.33
ROUTED TO	RET1A	1.15	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	C081	51.64	1	FLOW	1289.	2348.	2944.
				TIME	6.50	6.17	6.17
ROUTED TO	R052	51.64	1	FLOW	1287.	2348.	2943.
				TIME	6.50	6.33	6.33
HYDROGRAPH AT	607	0.03	1	FLOW	52.	279.	412.
				TIME	6.50	6.33	6.33
ROUTED TO	R013	0.03	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	X08	0.30	1	FLOW	42.	407.	617.
				TIME	3.83	3.50	3.33
ROUTED TO	R014	0.98	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.
				T	7	6	

HYDROGRAPH AT	SUB1B	1.49	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.	406.	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	3.61	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	.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	1.49	1	FLOW	118.	238.	306.
				TIME	3.50	3.50	3.50

2 COMBINED AT	C056	.82	1	FLOW	266.	530.	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	R061	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	3.58	4.47
				TI	3	33	.3

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	C063	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	0.31	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	C01	57.05	1	FLOW	1517.	3211.	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	0.0	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	1.23	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	RCR1	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	CCR1	1.73	1	FLOW	79.	175.	365.
				TIME	3.17	5.00	4.33
ROUTED TO	RCR2	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	CCR2	2.1[illegible]	1	FLOW	186.	382.	491.
				TIME	3.33	3.33	3.33
ROUTED TO	RCR4	2.10	1	FLOW	174.	376.	478.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUBRD	0.32	1	FLOW	136.	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	CCR3	2.65	1	FLOW	334.	692.	904.
				TIME	3.50	3.33	3.33
ROUTED TO	RCR5	2.65	1	FLOW	326.	683.	874.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUBRF	0.14	1	FLOW	55.	98.	122.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	SUBGH	0.22	1	FLOW	21.	52.	70.
				TIME	4.00	3.83	3.83
ROUTED TO	RCR8	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	CCR4	3.26	1	FLOW	425.	862.	1139.
				TIME	3.50	3.33	3.33
HYDROGRAPH AT	SUB1V	0.70	1	FLOW	60.	143.	193.
				TIME	4.17	4.17	4.00
ROUTED TO	RCR6	0.7[illegible]	1	FLOW	60.	141.	190.
				TIME	4.33	4.33	4.17
HYDROGRAPH AT	SUBRG	0.28	1	FLOW	54.	180.	227.
				TIME	3.33	3.33	3.33
2 COMBINED AT	CCR5	0.97	1	FLOW	95.	198.	265.
				TIME	3.33	4.00	4.00
ROUTED TO	RCR7	0.97	1	FLOW	92.	196.	264.
				TIME	4.50	4.50	4.17

HYDROGRAPH AT	SUBRH	0.3[illegible]	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
HYDROGRAPH 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
ROUTED TO	RORB	2.83	1	FLOW	555.	1162.	1395.
				TIME	3.67	3.50	3.50
HYDROGRAPH AT	SUBRI	0.27	1	FLOW	81.	170.	220.
				TIME	3.17	3.17	3.17
2 COMBINED AT	CORB	3.1[illegible]	1	FLOW	562.	1174.	1537.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	S1	0.01	1	FLOW	11.	17.	20.
				TIME	3.00	3.00	3.00
2 COMBINED AT	C1	3.11	1	FLOW	564.	1177.	1540.
				TIME	3.50	3.50	3.50
ROUTED TO	R1	3.11	1	FLOW	556.	1154.	1492.
				TIME	3.67	3.67	3.50
HYDROGRAPH AT	S2	0.0[illegible]	1	FLOW	4.	13.	18.
				TIME	3.17	3.00	3.00
HYDROGRAPH AT	S3	0.04	1	FLOW	19.	35.	44.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C2	3.13	1	FLOW	564.	1168.	1516.
				TIME	3.67	3.67	3.50
ROUTED TO	R2	3.13	1	FLOW	551.	1160.	1492.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT	S4	0.01	1	FLOW	1.	2.	3.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S5	0.08	1	FLOW	24.	48.	62.
				TIME	3.33	3.33	3.33
ROUTED TO	R3	0.08	1	FLOW	23.	47.	61.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S6	0.17	1	FLOW	99.	174.	214.
				TIME	3.17	3.17	3.17
ROUTED TO	R4	0.17	1	FLOW	89.	152.	190.
				TIME	3.33	3.17	3.17
HYDROGRAPH AT	S7	0.05	1	FLOW	16.	38.	49.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C4	0.22	1	FLOW	1[illegible]3.	190.	239.
				TIME	3.33	3.17	3.17
2 COMBINED AT	C5	0.31	1	FLOW	126.	232.	295.
				TIME	[illegible]	[illegible]	[illegible]

ROUTED TO	R5	0.31	1	FLOW	122.	229.	286.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S8	0.02	1	FLOW	2.	7.	10.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	S9	0.03	1	FLOW	36.	55.	64.
				TIME	3.00	3.00	3.00
ROUTED TO	R6	0.03	1	FLOW	32.	50.	60.
				TIME	3.00	3.00	3.00
HYDROGRAPH AT	S10	0.02	1	FLOW	13.	19.	24.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C6	0.05	1	FLOW	42.	69.	83.
				TIME	3.00	3.00	3.00
ROUTED TO	R7	0.05	1	FLOW	34.	56.	69.
				TIME	3.17	3.00	3.00
HYDROGRAPH AT	S11	0.03	1	FLOW	22.	37.	45.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C7	0.08	1	FLOW	57.	93.	114.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	S12	0.03	1	FLOW	15.	25.	29.
				TIME	3.33	3.33	3.33
2 COMBINED AT	C8	0.11	1	FLOW	68.	112.	137.
				TIME	3.17	3.17	3.17
ROUTED TO	R8	0.11	1	FLOW	61.	104.	131.
				TIME	3.33	3.17	3.17
HYDROGRAPH AT	S13	0.03	1	FLOW	4.	11.	15.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S14	0.05	1	FLOW	24.	46.	58.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C9	0.19	1	FLOW	83.	161.	205.
				TIME	3.33	3.17	3.17
3 COMBINED AT	C10	0.52	1	FLOW	207.	377.	469.
				TIME	3.33	3.33	3.33
ROUTED TO	R9	0.52	1	FLOW	203.	374.	468.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S15	0.02	1	FLOW	3.	9.	13.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	S16	0.03	1	FLOW	16.	29.	36.
				TIME	3.17	3.17	3.17
4 COMBINED AT	C11	3.76	1	FLOW	696.	1399.	1825.
				TIME	3.67	3.67	3.50
ROUTED TO	R10	3.76	1	FLOW	687.	1395.	1792.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT	S17	0.02	1	FLOW	3.	10.	14.
				TIME	3.17	3.00	3.00

HYDROGRAPH AT	S18	0.05	1	FLOW	23.	43.	54.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C12	3.83	1	FLOW	697.	1413.	1813.
				TIME	3.67	3.67	3.67
ROUTED TO	R11	3.83	1	FLOW	682.	1400.	1810.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT	S19	0.02	1	FLOW	10.	19.	23.
				TIME	3.17	3.17	3.17
ROUTED TO	R12	0.02	1	FLOW	10.	19.	23.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S20	0.01	1	FLOW	9.	13.	16.
				TIME	3.00	3.00	3.00
2 COMBINED AT	C13	0.03	1	FLOW	17.	30.	37.
				TIME	3.00	3.00	3.00
ROUTED TO	R13	0.03	1	FLOW	14.	24.	30.
				TIME	3.33	3.17	3.17
HYDROGRAPH AT	S21	0.01	1	FLOW	8.	12.	14.
				TIME	3.00	3.00	3.00
2 COMBINED AT	C14	0.04	1	FLOW	19.	36.	43.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S22	0.01	1	FLOW	9.	14.	17.
				TIME	3.17	3.17	3.17
ROUTED TO	R14	0.01	1	FLOW	8.	13.	15.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S23	0.02	1	FLOW	17.	27.	31.
				TIME	3.00	3.00	3.00
2 COMBINED AT	C15	0.03	1	FLOW	23.	37.	43.
				TIME	3.17	3.17	3.17
ROUTED TO	R15	0.03	1	FLOW	21.	34.	40.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S24	0.04	1	FLOW	19.	37.	46.
				TIME	3.17	3.17	3.17
ROUTED TO	R16	0.04	1	FLOW	19.	35.	43.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S25	0.04	1	FLOW	5.	15.	21.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C16	0.11	1	FLOW	44.	78.	96.
				TIME	3.33	3.33	3.33
2 COMBINED AT	C17	0.15	1	FLOW	61.	107.	135.
				TIME	3.33	3.33	3.17
HYDROGRAPH AT	S26	0.03	1	FLOW	22.	35.	41.
				TIME	3.33	3.33	3.33
ROUTED TO	R17	0.03	1	FLOW	21.	34.	40.
				TIME	3.33	3.33	3.33

HYDROGRAPH AT	S27	0.06	1	FLOW	29.	55.	69.
				TIME	3.17	3.17	3.17
ROUTED TO	R18	0.06	1	FLOW	28.	50.	62.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	S28	0.07	1	FLOW	11.	27.	36.
				TIME	3.33	3.33	3.33
3 COMBINED AT	C18	0.16	1	FLOW	69.	111.	139.
				TIME	3.33	3.33	3.33
ROUTED TO	R19	0.16	1	FLOW	56.	105.	134.
				TIME	3.50	3.33	3.33
HYDROGRAPH AT	S29	0.02	1	FLOW	18.	28.	32.
				TIME	3.00	3.00	3.00
HYDROGRAPH AT	S30	0.02	1	FLOW	24.	37.	43.
				TIME	3.00	3.00	3.00
HYDROGRAPH AT	S31	0.02	1	FLOW	3.	9.	12.
				TIME	3.17	3.17	3.17
4 COMBINED AT	C19	0.23	1	FLOW	73.	139.	173.
				TIME	3.33	3.17	3.33
ROUTED TO	R20	0.23	1	FLOW	71.	139.	172.
				TIME	3.50	3.33	3.33
HYDROGRAPH AT	S32	0.07	1	FLOW	32.	60.	75.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S33	0.02	1	FLOW	16.	27.	33.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	S34	0.03	1	FLOW	3.	10.	14.
				TIME	3.17	3.17	3.17
4 COMBINED AT	C20	0.34	1	FLOW	111.	215.	270.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C21	4.32	1	FLOW	831.	1598.	2055.
				TIME	3.67	3.67	3.50
ROUTED TO	R21	4.32	1	FLOW	790.	1591.	2048.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT	S35	0.01	1	FLOW	11.	17.	21.
				TIME	3.00	3.00	3.00
HYDROGRAPH AT	S36	0.03	1	FLOW	4.	12.	18.
				TIME	3.17	3.17	3.00
3 COMBINED AT	C22	4.37	1	FLOW	795.	1599.	2057.
				TIME	3.67	3.67	3.67
ROUTED TO	RGB14	4.37	1	FLOW	767.	1573.	2049.
				TIME	3.83	3.67	3.67
HYDROGRAPH AT	SUBRD	0.21	1	FLOW	112.	202.	251.
				TIME	3.17	3.17	3.00
HYDROGRAPH AT	SUBRP	0.24	1	FLOW	101.	195.	246.
				TIME	3.17	3.17	3.17

4 COMBINED AT	COR14	8.08	1	FLOW	1199.	2421.	3200.
				TIME	3.67	3.50	3.50
ROUTED TO	RET2	8.08	1	FLOW	38.	45.	48.
				TIME	10.00	11.17	10.83
			** PEAK STAGES IN FEET **				
			1	STAGE	976.63	978.73	979.81
				TIME	10.17	11.33	10.83
HYDROGRAPH AT	RD9	7.00	1	FLOW	43.	350.	542.
				TIME	10.00	11.17	10.83
ROUTED TO	RO79	6.00	1	FLOW	41.	343.	535.
				TIME	5.50	5.17	5.00
HYDROGRAPH AT	SUB2M	0.18	1	FLOW	40.	89.	117.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB2N	0.55	1	FLOW	352.	564.	672.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB2O	1.26	1	FLOW	194.	305.	361.
				TIME	3.17	3.17	3.17
3 COMBINED AT	C075	1.39	1	FLOW	580.	943.	1130.
				TIME	3.33	3.33	3.33
ROUTED TO	RET2N	1.07	1	FLOW	42.	67.	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
HYDROGRAPH AT	SUB2P	0.28	1	FLOW	199.	319.	380.
				TIME	3.17	3.17	3.17
ROUTED 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
3 COMBINED AT	COR4	1.29	1	FLOW	94.	417.	618.
				TIME	5.67	5.17	5.00
ROUTED TO	RO94	1.23	1	FLOW	94.	415.	613.
				TIME	5.67	5.33	5.17
HYDROGRAPH AT	SUB2Q	1.69	1	FLOW	79.	124.	148.
				TIME	3.17	3.17	3.17
ROUTED TO	RET2Q	1.69	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
2 COMBINED AT	COPB	1.37	1	FLOW	98.	422.	621.
				TIME	5.67	5.33	5.17
ROUTED TO	ROB1	1.37	1	FLOW	98.	422.	621.
				TIME	[illegible]	[illegible] 33	[illegible]

HYDROGRAPH AT	SUB3	1.33	1	FLOW	73.	169.	227.
				TIME	4.67	4.50	4.50
ROUTED TO	R021	1.03	1	FLOW	65.	161.	220.
				TIME	5.50	5.00	5.00
HYDROGRAPH AT	SUBT	1.09	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
2 COMBINED AT	CORC	3.40	1	FLOW	323.	709.	1013.
				TIME	3.67	5.17	5.00
ROUTED TO	R082	3.41	1	FLOW	323.	707.	1009.
				TIME	3.83	5.33	5.17
HYDROGRAPH AT	SUB2R	0.32	1	FLOW	143.	251.	308.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB2S	0.26	1	FLOW	79.	156.	198.
				TIME	3.33	3.33	3.33
2 COMBINED AT	C077	0.58	1	FLOW	222.	406.	505.
				TIME	3.33	3.33	3.33
ROUTED 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
ROUTED TO	R083	0.58	1	FLOW	18.	27.	30.
				TIME	6.50	6.50	6.50
HYDROGRAPH AT	SUB2T	0.39	1	FLOW	178.	329.	410.
				TIME	3.17	3.17	3.17
2 COMBINED AT	C078	0.97	1	FLOW	178.	329.	410.
				TIME	3.17	3.17	3.17
ROUTED 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
ROUTED TO	R084	0.97	1	FLOW	29.	46.	53.
				TIME	6.33	6.33	6.33
HYDROGRAPH AT	SUB2X	0.25	1	FLOW	153.	258.	313.
				TIME	3.17	3.17	3.17
ROUTED 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
ROUTED TO	R087	0.25	1	FLOW	9.	15.	17.
				TIME	6.83	6.67	6.50

HYDROGRAPH AT	SUB2Y	0.3[illegible]	1	FLOW	204.	337.	406.
				TIME	3.17	3.17	3.17
2 COMBINED AT	CO81	0.55	1	FLOW	204.	337.	406.
				TIME	3.17	3.17	3.17
HYDROGRAPH AT	SUB27	0.4[illegible]	1	FLOW	163.	315.	397.
				TIME	3.17	3.17	3.17
3 COMBINED AT	CO82	1.91	1	FLOW	368.	654.	808.
				TIME	3.17	3.17	3.17
ROUTED 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	7.09
				TIME	6.33	6.50	6.67
2 COMBINED AT	CO8D	5.32	1	FLOW	358.	775.	1084.
				TIME	3.83	5.33	5.17
HYDROGRAPH AT	SUB2U	0.16	1	FLOW	65.	118.	147.
				TIME	3.33	3.33	3.33
HYDROGRAPH AT	SUB2V	0.22	1	FLOW	113.	192.	234.
				TIME	3.33	3.33	3.33
2 COMBINED AT	CO79	[illegible].38	1	FLOW	178.	311.	380.
				TIME	3.33	3.33	3.33
ROUTED TO	RO85	0.38	1	FLOW	175.	298.	361.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT	SUB2W	[illegible].23	1	FLOW	172.	277.	331.
				TIME	3.17	3.17	3.17
2 COMBINED AT	CO83	[illegible].61	1	FLOW	385.	521.	634.
				TIME	3.33	3.33	3.33
ROUTED TO	RET2W	[illegible].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 ***

CALCULATIONS

1. LITCHFIELD ROAD, STREET FLOW AND STORM DRAIN ANALYSIS
2. THOMAS ROAD, STREET FLOW AND STORM DRAIN ANALYSIS
3. DYSART ROAD, STREET FLOW AND STORM DRAIN ANALYSIS
4. COLLECTOR ROAD, STREET FLOW AND STORM DRAIN ANALYSIS
5. CHANNEL HYDRAULICS
6. CULVERT HYDRAULICS

CALCULATION 1

LITCHFIELD ROAD, STREET FLOW AND STORM DRAIN ANALYSIS

1200-05
CVL-4-1276

LITCHFIELD ROAD

Street Flow & Storm Drain Analysis

The pavement section of Litchfield Road has been designed as a 26' pavement width for both the northbound and southbound traffic. Future, Phase 2, construction will increase this pavement width to 39' each direction.

Storm drain has been designed such that the 5-year storm does not exceed top of curb. Additional catch basins have been added to help keep nuisance flow from crossing the major streets. Hydrology calculations are based on the future (Phase 2) pavement width, and include runoff from the landscape easements. All storm drain, catch basins, and connector pipes, have been designed to carry flow from the future (Phase 2) condition.

Two storm drain systems have been designed for Litchfield Road. Flow is collected north of Thomas Road and piped on half mile south to a channel in the golf course. Additional flow is collected along the way. The second storm drain system, collects flow north of McDowell Road, and pipes it to an existing storm drain in Litchfield Road.

LITCHFIELD ROAD

Street Flow & Storm Drain Hydrology

CP#	Area (AC)	Land Use	Weighted C	Initial Flow Time (Min)	Flow Length (Ft)	Ave. Velocity (FPS)	Tc (Min)	I_5/I_{100} (in/hr)	Q_5/Q_{100} (CFS)
A	5.5	R/W	0.74	5	1603	1.5	23	2.4/4.7	10/19
B	7.4	R/W	0.74	23	550	2	28	2.1/4.1	12/23
C	12.1	R/W	0.74	28	1120	3	34	1.9/3.6	17/32
D	17.0	R/W	0.74	37	1415	3	42	1.6/3/1	20/39
E	19.0	R/W	0.74	49	565	3	45	1.5/3.0	21/42
F	7.1	R/W	0.74	5	2068	2	22	2.5/4.8	13/25
G	12.3	R/W	0.74	22	1502	3	31	2.0/3.8	18/35

LITCHFIELD ROAD

Hydraulic Summary

CP#	Total Flow Q_5/Q_{100} (CFS)	Flow in storm Drain Q_5/Q_{100} (CFS)	Flow in Street Q_5/Q_{100} (CFS)	Street Slope (%)	Street Capacity (CFS)
A	10/19	8/12	2/7	0.3%	27
B	12/23	12/20	0/3	0.6%	12**
C	17/32	14/23	3/9	0.2%	7**
D	20/39	18/31	2/8	0.2%	22
E	21/42	21/41	0/1	0.2%	22
F	13/26*	10/14	3/12	0.5%	34
G	18/36*	18/36	0/0	0.2%	22

* The 100-year flow included 1 CFS flow-by from CP# E.

** Superelevated section, only 1 gutter is accounted for in street capacity

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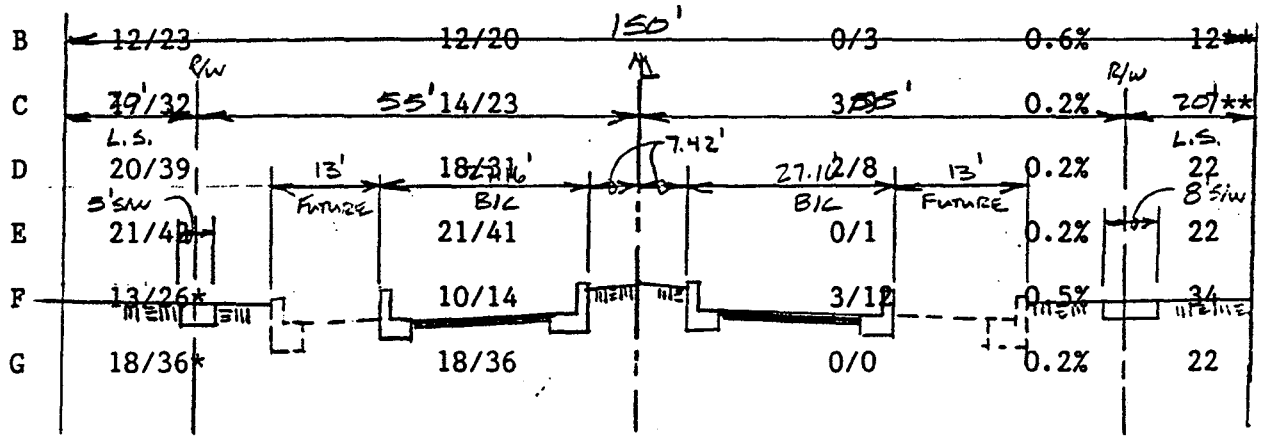
LITCHFIELD ROAD

Hydraulic Summary

Project LITCHFIELD RD.
Project No.
Sheet No. of
Calculated by ~~Street~~ V. Street Date 9-25-
Checked by Date

CP#	Total Flow Q_5/Q_{100} (CFS)	Flow in storm Drain Q_5/Q_{100} (CFS)	Flow in Street Q_5/Q_{100} (CFS)	Street Slope (%)	Street Capacity (CFS)
		WEIGHTED 'C'			
A	10/19	8/12	2/7	0.3%	27
B	~~12/23~~	~~12/20~~	~~0/3~~	~~0.6%~~	~~12~~**
C	~~19~~/32	55' 14/23	3~~55~~'	0.2%	20/**
D	20/39	18/31	27.1 2/8	0.2%	22
E	21/41	21/41	0/1	0.2%	22
F	13/26*	10/14	3/12	0.5%	34
G	18/36*	18/36	0/0	0.2%	22



* The 100-year flow included 1 CFS flow-by from CP# E.

** Superelevated section, only ~~1 gutter is accounted for~~ LITCHFIELD ROAD in street capacity

	LENGTH		'C' VALUE		
- IMPERVIOUS SURFACE	93.32	X	.95	=	88.65
- LANDSCAPE SURFACE	56.68	X	.40	=	22.67
TOTALS	150 ft.				111.32

WEIGHTED 'C' = 111.32/150 = 0.74

1200-05
CVL-4-1276

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Project LITCHFIELD
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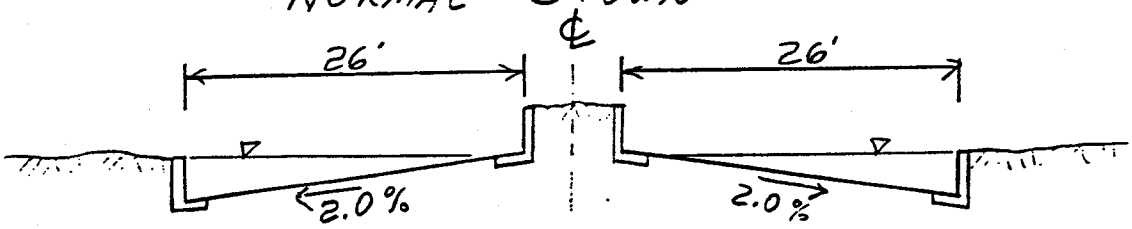
Checked by _____ Date _____

LITCHFIELD ROAD STREET CAPACITY

NORMAL CROWN



STREET CAPACITY USING MANNING'S FORMULA

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}, \quad R = \frac{A}{WP}, \quad Q = VA$$

$A = 12.5$ S.F. $WP = 51$ FT. $n = 0.015$

DEPTH IS TO TOP OF CURB (0.5')

SLOPE (%)	VELOCITY (fps)	STREET CAPACITY (cfs) ½ STREET	FULL STREET
0.2	1.74	10.9	21.8
0.3	2.13	13.3	26.6
0.4	2.45	15.4	30.8
0.5	2.74	17.2	34.4
0.6	3.01	18.8	37.6
0.7	3.25	20.3	40.6
0.8	3.47	21.7	43.4
0.9	3.68	23.0	46.0
1.0	3.88	24.3	48.6

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Project LITCHFIELD
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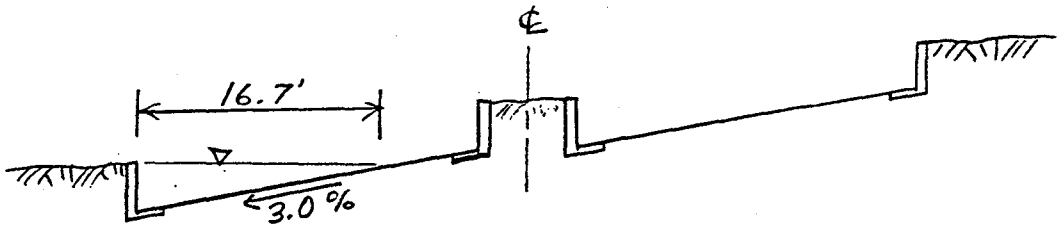
LITCHFIELD ROAD STREET CAPACITY
SUPERELEVATED SECTION



STREET CAPACITY USING MANNING'S FORMULA

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}, \quad R = \frac{A}{WP}, \quad Q = VA$$

$A = 4.2$ S.F. $WP = 17.2$ FT. $n = 0.015$

DEPTH IS TO TOP OF CURB (0.5') DUE TO POTENTIAL MEDIAN BREAKS, ONLY 1 GUTTER IS USED FOR CAPACITY

SLOPE (%)	VELOCITY (fps)	STREET CAPACITY ½ STREET (cfs)
0.2	1.72	7.1
0.3	2.11	8.7
0.4	2.44	10.1
0.5	2.73	11.3
0.6	2.99	12.3
0.7	3.22	13.3
0.8	3.45	14.2
0.9	3.66	15.1
1.0	3.85	15.9

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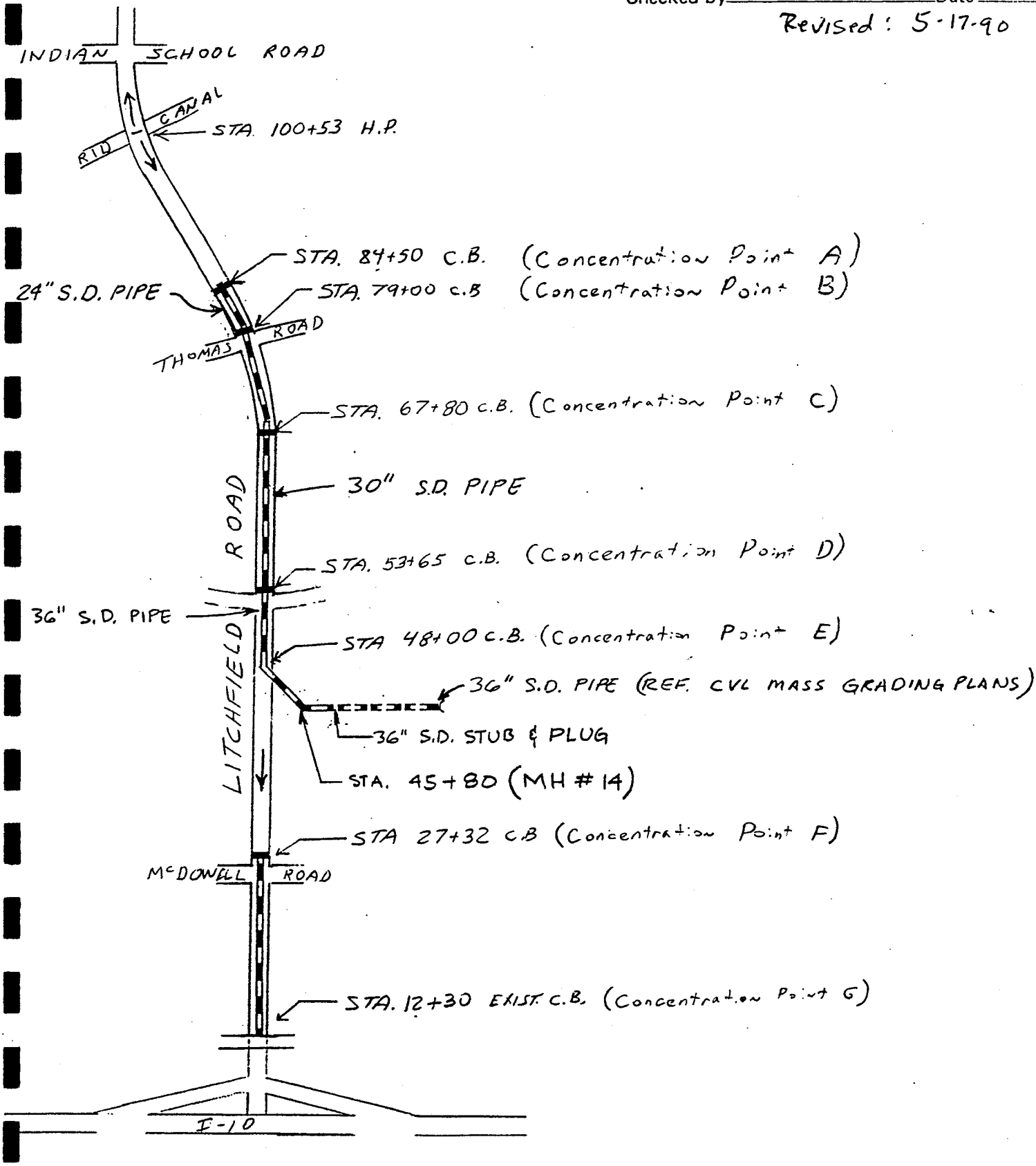
Project LITCHFIELD ROAD
Project No. 1200-05
Sheet No. 7 of 18
Calculated by J.M. Date 9-30-90
Checked by _____ Date _____
Revised: 5-17-90



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HYDRAULIC ANALYSIS NEW STORM DRAIN LATERAL

STORM SEWER CAPACITY CALCULATION RECORD

LOCATION DATA

Litchfield Road
I-10 to R.I.D. Canal

Date: 5/17/90

DESIGN DATA:

Frequency 100 years

Manning's n = 0.012

Location: Outlet no.	Pipe no.	From Sta	To Sta	Inc.	Total Q	Sewer Profile: Inlet inv.	Outlet inv.	Length	So	Sewer Design: D (in.)	K	Q full	V	V2/2g	Sf	hf	loss coeff.	hj	loss coeff.	he	ht (minor)	Hydraulic Grade Line: Elev. @ inlet	Elev. @ outlet	Depth @ inlet	Depth @ outlet
Storm drain sta. 84+50 to 42+30																									
OUTLET		4580	4230	0	41	990.20	989.50	350.00	0.0020	36	722.50	32.31	5.80	0.522281	0.00322	1.13	0.07	0.04	0.00	0.00	0.04	993.66	992.50	3.46	3.00
MH		4800	4580	10	41	990.65	990.20	220.00	0.0020	36	722.50	32.68	5.80	0.522281	0.00322	0.71	0.07	0.04	0.00	0.00	0.04	994.45	993.70	3.80	3.50
MH		5365	4800	8	31	992.75	990.65	565.00	0.0037	36	722.50	44.07	4.39	0.298579	0.00184	1.04	0	0.00	0.00	0.00	0.00	995.49	994.45	2.74	3.80
MH		6780	5365	3	23	996.50	993.25	1415.00	0.0023	30	444.28	21.29	4.68	0.340813	0.00268	3.79	0	0.00	0.00	0.00	0.00	999.28	995.49	2.78	2.24
MH		7782	6780	0	20	997.80	996.50	1002.00	0.0013	30	444.28	16.00	4.07	0.257704	0.00203	2.03	0.02	0.01	0.00	0.00	0.01	1001.32	999.28	3.52	2.78
MH		7900	7782	8	20	998.75	998.30	118.00	0.0038	24	245.02	15.13	6.37	0.629160	0.00666	0.79	0	0.00	0.00	0.00	0.00	1002.10	1001.32	3.35	3.02
MH		8450	7900	12	12	1000.25	998.75	550.00	0.0027	24	245.02	12.80	3.82	0.226497	0.00240	1.32	0	0.00	0.00	0.00	0.00	1003.42	1002.10	3.17	3.35
Storm drain sta. 27+32 to 12+30																									
OUTLET		1230	2732		14	986.10	982.30	1502.00	0.0025	24	245.02	12.32	4.46	0.308288	0.00326	4.90	0	0.00	0.00	0.00	0.00	989.20	984.30	3.10	2.00

* Revision for Pipe Extention in Golf Course
for Outlet Ref. CVL Mass Grading 1200-050

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LITCHFIELD ROAD CATCH BASINS CP#B

STA. 79+00 2 CATCH BASINS M-1, L=6 FLOW-SY
Catch Basins are in a superelevated section, north of Thomas Road.

Sizing based on C.O.P. Storm Drain Design Manual (pg. 28)
FLOW IN STREET:
$Q_5 = 12cfs - 8cfs$ in S.D. $= 4cfs = 2cfs$ each side
$Q_{100} = 23cfs - 12cfs$ in S.D. $= 11cfs = 6cfs$ each side

FOR 5-YR STORM

$Q_a = 2cfs$
$Y = 0.25'$
$a = 2'' = 0.16'$
$Q_a/L_a = 0.17$
$L_a = Q_a/0.17 = 2/0.17 = 12'$
$L = 9'$
$L/L_a = 9/12 = 0.75$
$a/Y = 0.16/0.25 = 0.64$
$Q/Q_a = 0.85$
$Q = Q_a \times 0.85 = 2 \times 0.85 = 2cfs$ each C.B.

FLOW INTERCEPTED $= 2 \times 2cfs = 4cfs$

FLOW REMAINING IN STREET $= 4cfs - 4cfs = 0cfs$

FLOW NOW IN STORM DRAIN $= 8cfs + 4cfs = 12cfs$

FOR 100-YR STORM

$Q_a = 6cfs$
$Y = 0.40'$
$a = 2'' = 0.16'$
$Q_a/L_a = 0.28$
$L_a = Q_a/0.28 = 6/0.28 = 21'$
$L = 9'$
$L/L_a = 9/21 = 0.42$
$a/Y = 0.16/0.40 = 0.40$
$Q/Q_a = 0.62$
$Q = Q_a \times 0.62 = 6 \times 0.62 = 4cfs$ each C.B.

FLOW INTERCEPTED $= 2 \times 4cfs = 8cfs$

FLOW REMAINING IN STREET $= 11cfs - 8cfs = 3cfs$

FLOW NOW IN STORM DRAIN $= 12cfs + 8cfs = 20cfs$

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LITCHFIELD ROAD CATCH BASINS CP#B

STA. 79+00 2 CATCH BASINS M-1, L=6 FLOW-SY
Catch Basins are in a superelevated section, north of Thomas Road.

Sizing based on C.O.P. Storm Drain Design Manual (pg. 28)
FLOW IN STREET:
$Q_5 = 12cfs - 8cfs$ in S.D. $= 4cfs = 2cfs$ each side
$Q_{100} = 23cfs - 12cfs$ in S.D. $= 11cfs = 6cfs$ each side

FOR 5-YR STORM

$Q_a = 2cfs$
$Y = 0.25'$
$a = 2'' = 0.16'$
$Q_a/L_a = 0.17$
$L_a = Q_a/0.17 = 2/0.17 = 12'$
$L = 9'$
$L/L_a = 9/12 = 0.75$
$a/Y = 0.16/0.25 = 0.64$
$Q/Q_a = 0.85$
$Q = Q_a \times 0.85 = 2 \times 0.85 = 2cfs$ each C.B.

FLOW INTERCEPTED $= 2 \times 2cfs = 4cfs$

FLOW REMAINING IN STREET $= 4cfs - 4cfs = 0cfs$

FLOW NOW IN STORM DRAIN $= 8cfs + 4cfs = 12cfs$

FOR 100-YR STORM

$Q_a = 6cfs$
$Y = 0.40'$
$a = 2'' = 0.16'$
$Q_a/L_a = 0.28$
$L_a = Q_a/0.28 = 6/0.28 = 2$
$L = 9'$
$L/L_a = 9/21 = 0.42$
$a/Y = 0.16/0.40 = 0.40$
$Q/Q_a = 0.62$
$Q = Q_a \times 0.62 = 6 \times 0.62 = 4c$ each C.B.

FLOW INTERCEPTED $= 2 \times 4cfs = 8c$

FLOW REMAINING IN STREET $= 11cfs - 8cfs = 3c$

FLOW NOW IN STORM DRAIN $12cfs + 8cfs = 20$

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LITCHFIELD ROAD CATCH BASINS

CATCH BASINS ON THOMAS ROAD IMMEDIATELY EAST OF LITCHFIELD ROAD.
APPROXIMATE LITCHFIELD ROAD STA. 77+82

THESE CATCH BASINS ARE TO PREVENT NUISANCE FLOW ON THOMAS ROAD FROM CROSSING LITCHFIELD ROAD.

THEREFORE, SMALL CATCH BASINS ARE USED, AND NO SIGNIFICANT FLOW IS ACCOUNTED FOR IN THE STORM DRAIN.

THESE CATCH BASINS ARE TO BE CONSTRUCTED WITH THE THOMAS ROAD PLANS.

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LITCHFIELD ROAD CATCH BASINS CPSE

STA 48+00 2 CATCH BASINS TYPE M-I L = 10' FLOW-BY
CATCH BASINS ARE IN NORMAL STREET SECTION

SIZING BASED ON C.O.P. STORM DRAIN DESIGN MANUAL

Q_5 = 21 cfs - 18 cfs IN S.D. = 3 cfs = 2 cfs each side
Q_{100} = 42 cfs - 31 cfs IN S.D. = 11 cfs = 6 cfs each side

FOR 5-YR STORM

Q_a = 2 cfs
Y = 0.25
a = 2" = 0.16'
Q_a/L_a = 0.17
$L_a = Q_a/0.17 = 2/0.17 = 12'$
L = 13'
THE ENTIRE 5-YR FLOW IS COLLECTED IN THE 13' C.B.

FLOW INTERCEPTED = 3 cfs

FLOW REMAINING IN STREET = 3 cfs - 3 cfs = 0 cfs

FLOW NOW IN STORM DRAIN 18 cfs + 3 cfs = 21 cfs

FOR 100-YR STORM

Q_a = 6 cfs
Y = 0.40'
a = 2" = 0.16'
Q_a/L_a = 0.28
$L_a = Q_a/0.28 = 6/0.28 = 21'$
L = 13'
$L/L_a = 13/21 = 0.62$
$a/Y = 0.16/0.40 = 0.40$
$Q/Q_a = 0.80$
$Q = Q_a \times 0.80 = 6 \times 0.80 = 5$ cfs each C.B.

FLOW INTERCEPTED = 2 x 5 = 10 cfs

FLOW REMAINING IN STREET = 11 cfs - 10 cfs = 1 cfs

FLOW NOW IN STORM DRAIN = 31 cfs + 10 cfs = 41 cfs

AT THIS POINT THE STORM DRAIN OUTLETS TO THE EAST INTO THE GOLF COURSE CHANNEL.

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LITCHFIELD ROAD CATCH BASINS CP ≠ F

STA. 27+32 2 CATCH BASINS M-1, L=3 0.3' SUMP
CATCH BASINS ARE IN A NORMAL STREET SECTION
NORTH OF McDOWELL ROAD.

Sizing based on C.O.P. STORM DRAIN DESIGN MANUAL Pg 29.

Q_5 = 13 cfs = 7 cfs each side
Q_{100} = 25 cfs + 1 cfs FROM FLOW-BY OF C.3 @ STA 48+00 = 26 cfs
= 13 cfs each side

FOR 5-YR STORM

h = 0.5'
y_o = 0.4'
y_o/h = 0.4/0.5 = 0.8
L = 6'
Q/L = 0.8
Q = L x 0.8 = 6 x 0.8 = 5 cfs each C.B.

FLOW INTERCEPTED = 2 x 5 cfs = 10 cfs

FLOW REMAINING IN STREET = 13 - 10 = 3 cfs

WEIR FLOW OVER CROWN IS 0.1' DEEP.

FLOW NOW IN STORM DRAIN = 10 cfs

FOR 100-YR STORM

h = 0.5'
y_o = 0.5'
y_o/h = 0.5/0.5 = 1.0
L = 6'
Q/L = 1.15
Q = L x 1.15 = 6 x 1.15 = 7 cfs each C.B.

FLOW INTERCEPTED = 2 x 7 cfs = 14 cfs

FLOW REMAINING IN STREET = 26 cfs - 14 cfs = 12 cfs

WEIR FLOW OVER CROWN IS 0.2' DEEP

FLOW NOW IN STORM DRAIN = 14 cfs

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LITCHFIELD ROAD CATCH BASINS CP # G

STA 12+30 2 EXISTING CATCH BASINS 39' OPENING
CATCH BASINS ARE IN NORMAL STREET SECTION IN FLOW-BY.
THESE CATCH BASINS WERE DESIGNED BY ADOT TO INTERCEPT 24 cfs EACH.
CALCULATIONS BELOW ARE TO VERIFY THIS

Q_5 = 18 cfs − 10 cfs IN S.D. = 8 cfs = 4 cfs each side
Q_{100} = 36 cfs − 14 cfs in S.D. = 22 cfs = 11 cfs each side

FOR 5-YR STORM

Q_a = 4 cfs
Y = 0.33'
a = 2" = 0.16'
Q_a/L_a = 0.23
$L_a = Q_a/0.23 = 4/0.23 = 17'$
L = 39'
THE ENTIRE 5-YR FLOW IS COLLECTED IN THE 39' C.B.

FLOW INTERCEPTED = 2 x 4 cfs = 8 cfs

FLOW NOW IN STORM DRAIN = 10 cfs + 18 cfs = 18 cfs

FOR 100-YR STORM

Q_a = 11 cfs
Y = 0.5'
a = 2" = 0.16'
Q_a/L_a = 0.37
$L_a = Q_a/0.37 = 11/0.37 = 30'$
L = 39'
THE ENTIRE 100-YR FLOW IS COLLECTED IN THE 39' C.B.

FLOW INTERCEPTED = 2 x 11 cfs = 22

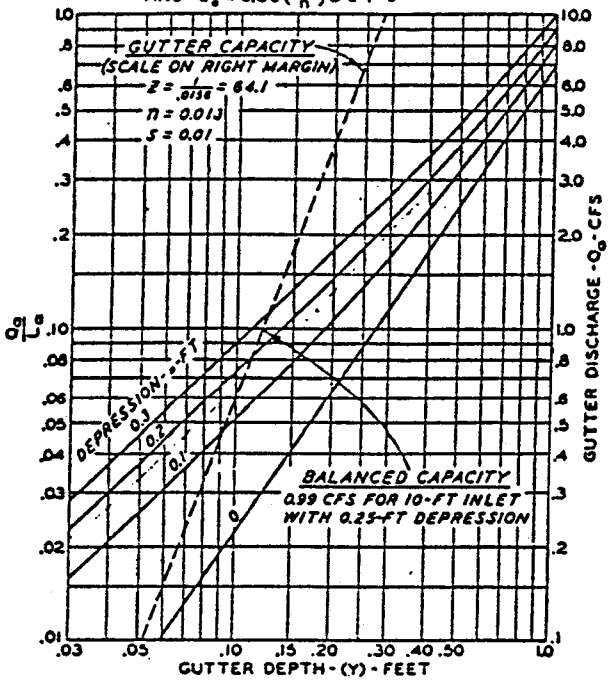
FLOW NOW IN STORM DRAIN = 14 cfs + 22 cfs = 36 cfs

THE EXISTING 36" RCP WITH A SLOPE OF 0.0078'/ft HAS THE CAPACITY TO CARRY 64 cfs.
∴ THE EXISTING CATCH BASINS AND PIPE WILL WORK.

GRAPHIC SOLUTION OF:

$$\frac{Q_a}{L_a} = 0.7\,(a+Y)^{3/2}\left[1-\left(1-\frac{Y}{a+Y}\right)^{3/2}\right]$$

AND $Q_o = 0.56\left(\frac{Z}{n}\right) S^{1/2}\, Y^{8/3}$



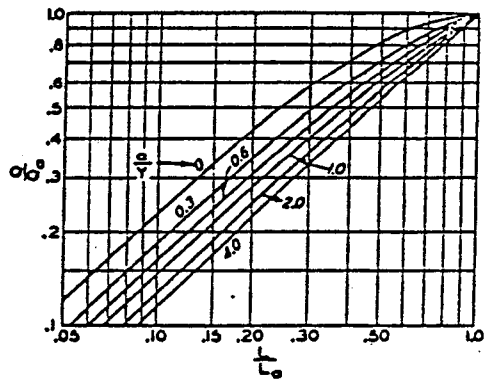
a.- CAPACITY OF CURB OPENING INLET IN CUBIC FEET PER SECOND PER FOOT OF LENGTH, DEPENDING UPON DEPTH IN APPROACH GUTTER (Y) IN FEET, AND DEPRESSION OF GUTTER FLOW LINE (a) IN FEET WHEN INTERCEPTING 100% OF GUTTER FLOW.

GRAPHIC SOLUTION OF:

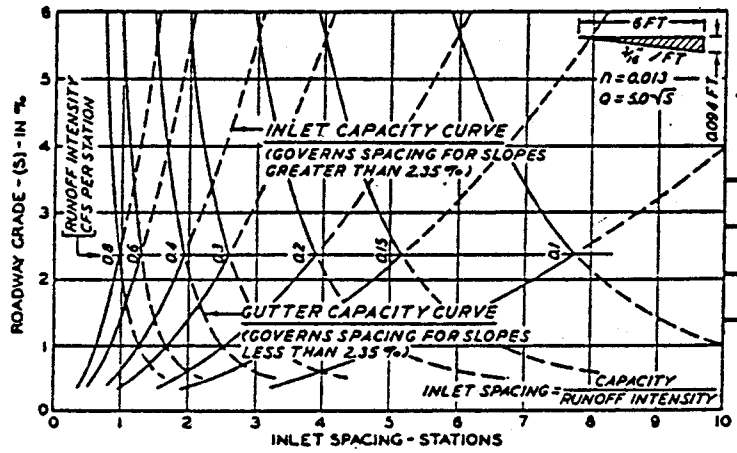
$$\frac{Q}{Q_o} = \frac{\left(\frac{a}{Y}+1\right)^{3/2} - \left(\frac{a}{Y}+1-\frac{L}{L_o}\right)^{3/2}}{\left(\frac{a}{Y}+1\right)^{3/2} - \left(\frac{a}{Y}\right)^{3/2}}$$

L = ACTUAL LENGTH OF INLET
L_o = REQUIRED LENGTH TO INTERCEPT ENTIRE FLOW, Q_o, IN GUTTER.

TOP CURVE IS APPROXIMATE INTERCEPTION RATIO FOR INLET GRATING IF L/L_o IS TAKEN AS RATIO OF WIDTH OF GRATE TO TOTAL WIDTH OF FLOW IN GUTTER.



b.- PARTIAL INTERCEPTION RATIO FOR CURB OPENING INLETS.



TYPE	WIDTH OF GRATE
"F"	2.12
"E"	1.25
"D"	2.12

C.- SAMPLE DESIGN CHART FOR INLET SPACING ON VARIOUS GRADES (CHART IS APPLICABLE ONLY TO A 10-FT INLET WITH A 0.25-FT DEPRESSION AND GUTTER CROSS SECTION AS INDICATED).

PREPARED BY
BUREAU OF PUBLIC ROADS

CURB INLETS
DESIGN CHARTS

Figure 12

GPO 811-336-4

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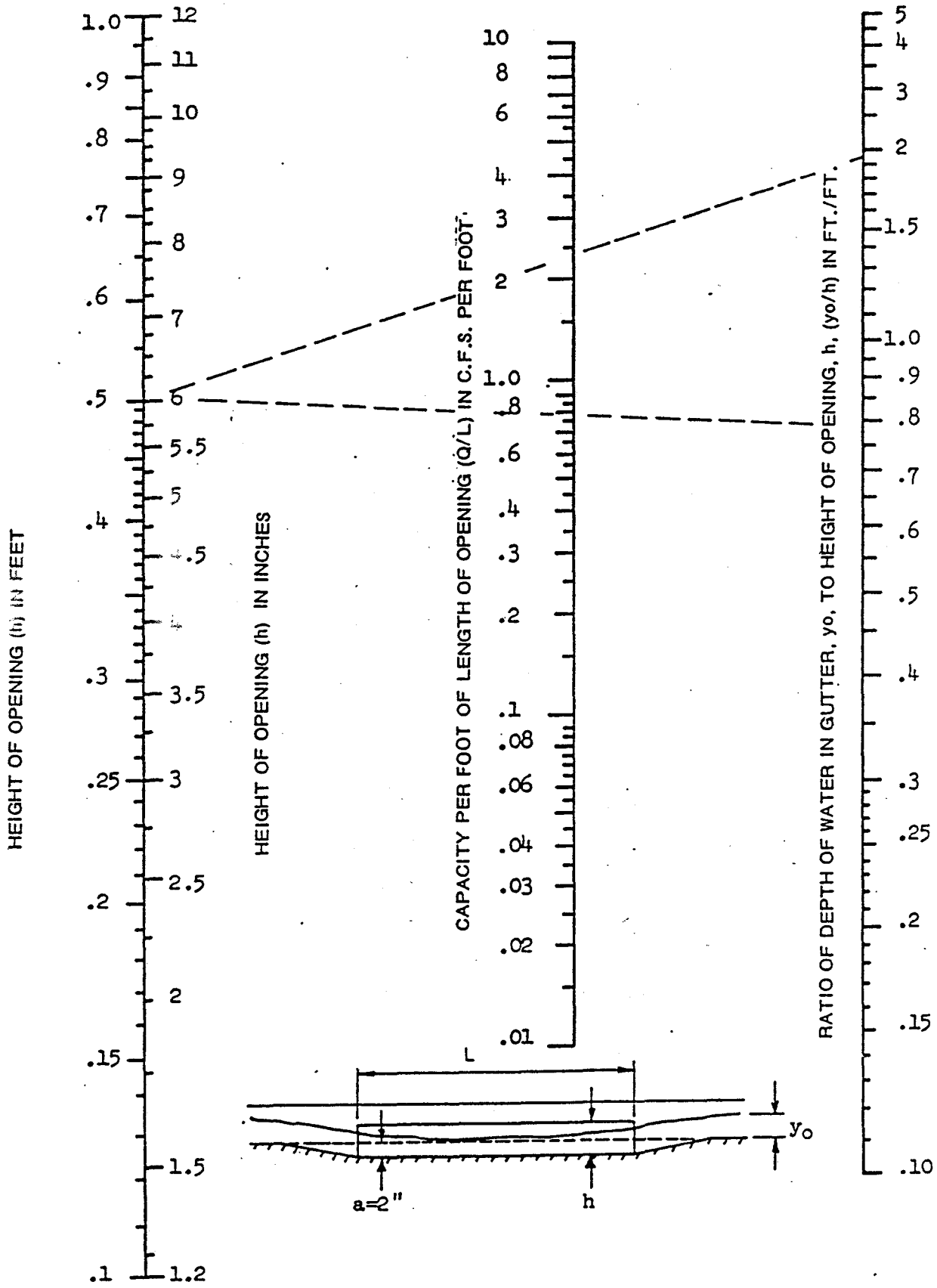

NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

COPIED FROM. REF. 10.

CALCULATION 2

THOMAS ROAD, STREET FLOW AND STORM DRAIN ANALYSIS

1200-05
CVL-4-1276

THOMAS ROAD

Street Flow & Storm Drain Analysis

The pavement section of Thomas Road, from Litchfield Road to Dysart Road, is being designed for a 26' pavement width for both eastbound and westbound traffic. The westbound lanes are not part of Phase 1 construction. They will be constructed at a future date as a part of Phase 2 construction. Phase 1 construction consists primarily of the eastbound lanes. A 2% cross slope will take storm water to the curb and gutter where it will flow to either catch basins or a low point that opens to a collector street. Storm drain and connector pipes will be designed to handle runoff from the ultimate pavement section.

The first location for catch basins on Thomas Road is approximately 925 feet east of Litchfield Road. The catch basins will be connected to a 3 barrel 8' by 8' concrete box culvert. The culvert crosses Thomas Road and outlets to the main drainage channel that flows through the golf course.

Another low point on Thomas Road is approximately 2554 feet east of Litchfield Road. At this location a small portion of drainage from Thomas Road will turn to the south and flow along a collector road before it eventually enters a 30" storm drain pipe and empties at the golf course. This 30" storm drain pipe also receives drainage from the future schools and park sites directly to the north of Thomas Road. The flow from the north that cannot be carried in the 30" storm drain, will cross Thomas Road and continue south on the collector street.

The second location for catch basins on Thomas Road is approximately 1700 feet west of Dysart Road. The catch basins will be connected to a 8' by 8' concrete box culvert. The culvert crosses Thomas Road and outlets into a smaller drainage channel that connects to the main channel in the golf course.

The hydrology, street flow, and catch basin calculations are included, following this sheet, while the culvert hydraulics are included in the section "Calculation 6". Final calculations for the design of the storm drain in the collector road will be done with the design of the collector road and included in the section "Calculation 4".

THOMAS ROAD
Street Flow & Storm Drain Hydrology

CP#	Area (AC)	Land Use	Weighted C	Initial Flow Time (Min)	Flow Length (Ft)	Ave. Velocity (FPS)	Tc (Min)	I_5/I_{100} (in/hr)	Q_5/Q_{100} (CFS)
A	1.5	R/W	0.69	5	535	1.0	14	3.1/5.9	3/6
B	4.0	R/W	0.69	5	1375	1.5	20	2.6/5.0	7/14
C	5.5	R/W	0.69	5	1465	1.5	20	2.6/5.0	10/19
D	0.7	R/W	0.69	5	254	1.0	9	3.7/7.0	2/3
E	1.9	R/W	0.69	5	660	1.0	16	2.9/5.6	4/7
F	1.4	R/W	0.69	5	475	1.0	13	3.2/6.1	3/6
G	4.9	R/W	0.69	5	1696	1.5	24	2.3/4.5	8/15
H	6.3	R/W	0.69	5	1696	1.5	24	2.3/4.5	10/20

I SEE HEC-1, ID #COR8 Q_{10} = 562 cfs Q_{100} = 1537 cfs

J SEE HEC-1, ID #S5 Q_{10} = 24 cfs Q_{100} = 62 cfs

K SEE HEC-1, ID #S6 Q_{10} = 99 cfs Q_{100} = 214 cfs

NOTE: This hydrology is for the fully improved future Thomas Road section (both eastbound and westbound).

THOMAS ROAD
Hydraulic Summary

CP#	Total Flow Q_5/Q_{100} (CFS)	Flow in Street Q_5/Q_{100} (CFS)	Street Slope (%)	Street Capacity (CFS)
A	3/6	3/6	0.2%	22
B	7/14	7/14	0.2%	22
C	10/19	FLOW AT CATCH BASINS		
D	2/3	2/3	0.2%	22
E	4/7	4/7	0.2%	22
F	3/6	3/6	0.2%	22
G	8/15	8/15	0.2%	22
H	10/20	FLOW AT CATCH BASINS		

NOTE: The flows and street capacities are for the fully improved future Thomas Road Section. Since the road is virtually symetrical, when only one half of the road is built, it will be just as effective.

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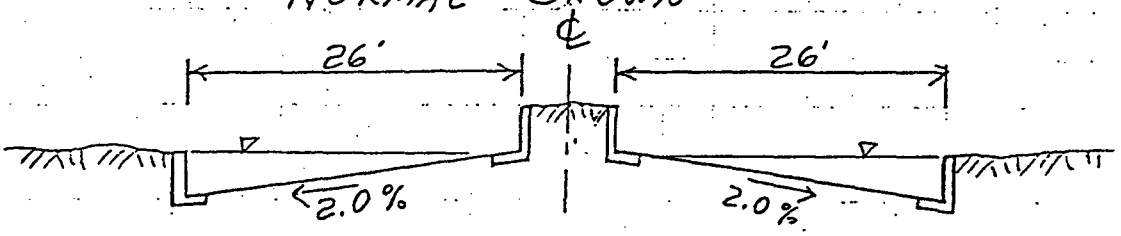
THOMAS ROAD STREET CAPACITY

NORMAL CROWN



STREET CAPACITY USING MANNING'S FORMULA

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}, \quad R = \frac{A}{WP}, \quad Q = VA$$

$A = 12.5$ S.F. $WP = 51$ FT. $n = 0.015$

DEPTH IS TO TOP OF CURB (0.5')

SLOPE (%)	VELOCITY (fps)	STREET CAPACITY (cfs) ½ STREET	FULL STREET
0.2	1.74	10.9	21.8
0.3	2.13	13.3	26.6
0.4	2.45	15.4	30.8
0.5	2.74	17.2	34.4
0.6	3.01	18.8	37.6
0.7	3.25	20.3	40.6
0.8	3.47	21.7	43.4
0.9	3.68	23.0	46.0
1.0	3.88	24.3	48.6

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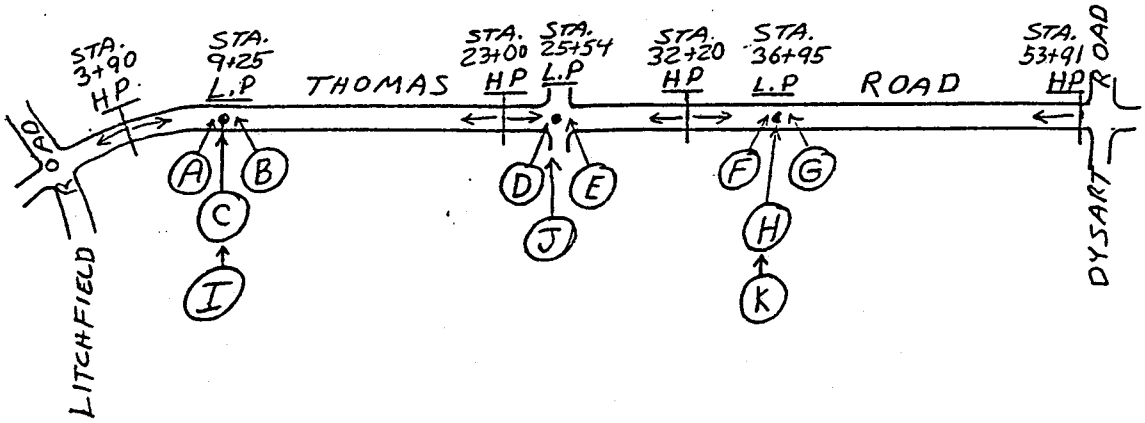
THOMAS ROAD



CONCENTRATION POINT (A) - STA. 9+25 FLOW FROM THE WEST

CONCENTRATION POINT (B) - STA. 9+25 FLOW FROM THE EAST

CONCENTRATION POINT (C) - STA. 9+25 COMBINED FLOW

CONCENTRATION POINT (D) - STA. 25+54 FLOW FROM THE WEST

CONCENTRATION POINT (E) - STA. 25+54 FLOW FROM THE EAST

CONCENTRATION POINT (F) - STA. 36+95 FLOW FROM THE WEST

CONCENTRATION POINT (G) - STA. 36+95 FLOW FROM THE EAST

CONCENTRATION POINT (H) - STA 36+95 COMBINED FLOW

CONCENTRATION POINT (I) - STA 8+35 FLOW CROSSING THOMAS ROAD THROUGH CULVERTS; HEC-1 ID# COR8

CONCENTRATION POINT (J) - STA 25+54 FLOW CROSSING THOMAS ROAD STORM DRAIN & SURFACE FLOW; HEC-1 ID# S5

CONCENTRATION POINT (K) - STA 36+95 FLOW CROSSING THOMAS ROAD THROUGH CULVERT; HEC-1 ID# S6

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THOMAS ROAD CATCH BASINS

CATCH BASINS ON THOMAS ROAD IMMEDIATELY EAST OF LITCHFIELD ROAD
THOMAS ROAD STATION 0+86

THESE CATCH BASINS ARE TO PREVENT NUISANCE FLOW ON THOMAS ROAD FROM CROSSING LITCHFIELD ROAD.

THEREFORE, SMALL CATCH BASINS ARE USED, AND NO SIGNIFICANT FLOW IS ACCOUNTED FOR IN THE LITCHFIELD ROAD STORM DRAIN.

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THOMAS ROAD CATCH BASIN CP # C

STA. 9+25 CATCH BASIN OVER BOX CULVERT
8' LONG OPENING IN A SUMP

ONLY HALF OF THE ULTIMATE ROAD IS BEING CONSTRUCTED AT THIS TIME (EAST BOUND), AND ONLY HALF OF THE ULTIMATE RUNOFF IS PRODUCED. THEREFORE ONLY 1 CATCH BASIN IS BEING DESIGNED AT THIS TIME. IT WILL INTERCEPT HALF OF THE ULTIMATE FLOW. WHEN THE REMAINDER OF THE ROAD IS DESIGNED, AN IDENTICAL CATCH BASIN CAN BE USED, AND THE ULTIMATE FLOW WILL BE COLLECTED.

$Q_5 = 10 \text{ cfs} / 2 = 5 \text{ cfs}$
$Q_{100} = 19 \text{ cfs} / 2 = 10 \text{ cfs}$

FOR 5-YR STORM

$h = 0.5'$
$L = 8'$
$Q = 5 \text{ cfs}$
$Q/L = 5/8 = 0.63$
$y_o/h = 0.68$
$y_o = 0.68 \times 0.5 = 0.34'$

DEPTH OF FLOW IN GUTTER TO INTERCEPT THE 5-YR STORM = 0.34'

FOR 100-YR STORM

$h = 0.5'$
$L = 8'$
$Q = 10 \text{ cfs}$
$Q/L = 10/8 = 1.25$
$y_o/h = 1.10$
$y_o = 1.10 \times 0.5 = 0.55$

DEPTH OF FLOW IN GUTTER TO INTERCEPT THE 100-YR STORM = 0.55'

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THOMAS ROAD CATCH BASIN CP # H

STA. 36+95 CATCH BASIN OVER BOX CULVERT
8' LONG OPENING IN A SUMP

ONLY HALF OF THE ULTIMATE ROAD IS BEING CONSTRUCTION AT THIS TIME (EAST BOUND), AND ONLY HALF OF THE ULTIMATE RUNOFF IS PRODUCED. THEREFORE ONLY 1 CATCH BASIN IS BEING DESIGNED AT THIS TIME. IT WILL INTERCEPT HALF OF THE ULTIMATE FLOW. WHEN THE REMAINDER OF THE ROAD IS DESIGNED, AN IDENTICAL CATCH BASIN CAN BE USED, AND THE ULTIMATE FLOW WILL BE COLLECTED.

$Q_5 = 10 \text{ cfs}/2 = 5 \text{ cfs}$
$Q_{100} = 20 \text{ cfs}/2 = 10 \text{ cfs}$

FOR 5-YR STORM

$h = 0.5'$
$L = 8'$
$Q = 5 \text{ cfs}$
$Q/L = 5/8 = 0.63$
$y_o/h = 0.68$
$y_o = 0.68 \times 0.5 = 0.34'$

DEPTH OF FLOW IN GUTTER TO INTERCEPT THE 5-YR STORM = 0.34'

FOR 100-YR STORM

$h = 0.5'$
$L = 8'$
$Q = 10 \text{ cfs}$
$Q/L = 10/8 = 1.25$
$y_o/h = 1.10$
$y_o = 1.10 \times 0.5 = 0.55$

DEPTH OF FLOW IN GUTTER TO INTERCEPT THE 100-YR STORM = 0.55'

CALCULATION 3

DYSART ROAD, STREET FLOW AND STORM DRAIN ANALYSIS

1200-05
CVL-4-1276

CALCULATION 3

DYSART ROAD, STREET FLOW AND STORM DRAIN ANALYSIS

1200-05
CVL-4-1276

DYSART ROAD

Hydraulic Summary

CP#	Total Flow Q_5/Q_{100} (CFS)	Flow in storm Drain Q_5/Q_{100} (CFS)	Flow in Street Q_5/Q_{100} (CFS)	Street Slope (%)	Street Capacity (CFS)
A	13/26	10/15	3/11	1.0%	49
B	21/39	18/26	3/13	0.4%	31
C	21/40	18/26	3/14	future collector street	
D	14/28	0/0	14/28	0.4%	31

NOTE: The flows and street capacities are for the fully improved future Dysart Road Section. Since the road is virtually symmetrical, and runoff is only from within the right-of-way, the half street will be just as effective.

CVL

DYSART ROAD

Street Flow & Storm Drain Hydrology

CP#	Area (AC)	Land Use	Weighted C	Initial Flow Time (Min)	Flow Length (Ft)	Ave. Velocity (FPS)	Tc (Min)	I_5/I_{100} (in/hr)	Q_5/Q_{100} (CFS)
A	7.2	R/W	0.74	5	2080	2.0	22	2.5/4.8	13/26
B	16.5	R/W	0.74	22	2712	2.5	40	1.7/3.2	21/39
C	17.4	R/W	0.74	40	400	3.0	42	1.6/3.1	21/40
D	8.5	R/W	0.74	5	1789	1.5	25	2.3/4.4	14/28

NOTE: This hydrology is for fully improved future Dysart Road section (both northbound and southbound).

CVL

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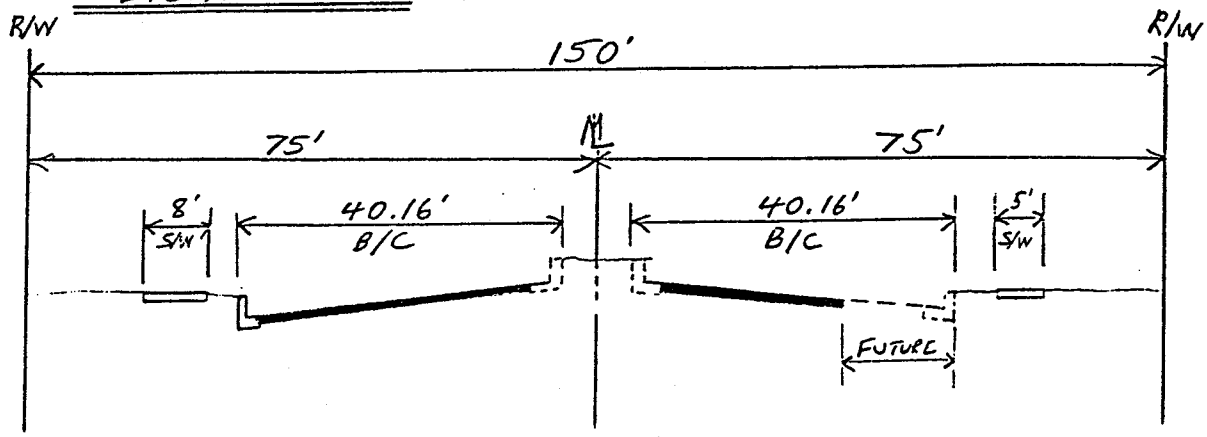
WEIGHTED "C"



DYSART ROAD
FUTURE CONDITION

	LENGTH	'C' VALUE	C x L
- IMPERVIOUS SURFACE	93.32'	0.95	88.65
- LANDSCAPE SURFACE	56.68'	0.40	22.67
TOTALS	150 ft.		111.32

WEIGHTED "C" = 111.32/150 = 0.74

4550 NORTH 12TH STREET • PHOENIX, ARIZONA 85014 • PHONE (602) 264-6831

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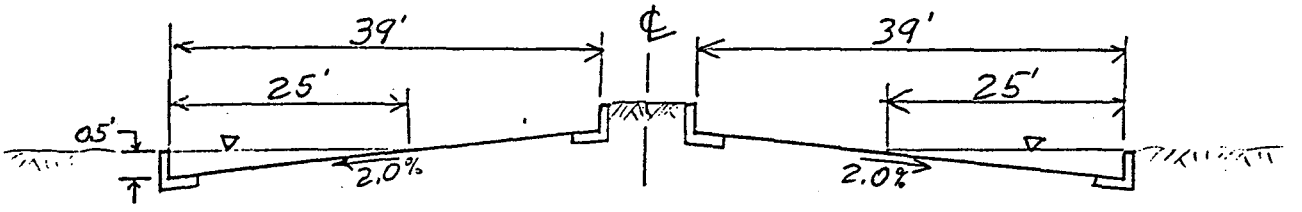
DYSART ROAD STREET CAPACITY

NORMAL CROWN



STREET CAPACITY USING MANNING'S FORMULA

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}, \quad R = \frac{A}{WP}, \quad Q = VA$$

FULL STREET $A = 12.5$ S.F. $WP = 51$ FT. $n = 0.015$

DEPTH IS TO TOP OF CURB (0.5')

SLOPE (%)	VELOCITY (fps)	STREET CAPACITY (cfs) ½ STREET	FULL STREET
0.2	1.74	10.9	21.8
0.3	2.13	13.3	26.6
0.4	2.45	15.4	30.8
0.5	2.74	17.2	34.4
0.6	3.01	18.8	37.6
0.7	3.25	20.3	40.6
0.8	3.47	21.7	43.4
0.9	3.68	23.0	46.0
1.0	3.88	24.3	48.6

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Project LITCHFIELD
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DYSART ROAD CATCH BASINS CP # A

STA. 79+64 2 - FUTURE CATCH BASINS M-1 L=3' 0.3' SUM
CATCH BASINS ARE IN A NORMAL STREET SECTION
NORTH OF THOMAS ROAD. [illegible]
TO [illegible] MAXIMUM FLOW [illegible]
Sizing BASED ON C.O.P. STORM DRAIN DESIGN MANUAL ([illegible]
[illegible]

$Q_5 = 13$ cfs = 7 cfs each side
$Q_{100} = 26$ cfs = 13 cfs each side

FOR 5-YR STORM

$h = 0.5'$
$y_o = 0.4'$
$y_o/h = 0.4/0.5 = 0.8$
$L = 6'$
$Q/L = 0.8$
$Q = L \times 0.8 = 6 \times 0.8 = 5$ cfs each C.B.

FLOW INTERCEPTED $= 2 \times 5$ cfs $= 10$ cfs

FLOW REMAWING IN STREET = $13 - 10 = 3$ cfs

WEIR FLOW OVER CROWN IS 0.1' DEEP.

FLOW NOW IN STORM DRAIN = 10 cfs.

FOR 100-YR STORM

$h = 0.5'$
$y_o = 0.55'$
$y_o/h = 0.55/0.5 = 1.1$
$L = 6'$
$Q/L = 1.25$
$Q = L \times 1.25 = 6 \times 1.25 = 7.5$ cfs each C.B.

FLOW INTERCEPTED $= 2 \times 7.5$ cfs $= 15$ cfs

FLOW REMAWING IN STREET = $26 - 15 = 11$ cfs

WEIR FLOW OVER CROWN IS 0.25' DEEP

FLOW NOW IN STORM DRAIN = 15 cfs

THESE TWO CATCH BASINS ARE TO BE BUILT IN THE FUTURE. THE PIPE IS TO BE BUILT AT THIS TIME. IN THE INTERIM, THE FLOW WILL SHEET OFF OF THE EDGE OF PAVEMENT INTO FARMLAND.

HYDRAULIC ANALYSIS NEW STORM DRAIN LATERAL

STORM SEWER CAPACITY CALCULATION RECORD

LOCATION DATA
Dysart Road
Golf Course to Thomas Road
Through Collector Rd & Dysart Rd
* Date:5/15/90

DESIGN DATA:
Frequency 100 years
Manning's n = 0.012

Location: Outlet no.	Pipe no.	From Sta	To Sta	Inc.	Total Q	Sewer Profile: Inlet inv.	Outlet inv.	Length	So	Sewer Design: D (in.)	K	Q full	V	V2/2g	Sf	hf	loss coeff.	hj	loss coeff.	he	ht (minor)	Hydraulic Grade Line: Elev. @ inlet	Elev. @ outlet	Depth @ inlet	Depth @ outlet
Storm drain sta. 46+00 to 79+64																									
OUTLET		4645	4600	8	41	990.75	990.65	45.00	0.0022	36	722.50	34.06	5.80	0.522281	0.00322	0.14	0.02	0.01	0.00	0.00	0.01	993.81	993.65	3.06	3.00
MH		4945	4645	0	33	991.35	990.75	300.00	0.0020	36	722.50	32.31	4.67	0.338348	0.00209	0.63	0.02	0.01	0.00	0.00	0.01	994.44	993.81	3.09	3.06
MH		5250	4945	0	33	991.96	991.35	305.00	0.0020	36	722.50	32.31	4.67	0.338348	0.00209	0.64	0.02	0.01	0.00	0.00	0.01	995.09	994.45	3.13	3.10
MH		5319	5250	18	33	992.20	992.06	69.00	0.0020	36	722.50	32.54	4.67	0.338348	0.00209	0.14	0.14	0.05	0.00	0.00	0.05	995.33	995.14	3.13	3.08
MH		6840	5319	0	15	997.27	993.16	1521.00	0.0027	24	245.02	12.74	4.77	0.353903	0.00375	5.70	0.02	0.01	0.00	0.00	0.01	1001.05	995.34	3.78	2.18
MH		7964	6840	15	15	1004.58	997.27	1124.00	0.0065	24	245.02	19.76	4.77	0.353903	0.00375	4.21	0.02	0.01	0.00	0.00	0.01	1005.27	1001.05	0.69	3.78

* Revised Street Flows Per Hec-1

HYDRAULIC ANALYSIS NEW STORM DRAIN LATERAL

STORM SEWER CAPACITY CALCULATION RECORD

LOCATION DATA
Dysart Road
Golf Course to Dysart Road
Through Parcel 10
Date:5/15/90

DESIGN DATA:
Frequency 100 years
Manning's n = 0.012

Location: Outlet no.	Pipe no.	From Sta	To Sta	Inc.	Total Q	Sewer Profile: Inlet inv.	Outlet inv.	Length	So	Sewer Design: D (in.)	K	Q full	V	V2/2g	Sf	hf	loss coeff.	hj	loss coeff.	he	ht (minor)	Hydraulic Grade Line: Elev. @ inlet	Elev. @ outlet	Depth @ inlet	Depth @ outlet
Storm drain sta. 0+00 to 10+93																									
OUTLET		260	0	0	21	986.59	986.00	260.00	0.0023	30	444.28	21.16	4.28	0.284119	0.00223	0.58	0.07	0.02	0.00	0.00	0.02	989.10	988.50	2.51	2.50
MH		535	260	0	21	987.21	986.59	275.00	0.0023	30	444.28	21.10	4.28	0.284119	0.00223	0.61	0.02	0.01	0.00	0.00	0.01	989.73	989.11	2.52	2.52
MH		805	535	0	21	987.83	987.21	270.00	0.0023	30	444.28	21.29	4.28	0.284119	0.00223	0.60	0.02	0.01	0.00	0.00	0.01	990.34	989.73	2.51	2.52
MH		1093	805	21	21	988.50	987.83	288.00	0.0023	30	444.28	21.43	4.28	0.284119	0.00223	0.64	0.02	0.01	0.00	0.00	0.01	991.00	990.35	2.50	2.52

* Revision for Pipe Extension in Golf Course for Outlet
Ref. CVL Mass Grading - 1200-050

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DYSART ROAD CATCH BASINS CP # A

STA. 79+64 2 - FUTURE CATCH BASINS M-1 L=3' 0.3' SUMP
CATCH BASINS ARE IN A NORMAL STREET SECTION
NORTH OF THOMAS ROAD. [illegible]
TO [illegible] MAXIMUM FLOW [illegible]
Sizing BASED ON C.O.P. STORM DRAIN DESIGN MANUAL (Pg 2
[illegible]

$Q_5 = 13$ cfs = 7 cfs each side
$Q_{100} = 26$ cfs = 13 cfs each side

FOR 5-YR STORM

$h = 0.5'$
$y_o = 0.4'$
$y_o/h = 0.4/0.5 = 0.8$
$L = 6'$
$Q/L = 0.8$
$Q = L \times 0.8 = 6 \times 0.8 = 5$ cfs each C.B.

FLOW INTERCEPTED $= 2 \times 5$ cfs $= 10$ cfs

FLOW REMAINING IN STREET = $13 - 10 = 3$ cfs

WEIR FLOW OVER CROWN IS 0.1' DEEP.

FLOW NOW IN STORM DRAIN = 10 cfs.

FOR 100-YR STORM

$h = 0.5'$
$y_o = 0.55'$
$y_o/h = 0.55/0.5 = 1.1$
$L = 6'$
$Q/L = 1.25$
$Q = L \times 1.25 = 6 \times 1.25 = 7.5$ cfs each C.B.

FLOW INTERCEPTED $= 2 \times 7.5$ cfs $= 15$ cfs

FLOW REMAINING IN STREET = $26 - 15 = 11$ cfs

WEIR FLOW OVER CROWN IS 0.25' DEEP

FLOW NOW IN STORM DRAIN = 15 cfs

THESE TWO CATCH BASINS ARE TO BE BUILT IN THE FUTURE. THE PIPE IS TO BE BUILT AT THIS TIME. IN THE INTERIM, THE FLOW WILL SHEET OFF OF THE EDGE OF PAVEMENT INTO FARMLAND.

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Project LITCHFIELD
Project No. 1200-05
Sheet No. 9 of 11
Calculated by JM Date 10-12
Checked by _____ Date _____

DYSART ROAD CATCH BASINS CP # B Rt.

STA. 53+19 Rt. FUTURE CATCH BASIN M-1 L=3 0.4' sump
CATCH BASIN IS IN A NORMAL STREET SECTION

SIZING BASED ON C.O.P. STORM DRAIN DESIGN MANUAL (Pg 29)

$Q_5 = 21$ cfs $- 10$ cfs in S.D. $= 11$ cfs $= 6$ cfs each side
$Q_{100} = 39$ cfs $- 15$ cfs in S.D. $= 24$ cfs $= 12$ cfs each side

FOR 5-YR STORM

$h = 0.5'$
$y_o = 0.45'$
$y_o/h = 0.45/0.5 = 0.9$
$L = 6'$
$Q/L = 1.0$
$Q = L \times 1.0 = 6 \times 1.0 = 6$ cfs

ENTIRE 5-YR FLOW IS INTERCEPTED

FOR 100-YR STORM

$h = 0.5'$
$y_o = 0.6'$
$y_o/h = 0.6/0.5 = 1.2$
$L = 6'$
$Q/L = 1.4$
$Q = L \times 1.4 = 6 \times 1.4 = 8$ cfs

FLOW REMAINING IN STREET $= 12 - 8 = 4$ cfs

WEIR FLOW OVER CROWN IS 0.2' DEEP

FLOW NOW IN STORM DRAIN = $10 + 6 = 16$ cfs

FLOW NOW IN STORM DRAIN = $15 + 8 = 23$ cfs

THIS CATCH BASIN IS TO BE BUILT IN THE FUTURE. THE CONNECTOR PIPE IS TO BE BUILT AT THIS TIME. IN THE INTERIM, THE FLOW WILL SHEET OFF OF THE EDGE OF PAVEMENT INTO FARMLAND.

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Project LITCHFIELD
Project No. 1200-05
Sheet No. 11 of 11
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Checked by _____ Date _____

DYSART ROAD CATCH BASINS CP # D

STA. 32+78 2-CATCH BASINS (1 IS FUTURE)
M-2, L = 3' IN A SUMP NORTH OF McDOWELL RD

SIZING BASED ON C.O.P. STORM DRAIN DESIGN MANUAL (Pg.

$Q_5 = 14$ cfs = 7 cfs each side
$Q_{100} = 28$ cfs = 14 cfs each side

FOR 5-YR STORM

$h = 0.5'$
$Q = 7$ cfs
$L = 9'$
$Q/L = 7/9' = 0.78$
$y_o/h = 0.78$
$y_o = 0.78 \times h = 0.78 \times 0.5 = 0.39'$

THE 5-YR STORM WILL BE INTERCEPTED AT 0.39' DEEP

FOR 100-YR STORM

$h = 0.5'$
$Q = 14$ cfs
$L = 9'$
$Q/L = 14/9 = 1.56$
$y_o/h = 1.30$
$y_o = 1.30 \times h = 1.30 \times 0.5 = 0.65$

THE 100-YR STORM WILL BE INTERCEPTED AT 0.65' DEEP

THE RIGHT CATCH BASIN IS TO BE BUILT IN THE FUTURE. THE PIPE IS TO BE BUILT AT THIS TIME. IN THE INTIRIM, THE FLOW WILL SHEET OFF OF THE EDGE OF THE PAVEMENT INTO FARMLAND.

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Project LITCHFIELD
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DYSART ROAD CATCH BASINS CP # B Lt.

STA 53+19 Lt. CATCH BASIN M-I L=3 FLOW-BY
CATCH BASIN IS IN NORMAL STREET SECTION.

SIZING BASED ON C.O.P. STORM DRAIN DESIGN MANUAL

$Q_5 = 21$ cfs $- 10$ cfs in S.D. $= 11$ cfs $= 6$ cfs each side
$Q_{100} = 39$ cfs $- 15$ cfs in S.D. $= 24$ cfs $= 12$ cfs each side

FOR 5-YR STORM

$Q_a = 6$ cfs
$Y = 0.36$
$a = 2'' = 0.16'$
$Q_a / L_a = 0.25$
$L_a = Q_a / 0.25 = 6/0.25 = 24'$
$L = 6'$
$L/L_a = 6/24 = 0.25$
$a/Y = 0.16/0.36 = 0.44$
$Q/Q_a = 0.40$
$Q = Q_a \times 0.40 = 6 \times 0.40 = 2$ cfs

FLOW INTERCEPTED = 2 cfs

FLOW NOW IN STORM DRAIN =
10 cfs + 6 cfs (Rt.) + 2 cfs = 18 cfs

FLOW REMAINING IN STREET =
21 - 18 = 3 cfs

FOR 10-YR STORM

$Q_a = 12$ cfs
$Y = 0.46$
$a = 2'' = 0.16'$
$Q_a / L_a = 0.33$
$L_a = Q_a / 0.33 = 12/0.33 = 36'$
$L = 6'$
$L/L_a = 6/36 = 0.17$
$a/Y = 0.16/0.46 = 0.35$
$Q/Q_a = 0.29$
$Q = Q_a \times 0.29 = 12 \times 0.29 = 3$ cfs

FLOW INTERCEPTED = 3 cfs

FLOW NOW IN STORM DRAIN
15 cfs + 8 cfs (Rt) + 3 cfs = 26 cfs

FLOW REMAINING IN STREET
39 - 26 = 13 cfs

THE FLOW REMAINING IN THE STREET WILL TURN WEST ONTO THE COLLECTOR & ALL OF THE FLOW WILL OUTLET INTO THE GOLF COURSE.

CALCULATION 4

COLLECTOR ROAD, STREET FLOW AND STORM DRAIN ANALYSIS

1200-05
CVL-4-1276

COLLECTOR STREETS

Preliminary Street Flow & Storm Drain Analysis

The pavement section for the low volume and high volume collector streets are being designed for a total width of 40 feet and 64 feet respectively. Storm water that flows to the collector streets will be carried to either the golf course or the ADOT Retention Basins.

The streets will be designed to contain the 5-year storm within the 6" curb. Where this criteria cannot be met, catch basins and storm drain pipe will be placed to carry the excess storm water.

This preliminary analysis will be updated and finalized with the final street design.

CALCULATION 5

CHANNEL HYDRAULICS

1200-05
CVL-4-1276

CHANNEL HYDRAULICS

The channels will be designed to convey the expected 100-year flow with adequate freeboard. This design will be done at the time of the mass grading design.

MASS GRADING NORTH OF ADOT DETENTION BASINS

Offsite flows entering the ADOT detention basin from the North will be concentrated at three separate points with additional sheet flow entering the basin directly from the east and west. The major concentration flow from the north is conveyed to the basin by a earthen channel located half way between Litchfield and Dysart Roads. The two remaining concentration point flows, located between the earthen channel and roads, will be conveyed by pipe culvert (future catch basins).

The channel in ADOT's Right-of-Way will be designed to convey the 100-year flow with adequate (1' min.) freeboard. Rip-rap channel protection will be provided at the channel termination in the detention basin. The channel concept and flows used in channel design have been approved per ADOT office memo dated August 22, 1989. Construction of the channel will be completed under Phase I construction.

All culvert structures upstream of the detention basin will be designed to convey the 100 year storm. In addition catch basin outlet pipes will be provided to handle street and parcel flows from the 10-year storm. Contributing area for the pipes is bounded on the north by McDowell Road, and on the east and west by Dysart and Litchfield Roads. Storm events larger than 10-year, will overtop proposed road and sheet flow into the existing detention basin as currently designed. Mass grading of above described area will be completed under Phase II construction. Outlet pipes will be completed under Phase I construction.

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

April 19, 1990
A.D.D.T. Channel Capacity Computation
Litchfield Park, Phase 1
A.D.D.T. R/W to Detention Basin

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	2060.0
Channel Bottom Slope (feet per foot).....	0.0021
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	10.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	7.99
Flow Velocity (feet per second).....	6.14
Froude Number (Flow is Sub-Critical).....	0.508
Velocity Head (feet).....	0.59
Energy Head (feet).....	8.58
Cross-Sectional Area of Flow (square feet).....	335.34
Top Width of Flow (feet).....	73.93

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

April 19, 1990
A.D.O.T. Channel Capacity Computation
Litchfield Park, Phase 1
A.D.O.T. R/W to Detention Basin

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0021
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	10.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	26.8	1.91	0.382	0.057	1.057	14.0	18.0
2.0	100.7	2.80	0.419	0.122	2.122	36.0	26.0
3.0	230.9	3.50	0.443	0.190	3.190	66.0	34.0
4.0	427.5	4.11	0.460	0.262	4.262	104.0	42.0
5.0	700.2	4.67	0.475	0.338	5.338	150.0	50.0
6.0	1058.2	5.19	0.487	0.418	6.418	204.0	58.0
7.0	1510.2	5.68	0.498	0.501	7.501	266.0	66.0
7.9	2004.5	6.10	0.507	0.578	8.478	328.6	73.2
8.0	2064.8	6.15	0.508	0.586	8.586	336.0	74.0
9.0	2729.8	6.59	0.517	0.675	9.675	414.0	82.0
10.0	3513.2	7.03	0.525	0.767	10.767	500.0	90.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

April 20, 1990
Litchfield Park, Phase 1
3 - 8'x8' Concrete Box Culverts
North A.D.O.T. R/W

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	8.00
Culvert Rise (Height of Opening) (feet).....	8.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	60.0
Culvert Slope (feet per foot).....	0.0025

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
685.0	8.00	10.75	10.70	7.34	6.11	7.34	11.67
685.0	8.50	10.75	11.20	7.34	6.11	8.00	10.70

==========

BOX CULVERT ANALYSIS COMPUTER PROGRAM Version 1.6 Copyright (c) 1986
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TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

April 19, 1990
Litchfield Park, Phase 1
McDowell Road to A.D.O.T. R/W
Channel Capacity Computation

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0025
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	7.00
Channel Bottom Width (feet).....	10.0

==========

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	31.0	2.00	0.410	0.062	1.062	15.5	21.0
2.0	123.0	2.93	0.450	0.133	2.133	42.0	32.0
3.0	292.2	3.68	0.476	0.210	3.210	79.5	43.0
4.0	554.9	4.33	0.496	0.292	4.292	128.0	54.0
5.0	926.1	4.94	0.513	0.379	5.379	187.5	65.0
6.0	1420.1	5.50	0.526	0.470	6.470	258.0	76.0
7.0	2050.3	6.04	0.539	0.566	7.566	339.5	87.0
8.0	2829.3	6.55	0.550	0.666	8.666	432.0	98.0
9.0	3769.5	7.04	0.560	0.769	9.769	535.5	109.0
10.0	4882.8	7.51	0.569	0.876	10.876	650.0	120.0

==========

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

CALCULATION 6

CULVERT HYDRAULICS

1200-05
CVL-4-1276

CULVERT HYDRAULICS

The culverts will be designed to convey the expected 100-year flow. The design of the culverts will be done at the time of the street design or mass grading design.

PROJECT: Litchfield / Thomas Road

DESIGNER: ACP

DATE: 10/4/89

HYDROLOGIC AND CHANNEL INFORMATION

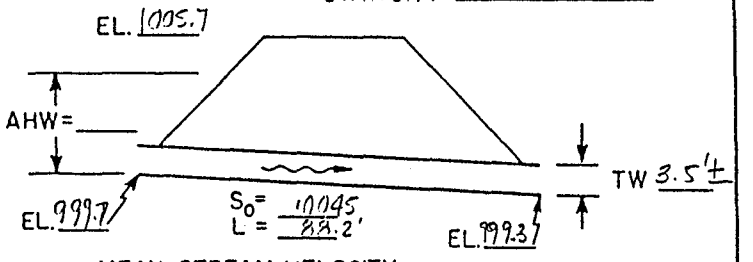
Q_1 = 214 cfs (Q_{100}) TW_1 = 3.5' ±

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 36+95

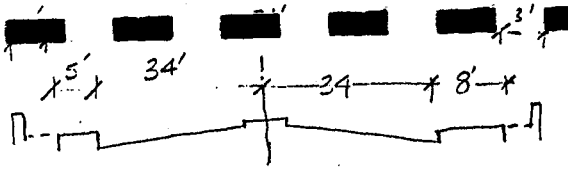


MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs/ft	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h₀−LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
inlet rsings	27	1-8x4	1.13	4.5'	.2	1	2.7	3.35	3.5	3.5	.4	4.1	4.5	6.7		∴ adequate
																*
																Use 1-8'x8'
																to allow
																Ped. underpass

SUMMARY & RECOMMENDATIONS: * To allow pedestrian underpass, a minimum size of 8'x8' is recommended. Note - design plans show lowered flowline elevations. INV. EL. U = 995.1, S = 995.3

Figure 7



PROJECT: Litchfield Thomas Road , MAIN WASH

DESIGNER: tcf

DATE: 10/4/89

HYDROLOGIC AND CHANNEL INFORMATION

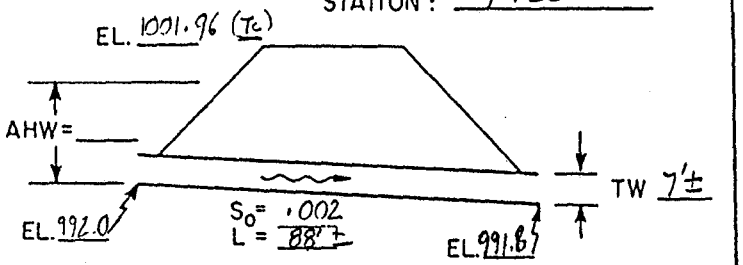
Q_1 = 1537 cfs (100-yr) TW_1 = 7' ±

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE , SAY Q_{25}
Q_2 = CHECK DISCHARGE , SAY Q_{50} OR Q_{100})

SKETCH

STATION : 9+25



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs/ft	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
headwall																
try 3-8x8	64	3-8x8	1.0	8.0	.2	1.46	5	6.5	7	7	.2	8.26	8.3	8		274.5 cy.
try 2-10x8	77	2-10x8	1.13	9.04	.2	3.4	5.7	6.9	7	7	.2	10.2	10.2	9.6		256.0 cy.

SUMMARY & RECOMMENDATIONS: Use - Inlet & Outlet headwalls for 0° skew

Figure 7

PLATES

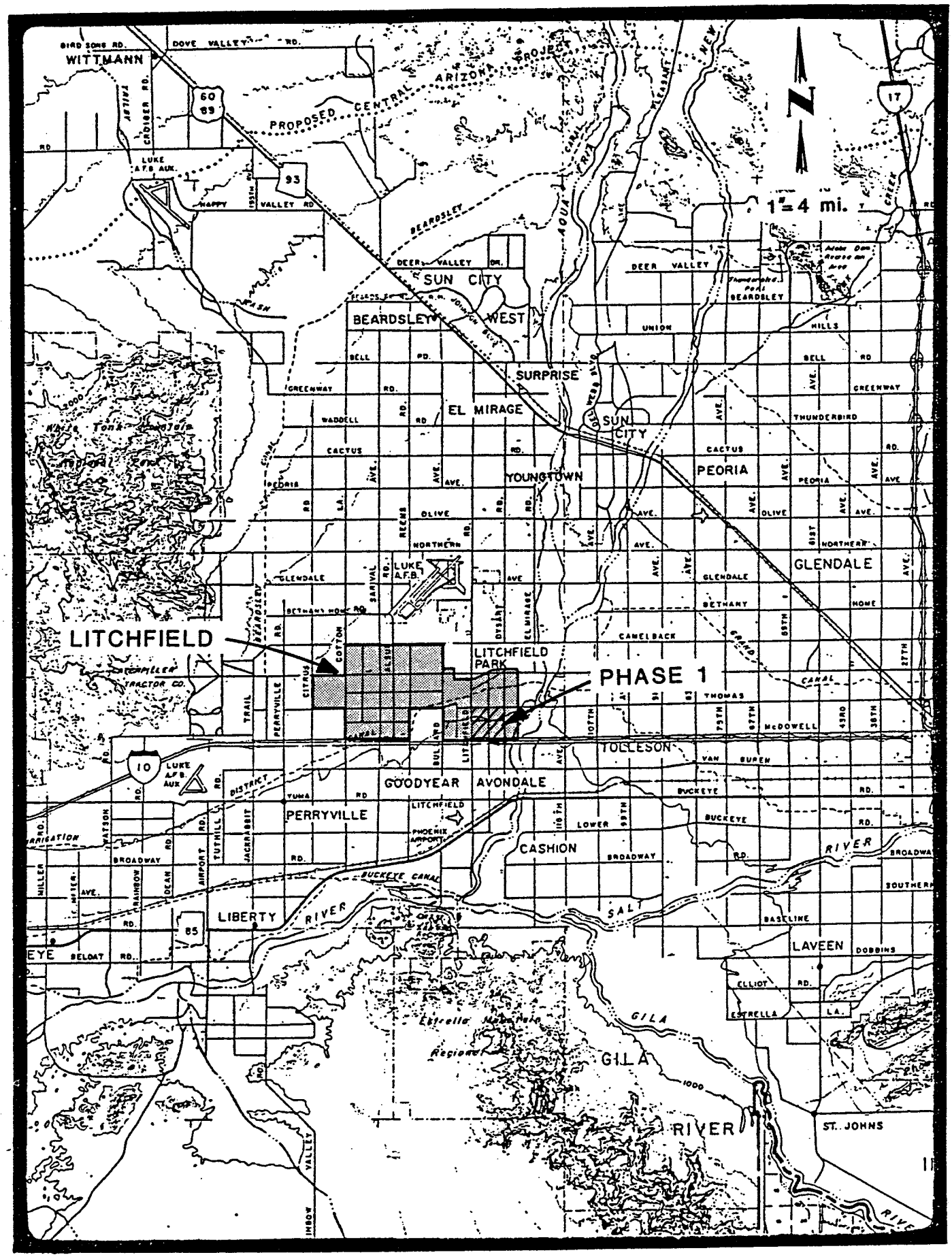
1. VICINITY MAP

2. OFFSITE DRAINAGE MAP & EXISTING HEC-1 SCHEMATIC

3. LITCHFIELD POST-DEVELOPMENT HEC-1 SCHEMATIC

4. LITCHFIELD PHASE 1 POST-DEVELOPMENT HEC-1 SCHEMATIC

5. MASS GRADING CONCEPT PLAN



VICINITY MAP

PLATE -

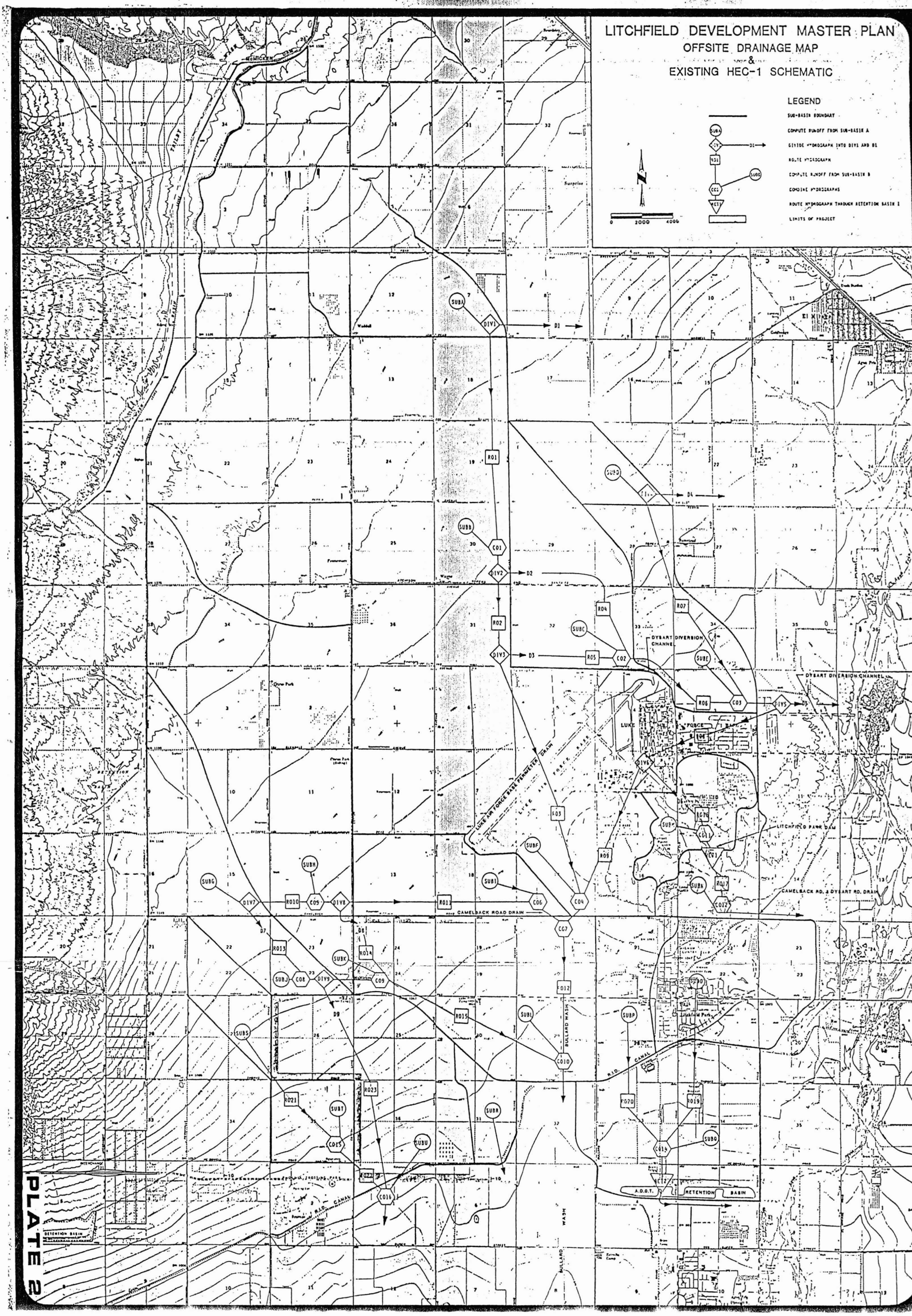

LITCHFIELD DEVELOPMENT MASTER PLAN
OFFSITE DRAINAGE MAP
&
EXISTING HEC-1 SCHEMATIC
LEGEND
SUB-BASIN BOUNDARY
COMPUTE RUNOFF FROM SUB-BASIN A
DIVIDE HYDROGRAPH INTO DIV1 AND D1
ROUTE HYDROGRAPH
COMPUTE RUNOFF FROM SUB-BASIN B
COMBINE HYDROGRAPHS
ROUTE HYDROGRAPH THROUGH RETENTION BASIN 1
LIMITS OF PROJECT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

PLATE 2