DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY

FCD 94-28

EXISTING HYDROLOGY REPORT

Prepared For:

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3511 East Indian School Road
Phoenix, AZ 85018
(602) 956-3200

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1.0 SYNOPSIS

Kaminski-Hubbard Engineering, Inc. (KHE) was retained by Hook Engineering, Inc. to prepare an existing condition hydrologic analysis of the Doubletree Ranch Road Regional Drainage Study Area contributing to Indian Bend Wash east of the Phoenix Mountain Preserves, north of Mummy Mountain and south of Mountain View Road. This watershed drains approximately 4 square miles of natural desert, mountainous desert and residential developments which flows directly into Indian Bend Wash. The study area is located in the City of Phoenix and the Town of Paradise Valley as shown on the Vicinity Map (See Figure 1).

In general, the boundary between the City of Phoenix and Town of Paradise Valley within the study area is Tatum Boulevard. A large percentage of storm runoff originates in the steep mountains west of Tatum Boulevard and drains northeasterly through residential streets and subdivision drainageways to the Indian Bend Wash. Historically, flows emanating from the mountains had traveled overland though numerous small washes to the Indian Bend Wash. Developments have altered many of these flow paths due to parcel subdivision, landscaping and block wall construction. As a result, many homes experience flooding during frequent rainfall events and standing water in streets isolates the community.

This report presents the existing condition hydrologic analysis developed for the watershed. The HEC-1 computer model was used to compute the 2-, 10-, 50- and 100-year peak discharges for both the 6-hour and 24-hour duration storm events. Although the 24-hour duration storm produces a slightly higher runoff volume than the 6-hour duration storm, the peak discharges were found to be almost equal. Therefore, to be consistent with an earlier hydrology study performed in the area by the Flood Control District of Maricopa County (FCDMC), the flows from a 6-hour duration storm should be considered for any future design purposes (Ref. 9). Table 1 summarizes the computed peak discharges for existing conditions resulting from a 6-hour duration storm at specific locations within the watershed.

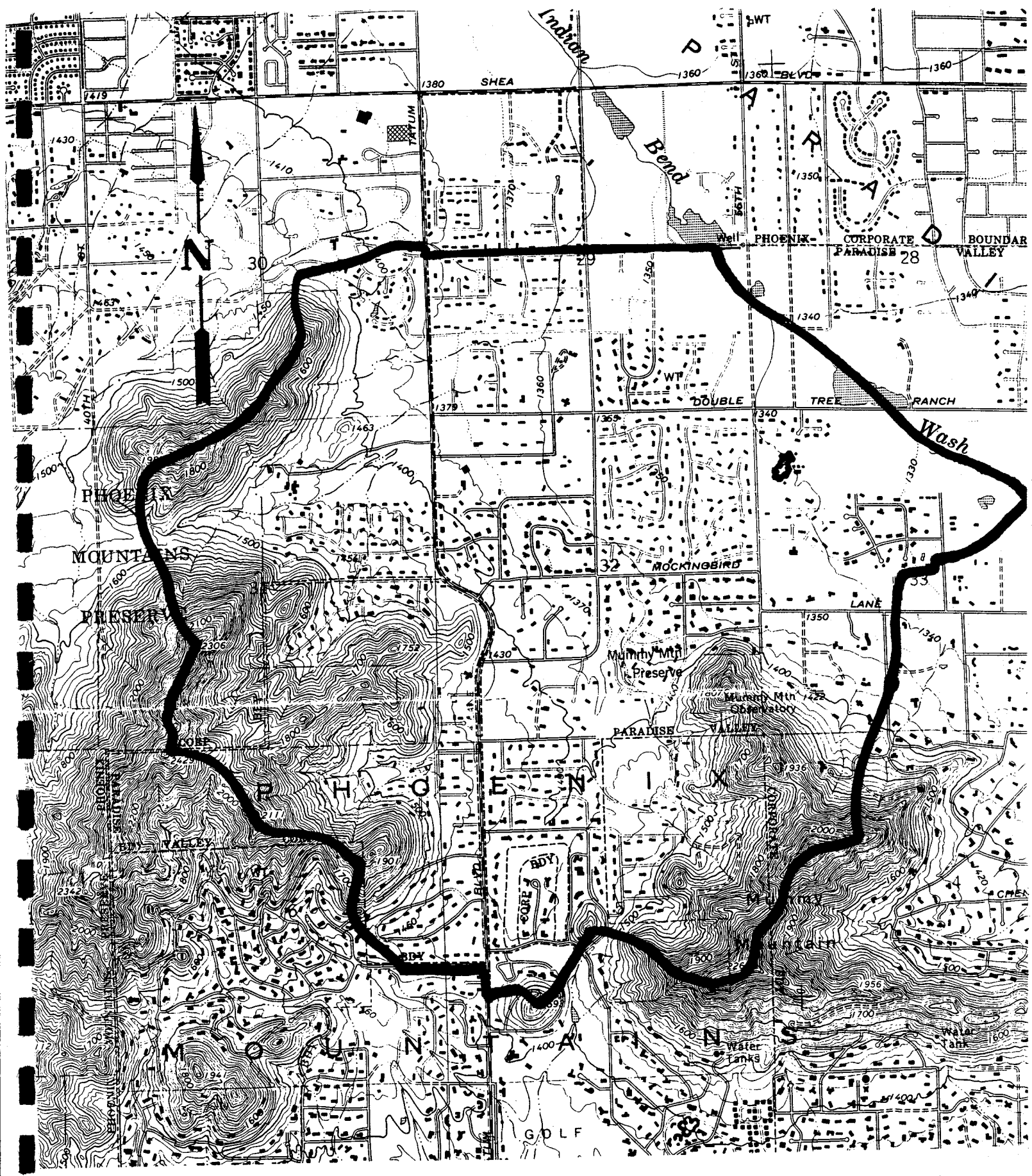

FIGURE 1 - VICINITY MAP

TABLE 1

Existing 6-Hour Peak Discharges (cfs)

Location	HEC-1 I.D.	2-Year	10-Year	50-Year	100-Year
Berneil Dr. & Tatum Blvd.	HC145	24	87	165	199
Channel at west property line of Doubletree Canyon Subdivision	170S	33	101	194	234
Doubletree Canyon subdivision channel at Horseshoe Rd.	HC205	86	260	505	615
Doubletree Ranch Rd. & Tatum Blvd.	HC211	96	299	577	701
Tatum Blvd. & Mohave Pl.	290S	16	54	100	120
Tatum Blvd. south of Foothill Dr.	310S	43	126	241	293
Desert Park Ln. east of Tatum Blvd.	HC335	69	218	364	425
Paradise Canyon east of Las Brisas Ln.	340S	17	51	85	99
Roadrunner Rd. west of 54th St.	350S	23	61	98	114
Desert Jewel Dr. east of Arroyo Dr.	HC365	161	517	967	1159
54th St. & Desert Jewel Dr.	370S	31	93	162	192
Cherokee Wash east of 51st St.	HC385	214	691	1307	1574
Cherokee Wash and 54th St.	HC395	217	713	1355	1634
Cherokee Wash at Indian Bend Wash	HC435	219	775	1490	1790

2.0 INTRODUCTION

A hydrologic analysis of the Doubletree Ranch Road watershed for existing conditions was prepared by Kaminski-Hubbard Engineering, Inc. (KHE) for Hook Engineering, Inc. This watershed is bounded to the west by the Phoenix Mountains Preserve, to the north by Mountain View Road, to the east by the Indian Bend Wash and to the south by Mummy Mountain.

This watershed includes three major concentration points where stormwater runoff enters Indian Bend Wash. This study has evaluated drainage characteristics associated with Tatum Boulevard, Doubletree Ranch Road and Cherokee Wash.

The study area was divided into sub-basins and is composed of natural desert mountains and urban residential development. This watershed is unique in its topography with shallow concentrated flows originating in the upper mountain slopes draining northeasterly into sheet flows through the residential developments. Intense rainfall produces flooding within the residential areas approaching the Indian Bend Wash with standing water in streets preventing travel within the community.

This report presents the existing hydrologic analysis for the watershed contributing to Indian Bend Wash from the Phoenix Mountains Preserve and Mummy Mountain. The hydrology was developed using the FCDMC's design criteria (Ref. 7 and 8) and documents the assumptions and methodologies used in development of the hydrologic analysis.

3.0 STUDY PARAMETERS

3.1 Study Area

The watershed area is located northeasterly of the Phoenix Mountains Preserve and Mummy Mountain in the City of Phoenix and Town of Paradise Valley as shown on Figure 1. The watershed area is approximately 4 square miles in size and ultimately drains directly into a 1¼ mile reach of Indian Bend Wash. The area is bounded by Mountain View Road to the north, Indian Bend Wash to the east, Mummy Mountain to the south, and the Phoenix Mountain Preserve to the west. Significant features which affect drainage patterns in the area are residential developments, Tatum Boulevard, Doubletree Ranch Road and Cherokee Wash.

3.2 Survey and Mapping

The available mapping utilized in this study are as follows:

1. **FCDMC Mapping:** The Doubletree Ranch Road watershed was delineated based on topographic mapping prepared by McLain Harbers Company, Inc. at a scale of 1 inch = 200 feet with 2 foot contour intervals. These maps were flown on June 22, 1994. These maps were also used to establish flow patterns and slopes. A small portion of the west boundary of the watershed was delineated based on topographic mapping prepared for the Arizona Canal Diversion Channel Area Drainage Master Study.

2. **USGS Quadrangle Maps:** Paradise Valley, Arizona, 7.5 minute series. The horizontal scale is 1 inch = 2000 feet. The contour interval is 20 feet. These maps were photo revised in 1982.

3. **As-Built Plans:** As-built plans for storm drains associated with Tatum Boulevard improvements (Ref. 11).

4. **Field Reconnaissance:** Field investigations were undertaken to verify hydrologic information obtained from topographic mapping. Areas of new development or developments under construction were identified.

5. **Survey Data:** Detailed surveys were conducted along 56th Street in the vicinity of the Cherokee Wash crossing.

3.3 Study Criteria

The following criteria and guidelines were set forth by the FCDMC prior to and during the drainage study:

1. Hydrology calculations will be completed for the 2-, 10-, 50-, and 100-year storms.

2. Storm durations of 6- and 24-hours will be evaluated for all four storms.

3. The U.S. Army Corps of Engineers (COE) HEC-1 computer program will be used for hydrograph computations.

4. The Clark Unit Hydrograph method will be utilized.

5. The Green-Ampt Loss Method will be utilized for estimation of precipitation losses.

6. The Maricopa County Unit Hydrograph Procedure 1 (MCUHP1) computer program, as provided by the FCDMC, will be used to compute times of concentration and storage coefficients for the Clark Unit Hydrograph Method.

7. Rainfall distributions and depth area relations for the 6-hour storm duration will be based on NOAA HYDRO-40 (Ref. 17), as presented in the FCDMC's Drainage Design Manual (Ref. 7). This data is included in the MCUHP1 program to develop areal reduction for the watershed.

8. The SCS Type II rainfall distribution will be used for the 24-hour storm, with corresponding depth-area ratios based on NOAA HYDRO-40 (Ref. 17). This data is included in the MCUHP1 Program.

9. Transmission losses will be estimated based on existing field data or literature. Existing field data or literature was not available to estimate infiltration losses. Due to this study's detailed determination for the watershed roughness coefficient (K_b), the exclusion of transmission losses has little impact on the flow peaks and volumes.

10. Point precipitation values will be determined from isopluvial maps included in the FCDMC's Drainage Design Manual (Ref. 7). The option to use twelve precipitation values as input to the PREFRE computer program will be utilized to develop all rainfall depths.

11. Areal reduction will be applied to the point precipitation value in the rainfall depth input to HEC-1 data for a 4 square mile watershed.

12. The Normal-Depth option will be used for HEC-1 channel routing operations. Cross-sections will be representative of average conditions based on mapping and field reconnaissance.

13. Diversion operations in the HEC-1 computer model will be based on Manning's Equation used to calculate street capacities, a broad crested weir analysis used to calculate overtopping of roadways at culverts and nomographs used to calculate pipe culvert capacities (Ref. 18).

4.0 HYDROLOGY

4.1 General

The existing hydrologic analysis for the Doubletree Ranch Road watershed was prepared for the 2-, 10-, 50-, and 100-year storms. The 6- and 24-hour storm durations were evaluated for all four storms. The watershed was modeled using the COE HEC-1 computer program. The May, 1991, large-array version of HEC-1 was used for this study. The large-array version of HEC-1 provides the capability of using 2,000 hydrograph ordinates rather than the maximum of 300 ordinates available in the standard version (September, 1990). The Clark Unit Graph, the Green-Ampt Loss Rate, and the Normal Depth Channel Routing options were used in the HEC-1 computer model. This section describes the assumptions and methodologies used to develop the HEC-1 computer model for existing conditions within the Doubletree Ranch Road watershed. Summaries of peak discharge values are presented in Table 15 in Section III of the Appendix. The HEC-1 schematic diagram is shown on Plate 1 in Section VII of the Appendix.

4.2 Previous Hydrologic Investigations

Previous hydrologic investigations of the watershed were reviewed for historical, as well as, hydrologic information which could be used as part of our analysis for existing conditions. Particular attention was given to hydrologic modeling techniques, sub-basin delineation, storm frequency and duration, reach routing methods, location of concentration points, and location of future drainage structures. A brief summary of previous investigations reviewed for the hydrologic analysis for the Doubletree Ranch Road watershed are presented below.

Cherokee Wash/Recommended Plan (Ref. 4)

In 1993, the Town of Paradise Valley retained the services of Erie & Associates, Inc. to prepare a hydrologic analysis for Cherokee Wash. The purpose of this study was to assess peak discharge values for various storm frequencies along Cherokee Wash in order to develop alternatives for flood protection and recommend an acceptable alternative to the community. The recommended plan involved nonstructural solutions for floodplain management with minimal improvements.

Laughlin's Tatum Property, Preliminary Drainage Study Report (Ref.1)

In 1994, Anderson-Nelson prepared a drainage report for development of a 14.3 acre residential subdivision for D.J. Laughlin Proprietorship. This report assessed the magnitude of off-site storm water entering the project site for various storm frequencies. In addition, it develops a design for roadway profiles and culvert drainage structures.

Preliminary Drainage Report, Tatum Boulevard (Ref.11)

In 1988, the Town of Paradise Valley retained the services of Johannessen & Girand to prepare a drainage analysis for the horizontal and vertical realignment of Tatum Boulevard. This study identified existing drainage paths, computed runoff volumes and provided design features for maintaining drainage paths after construction.

Report on Hydrology of Tatum Wash (Ref.9)

In 1995, the Flood Control District of Maricopa County prepared a hydrologic analysis for Tatum Wash. This report estimated peak flows and volumes at Shea Boulevard to determine location and size of proposed detention basins to reduce flows. This boundary was used as the northwest watershed delineation for the Doubletree Ranch Road study area.

Final Hydrology Report For Tatum Boulevard, Caida Del Sol to Shea Boulevard, P-886515 (Ref.12)

In 1993, the City of Phoenix retained the services of Kaminski-Hubbard Engineering, Inc. to prepare a drainage analysis for upgrading Tatum Boulevard from a four-lane arterial street to a six-lane arterial street with a raised landscape median. This report estimated peak discharge values concentrating at Tatum Boulevard and provided a design for drainage structures to convey flows under Tatum Boulevard for street improvements.

4.3 Parameter Estimation

4.3.1 Drainage Area Boundaries

Existing Conditions

The sub-basin boundaries were delineated using 1 inch = 200 feet topographic mapping, which was provided by the District. Particular attention was given to areas of reported flooding. In-house drainage delineations were also supplemented by as-built drawings and field reconnaissance. The field reconnaissance included verification of sub-basin boundaries, flow patterns and split flow locations. Observations were also made to verify flow patterns for the lower frequency storm events.

4.3.2 Rainfall Parameters

Rainfall Distributions

The rainfall distribution used for the 6-hour storm duration are as documented in the FCDMC's Drainage Design Manual (Ref. 7) and contained in the MCUHP1 Program. The SCS Type II distribution was used for the 24-hour storm. The rainfall distributions are presented in Tables 7 and 8 in Section I of the Appendix.

Precipitation Data

The point precipitation values used in this analysis were obtained from isopluvial maps for Maricopa County as published in the FCDMC's Drainage Design Manual (Ref. 7). The option using twelve precipitation values as input to the PREFRE computer program were used to develop all rainfall depths. The point precipitation values are presented in Table 5 in Section I of the Appendix.

Areal Reduction Factors

The point precipitation values used for this study were adjusted to account for the reduction in precipitation depth over a very large area. Reduction factors for the 6-hour duration storms were obtained from the FCDMC's Drainage Design Manual (Ref. 7). This information was also included in the FCDMC's MCUHP 1 Program. The 24-hour storm reduction factors were obtained from the NOAA Technical Memorandum NWS HYDRO-40 (Ref. 17). These factors are presented in Table 6 in Section I of the Appendix.

4.3.3 Physical Parameters

Loss Rate Estimation

The Green-Ampt loss rate method in HEC-1 was used to estimate rainfall losses. This method involves a two phase process in simulating rainfall losses. The first phase involves no infiltration of rainfall until the accumulated rainfall equals the initial loss (IA). Recommended IA values are presented in Table 4.1 in the Drainage Design Manual (Ref. 7). Initial losses for vacant desert areas were selected as 0.20 inches assuming a mountain land use with moderate vegetated surface. Initial losses for residential areas were selected as 0.10 inches.

The second phase is the infiltration of rainfall into the soil immediately after IA is completely satisfied. The three Green-Ampt infiltration parameters as coded in HEC-1 are: hydraulic conductivity at natural saturation (XKSAT); wetting front capillary suction (PSIF); and volummetric soil moisture deficit at the start of rainfall (DTHETA).

The Green-Ampt parameters were determined using a spreadsheet provided by the FCDMC. The XKSAT values were determined by the FCDMC for all map units contained in the SCS Soil Surveys (Ref. 14 and 15) using log averaging of major and minor soil XKSAT values. These map units along with their corresponding XKSAT and percent rock outcrop values are presented in lookup tables within the Green-Ampt spreadsheet. The Aguila/Carefree soil survey for map unit 109 was modified in the lookup table. The percent rock outcrop was changed from 35 to 65 in order to match the Eastern County soil survey for map unit Ro.

The area of each soil unit within each sub-basin was determined and used as input into the Green-Ampt Loss Parameter spreadsheet. These area calculations were determined using ARC INFO GIS. The spreadsheet subsequently computed average sub-basin XKSAT values using log averaging methods. Next, values for PSIF and each normal DTHETA condition were interpolated using the computed XKSAT. These tables were contained within the spreadsheet and were similar to Figure 4.3 (Ref. 7).

The Green-Ampt parameters computed above were based strictly on soil characteristics and adjustments were necessary to account for vegetative cover and land use. Vegetative cover was assumed to be 35 percent throughout the watershed. These guidelines are presented in the FCDMC's Drainage Design Manual (Ref. 7) and are incorporated in the Green-Ampt Loss Parameter spreadsheet. The area of each land use within each sub-basin was also determined and used as input into the spreadsheet.

The "percent impervious" for each sub-basin was computed as a function of both natural rock outcrop and land use. The percentage of impervious rock outcrop within each sub-basin was estimated from soil unit data provided in the SCS Soil Surveys (Ref. 14 and 15). A factor of 0.6 was used to convert the "percentage of rock outcrops" to the "percent impervious" for each sub-basin.

Next, the impervious areas associated with the various land use categories were determined for each sub-basin. The City of Phoenix residential development was based on assuming a 25 percent impervious factor, while Town of Paradise Valley residential development was based on assuming a 15 percent impervious factor. All vacant desert areas were based on assuming only the rock outcrop areas as impervious.

The total "percent impervious" value for each sub-basin was computed as a summation of the above two "percent impervious" values. The computation was also incorporated into the Green-Ampt Loss Parameter spreadsheet. The average Green-Ampt parameters for each sub-basin are presented in Table 9 in Section II of the Appendix. Soil survey map units are shown on Plate 3 in Section VII of the Appendix. Land use categories are shown on Plate 2 in Section VII of the Appendix.

Time of Concentration

The Clark Unit Hydrograph Method requires the estimation of the time of concentration, T_c. The following empirical equation was used to compute the time of concentration as a function of watershed characteristics (Ref. 7):

$$T_c = 1.14L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

where

T_c = time of concentration, in hours.
L = length of the flow path for T_c, in miles.
K_b = representative watershed resistance coefficient.
S = watercourse slope, in feet/mile.
i = the average rainfall excess intensity, during the time T_c, in inches/hour.

The length of flow path for T_c and its corresponding slope within each sub-basin were determined using 1 inch = 200 feet topographic maps. Street flow patterns observed from the field investigations were also used to determine the flow path for T_c considerations. The MCUHP1 Program, as provided by the FCDMC, was used to calculate the time of concentration, T_c, and storage coefficient, R, for each sub-basin.

The watershed resistance coefficient, K_b, necessary to determine T_c was estimated using the following equation (Ref. 7 and 8):

$$K_b = m \log A + b$$

where:

K_b = watershed resistance coefficient.
A = drainage area, in acres.
m&b = parameters dependent on land use and vegetation cover.

The watershed resistance coefficient, K_b, for each sub-basin was weighted to account for varying roughness conditions associated with mixed land use classifications. The land use classifications within each sub-basin were categorized into roughness types using the descriptions presented in Table 5.1 (Ref. 7). All vacant areas of mountainous desert conditions were placed under the category of maximum roughness (Type D). Paradise Valley residential areas were labeled as having moderately low roughness (Type B). Phoenix residential areas were placed under the category of minimal roughness (Type A).

The time of concentration and flow paths are shown on Plates 4 in Section VII of the Appendix. The hydrologic sub-basin characteristics are summarized in Tables 10 through 14 in Section III of the Appendix.

4.3.4 Routing Parameters

Channel Routing

The Normal-Depth option of HEC-1 was used to route a hydrograph through a downstream sub-basin. The program uses an eight point cross-section which is representative of the routing reach. The reach routing length, slope and cross-section information were developed from new contour mapping. The Manning's roughness coefficients were estimated using observations made during the field investigation.

The number of computation steps (NSTPS) used in the Normal Depth routing method was estimated by reach length/average velocity/NMIN where NMIN is the computation interval. The average velocity for the representative eight point cross-section was estimated using the Manning's equation for normal depth calculation. The average peak discharge between the upstream and downstream routing locations was used for the velocity calculations for each storm frequency.

Representative cross-section work sheets for each routing reach are included in Section IV of the Appendix. The NSTPS calculations for the various storm frequencies are presented in Section IV of the Appendix. Channel routing flow paths for existing conditions are presented on Plate 4 in Section VII of the Appendix.

4.4 Special Considerations

4.4.1 Tatum Boulevard

Numerous dip roadway crossings are located along Tatum Boulevard and have allowed surface water runoff to flow from the Phoenix Mountains Preserve, northeasterly. This flow crossing Tatum Boulevard has been both a nuisance to area residents and a hazard to motorists traveling in both directions. Once surface water runoff crosses Tatum Boulevard, flows spread as sheet flow and are conveyed primarily along residential streets and subdivision drainage ways. Many homes are surrounded by water during major storm events particularly east of Tatum Boulevard in the vicinity of Doubletree Ranch Road.

Several pipe culvert crossings are located in Tatum Boulevard at well defined drainage paths. These culverts allow storm water to pond against Tatum Boulevard and drain under the roadway in a controlled manner. Several residences experience flooding during high ponded water depths.

4.4.2 Doubletree Ranch Road

A significant amount of stormwater runoff is collected in Doubletree Ranch Road east of Tatum Boulevard. This portion of roadway has no curb and gutter. Roadside ditches are located both on the north and south sides of the street but are not adequate in size to accommodate and convey flows generated during a major rainstorm. Stormwater runoff overtops the roadside ditches and drains away from roadway. Numerous homes in the vicinity of Doubletree Ranch Road are continuously flooded.

4.4.3 Cherokee Wash

Rainfall in the Mummy Mountain area and the southern Phoenix Mountains Preserve area drains to Cherokee Wash which collects and conveys stormwater runoff to Indian Bend Wash. Several roadway culverts, located at 51st Street, 54th Street, 56th Street and Caballo Lane constrict stormwater runoff and create a backwater of flow into yards and causes many homes to be surrounded by water during major storms. In addition, streets become flooded because they are relatively flat and do not drain. Brush and debris in Cherokee Wash also contribute to flooding problems.

Particular attention was given to the pipe culvert crossing in 56th Street at Cherokee Wash. Field surveys were conducted to provide information for analysis of the four barrel-24"x36" corrugated metal pipe, the roadway profile crossing, Cherokee Wash channel capacity and 56th Street capacity downstream of Cherokee Wash. An extensive analysis was performed at this location to determine quantity of flows breaking out of Cherokee Wash and flowing north in 56th Street towards Doubletree Ranch Road. The split flow analysis was prepared using Manning's Equation for 56th Street capacity, broad-crested weir analysis for flows in Cherokee Wash crossing the 56th Street roadway profile and FHWA HEC No. 5 for culvert analysis (See Ref. 18.) The split flow analysis documentation is included in Section V of the Appendix.

4.4.4 Cherokee Elementary School

The Cherokee Elementary School is located north of Cherokee Wash east of 56th Street. This area experiences a significant amount of storm water runoff ponding in 56th Street at the front of the school. On October 7th, 1993, a major storm created so much standing water along 56th Street and Doubletree Ranch Road that children were forced to remain at school until the evening when the flooding subsided.

5.0 Results and Conclusions

The HEC-1 computer model was used to compute the 2-, 10-, 50- and 100-year peak discharge values for both the 6-hour and 24-hour duration storm events. The 100-year peak discharge and volume results for both the 6-hour and 24-hour duration storms are presented in Table 2 for selected locations within the watershed. The results show that the 24-hour duration storm produces a slightly higher runoff volume than the 6-hour duration storm. However, the peak discharge results for both storm durations were found to be quite similar, almost equal in some cases, with no one storm duration more dominant than the other. Therefore, to be consistent with an earlier hydrology study performed in the area by the FCDMC, the flows from a 6-hour duration storm should be considered for any future design purposes (Ref. 9).

Table 3 shows a unit peak discharge comparison of same size drainage areas between the results of this study and the results from a recent hydrology study performed by the FCDMC for Tatum Wash (Ref. 9). The Tatum Wash watershed is located northwest of the Doubletree Ranch Road study area. The two study areas share a common watershed boundary within the Phoenix Mountains Preserve and have similar watershed runoff characteristics. The results of this study were compared against the Tatum Wash study results for the Phase 2, Case 2 scenario which examines the effects of a storm cell concentrated over the entire Tatum Wash drainage area. This particular rainfall scenario was similar to the rainfall relationship utilized for the Doubletree Ranch Road study area. Based on unit peak discharge results shown in Table 3, the two independent studies have arrived at quite comparable results.

Table 4 lists a comparison of 100-year peak discharge results between this study and two previous studies. The 100-year, 6-hour peak discharge results from this study are significantly lower than the two previous investigations. This difference in runoff values are attributed to the selection of precipitation depth, the use of varying rainfall distributions, and the use of areal reduction. The peak discharge results from the Cherokee Wash study performed by Erie and Associates, Inc. were developed for a 100-year, 2-hour duration storm event having a rainfall depth of 2.64 inches (Ref. 4). The analysis used a 2-hour storm rainfall distribution and did not account for areal reduction. This difference in design rainfall criteria had a significant affect on peak discharge values as shown in Table 4.

The 100-year peak discharge results for the Tatum Boulevard Study prepared by Kaminski-Hubbard Engineering, Inc. in 1993 are significantly higher than the results of this study as shown in Table 4 (Ref. 12). The 1993 Tatum Boulevard study results were computed using the HEC-1 computer model for a 100-year 6-hour duration storm event having a rainfall depth of 3.35 inches. This rainfall depth was greater than the areal reduced rainfall depth of 3.04 inches used for this study. The 1993 Tatum Boulevard study utilized a 6-hour rainfall distribution pattern number of 1.00 compared to pattern number 2.22 for this study. These slight rainfall depth and distribution differences are significant enough to make the 1993 Tatum Boulevard Study peak discharge results twice as great as this study's peak discharge results for each comparable location.

The large disparity in peak discharge results between this study and the 1993 Tatum Boulevard Study was further investigated in order to quantify the impacts associated with varying rainfall depth and distribution. The rainfall design criteria utilized for this study were applied to the HEC-1 model developed for the 1993 Tatum Boulevard Study. The peak discharge results for this analysis are presented in the last column of the 1993 Tatum Boulevard Study results shown in Table 4. The revised peak discharge results for the 1993 Tatum Boulevard Study were found to be quite comparable to the results of this study.

TABLE 2

Summary Of 100-Year Peak Discharges And Volumes

Location	HEC-1 I.D.	100-Yr. - 6 Hr.		100-Yr. - 24-Hr.	
		Q (cfs)	V (Ac-Ft)	Q (cfs)	V (Ac-Ft)
Berneil Dr. & Tatum Blvd.	HC145	199	14	206	15
Channel at west property line of Doubletree Canyon Subdivision	170S	234	17	234	19
Doubletree Canyon subdivision channel at Horseshoe Rd.	HC205	615	50	602	56
Doubletree Ranch Rd. & Tatum Blvd.	HC211	701	58	686	63
Tatum Blvd. south of Foothill Dr.	310S	293	24	288	27
Desert Park Ln. east of Tatum Blvd.	HC335	425	30	438	29
Desert Jewel Dr. east of Arroyo Dr.	HC365	1,159	89	1,190	93
Cherokee Wash east of 51st St.	HC385	1,574	120	1,611	127
Cherokee Wash and 54th St.	HC395	1,634	125	1,668	132
Cherokee Wash at Indian Bend Wash	HC435	1,790	147	1,796	159

TABLE 3

Unit Peak Discharge Comparison

Tatum Wash Study (Ref. 9) Phase 2 - Case 2 Results				Doubletree Ranch Road Study Results			
HEC-1 I.D.	A (sq. mi.)	Q (cfs)	Q/A (cfs/sq. mi.)	HEC-1 I.D.	A (sq. mi.)	Q (cfs)	Q/A (cfs/sq. mi.)
S1C	0.11	138	1,255	370S	0.14	192	1,371
S1B	0.23	319	1,387	170S	0.19	234	1,232
CP1C	0.67	892	1,331	HC211	0.62	701	1,131
CP1E	1.49	1,911	1,283	HC395	1.36	1,634	1,202
CP1F	1.77	2,212	1,250	HC405	1.51	1,786	1,183
CP2E	2.01	2,315	1,151	HC435	1.94	1,790	923

TABLE 4

Comparison of Peak Discharges with Previous Studies

Location	KHE - 1995 Doubletree Ranch Road Study		Erie & Assoc. Cherokee Wash Study		KHE - 1993 Tatum Boulevard Study		
	D.A. (sq.mi.)	Q (cfs)	D.A. (sq.mi.)	Q (cfs)	D.A. (sq.mi.)	Q (cfs)	Q* (cfs)
Berneil Dr. & Tatum Blvd.	0.16	199	—	—	0.15	455	217
Channel at west property line of Doubletree Canyon Subdivision	0.19	234	—	—	0.19	564	300
Doubletree Canyon Subdivision Channel at Horseshoe Rd.	0.54	615	—	—	0.48	1348	749
Doubletree Ranch Rd. & Tatum Blvd.	0.62	701	—	—	0.55	1466	826
Tatum Blvd. & Mohave Pl.	0.09	120	0.10	297	—	—	—
Tatum Blvd. south of Foothill Dr.	0.25	293	0.25	562	—	—	—
Desert Park Ln. east of Tatum Blvd.	0.29	425	0.28	513	—	—	—
Paradise Canyon east of Las Brisas Ln.	0.07	99	0.09	244	—	—	—
Roadrunner Rd. west of 54th St.	0.08	114	0.08	231	—	—	—
Desert Jewel Dr. east of Arroyo Dr.	0.94	1159	0.93	1791	—	—	—
54th St. & Desert Jewel Dr.	0.14	192	0.16	401	—	—	—
Cherokee Wash east of 51st St.	1.30	1574	1.12	2070	—	—	—
Cherokee Wash at 54th St.	1.36	1634	1.46	2568	—	—	—
Cherokee Wash & Indian Bend Wash	1.94	1790	1.89	2251	—	—	—

* 1993 Tatum Boulevard Study results using the same rainfall depth and distribution parameters as the 1995 Doubletree Ranch Road Study.

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APPENDIX

SECTION I	Rainfall And Physical Hydrologic Parameters
SECTION II	Green & Ampt & Land Use Parameters
SECTION III	Hydrologic Sub-Basin Characteristics
SECTION IV	Hydrograph Routing Parameters
SECTION V	Divert Parameters
SECTION VI	HEC-1 Hydrology Results, 100-year, 6-hour Storm (Existing Conditions)
SECTION VII	Plates
SECTION VIII	HEC-1 Data Files On Computer Diskette

SECTION I

Rainfall And Physical Hydrologic Parameters

TABLE 5

Point Precipitation Values
(Inches)

Return Period (Years)	Storm Duration	
	6-Hr.	24-Hr.
2	1.19	1.38
10	2.01	2.38
50	2.80	3.35
100	3.15	3.77

Source: NOAA Atlas Isopluvial Maps For Arizona

TABLE 6

Areal Precipitation Reduction Data

Watershed Area (Sq. Mi.)	Storm Duration	
	6-Hr[1]	24-Hr[2]
0	1.00	1.00
1	0.99	---
3	---	0.98
5	0.96	---
10	0.94	0.96
20	0.91	0.92
30	0.89	0.90
40	0.87	0.89

[1] Drainage Design Manual For Maricopa County, (Ref. 17)
[2] NOAA Technical Memorandum NWS HYDRO-40, (Ref. 17)

TABLE 7

6-HOUR STORM RAINFALL DISTRIBUTIONS
(Furnished by FCDMC's Maricopa County Unit Hydrograph Procedure 1)
Cumulative Rainfall Table

Storm Time (Hours)	Watershed (Sq. Mi.)				
	≤0.5	2.8	16	90	500
0.00	0.000	0.000	0.000	0.000	0.000
0.25	0.008	0.009	0.015	0.021	0.024
0.50	0.016	0.016	0.020	0.035	0.043
0.75	0.025	0.025	0.030	0.051	0.059
1.00	0.033	0.034	0.048	0.071	0.078
1.25	0.041	0.042	0.063	0.087	0.098
1.50	0.050	0.051	0.076	0.105	0.119
1.75	0.058	0.059	0.090	0.125	0.141
2.00	0.066	0.067	0.105	0.143	0.162
2.25	0.074	0.076	0.119	0.160	0.186
2.50	0.087	0.087	0.135	0.179	0.212
2.75	0.099	0.100	0.152	0.201	0.239
3.00	0.118	0.120	0.175	0.232	0.271
3.25	0.138	0.163	0.222	0.281	0.321
3.50	0.216	0.252	0.304	0.364	0.408
3.75	0.377	0.451	0.472	0.500	0.515
4.00	0.834	0.694	0.670	0.658	0.627
4.25	0.911	0.837	0.796	0.773	0.735
4.50	0.931	0.900	0.868	0.841	0.814
4.75	0.950	0.938	0.912	0.888	0.864
5.00	0.962	0.950	0.946	0.927	0.907
5.25	0.972	0.963	0.960	0.945	0.930
5.50	0.983	0.975	0.973	0.964	0.954
5.75	0.991	0.988	0.987	0.982	0.977
6.00	1.000	1.000	1.000	1.000	1.000

TABLE 8

24-HOUR STORM RAINFALL DISTRIBUTIONS
(Standard SCS 24-Hour, Type II Distribution
Cumulative Rainfall Table)

Storm Time (Hours)	Precipitation Ratio
0.0	0.000
0.5	0.005
1.0	0.011
1.5	0.016
2.0	0.022
2.5	0.028
3.0	0.035
3.5	0.041
4.0	0.048
4.5	0.056
5.0	0.063
5.5	0.071
6.0	0.080
6.5	0.089
7.0	0.098
7.5	0.109
8.0	0.120
8.5	0.133
9.0	0.147
9.5	0.163
10.0	0.181
10.5	0.204
11.0	0.235
11.5	0.283
12.0	0.663

Storm Time (Hours	Precipitation Ratio
12.5	0.735
13.0	0.772
13.5	0.799
14.0	0.820
14.5	0.838
15.0	0.854
15.5	0.868
16.0	0.880
16.5	0.891
17.0	0.902
17.5	0.912
18.0	0.921
18.5	0.929
19.0	0.937
19.5	0.945
20.0	0.952
20.5	0.959
21.0	0.965
21.5	0.972
22.0	0.978
22.5	0.984
23.0	0.989
23.5	0.995
24.0	1.000

*** O U T P U T D A T A ***

REVISED JUNE 1988 TO UPDATE COMPUTATION OF SHORT-DURATION VALUES

PRECIPITATION FREQUENCY VALUES FOR DOUBLETREE RANCH RD STUDY,
PRIMARY ZONE NUMBER= 7
SHORT-DURATION ZONE NUMBER= 8

OPTION NUMBER 2 --- INPUT OF 12 PRECIP VALUES
LATITUDE 33.56N LONGITUDE 111.97W ELEVATION 1360 FEET

POINT VALUES

RETURN PERIOD

DURATION	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	
5-MIN	.33	.43	.50	.59	.67	.74	.92	5-MIN
10-MIN	.49	.65	.75	.90	1.02	1.14	1.41	10-MIN
15-MIN	.59	.81	.95	1.15	1.31	1.46	1.82	15-MIN
30-MIN	.78	1.08	1.28	1.56	1.77	1.98	2.47	30-MIN
1-HR	.96	1.33	1.59	1.94	2.21	2.48	3.10	1-HR
2-HR	1.04	1.45	1.73	2.11	2.41	2.71	3.39	2-HR
3-HR	1.09	1.53	1.83	2.23	2.55	2.86	3.58	3-HR
6-HR	1.19	1.68	2.01	2.45	2.80	3.15	3.95	6-HR
12-HR	1.29	1.83	2.19	2.69	3.08	3.46	4.35	12-HR
24-HR	1.38	1.98	2.38	2.93	3.35	3.77	4.75	24-HR

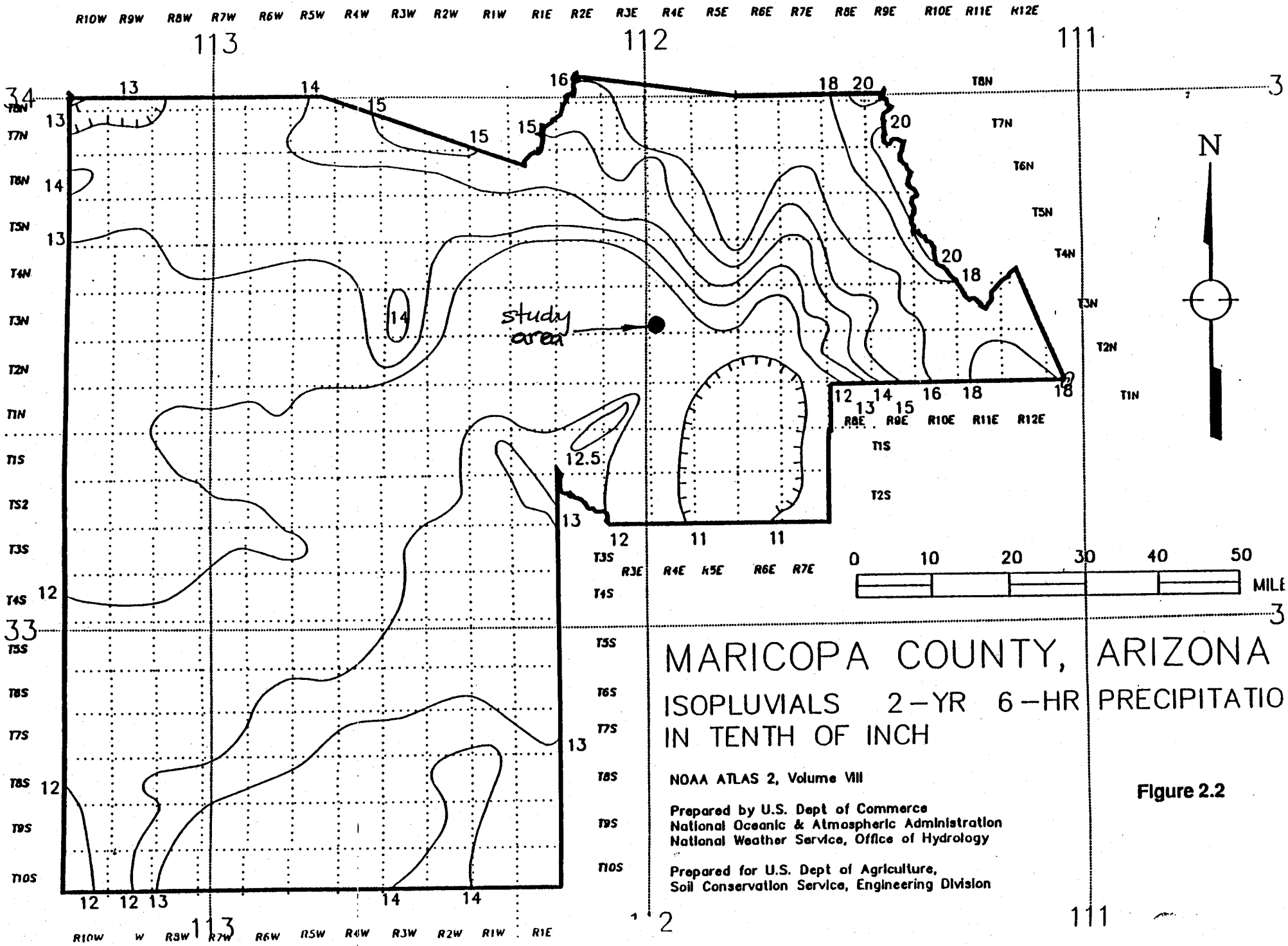
* IF YOUR SITE IS IN ARIZONA OR NEW MEXICO, PLEASE CONSULT THE
FOLLOWING PAPER FOR REVISED DEPTH-AREA VALUES:
DEPTH-AREA RATIOS IN THE SEMI-ARID SOUTHWEST UNITED STATES
NOAA TECHNICAL MEMORANDUM NWS HYDRO-40
ZEHR AND MYERS
AUGUST 1984

INPUT DATA

PROJECT NAME=DOUBLETREE RANCH RD STUDY,
ZONE= 7 SHORT-DURATION ZONE= 8
LATITUDE= 33.56 LONGITUDE= 111.97 ELEVATION= 1360
12-VALUE PRECIPITATION OPTION
PRECIPITATION VALUE:

1.18	1.70
2.00	2.45
2.80	3.15
1.40	1.98
2.37	2.90
3.35	3.80

* * * * E N D O F R U N * * * *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Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
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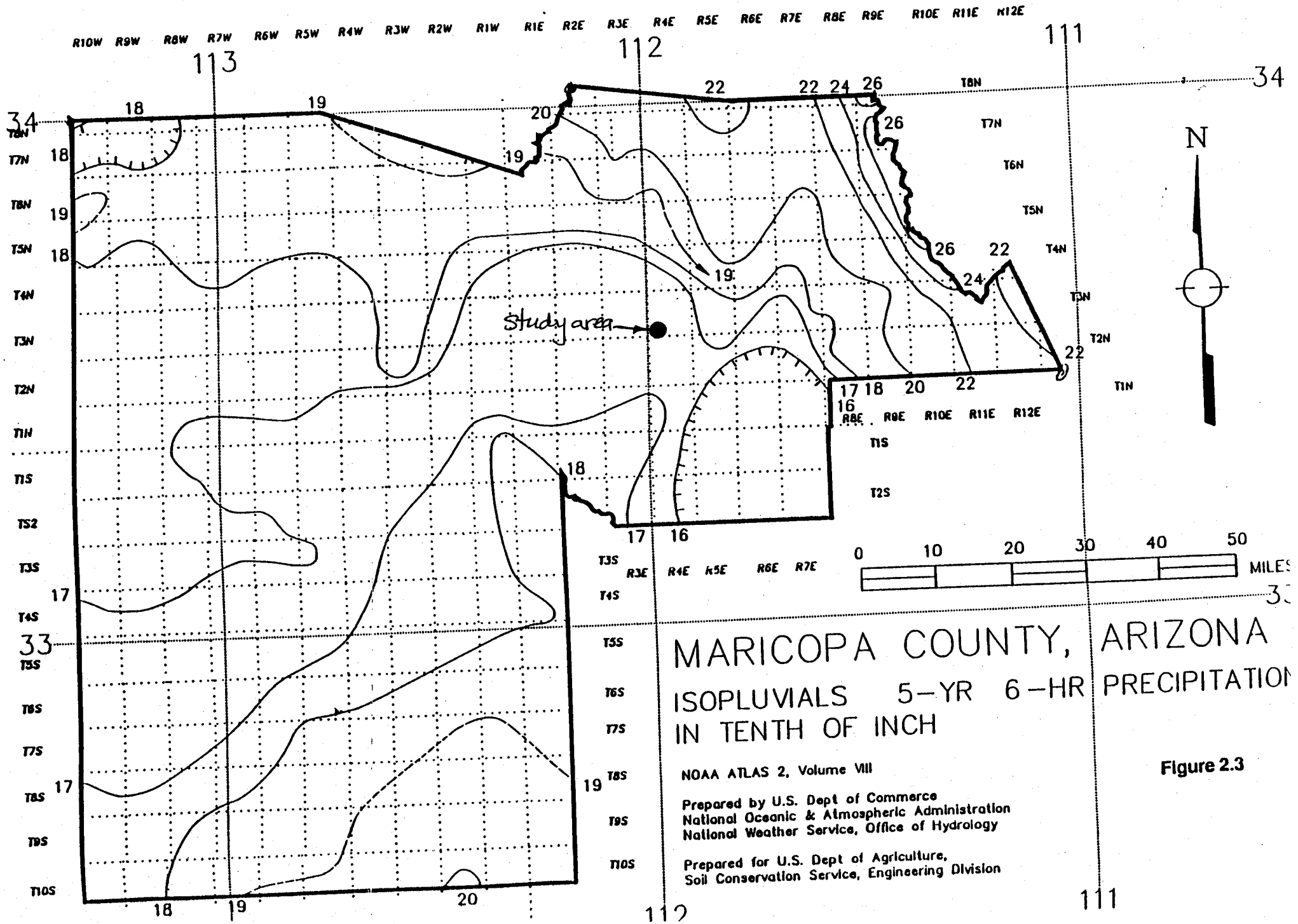
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Soil Conservation Service, Engineering Division
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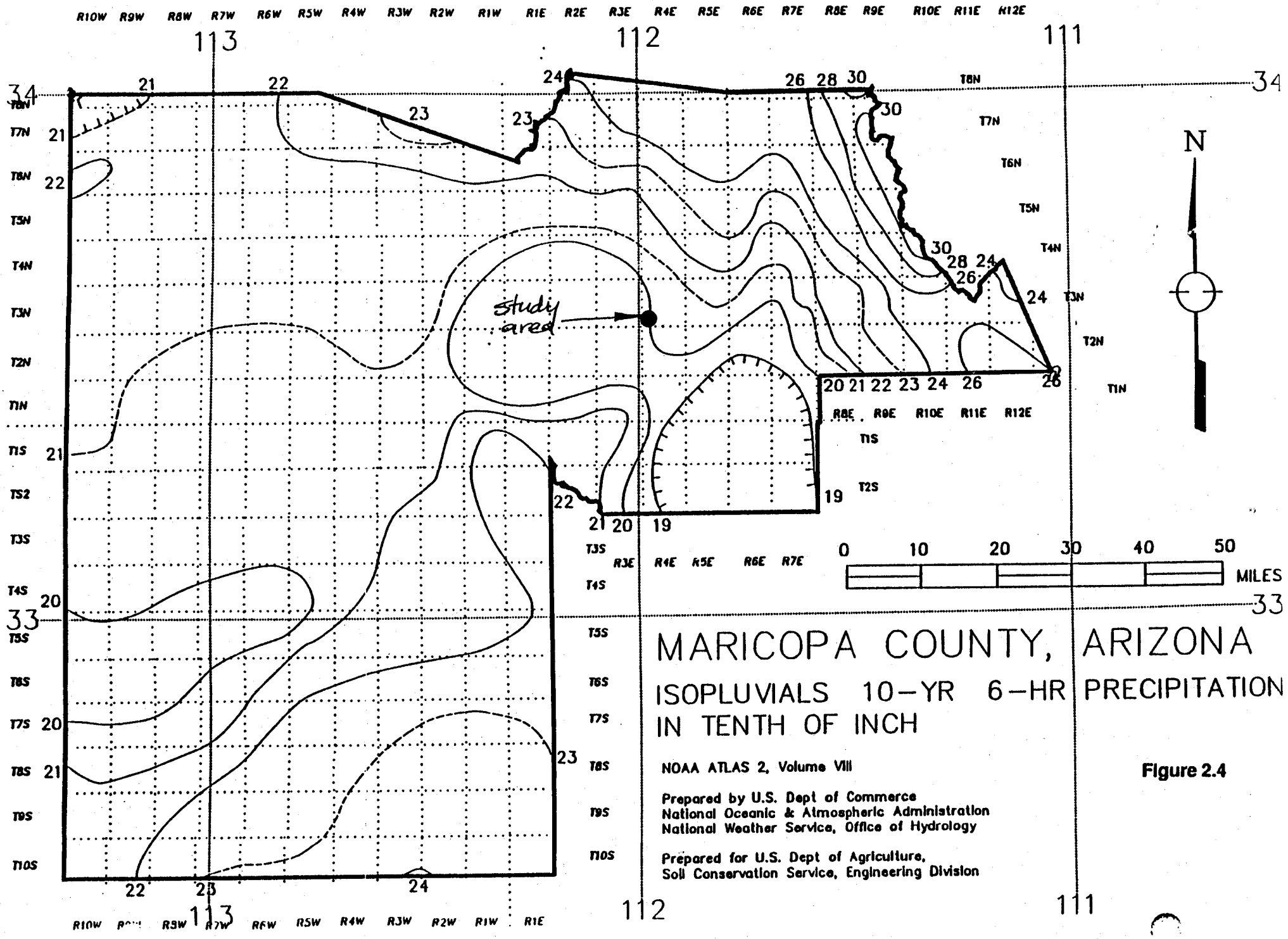
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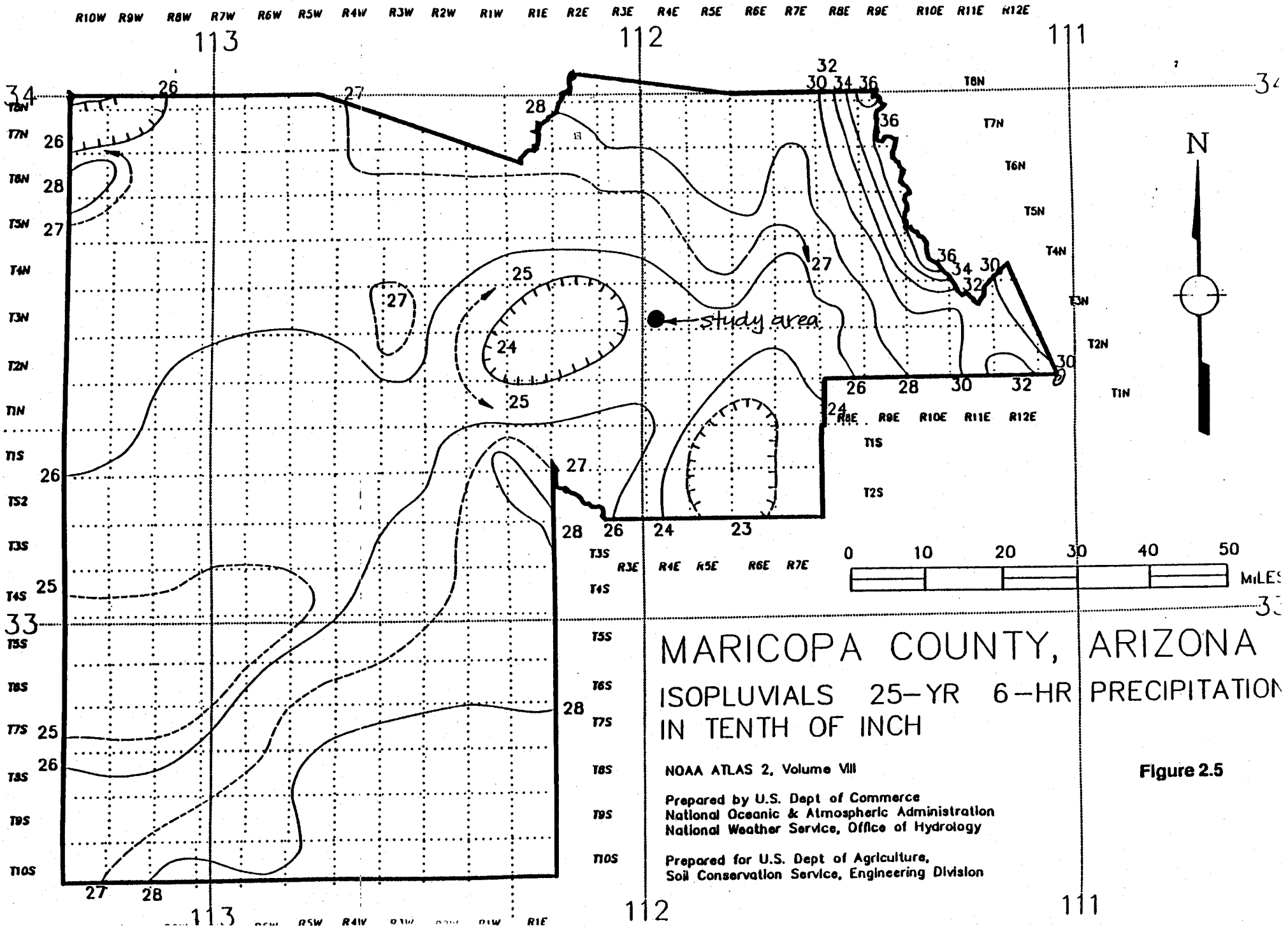
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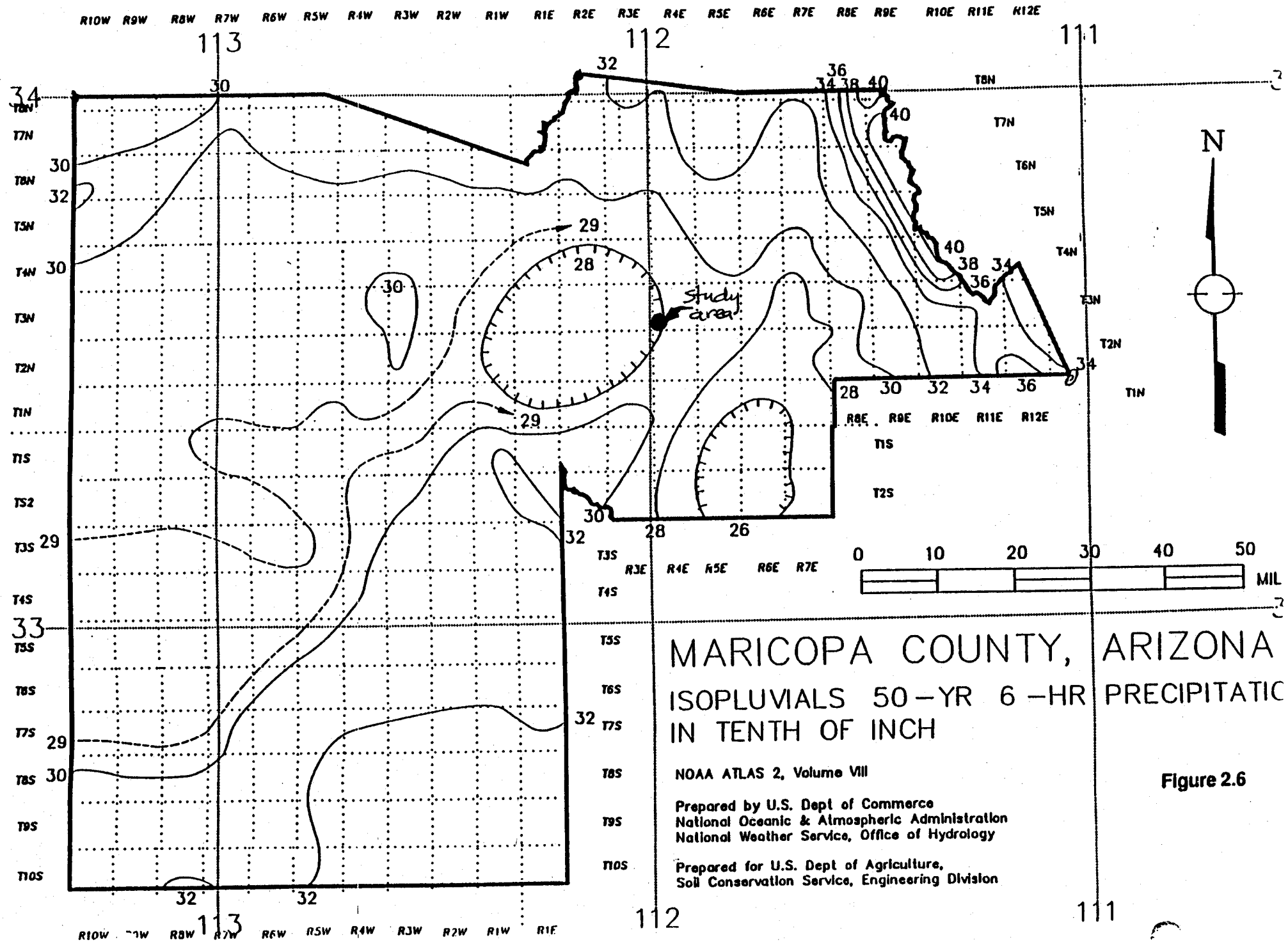
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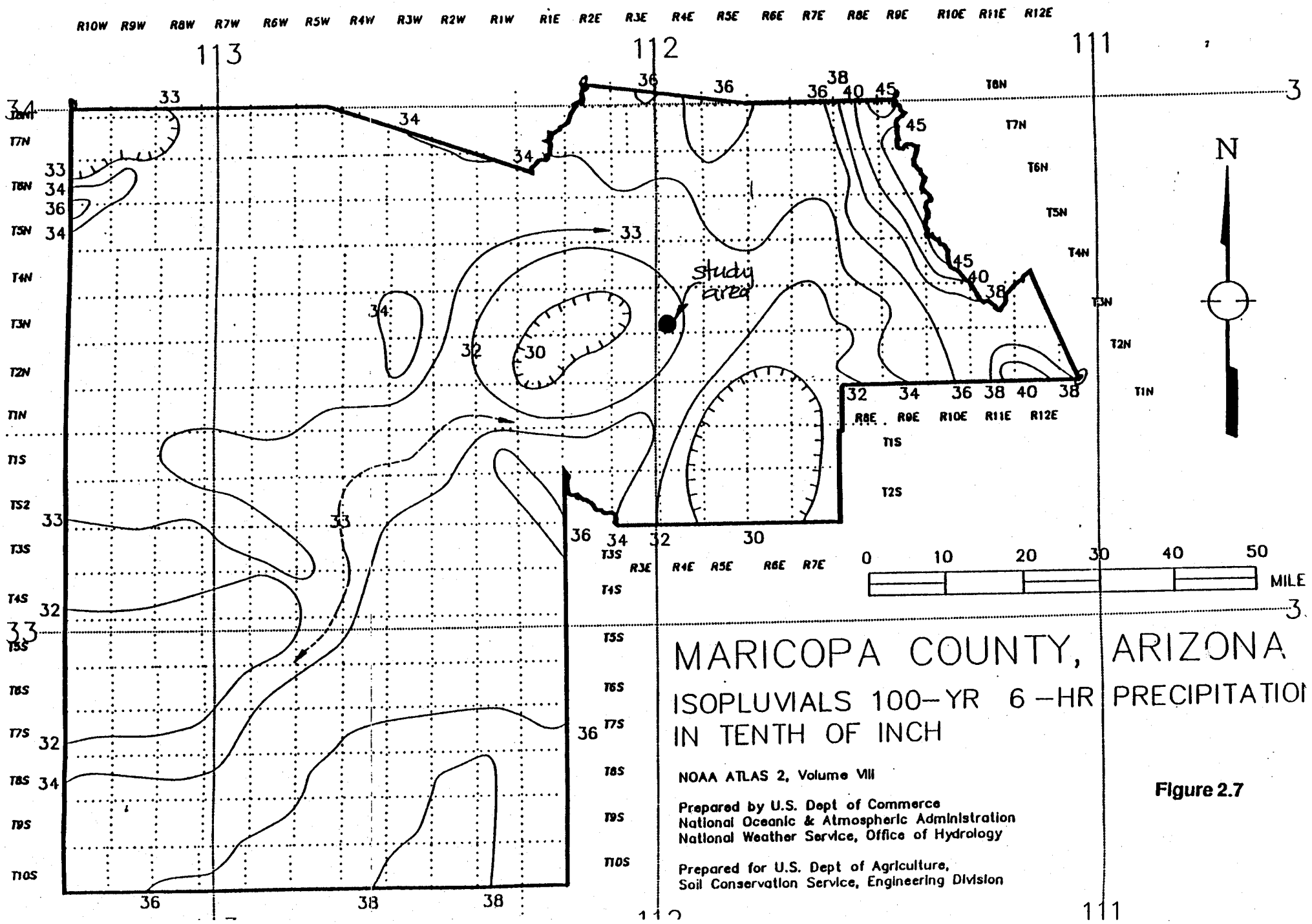
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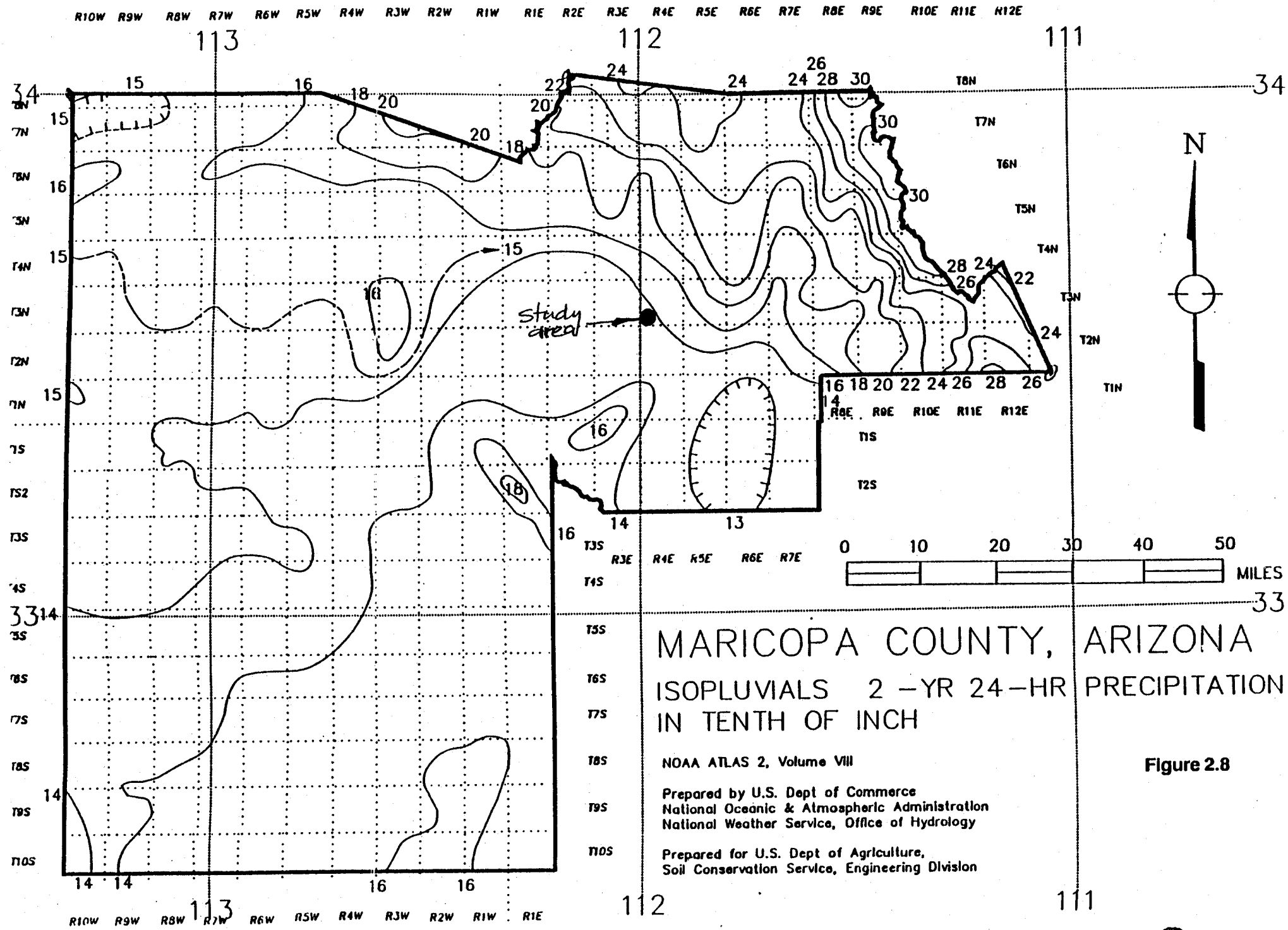
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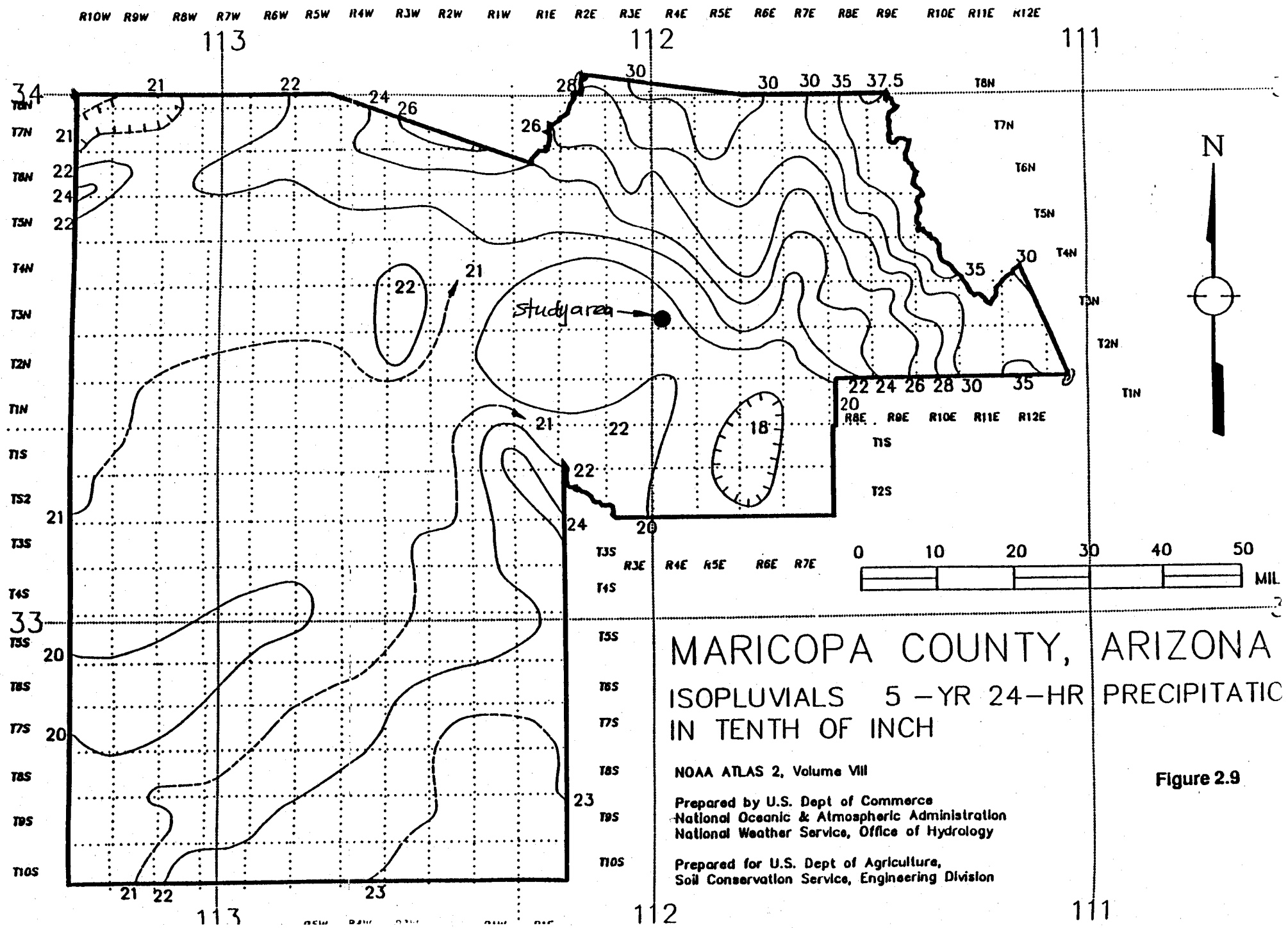
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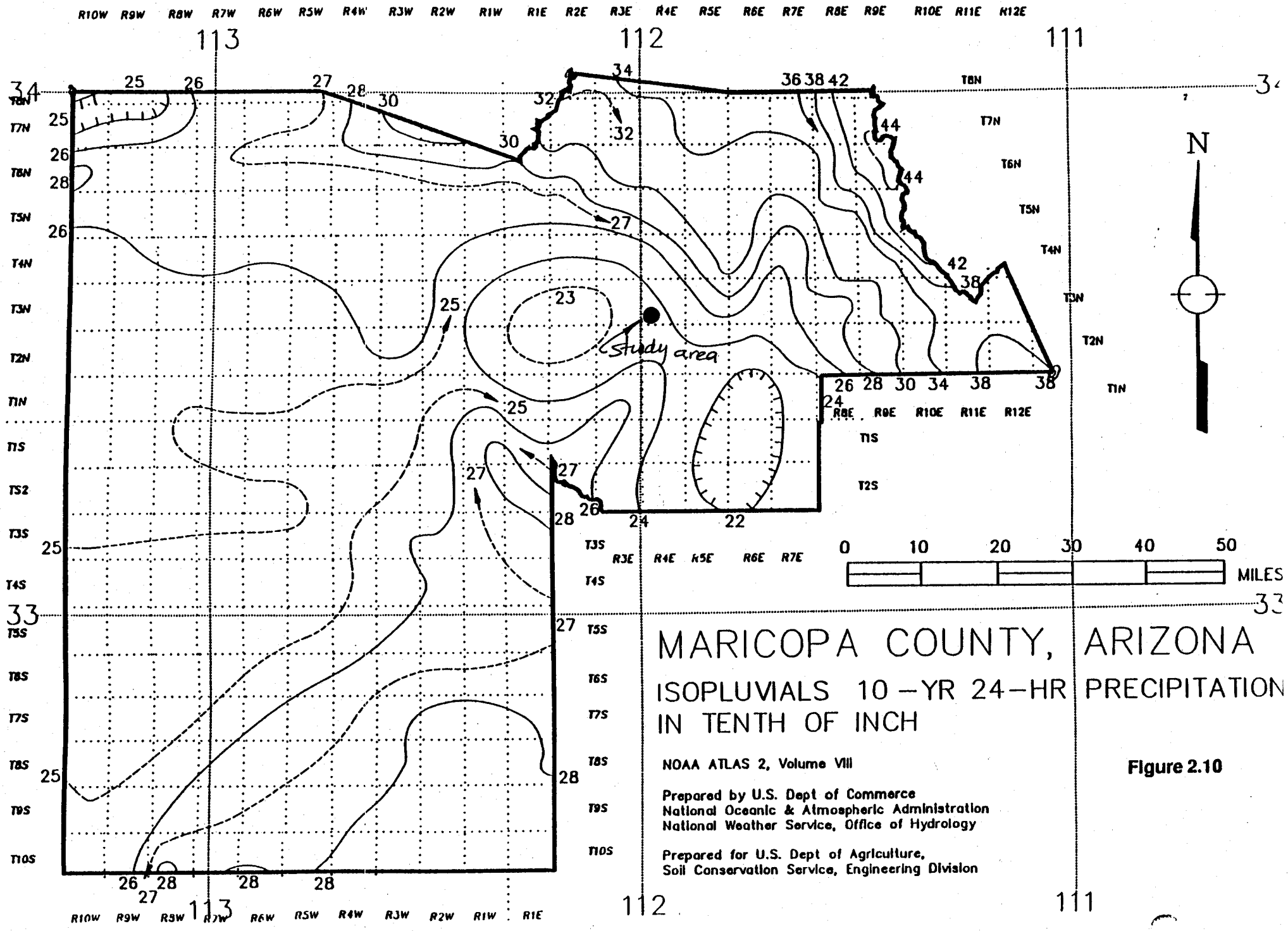
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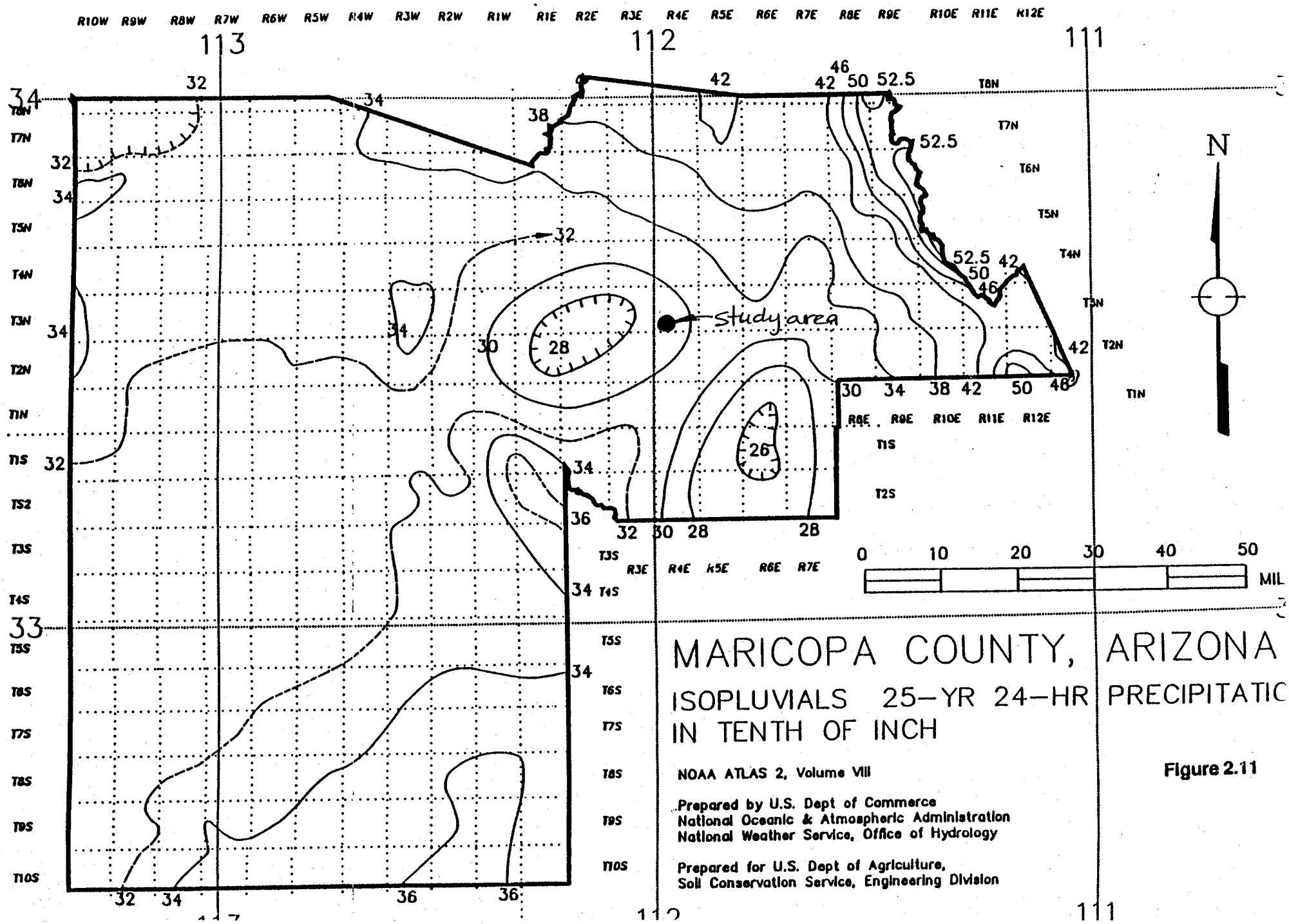
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MARICOPA COUNTY, ARIZONA
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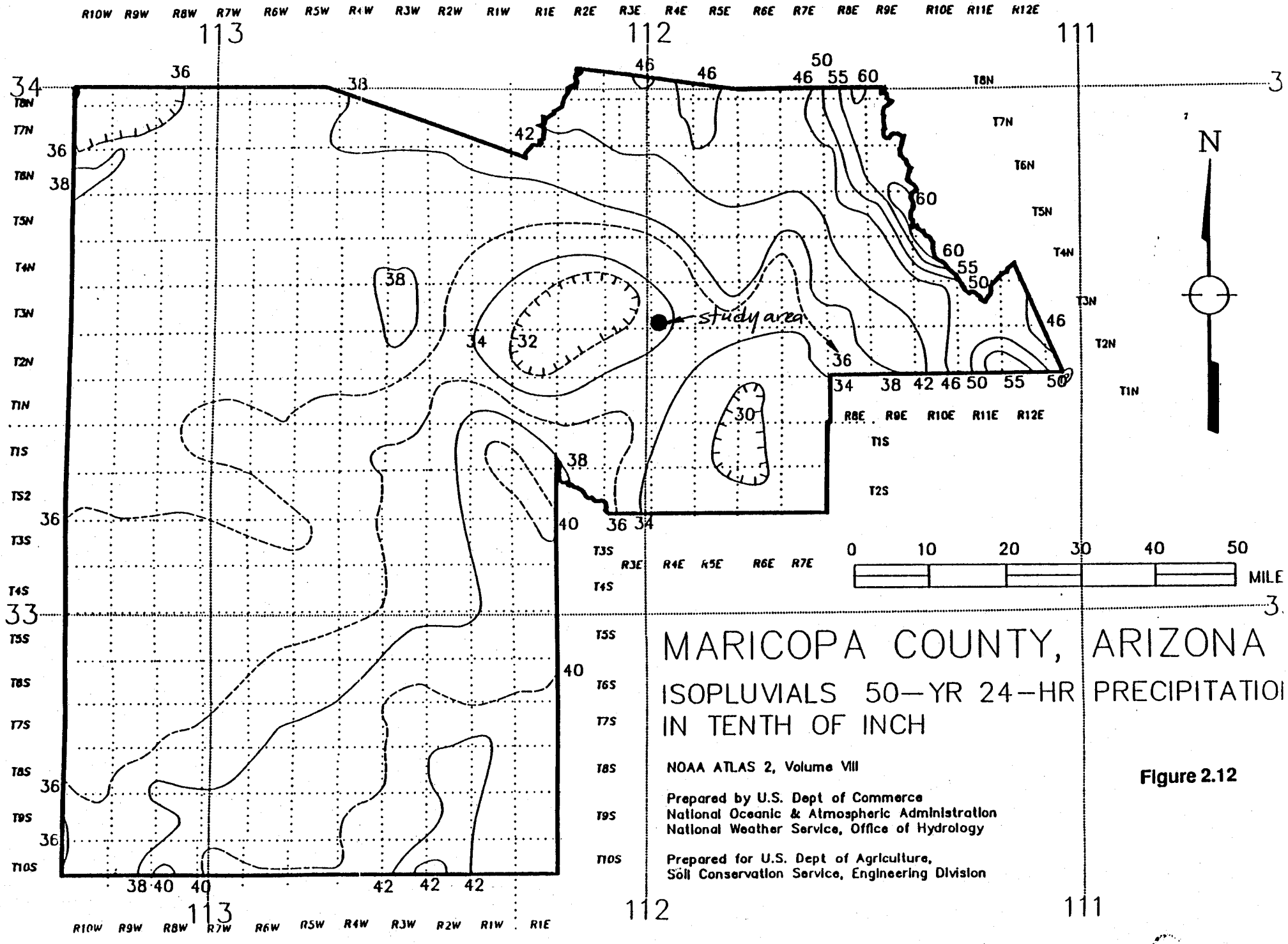
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Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.12

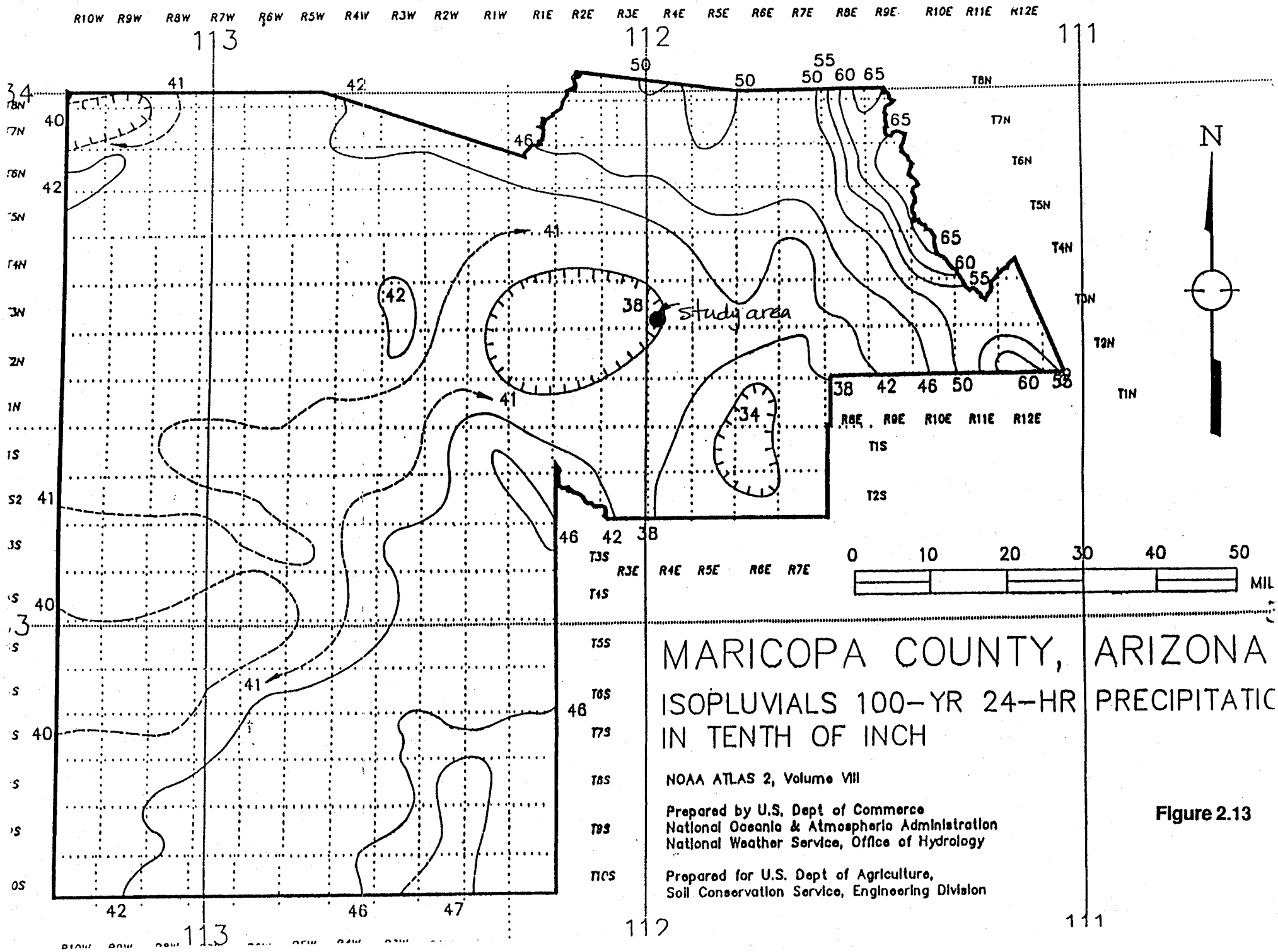

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 24-HR PRECIPITATIC
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
study area
N
0 10 20 30 40 50
MIL
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111

Figure 2.13

SECTION II

Green & Ampt & Land Use Parameters

TABLE 9

Average Green-Ampt Parameters

Sub-Basin	IA (in)	DTHETA	PSIF (in)	XKSAT (in/Hr.)	RTIMP (%)
100	0.140	0.250	4.15	0.470	18.0
110	0.100	0.250	4.45	0.400	15.0
120	0.100	0.250	4.65	0.350	15.0
130	0.200	0.250	4.25	0.450	32.0
140	0.140	0.250	4.30	0.430	29.0
150	0.100	0.250	4.65	0.350	15.0
160	0.100	0.250	4.65	0.350	15.0
170	0.200	0.250	4.25	0.450	37.0
180	0.150	0.250	4.15	0.470	28.0
190	0.170	0.250	4.25	0.450	42.0
200	0.150	0.250	4.15	0.470	35.0
210	0.100	0.250	0.34	0.490	21.0
215	0.100	0.250	4.80	0.320	15.0
220	0.100	0.250	3.95	0.510	15.0
230	0.100	0.250	4.50	0.380	15.0
240	0.100	0.250	4.70	0.330	15.0
250	0.160	0.250	4.20	0.460	37.0
260	0.100	0.250	4.35	0.420	15.0
270	0.100	0.250	4.70	0.330	15.0
280	0.100	0.250	4.65	0.350	15.0
290	0.160	0.250	4.15	0.470	30.0
300	0.100	0.250	3.95	0.510	15.0
310	0.170	0.250	4.20	0.460	36.0
320	0.140	0.250	5.60	0.230	30.0
330	0.110	0.150	7.30	0.120	17.0
340	0.180	0.250	4.80	0.320	42.0
350	0.140	0.250	4.80	0.320	48.0
360	0.110	0.250	4.10	0.490	19.0

TABLE 9

Average Green-Ampt Parameters

Sub-Basin	IA (in)	DTHETA	PSIF (in)	XKSAT (in/Hr.)	RTIMP (%)
370	0.160	0.250	4.80	0.320	42.0
380	0.100	0.250	4.00	0.500	17.0
390	0.100	0.250	4.45	0.400	15.0
400	0.130	0.250	4.65	0.350	25.0
410	0.140	0.250	4.55	0.370	31.0
420	0.150	0.250	4.55	0.370	31.0
430	0.100	0.250	4.65	0.350	15.0

LOSS PARAMETERS FOR SUBBASIN: 100

Soil Survey Used Aguila/Carefree

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
98	0.069	78.4	0.37	0
109	0.018	20.5	0.35	65
68	0.001	1.1	0.63	0

TOTAL = 0.088 Sq.Miles XKSAT = 0.37 %Rock = 13

DTHETA

Dry = 0.35 PSIF = 4.15
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.031	Desert	35.2	NORMAL	35	0	0.20	0.03	Max	0.16
0.057	L.D.R.	64.8	NORMAL	35	15	0.10	0.05	Low	0.06

0.088 = Total Area Avg. = 35 10% 0.140

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.47

IMPERVIOUS AREA: URBAN @ 100 % effective = 10
ROCK OUTCROP @ 60 % effective = 13

% EFFECTIVE IMP. = 18

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
100	0.088	0.450	0.088	315.0	0.14	0.25	4.15	0.47	18

LOSS PARAMETERS FOR SUBBASIN: 110

Soil Survey Used Aguila/Carefree

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.078	67.8	0.27	0
98	0.030	26.1	0.37	0
68	0.007	6.1	0.63	0

TOTAL = 0.115 Sq.Miles XKSAT = 0.31 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.45
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb	Kb Type
0.115	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.115 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.40

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
110	0.115	0.720	0.054	42.0	0.10	0.25	4.45	0.40	15

LOSS PARAMETERS FOR SUBBASIN: 120

Soil Survey Used Aguila/Carefree

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.086	100.	0.27	0

TOTAL = 0.086 Sq.Miles XKSAT = 0.27 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.086	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.086 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0
% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
120	0.086	0.450	0.056	27.0	0.10	0.25	4.65	0.35	15

LOSS PARAMETERS FOR SUBBASIN: 130

Soil Survey Used Aguila/Carefree

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.022	81.5	0.35	65
98	0.005	18.5	0.37	0

TOTAL = 0.027 Sq.Miles XKSAT = 0.35 %Rock = 53

DTHETA

Dry = 0.35 PSIF = 4.25
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.027	Desert	100.	NORMAL	35	0	0.20	0.03	Max	0.16

0.027 = Total Area Avg. = 35 0% 0.200

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.45

IMPERVIOUS AREA: URBAN @ 100 % effective = 0
ROCK OUTCROP @ 60 % effective = 53

% EFFECTIVE IMP. = 32

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
130	0.027	0.230	0.163	315.0	0.20	0.25	4.25	0.45	32

LOSS PARAMETERS FOR SUBBASIN: 140

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.049	36.6	0.35	65
98	0.038	28.4	0.37	0
PvC	0.018	13.4	0.40	0
Es	0.015	11.2	0.25	0
55	0.014	10.4	0.27	0

TOTAL = 0.134 Sq.Miles XKSAT = 0.34 %Rock = 24

DTHETA

Dry = 0.35 PSIF = 4.30
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.054	Desert	40.3	NORMAL	35	0	0.20	0.03	Max	0.15
0.080	M.D.R.	59.7	NORMAL	35	25	0.10	0.05	Min	0.03

0.134 = Total Area Avg. = 35 15% 0.140

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.43

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 60 % effective = 24

% EFFECTIVE IMP. = 29

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
140	0.134	0.680	0.074	315.0	0.14	0.25	4.30	0.43	29

LOSS PARAMETERS FOR SUBBASIN: 150

Soil Survey Used Aguila/Carefree

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.119	98.3	0.27	0
98	0.002	1.7	0.37	0

TOTAL = 0.121 Sq.Miles XKSAT = 0.27 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.121	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.121 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
150	0.121	0.620	0.054	39.0	0.10	0.25	4.65	0.35	15

LOSS PARAMETERS FOR SUBBASIN: 160

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.136	94.4	0.27	0
Es	0.008	5.6	0.25	0

TOTAL = 0.144 Sq.Miles XKSAT = 0.27 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.144	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.144 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
160	0.144	0.910	0.053	24.0	0.10	0.25	4.65	0.35	15

LOSS PARAMETERS FOR SUBBASIN: 170

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.177	94.7	0.35	65
PvC	0.010	5.3	0.40	0

TOTAL = 0.187 Sq.Miles XKSAT = 0.35 %Rock = 62

DTHETA

Dry = 0.35 PSIF = 4.25
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.187	Desert	100.	NORMAL	35	0	0.20	0.03	Max	0.14

0.187 = Total Area Avg. = 35 0% 0.200

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.45

IMPERVIOUS AREA: URBAN @ 100 % effective = 0
ROCK OUTCROP @ 60 % effective = 62

% EFFECTIVE IMP. = 37

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
170	0.187	0.610	0.138	315.0	0.20	0.25	4.25	0.45	37

LOSS PARAMETERS FOR SUBBASIN: 180

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.048	50.5	0.35	65
PvC	0.047	49.5	0.40	0

TOTAL = 0.095 Sq.Miles XKSAT = 0.37 %Rock = 33

DTHETA

Dry = 0.35 PSIF = 4.15
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.047	Desert	49.5	NORMAL	35	0	0.20	0.03	Max	0.16
0.048	L.D.R.	50.5	NORMAL	35	15	0.10	0.05	Low	0.06
0.095 = Total Area			Avg. =	35	8%	0.150			

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.47

IMPERVIOUS AREA: URBAN @ 100 % effective = 8
ROCK OUTCROP @ 60 % effective = 33

% EFFECTIVE IMP. = 28

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
180	0.095	0.680	0.100	315.0	0.15	0.25	4.15	0.47	28

LOSS PARAMETERS FOR SUBBASIN: 190

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.203	97.6	0.35	65
PvC	0.005	2.4	0.40	0

TOTAL = 0.208 Sq.Miles XKSAT = 0.35 %Rock = 63

DTHETA

Dry = 0.35 PSIF = 4.25
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.156	Desert	75.0	NORMAL	35	0	0.20	0.03	Max	0.14
0.052	L.D.R.	25.0	NORMAL	35	15	0.10	0.05	Low	0.06

0.208 = Total Area Avg. = 35 4% 0.170

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.45

IMPERVIOUS AREA: URBAN @ 100 % effective = 4
ROCK OUTCROP @ 60 % effective = 63

% EFFECTIVE IMP. = 42

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
190	0.208	0.910	0.115	315.0	0.17	0.25	4.25	0.45	42

LOSS PARAMETERS FOR SUBBASIN: 200

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.027	56.2	0.35	65
PvC	0.021	43.8	0.40	0

TOTAL = 0.048 Sq.Miles XKSAT = 0.37 %Rock = 37

DTHETA

Dry = 0.35 PSIF = 4.15
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.024	Desert	50.0	NORMAL	35	0	0.20	0.03	Max	0.16
0.024	M.D.R.	50.0	NORMAL	35	25	0.10	0.05	Min	0.03

0.048 = Total Area Avg. = 35 13% 0.150

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.47

IMPERVIOUS AREA: URBAN @ 100 % effective = 13
ROCK OUTCROP @ 60 % effective = 37

% EFFECTIVE IMP. = 35

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
200	0.048	0.380	0.093	315.0	0.15	0.25	4.15	0.47	35

LOSS PARAMETERS FOR SUBBASIN: 210

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.001	1.2	0.35	65
Es	0.008	10.0	0.25	0
PvC	0.071	88.8	0.40	0

TOTAL = 0.080 Sq.Miles XKSAT = 0.38 %Rock = 1

DTHETA

Dry = 0.35 PSIF = 4.10
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.040	L.D.R.	50.0	NORMAL	35	15	0.10	0.05	Low	0.06
0.040	M.D.R.	50.0	NORMAL	35	25	0.10	0.05	Min	0.03

0.080 = Total Area Avg. = 35 20% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.49

IMPERVIOUS AREA: URBAN @ 100 % effective = 20
ROCK OUTCROP @ 60 % effective = 1
% EFFECTIVE IMP. = 21

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
210	0.080	0.610	0.043	185.0	0.10	0.25	0.34	0.49	21

LOSS PARAMETERS FOR SUBBASIN: 215

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Es	0.028	100.	0.25	0

TOTAL = 0.028 Sq.Miles XKSAT = 0.25 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.80
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.028	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06
0.028 = Total Area			Avg. =	35	15%	0.100			

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.32

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0
% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
215	0.028	0.510	0.063	51.0	0.10	0.25	4.80	0.32	15

LOSS PARAMETERS FOR SUBBASIN: 220

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
PvC	0.024	100.	0.40	0

TOTAL = 0.024 Sq.Miles XKSAT = 0.40 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 3.95
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.024	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.024 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.51

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
220	0.024	0.270	0.064	219.2	0.10	0.25	3.95	0.51	15

LOSS PARAMETERS FOR SUBBASIN: 230

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Es	0.119	57.8	0.25	0
PvC	0.085	41.3	0.40	0
55	0.002	1.0	0.27	0

TOTAL = 0.206 Sq.Miles XKSAT = 0.30 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.50
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.206	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.206 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.38

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0
% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
230	0.206	0.720	0.051	104.0	0.10	0.25	4.50	0.38	15

LOSS PARAMETERS FOR SUBBASIN: 240

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.039	68.4	0.27	0
Es	0.018	31.6	0.25	0

TOTAL = 0.057 Sq.Miles XKSAT = 0.26 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.70
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.057	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.057 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.33

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
240	0.057	0.380	0.059	34.0	0.10	0.25	4.70	0.33	15

LOSS PARAMETERS FOR SUBBASIN: 250

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.061	78.2	0.35	65
PvC	0.017	21.8	0.40	0

TOTAL = 0.078 Sq.Miles XKSAT = 0.36 %Rock = 51

DTHETA

Dry = 0.35 PSIF = 4.20
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.047	Desert	60.3	NORMAL	35	0	0.20	0.03	Max	0.16
0.031	L.D.R.	39.7	NORMAL	35	15	0.10	0.05	Low	0.06

0.078 = Total Area Avg. = 35 6% 0.160

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.46

IMPERVIOUS AREA: URBAN @ 100 % effective = 6
ROCK OUTCROP @ 60 % effective = 51

% EFFECTIVE IMP. = 37

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
250	0.078	0.450	0.112	315.0	0.16	0.25	4.20	0.46	37

LOSS PARAMETERS FOR SUBBASIN: 260

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
PvC	0.086	58.5	0.40	0
LaA	0.033	22.5	0.25	0
Es	0.022	15.0	0.25	0
55	0.005	3.4	0.27	0
109	0.001	0.7	0.35	35

TOTAL = 0.147 Sq.Miles XKSAT = 0.33 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.35
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.147	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.147 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.42

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 60 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
260	0.147	0.640	0.053	103.0	0.10	0.25	4.35	0.42	15

LOSS PARAMETERS FOR SUBBASIN: 270

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.104	70.8	0.27	0
LaA	0.031	21.1	0.25	0
Es	0.012	8.2	0.25	0

TOTAL = 0.147 Sq.Miles XKSAT = 0.26 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.70
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.147	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.147 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.33

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
270	0.147	0.720	0.053	36.0	0.10	0.25	4.70	0.33	15

LOSS PARAMETERS FOR SUBBASIN: 280

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.114	99.1	0.27	0
LaA	0.001	0.9	0.25	0

TOTAL = 0.115 Sq.Miles XKSAT = 0.27 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.115	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.115 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
280	0.115	0.490	0.054	24.0	0.10	0.25	4.65	0.35	15

LOSS PARAMETERS FOR SUBBASIN: 290

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.056	60.9	0.35	65
PvC	0.036	39.1	0.40	0

TOTAL = 0.092 Sq.Miles XKSAT = 0.37 %Rock = 40

DTHETA

Dry = 0.35 PSIF = 4.15
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.055	Desert	59.8	NORMAL	35	0	0.20	0.03	Max	0.15
0.037	L.D.R.	40.2	NORMAL	35	15	0.10	0.05	Low	0.06

0.092 = Total Area Avg. = 35 6% 0.160

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.47

IMPERVIOUS AREA: URBAN @ 100 % effective = 6
ROCK OUTCROP @ 60 % effective = 40

% EFFECTIVE IMP. = 30

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
290	0.092	0.380	0.111	315.0	0.16	0.25	4.15	0.47	30

LOSS PARAMETERS FOR SUBBASIN: 300

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
PvC	0.052	100.	0.40	0

TOTAL = 0.052 Sq.Miles XKSAT = 0.40 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 3.95
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.052	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.052 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.51

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
300	0.052	0.380	0.059	153.0	0.10	0.25	3.95	0.51	15

LOSS PARAMETERS FOR SUBBASIN: 310

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.200	80.3	0.35	65
PvC	0.049	19.7	0.40	0

TOTAL = 0.249 Sq.Miles XKSAT = 0.36 %Rock = 52

DTHETA

Dry = 0.35 PSIF = 4.20
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.162	Desert	65.1	NORMAL	35	0	0.20	0.03	Max	0.14
0.087	L.D.R.	34.9	NORMAL	35	15	0.10	0.05	Low	0.06

0.249 = Total Area Avg. = 35 5% 0.170

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.46

IMPERVIOUS AREA: URBAN @ 100 % effective = 5
ROCK OUTCROP @ 60 % effective = 52

% EFFECTIVE IMP. = 36

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
310	0.249	0.950	0.104	315.0	0.17	0.25	4.20	0.46	36

LOSS PARAMETERS FOR SUBBASIN: 320

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
109	0.091	53.5	0.35	65
CeC	0.064	37.7	0.06	0
PvC	0.015	8.8	0.40	0

TOTAL = 0.170 Sq.Miles XKSAT = 0.18 %Rock = 35

DTHETA

Dry = 0.38 PSIF = 5.60
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.068	Desert	40.0	NORMAL	35	0	0.20	0.03	Max	0.15
0.102	L.D.R.	60.0	NORMAL	35	15	0.10	0.05	Low	0.06

0.170 = Total Area Avg. = 35 9% 0.140

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.23

IMPERVIOUS AREA: URBAN @ 100 % effective = 9
ROCK OUTCROP @ 60 % effective = 35

% EFFECTIVE IMP. = 30

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
320	0.170	0.680	0.087	315.0	0.14	0.25	5.60	0.23	30

LOSS PARAMETERS FOR SUBBASIN: 330

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
CeC	0.091	74.0	0.06	0
PvC	0.019	15.4	0.40	0
Ro	0.013	10.6	0.25	65

TOTAL = 0.123 Sq.Miles XKSAT = 0.09 %Rock = 7

DTHETA

Dry = 0.33 PSIF = 7.30
Normal = 0.15
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.018	Desert	14.6	NORMAL	35	0	0.20	0.03	Max	0.17
0.105	L.D.R.	85.4	NORMAL	35	15	0.10	0.05	Low	0.05

0.123 = Total Area Avg. = 35 13% 0.110

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.15

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.12

IMPERVIOUS AREA: URBAN @ 100 % effective = 13
ROCK OUTCROP @ 60 % effective = 7
% EFFECTIVE IMP. = 17

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
330	0.123	0.490	0.067	264.4	0.11	0.15	7.30	0.12	17

LOSS PARAMETERS FOR SUBBASIN: 340

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.069	100.	0.25	65

TOTAL = 0.069 Sq.Miles XKSAT = 0.25 %Rock = 65

DTHETA

Dry = 0.35 PSIF = 4.80
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.055	Desert	79.7	NORMAL	35	0	0.20	0.03	Max	0.15
0.014	L.D.R.	20.3	NORMAL	35	15	0.10	0.05	Low	0.07

0.069 = Total Area Avg. = 35 3% 0.180

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.32

IMPERVIOUS AREA: URBAN @ 100 % effective = 3
ROCK OUTCROP @ 60 % effective = 65

% EFFECTIVE IMP. = 42

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
340	0.069	0.340	0.132	315.0	0.18	0.25	4.80	0.32	42

LOSS PARAMETERS FOR SUBBASIN: 350

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.076	100.	0.25	65

TOTAL = 0.076 Sq.Miles XKSAT = 0.25 %Rock = 65

DTHETA

Dry = 0.35 PSIF = 4.80
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.030	Desert	39.5	NORMAL	35	0	0.20	0.03	Max	0.16
0.046	L.D.R.	60.5	NORMAL	35	15	0.10	0.05	Low	0.06

0.076 = Total Area Avg. = 35 9% 0.140

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.32

IMPERVIOUS AREA: URBAN @ 100 % effective = 9
ROCK OUTCROP @ 60 % effective = 65

% EFFECTIVE IMP. = 48

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
350	0.076	0.380	0.093	315.0	0.14	0.25	4.80	0.32	48

LOSS PARAMETERS FOR SUBBASIN: 360

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
PvC	0.225	88.2	0.40	0
Ro	0.030	11.8	0.25	65

TOTAL = 0.255 Sq.Miles XKSAT = 0.38 %Rock = 8

DTHETA

Dry = 0.35 PSIF = 4.10
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.013	Desert	5.1	NORMAL	35	0	0.20	0.03	Max	0.17
0.242	L.D.R.	94.9	NORMAL	35	15	0.10	0.05	Low	0.05

0.255 = Total Area Avg. = 35 14% 0.110

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.49

IMPERVIOUS AREA: URBAN @ 100 % effective = 14
ROCK OUTCROP @ 60 % effective = 8
% EFFECTIVE IMP. = 19

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
360	0.255	0.870	0.054	297.2	0.11	0.25	4.10	0.49	19

LOSS PARAMETERS FOR SUBBASIN: 370

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.136	95.8	0.25	65
PvC	0.006	4.2	0.40	0

TOTAL = 0.142 Sq.Miles XKSAT = 0.25 %Rock = 62

DTHETA

Dry = 0.35 PSIF = 4.80
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.092	Desert	64.8	NORMAL	35	0	0.20	0.03	Max	0.15
0.050	L.D.R.	35.2	NORMAL	35	15	0.10	0.05	Low	0.06

0.142 = Total Area Avg. = 35 5% 0.160

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.32

IMPERVIOUS AREA: URBAN @ 100 % effective = 5
ROCK OUTCROP @ 60 % effective = 62

% EFFECTIVE IMP. = 42

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
370	0.142	0.640	0.111	315.0	0.16	0.25	4.80	0.32	42

LOSS PARAMETERS FOR SUBBASIN: 380

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
PvC	0.065	95.6	0.40	0
Ro	0.003	4.4	0.25	65

TOTAL = 0.068 Sq.Miles XKSAT = 0.39 %Rock = 3

DTHETA

Dry = 0.35 PSIF = 4.00
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.068	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.068 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.50

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 60 % effective = 3

% EFFECTIVE IMP. = 17

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
380	0.068	0.450	0.057	151.0	0.10	0.25	4.00	0.50	17

LOSS PARAMETERS FOR SUBBASIN: 390

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
LaA	0.032	48.5	0.25	0
PvC	0.032	48.5	0.40	0
55	0.002	3.0	0.27	0

TOTAL = 0.066 Sq.Miles XKSAT = 0.31 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.45
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.066	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.06

0.066 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.40

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0
% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
390	0.066	0.530	0.058	77.0	0.10	0.25	4.45	0.40	15

LOSS PARAMETERS FOR SUBBASIN: 400

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.056	38.6	0.25	65
LaA	0.036	24.8	0.25	0
55	0.031	21.4	0.27	0
PvC	0.022	15.2	0.40	0

TOTAL = 0.145 Sq.Miles XKSAT = 0.27 %Rock = 25

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.044	Desert	30.3	NORMAL	35	0	0.20	0.03	Max	0.16
0.101	L.D.R.	69.7	NORMAL	35	15	0.10	0.05	Low	0.06

0.145 = Total Area Avg. = 35 10% 0.130

PERCENT OF SUBBASIN
DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA:
URBAN @ 100 % effective = 10
ROCK OUTCROP @ 60 % effective = 25

% EFFECTIVE IMP. = 25

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
400	0.145	0.910	0.079	303.0	0.13	0.25	4.65	0.35	25

LOSS PARAMETERS FOR SUBBASIN: 410

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.042	56.0	0.25	65
PvC	0.025	33.3	0.40	0
LaA	0.008	10.7	0.25	0

TOTAL = 0.075 Sq.Miles XKSAT = 0.29 %Rock = 36

DTHETA

Dry = 0.35 PSIF = 4.55
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.030	Desert	40.0	NORMAL	35	0	0.20	0.03	Max	0.16
0.045	L.D.R.	60.0	NORMAL	35	15	0.10	0.05	Low	0.06

0.075 = Total Area Avg. = 35 9% 0.140

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.37

IMPERVIOUS AREA: URBAN @ 100 % effective = 9
ROCK OUTCROP @ 60 % effective = 36
% EFFECTIVE IMP. = 31

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
410	0.075	0.450	0.094	315.0	0.14	0.25	4.55	0.37	31

LOSS PARAMETERS FOR SUBBASIN: 420

Soil Survey Used Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
Ro	0.074	60.2	0.25	65
PvC	0.038	30.9	0.40	0
LaA	0.011	8.9	0.25	0

TOTAL = 0.123 Sq.Miles XKSAT = 0.29 %Rock = 39

DTHETA

Dry = 0.35 PSIF = 4.55
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.061	Desert	49.6	NORMAL	35	0	0.20	0.03	Max	0.15
0.062	L.D.R.	50.4	NORMAL	35	15	0.10	0.05	Low	0.06

0.123 = Total Area Avg. = 35 8% 0.150

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.37

IMPERVIOUS AREA: URBAN @ 100 % effective = 8
ROCK OUTCROP @ 60 % effective = 39

% EFFECTIVE IMP. = 31

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
420	0.123	0.800	0.099	315.0	0.15	0.25	4.55	0.37	31

LOSS PARAMETERS FOR SUBBASIN: 430

Soil Survey Used Aguila/Carefree & Eastern County

XKSAT

Map Unit	AREA Sq.Miles	% Area	XKSAT	% Rock Outcrop
55	0.198	83.5	0.27	0
LaA	0.039	16.5	0.25	0

TOTAL = 0.237 Sq.Miles XKSAT = 0.27 %Rock = 0

DTHETA

Dry = 0.35 PSIF = 4.65
Normal = 0.25
Wet = 0.00

LAND USE

AREA Sq.Miles	LAND USE Type	% Area	DTHETA condition	%Veg. cover	RTIMP%	IA in.	Kn	Kb Type	Kb
0.237	L.D.R.	100.	NORMAL	35	15	0.10	0.05	Low	0.05

0.237 = Total Area Avg. = 35 15% 0.100

PERCENT OF SUBBASIN DRY = 0.0 %
NORMAL = 100. %
WET = 0.0 %

SUBBASIN DTHETA WEIGHTED BY LAND USE = 0.25

SUBBASIN XKSAT ADJUSTED FOR VEG. = 0.35

IMPERVIOUS AREA: URBAN @ 100 % effective = 15
ROCK OUTCROP @ 100 % effective = 0

% EFFECTIVE IMP. = 15

INPUT VALUES FOR MCUHP1 PROGRAM

SUBBASIN	Area sq.mi.	Length mi.	Kb	Slope ft/mi	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %
430	0.237	0.980	0.050	29.0	0.10	0.25	4.65	0.35	15

SECTION III

Hydrologic Sub-Basin Characteristics

TABLE 10

Existing Hydrologic Sub-Basin Parameters

Sub-Basin I.D.	Highest Elevation (Ft.)	Lowest Elevation (Ft.)	Flow Path Length (Miles)	Slope (Ft./Mile)	Adjusted Slope (Ft./Mile)	Kb
100	1752.6	1380.0	0.45	828.0	315.0	0.088
110	1386.0	1356.0	0.72	42.0	42.0	0.054
120	1356.0	1344.0	0.45	27.0	27.0	0.056
130	1777.9	1404.0	0.23	1626.0	315.0	0.163
140	1813.6	1376.0	0.68	643.5	315.0	0.074
150	1379.0	1355.0	0.62	39.0	39.0	0.054
160	1356.0	1334.0	0.91	24.0	24.0	0.053
170	2202.9	1442.0	0.61	1247.4	315.0	0.138
180	2240.0	1412.0	0.68	1217.6	315.0	0.100
190	2428.5	1460.0	0.91	1064.3	315.0	0.115
200	1813.6	1402.0	0.38	1083.2	315.0	0.093
210	1495.0	1382.0	0.61	185.0	185.0	0.043
215	1384.0	1358.0	0.51	51.0	51.0	0.063
220	1470.0	1410.0	0.27	222.2	219.2	0.064
230	1430.0	1355.0	0.72	104.0	104.0	0.051
240	1361.0	1348.0	0.38	34.0	34.0	0.059
250	1765.7	1412.5	0.45	784.9	315.0	0.112
260	1426.0	1360.0	0.64	103.0	103.0	0.053
270	1364.0	1338.0	0.72	36.0	36.0	0.053
280	1346.0	1334.0	0.49	24.0	24.0	0.054
290	1831.2	1428.3	0.38	1060.3	315.0	0.111
300	1438.0	1380.0	0.38	153.0	153.0	0.059
310	2150.0	1440.0	0.95	747.4	315.0	0.104
320	1884.0	1420.0	0.68	682.4	315.0	0.087
330	1560.0	1410.0	0.49	306.1	264.4	0.067
340	2249.8	1516.0	0.34	2158.2	315.0	0.132

TABLE 10

Existing Hydrologic Sub-Basin Parameters

Sub-Basin I.D.	Highest Elevation (Ft.)	Lowest Elevation (Ft.)	Flow Path Length (Miles)	Slope (Ft./Mile)	Adjusted Slope (Ft./Mile)	Kb
350	2206.4	1480.0	0.38	1911.6	315.0	0.093
360	1736.5	1383.0	0.87	406.3	297.2	0.054
370	2232.5	1405.0	0.64	1293.0	315.0	0.111
380	1438.0	1370.0	0.45	151.0	151.0	0.057
390	1400.0	1359.0	0.53	77.0	77.0	0.058
400	1805.0	1346.0	0.91	504.4	303.0	0.079
410	1881.2	1348.0	0.45	1184.9	315.0	0.094
420	2232.5	1342.0	0.80	1113.1	315.0	0.099
430	1352.0	1324.0	0.98	29.0	29.0	0.050

TABLE 11

Existing Hydrologic Sub-Basin Characteristics
2-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time Of Concentration (Hours)
100	0.088	0.45	315.0	0.088	1.575	0.429
110	0.115	0.72	42.0	0.054	1.029	0.992
120	0.086	0.45	27.0	0.056	0.879	0.846
130	0.027	0.23	315.0	0.163	0.387	0.387
140	0.134	0.68	315.0	0.074	0.454	0.450
150	0.121	0.62	39.0	0.054	0.921	0.883
160	0.144	0.91	24.0	0.053	1.500	1.479
170	0.187	0.61	315.0	0.138	0.650	0.629
180	0.095	0.68	315.0	0.100	0.592	0.563
190	0.208	0.91	315.0	0.115	0.712	0.704
200	0.048	0.38	315.0	0.093	0.350	0.363
210	0.080	0.61	185.0	0.043	0.292	0.317
215	0.028	0.51	51.0	0.063	0.771	0.738
220	0.024	0.27	219.2	0.064	0.287	0.308
230	0.206	0.72	104.0	0.051	0.637	0.600
240	0.057	0.38	34.0	0.059	0.712	0.679
250	0.078	0.45	315.0	0.112	0.442	0.442
260	0.147	0.64	103.0	0.053	0.625	0.587
270	0.147	0.72	36.0	0.053	1.033	1.000
280	0.115	0.49	24.0	0.054	0.962	0.929
290	0.092	0.38	315.0	0.111	0.417	0.417
300	0.052	0.38	153.0	0.059	0.408	0.404
310	0.249	0.95	315.0	0.104	0.721	0.704
320	0.170	0.68	315.0	0.087	0.458	0.454
330	0.123	0.49	264.4	0.067	0.292	0.308
340	0.069	0.34	315.0	0.132	0.379	0.387

TABLE 11

Existing Hydrologic Sub-Basin Characteristics
2-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time Of Concentration (Hours)
350	0.076	0.38	315.0	0.093	0.304	0.321
360	0.255	0.87	297.2	0.054	0.496	0.471
370	0.142	0.64	315.0	0.111	0.512	0.504
380	0.068	0.45	151.0	0.057	0.442	0.429
390	0.066	0.53	77.0	0.058	0.654	0.617
400	0.145	0.91	303.0	0.079	0.592	0.567
410	0.075	0.45	315.0	0.094	0.387	0.392
420	0.123	0.80	315.0	0.099	0.608	0.592
430	0.237	0.98	29.0	0.050	1.421	1.362

TABLE 12

Existing Hydrologic Sub-Basin Characteristics
10-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time Of Concentration (Hours)
100	0.088	0.45	315.0	0.088	0.246	0.279
110	0.115	0.72	42.0	0.054	0.600	0.646
120	0.086	0.45	27.0	0.056	0.521	0.558
130	0.027	0.23	315.0	0.163	0.237	0.262
140	0.134	0.68	315.0	0.074	0.279	0.313
150	0.121	0.62	39.0	0.054	0.542	0.583
160	0.144	0.91	24.0	0.053	0.908	0.979
170	0.187	0.61	315.0	0.138	0.412	0.442
180	0.095	0.68	315.0	0.100	0.358	0.392
190	0.208	0.91	315.0	0.115	0.467	0.496
200	0.048	0.38	315.0	0.093	0.229	0.250
210	0.080	0.61	185.0	0.043	0.221	0.242
215	0.028	0.51	51.0	0.063	0.458	0.492
220	0.024	0.27	219.2	0.064	0.183	0.200
230	0.206	0.72	104.0	0.051	0.371	0.408
240	0.057	0.38	34.0	0.059	0.425	0.458
250	0.078	0.45	315.0	0.112	0.279	0.313
260	0.147	0.64	103.0	0.053	0.354	0.392
270	0.147	0.72	36.0	0.053	0.617	0.663
280	0.115	0.49	24.0	0.054	0.571	0.613
290	0.092	0.38	315.0	0.111	0.254	0.283
300	0.052	0.38	153.0	0.059	0.233	0.258
310	0.249	0.95	315.0	0.104	0.458	0.488
320	0.170	0.68	315.0	0.087	0.300	0.333
330	0.123	0.49	264.4	0.067	0.221	0.237
340	0.069	0.34	315.0	0.132	0.254	0.279

TABLE 12

Existing Hydrologic Sub-Basin Characteristics
10-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time Of Concentration (Hours)
350	0.076	0.38	315.0	0.093	0.221	0.237
360	0.255	0.87	297.2	0.054	0.279	0.317
370	0.142	0.64	315.0	0.111	0.346	0.379
380	0.068	0.45	151.0	0.057	0.250	0.279
390	0.066	0.53	77.0	0.058	0.375	0.417
400	0.145	0.91	303.0	0.079	0.363	0.400
410	0.075	0.45	315.0	0.094	0.246	0.275
420	0.123	0.80	315.0	0.099	0.383	0.421
430	0.237	0.98	29.0	0.050	0.842	0.904

TABLE 13

Existing Hydrologic Sub-Basin Characteristics
50-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Time Of Concentration (Hours)
100	0.088	0.45	315.0	0.088	0.208	0.229
110	0.115	0.72	42.0	0.054	0.446	0.492
120	0.086	0.45	27.0	0.056	0.396	0.438
130	0.027	0.23	315.0	0.163	0.204	0.225
140	0.134	0.68	315.0	0.074	0.233	0.254
150	0.121	0.62	39.0	0.054	0.412	0.454
160	0.144	0.91	24.0	0.053	0.671	0.746
170	0.187	0.61	315.0	0.138	0.321	0.363
180	0.095	0.68	315.0	0.100	0.279	0.317
190	0.208	0.91	315.0	0.115	0.371	0.412
200	0.048	0.38	315.0	0.093	0.196	0.213
210	0.080	0.61	185.0	0.043	0.192	0.208
215	0.028	0.51	51.0	0.063	0.354	0.396
220	0.024	0.27	219.2	0.064	0.154	0.171
230	0.206	0.72	104.0	0.051	0.287	0.325
240	0.057	0.38	34.0	0.059	0.329	0.367
250	0.078	0.45	315.0	0.112	0.233	0.258
260	0.147	0.64	103.0	0.053	0.275	0.313
270	0.147	0.72	36.0	0.053	0.463	0.504
280	0.115	0.49	24.0	0.054	0.429	0.471
290	0.092	0.38	315.0	0.111	0.213	0.237
300	0.052	0.38	153.0	0.059	0.196	0.217
310	0.249	0.95	315.0	0.104	0.358	0.400
320	0.170	0.68	315.0	0.087	0.246	0.275
330	0.123	0.49	264.4	0.067	0.192	0.208
340	0.069	0.34	315.0	0.132	0.217	0.237

TABLE 13

Existing Hydrologic Sub-Basin Characteristics
50-Year Storm

Sub-Basin I.D.	Area (Sq. Mile)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mile)	Kb	6-Hr. Time Of Concentration (Hours)	24-Time Of Concentration (Hours)
350	0.076	0.38	315.0	0.093	0.192	0.208
360	0.255	0.87	297.2	0.054	0.229	0.254
370	0.142	0.64	315.0	0.111	0.279	0.313
380	0.068	0.45	151.0	0.057	0.208	0.229
390	0.066	0.53	77.0	0.058	0.292	0.333
400	0.145	0.91	303.0	0.079	0.287	0.325
410	0.075	0.45	315.0	0.094	0.213	0.233
420	0.123	0.80	315.0	0.099	0.304	0.342
430	0.237	0.98	29.0	0.050	0.608	0.688

TABLE 14

Existing Hydrologic Sub-Basin Characteristics
100-Year Storm

Sub-Basin I.D.	Area (Sq. Mi.)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mi.)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time of Concentration (Hours)
100	0.088	0.45	315.0	0.088	0.196	0.217
110	0.115	0.72	42.0	0.054	0.412	0.458
120	0.086	0.45	27.0	0.056	0.367	0.408
130	0.027	0.23	315.0	0.163	0.192	0.213
140	0.134	0.68	315.0	0.074	0.221	0.242
150	0.121	0.62	39.0	0.054	0.379	0.425
160	0.144	0.91	24.0	0.053	0.608	0.683
170	0.187	0.61	315.0	0.138	0.300	0.338
180	0.095	0.68	315.0	0.100	0.258	0.296
190	0.208	0.91	315.0	0.115	0.342	0.383
200	0.048	0.38	315.0	0.093	0.183	0.204
210	0.080	0.61	185.0	0.043	0.183	0.200
215	0.028	0.51	51.0	0.063	0.329	0.371
220	0.024	0.27	219.2	0.064	0.146	0.162
230	0.206	0.72	104.0	0.051	0.267	0.304
240	0.057	0.38	34.0	0.059	0.304	0.346
250	0.078	0.45	315.0	0.112	0.221	0.242
260	0.147	0.64	103.0	0.053	0.258	0.292
270	0.147	0.72	36.0	0.053	0.429	0.471
280	0.115	0.49	24.0	0.054	0.396	0.442
290	0.092	0.38	315.0	0.111	0.204	0.225
300	0.052	0.38	153.0	0.059	0.183	0.204
310	0.249	0.95	315.0	0.104	0.333	0.375
320	0.170	0.68	315.0	0.087	0.237	0.258
330	0.123	0.49	264.4	0.067	0.183	0.200
340	0.069	0.34	315.0	0.132	0.208	0.229

TABLE 14

Existing Hydrologic Sub-Basin Characteristics
100-Year Storm

Sub-Basin I.D.	Area (Sq. Mi.)	Flow Path Length (Miles)	Adjusted Slope (Ft./Mi.)	Kb	6-Hr. Time Of Concentration (Hours)	24-Hr. Time of Concentration (Hours)
350	0.076	0.38	315.0	0.093	0.183	0.200
360	0.255	0.87	297.2	0.054	0.217	0.242
370	0.142	0.64	315.0	0.111	0.262	0.296
380	0.068	0.45	151.0	0.057	0.200	0.221
390	0.066	0.53	77.0	0.058	0.271	0.308
400	0.145	0.91	303.0	0.079	0.271	0.304
410	0.075	0.45	315.0	0.094	0.200	0.221
420	0.123	0.80	315.0	0.099	0.283	0.321
430	0.237	0.98	29.0	0.050	0.563	0.629

TABLE 15

Summary Of Sub-Basin Peak Discharges (CFS)
(Existing Conditions)

Sub-Basin	2-Year		10-Year		50-Year		100-Year	
	6-Hr.	24-Hr.	6-Hr.	24-Hr.	6-Hr.	24-Hr.	6-Hr.	24-Hr.
100	4	8	43	46	88	92	108	112
110	5	5	34	35	80	80	102	100
120	5	5	34	35	73	74	91	91
130	5	4	16	16	29	29	35	35
140	20	18	74	76	140	145	169	174
150	7	6	45	47	98	99	123	122
160	5	4	33	31	79	72	103	92
170	33	31	101	103	194	194	234	234
180	11	10	40	42	85	86	105	105
190	37	32	105	104	198	194	241	235
200	9	8	28	29	52	54	62	64
210	23	22	60	59	96	97	112	113
215	1	1	9	9	19	18	23	22
220	2	2	11	12	23	25	29	30
230	15	14	98	104	203	209	249	254
240	4	4	25	26	52	53	64	64
250	15	14	46	47	84	85	101	102
260	10	9	65	69	139	143	171	175
270	8	7	52	52	114	114	142	140
280	7	6	44	46	97	98	121	121
290	16	15	54	55	100	103	120	123
300	4	4	23	25	49	52	61	63
310	43	38	126	126	241	238	293	288
320	33	34	118	120	203	207	238	244
330	45	46	110	113	169	174	195	200
340	17	16	51	51	85	86	99	101

TABLE 15

Summary Of Sub-Basin Peak Discharges (CFS)
(Existing Conditions)

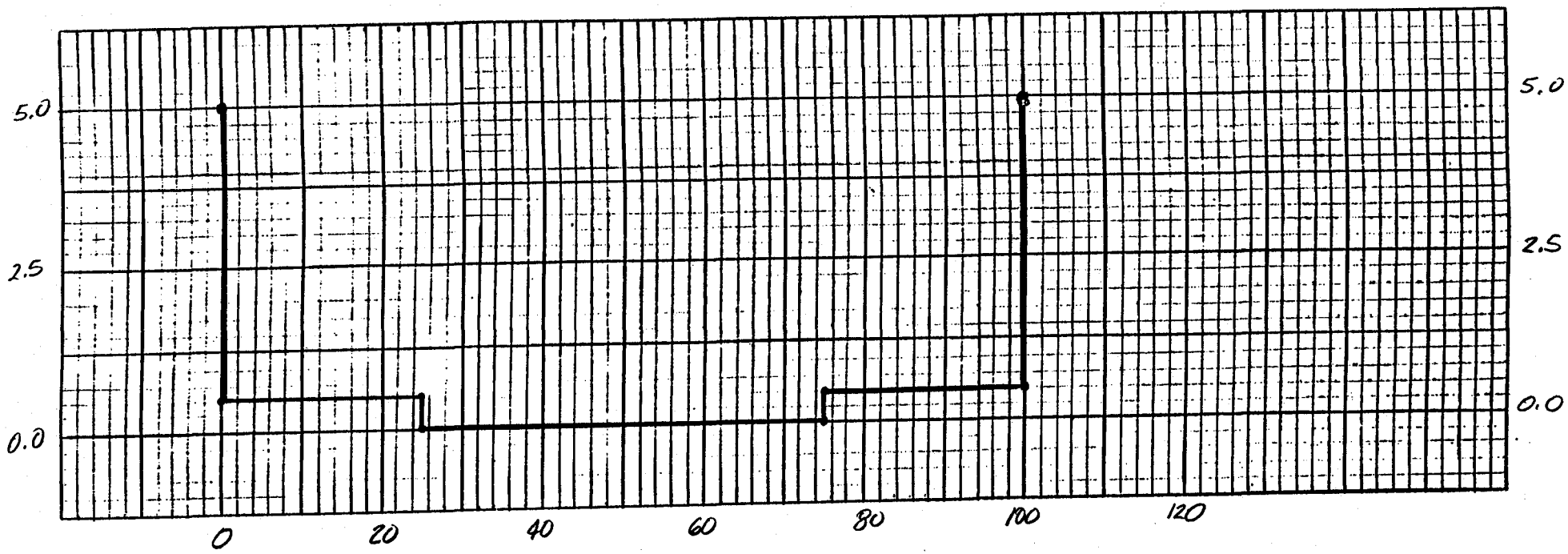
Sub-Basin	2-Year		10-Year		50-Year		100-Year	
	6-Hr.	24-Hr.	6-Hr.	24-Hr.	6-Hr.	24-Hr.	6-Hr.	24-Hr.
350	23	22	61	62	98	100	114	117
360	25	24	122	129	251	263	308	319
370	31	29	93	93	162	161	192	191
380	6	5	31	33	65	68	80	83
390	4	4	25	27	56	57	70	70
400	16	15	69	71	137	137	167	167
410	13	12	47	48	84	87	101	103
420	16	14	59	60	116	115	141	140
430	10	9	66	63	155	145	196	184

SECTION IV

Hydrograph Routing Parameters

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R101



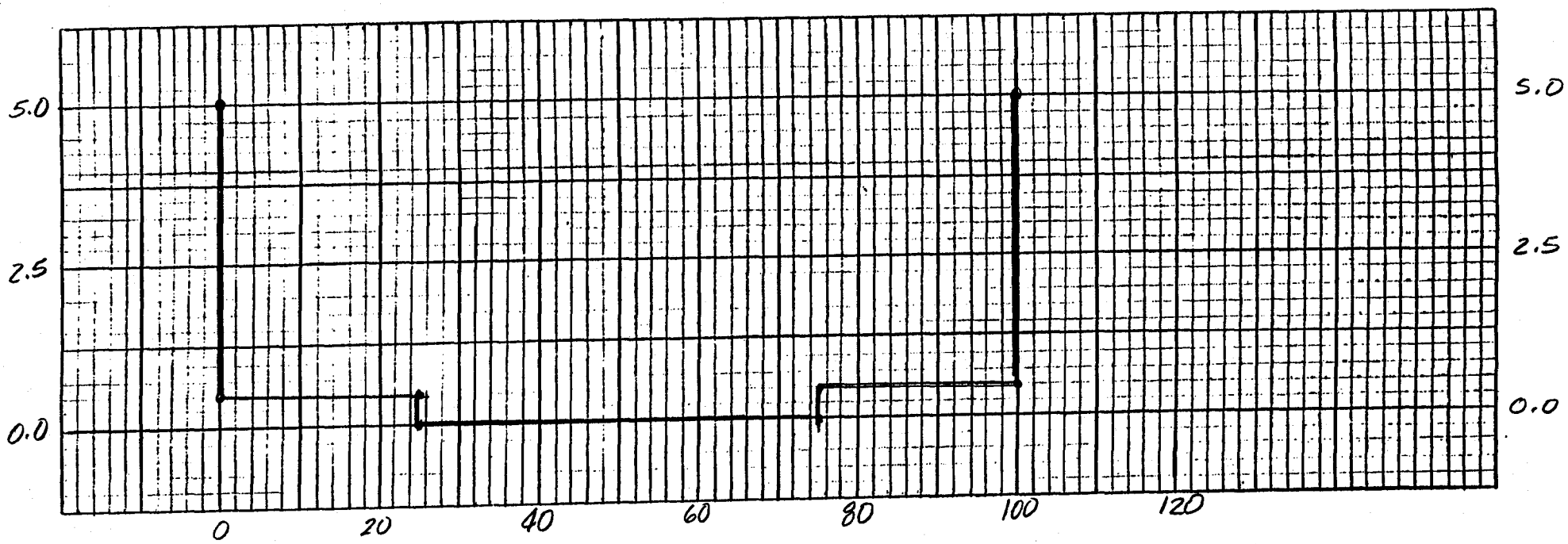
RS	*	FLOW	-1					
RC	0.100	0.025	0.100	2800	0.0086			
RX	0.0	0.0	25	25	75	75	100	100
RY	5.0	0.5	0.5	0.0	0.0	0.5	0.5	5.0

CALCULATED BY: D. Bradley

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R116



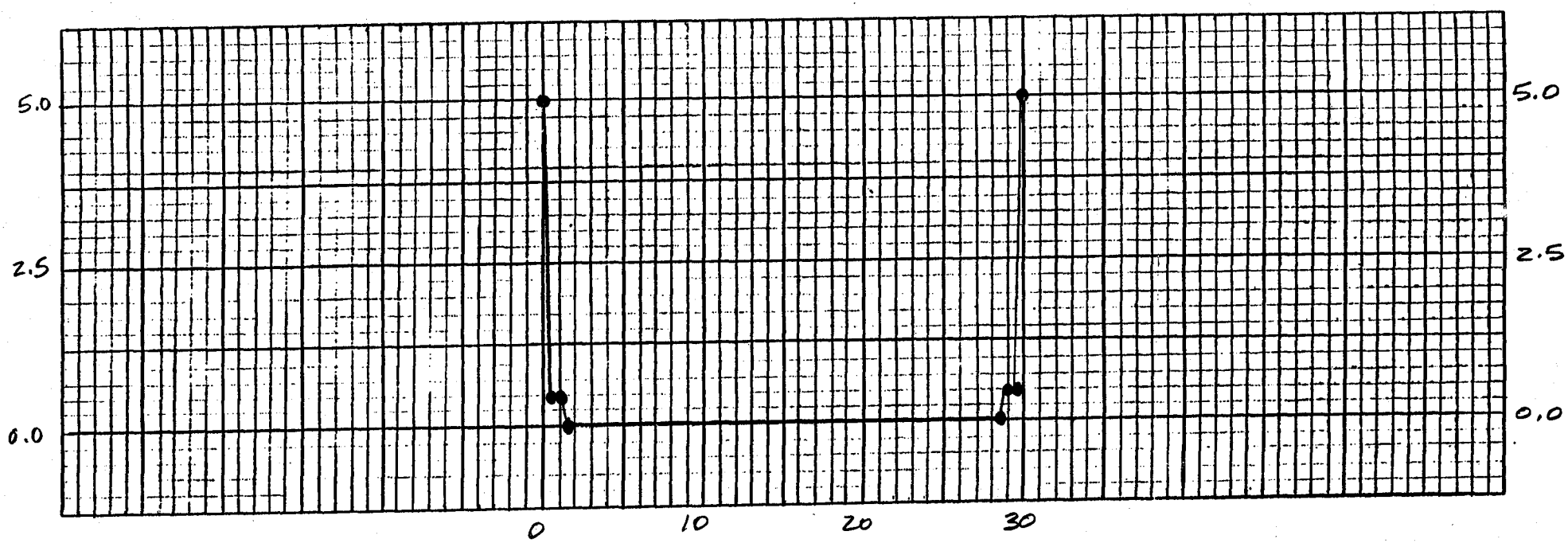
RS	*	FLOW	-1					
RC	0.100	0.025	0.100	2200	0.0055			
RX	0.0	0.0	25	25	75	75	100	100
RY	5.0	0.5	0.5	0.0	0.0	0.5	0.5	5.0

CALCULATED BY: D. Bradley

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R131



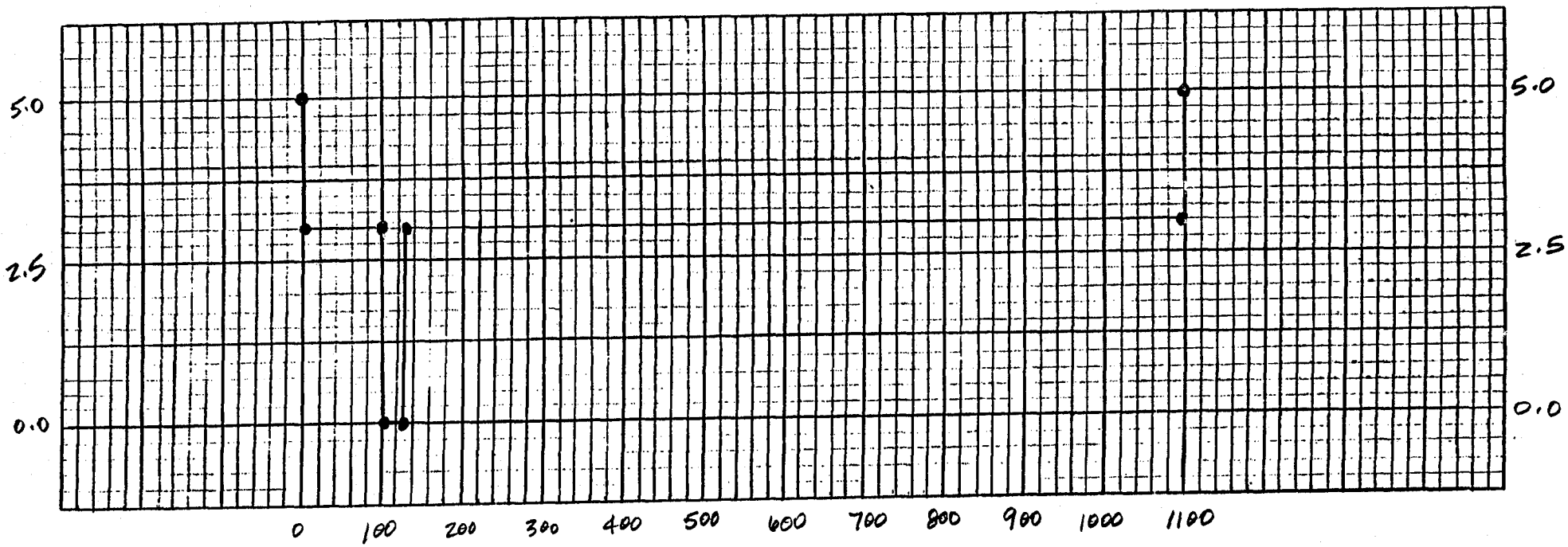
RS	*	FLOW	-1					
RC	0.015	0.015	0.015	1800	0.0156			
RX	0.0	0.5	1.0	1.5	28.5	29.0	29.5	30.0
RY	5.0	0.5	0.5	0.0	0.0	0.5	0.5	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R146



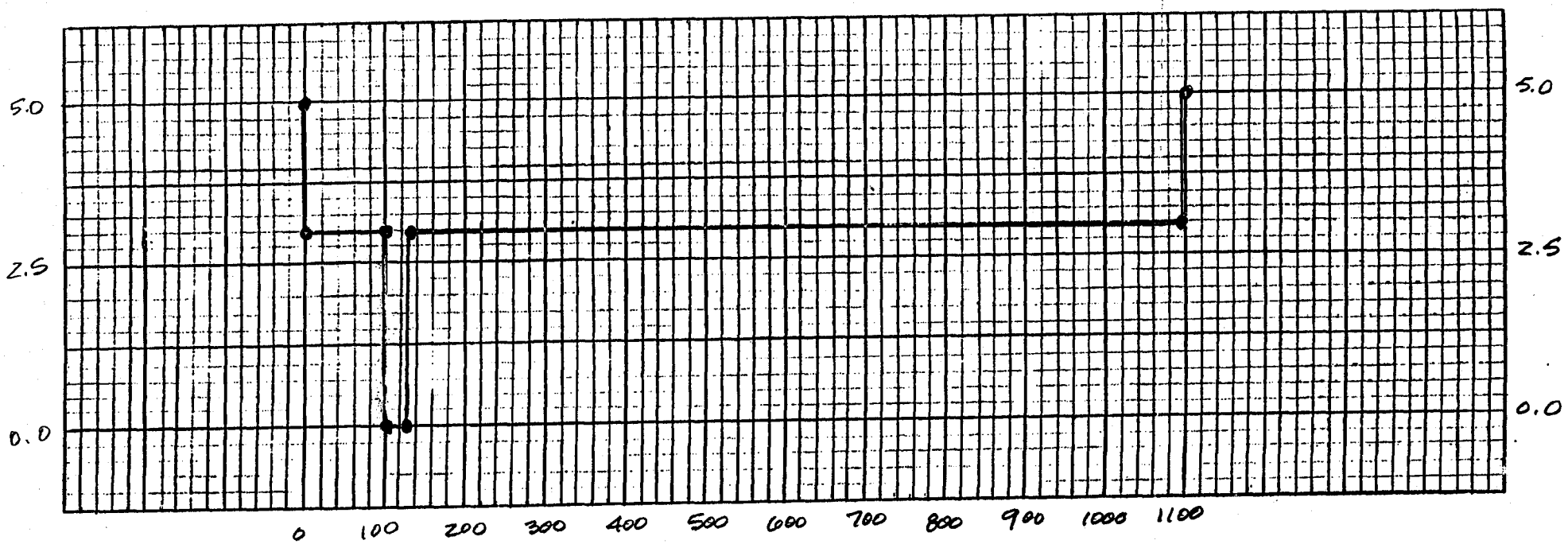
RS	*	FLOW	-1					
RC	0.100	0.035	0.100	1355	0.0081			
RX	0.0	0.5	100.0	100.5	129.5	130.0	1099.5	1100.0
RY	5.0	3.0	3.0	0.0	0.0	3.0	3.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R156



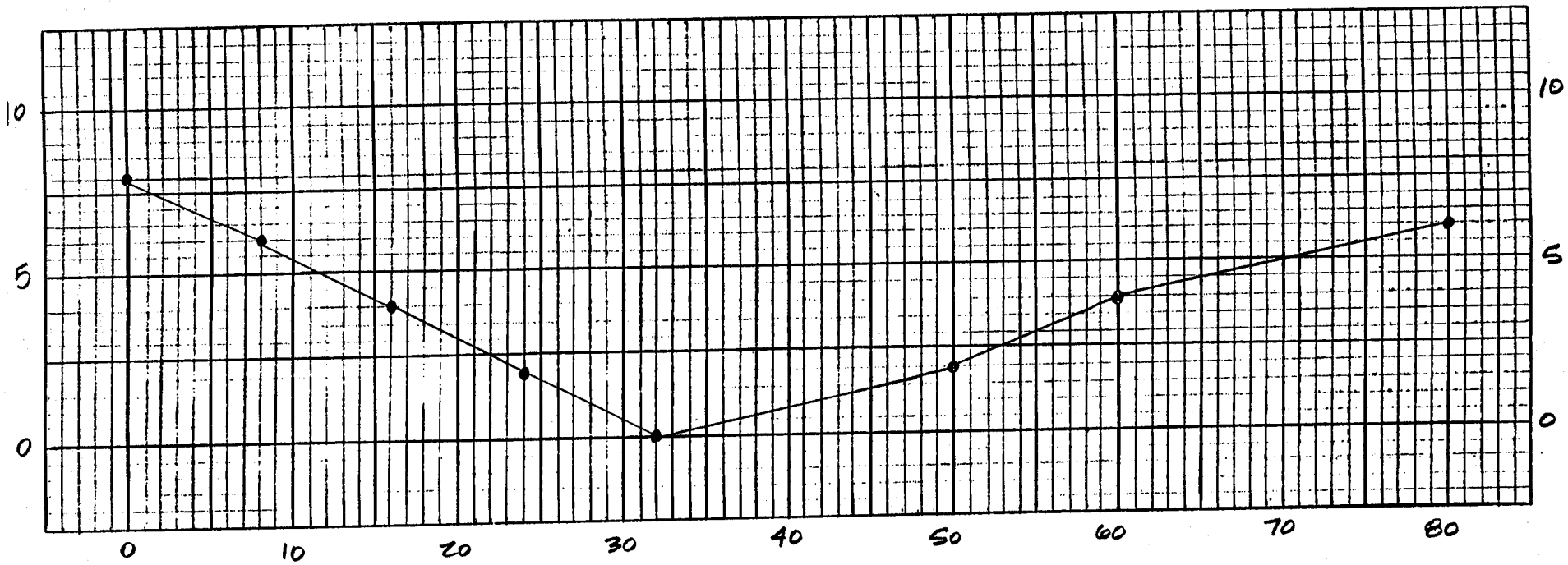
RS	*	FLOW	-1					
RC	0.100	0.035	0.100	4600	0.0046			
RX	0.0	0.5	100.0	100.5	129.5	130.0	1099.5	1100.0
RY	5.0	3.0	3.0	0.0	0.0	3.0	3.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R171



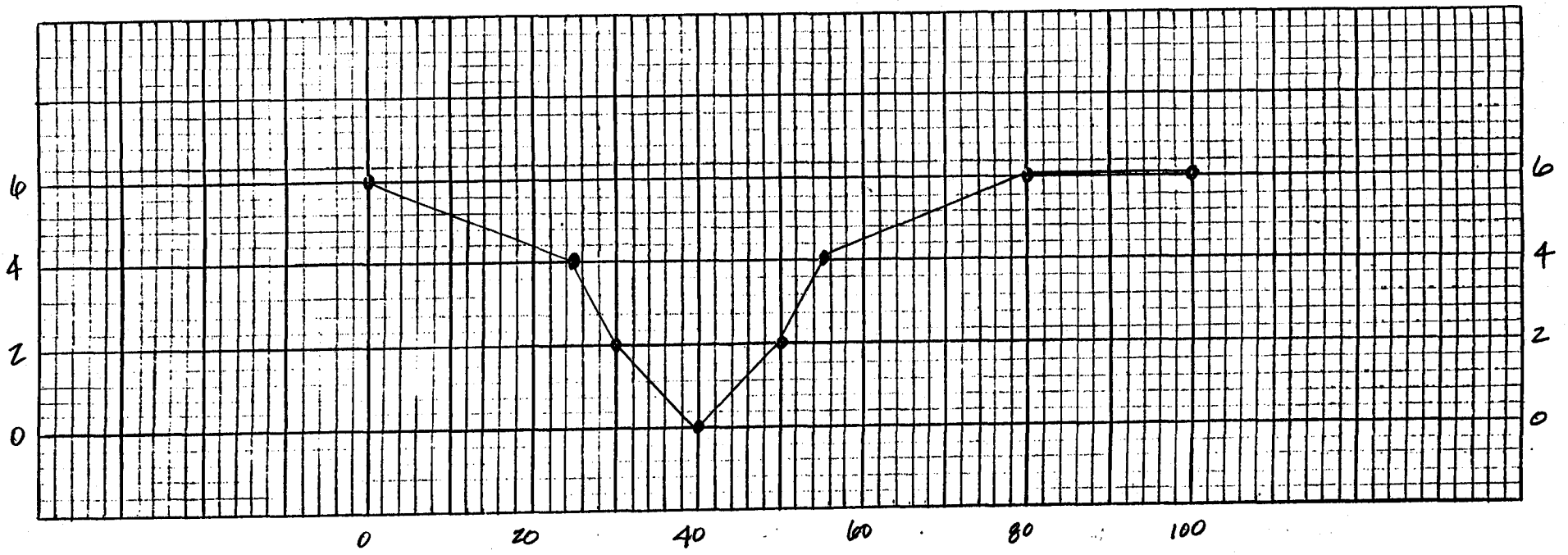
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1200	0.0250			
RX	0.0	8.0	16.0	24.0	32.0	50.0	60.0	80.0
RY	8.0	6.0	4.0	2.0	0.0	2.0	4.0	6.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R191



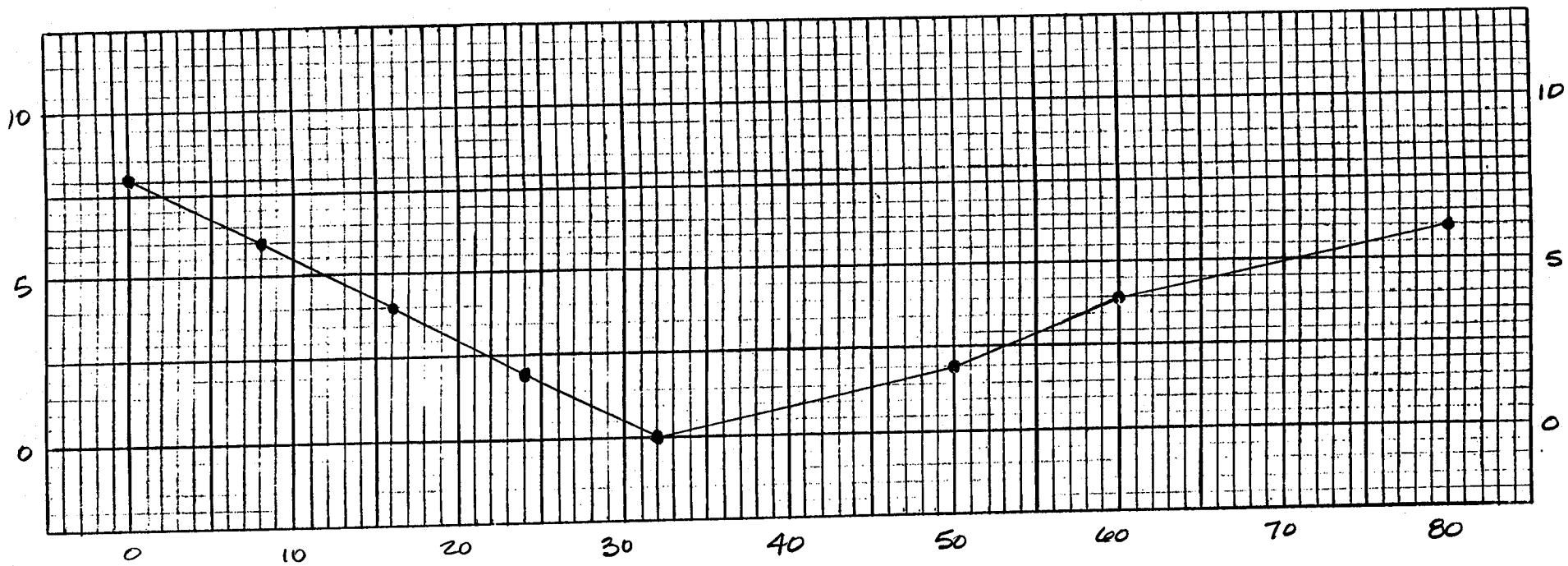
RS	*	FLOW	-1					
RC	0.035	0.035	0.035	1200	0.0400			
RX	0.0	25.0	30.0	40.0	50.0	55.0	80.0	100.0
RY	6.0	4.0	2.0	0.0	2.0	4.0	6.0	6.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R196



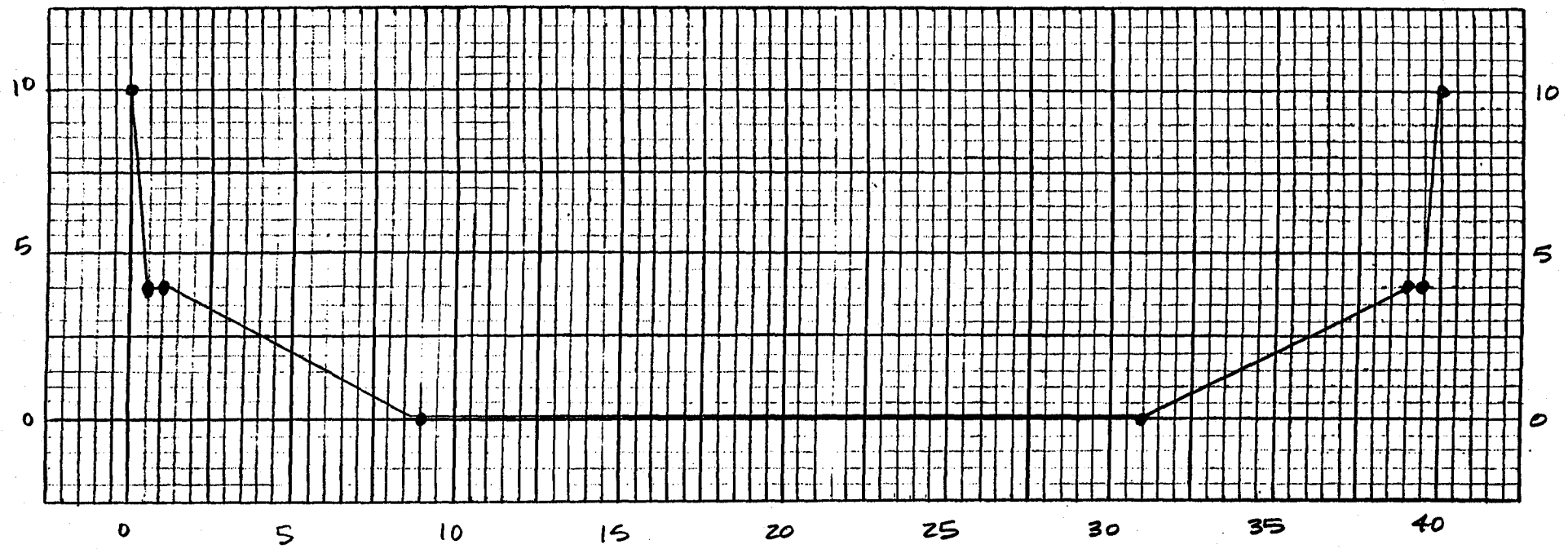
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	200	0.0500			
RX	0.0	8.0	16.0	24.0	32.0	50.0	60.0	80.0
RY	8.0	6.0	4.0	2.0	0.0	2.0	4.0	6.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R206



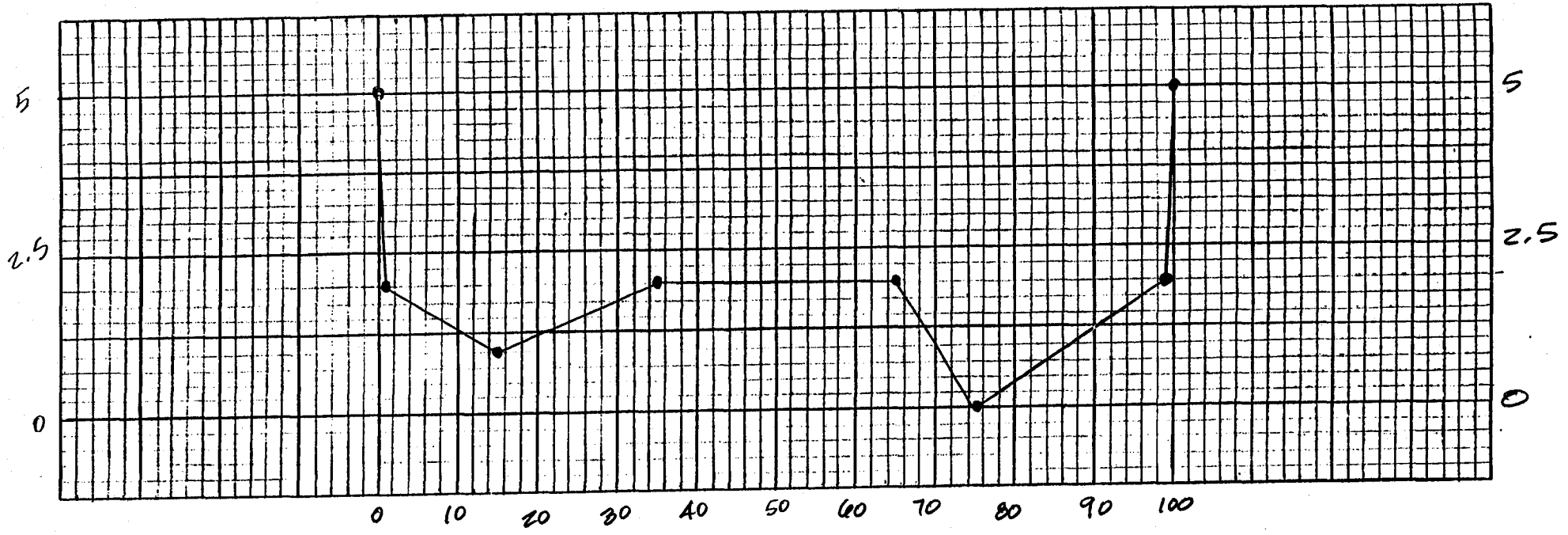
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1600	0.0125			
RX	0.0	0.5	1.0	9.0	31.0	39.0	39.5	40.0
RY	10.0	4.0	4.0	0.0	0.0	4.0	4.0	10.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R212



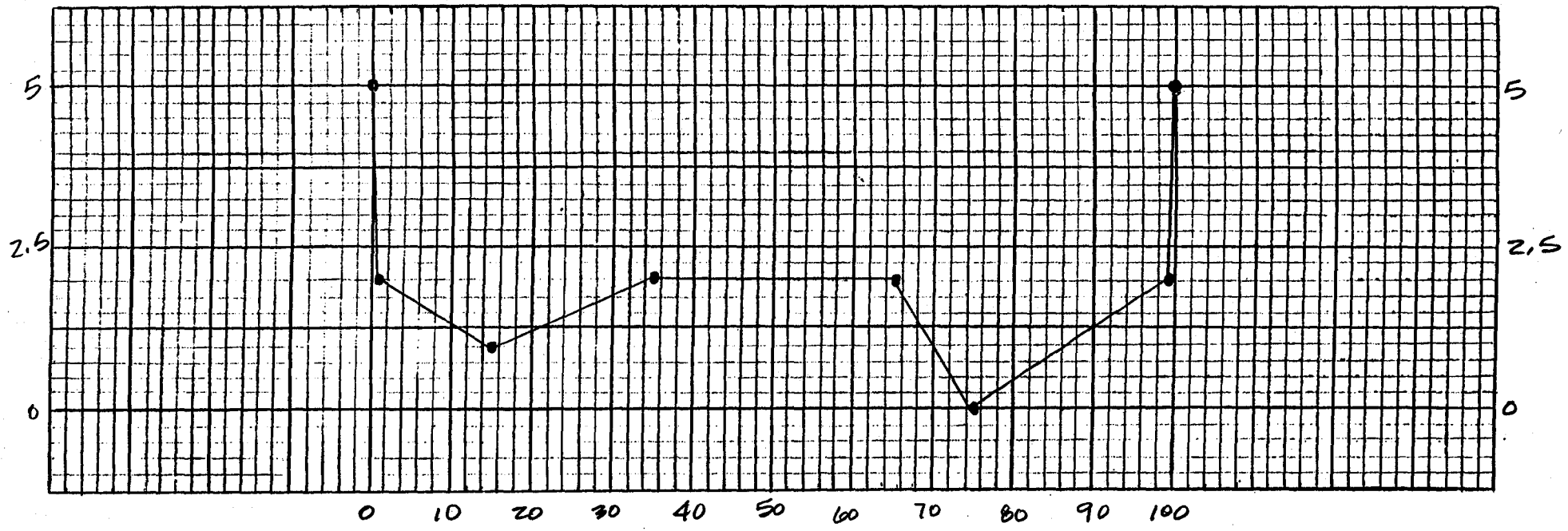
RS	*	FLOW	-1					
RC	0.015	0.015	0.015	2600	0.0092			
RX	0.0	0.5	15.0	35.0	65.0	75.0	99.5	100.0
RY	5.0	2.0	1.0	2.0	2.0	0.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R217



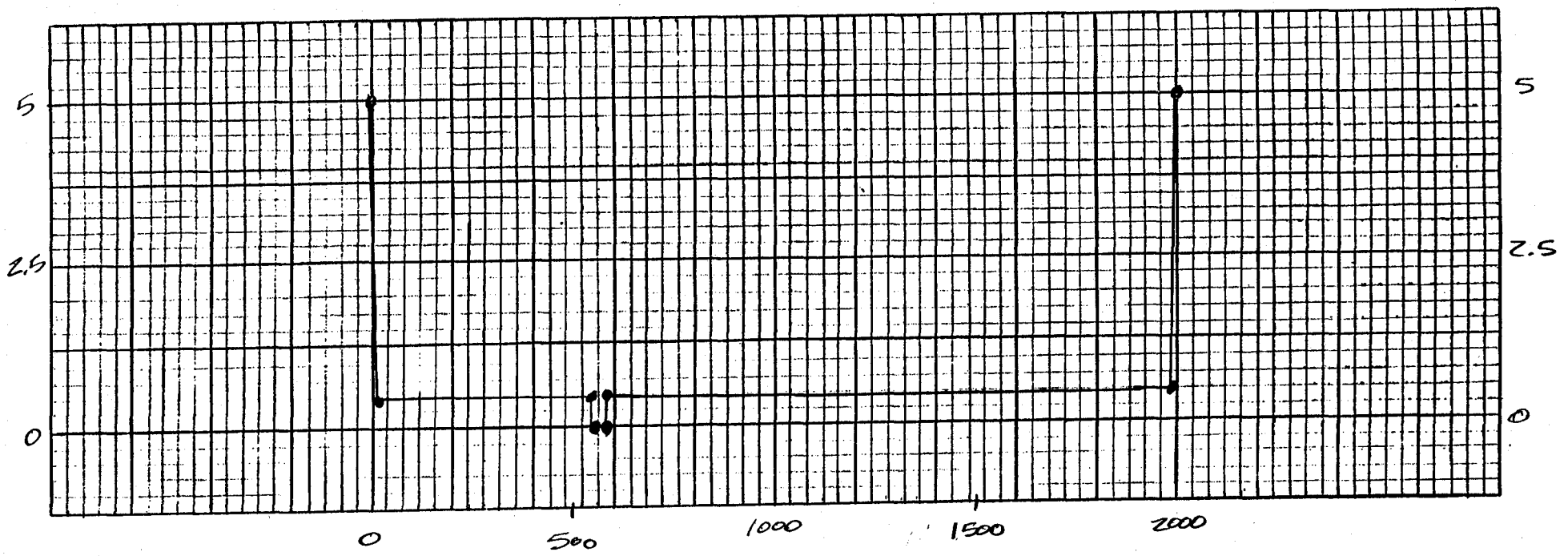
RS	*	FLOW	-1					
RC	0.015	0.015	0.015	2600	0.0077			
RX	0.0	0.5	15.0	35.0	65.0	75.0	99.5	100.0
RY	5.0	2.0	1.0	2.0	2.0	0.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R221



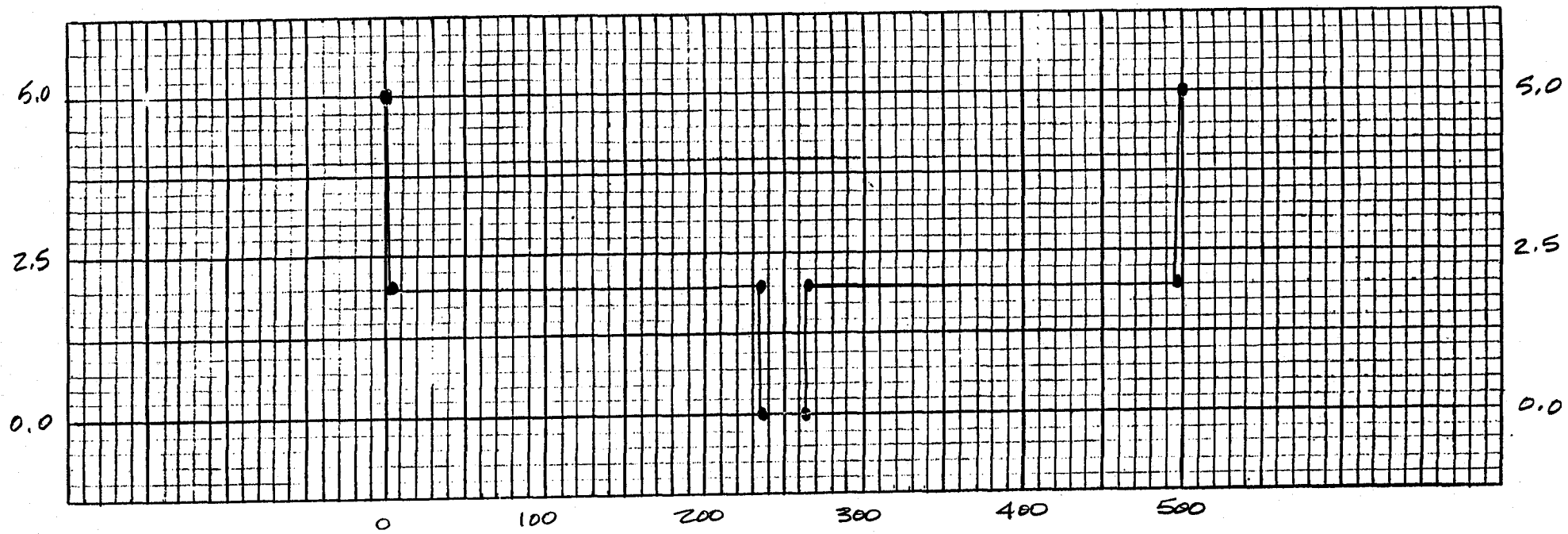
RS	*	FLOW	-1					
RC	0.100	0.015	0.100	3000	0.0183			
RX	0.0	0.5	550.0	550.5	579.5	580.0	1999.5	2000.0
RY	5.0	0.5	0.5	0.0	0.0	0.5	0.5	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R236



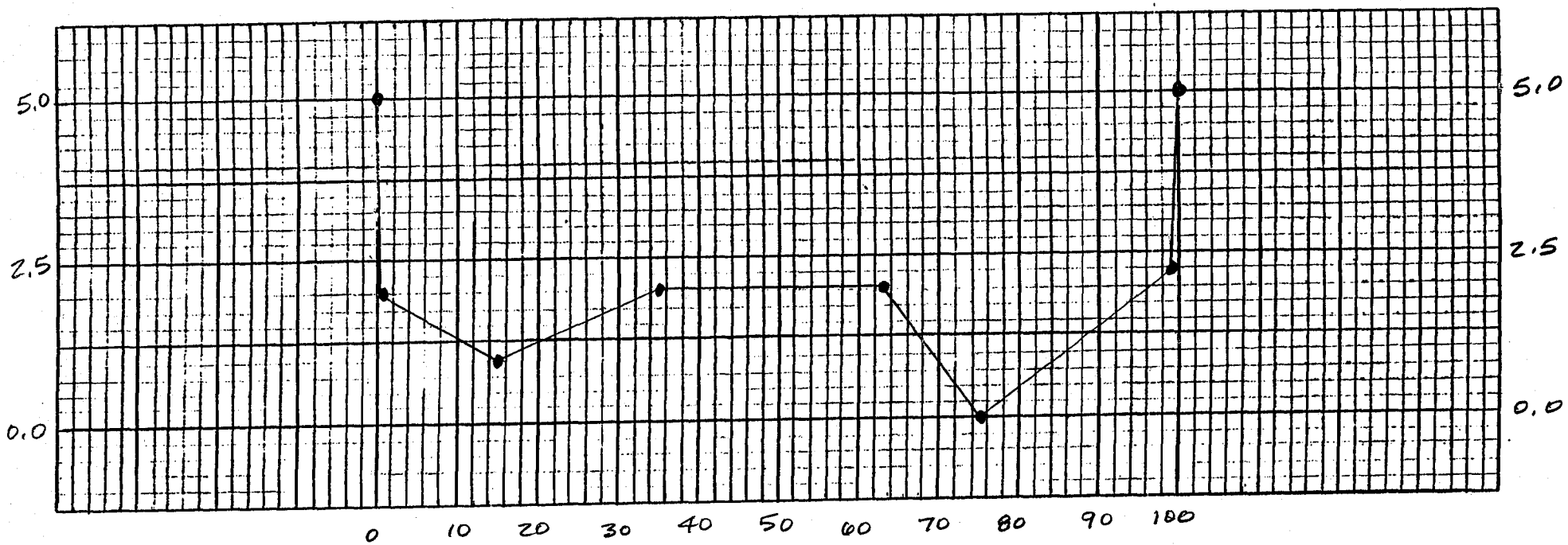
RS	*	FLOW	-1					
RC	0.100	0.030	0.100	1000	0.0070			
RX	0.0	0.5	235.0	235.5	264.5	265.0	499.5	500.0
RY	5.0	2.0	2.0	0.0	0.0	2.0	2.0	5.0

CALCULATED BY: L Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R-246



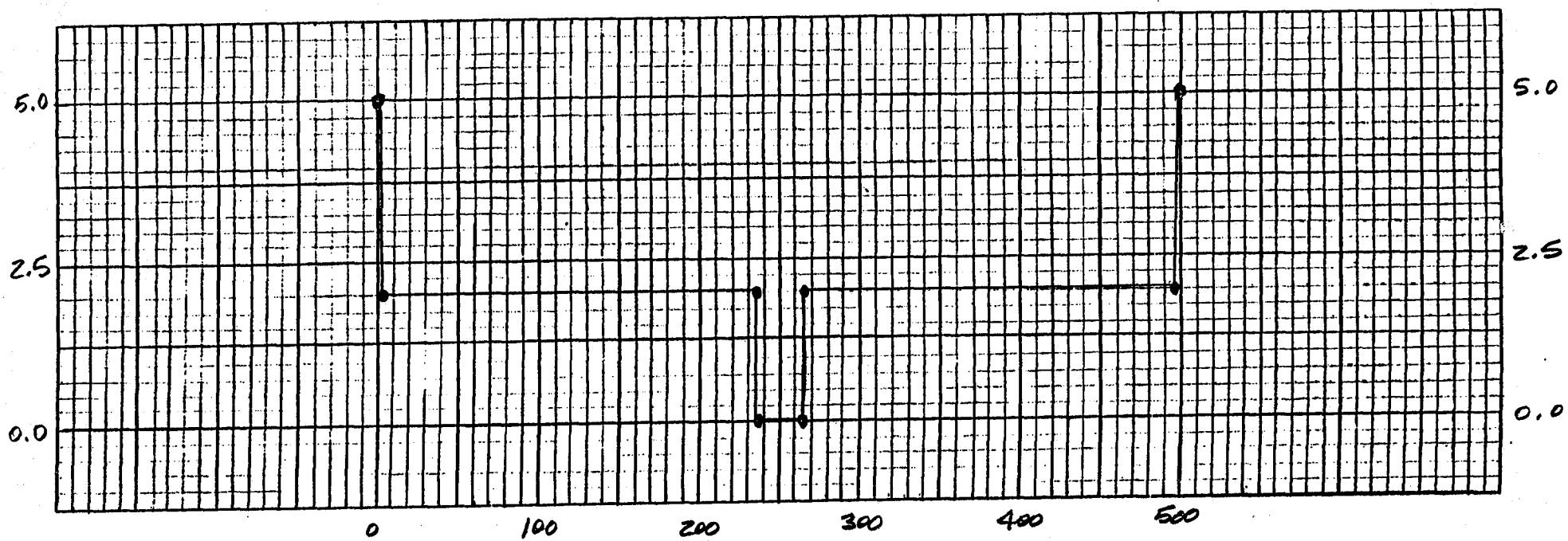
RS	*	FLOW	-1					
RC	0.015	0.015	0.015	1800	0.0056			
RX	0.0	0.5	15.0	35.0	65.0	75.0	99.5	100.0
RY	5.0	2.0	1.0	2.0	2.0	0.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R251



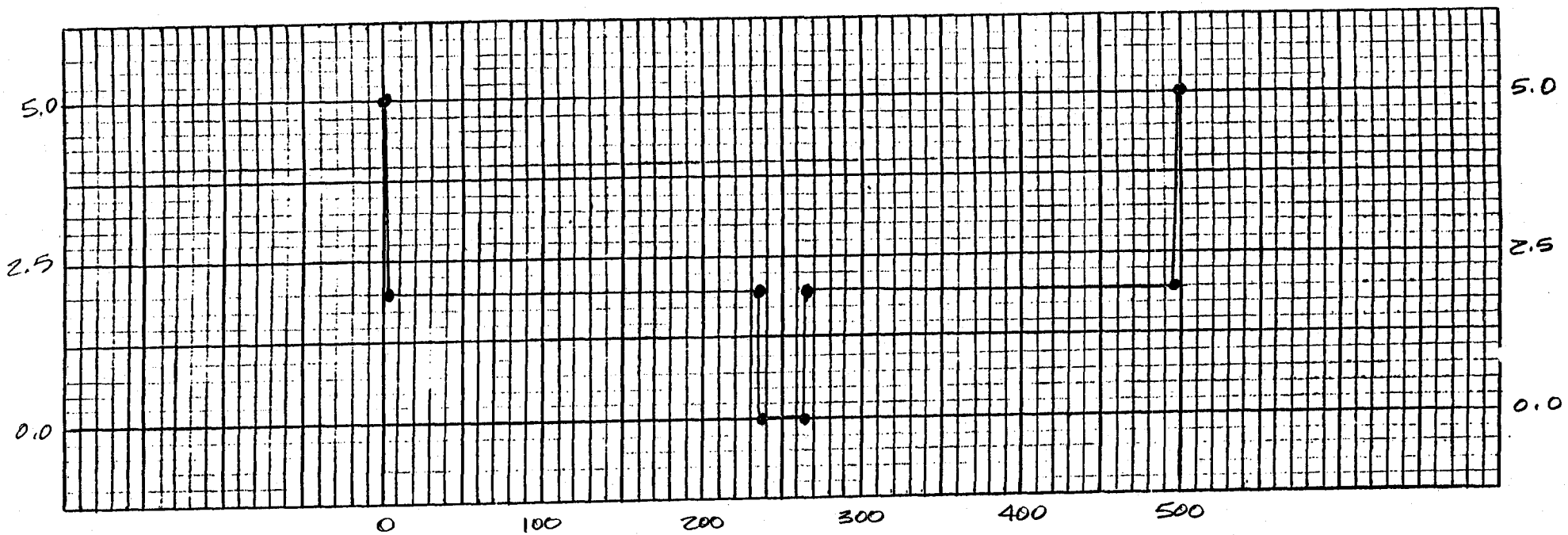
R S	*	FLOW	-1					
RC	0.100	0.030	0.100	3200	0.0164			
RX	0.0	0.5	235.0	235.5	264.5	265.0	499.5	500.0
RY	5.0	2.0	2.0	0.0	0.0	2.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R266



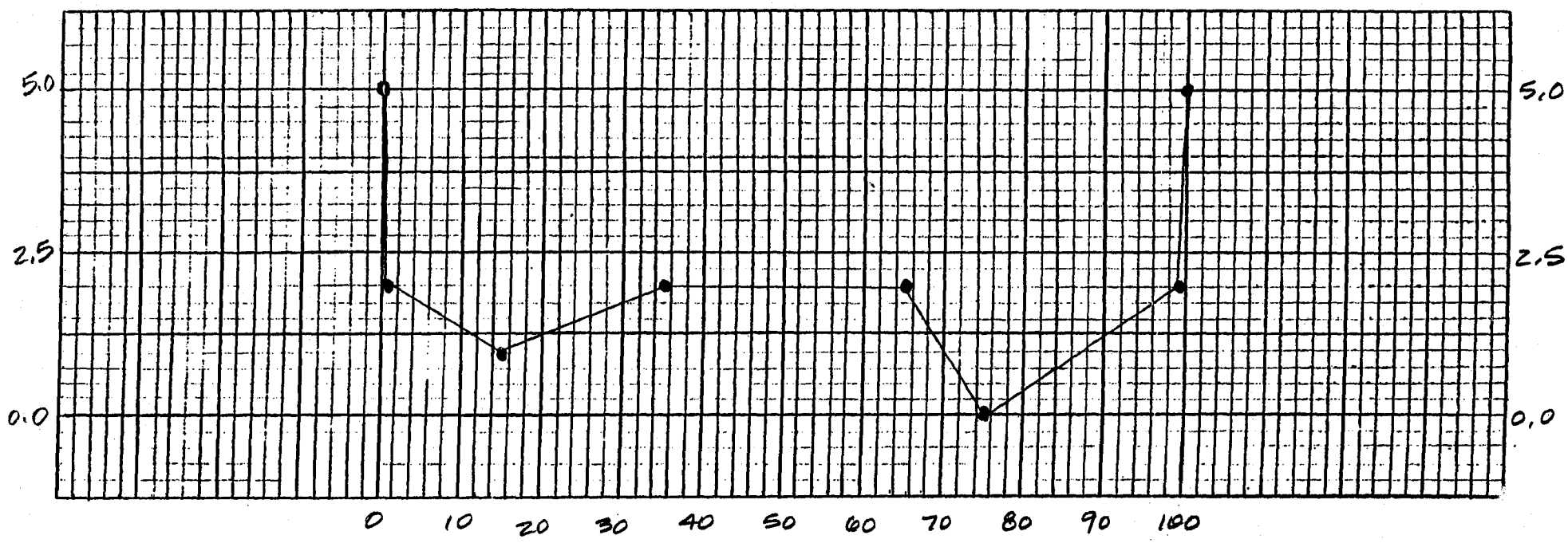
RS	*	FLOW	-1					
RC	0.100	0.030	0.100	1400	0.0086			
RX	0.0	0.5	235.0	235.5	264.5	265.0	499.5	500.0
RY	5.0	2.0	2.0	0.0	0.0	2.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R276



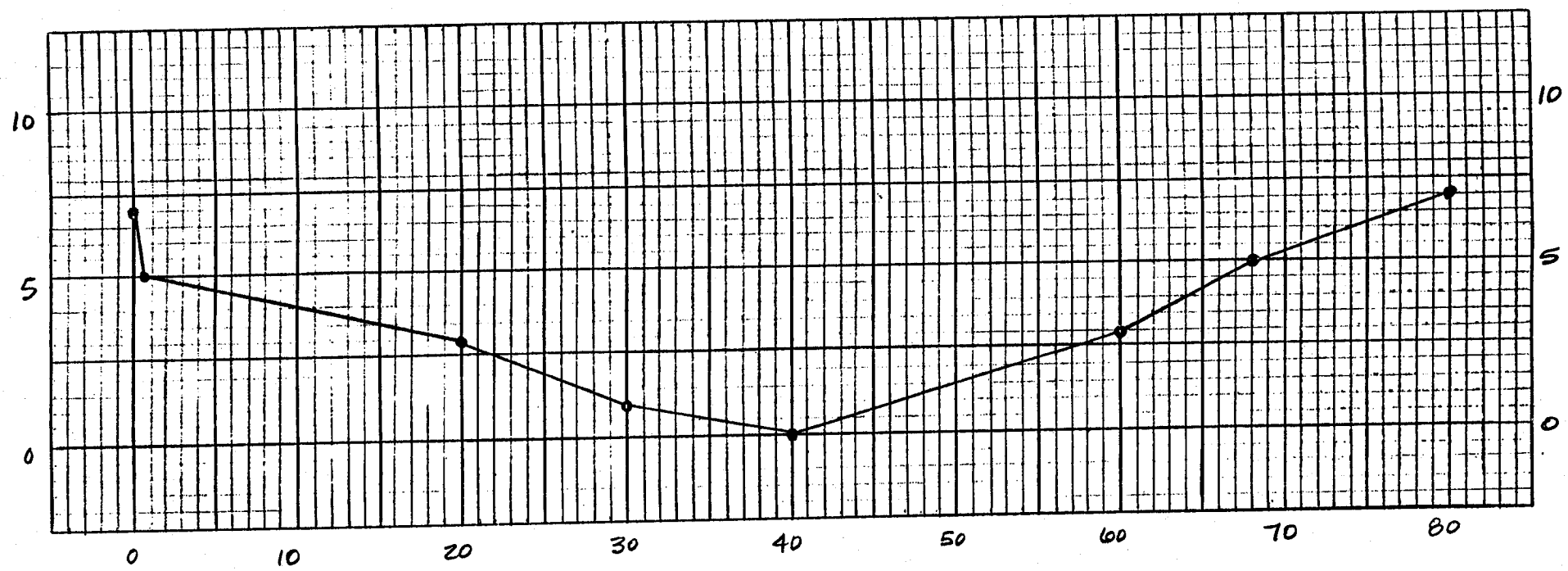
RS	*	FLOW	-1					
RC	0.015	0.015	0.015	1400	0.0029			
RX	0.0	0.5	15.0	35.0	65.0	75.0	99.5	100.0
RY	5.0	2.0	1.0	2.0	2.0	0.0	2.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R291



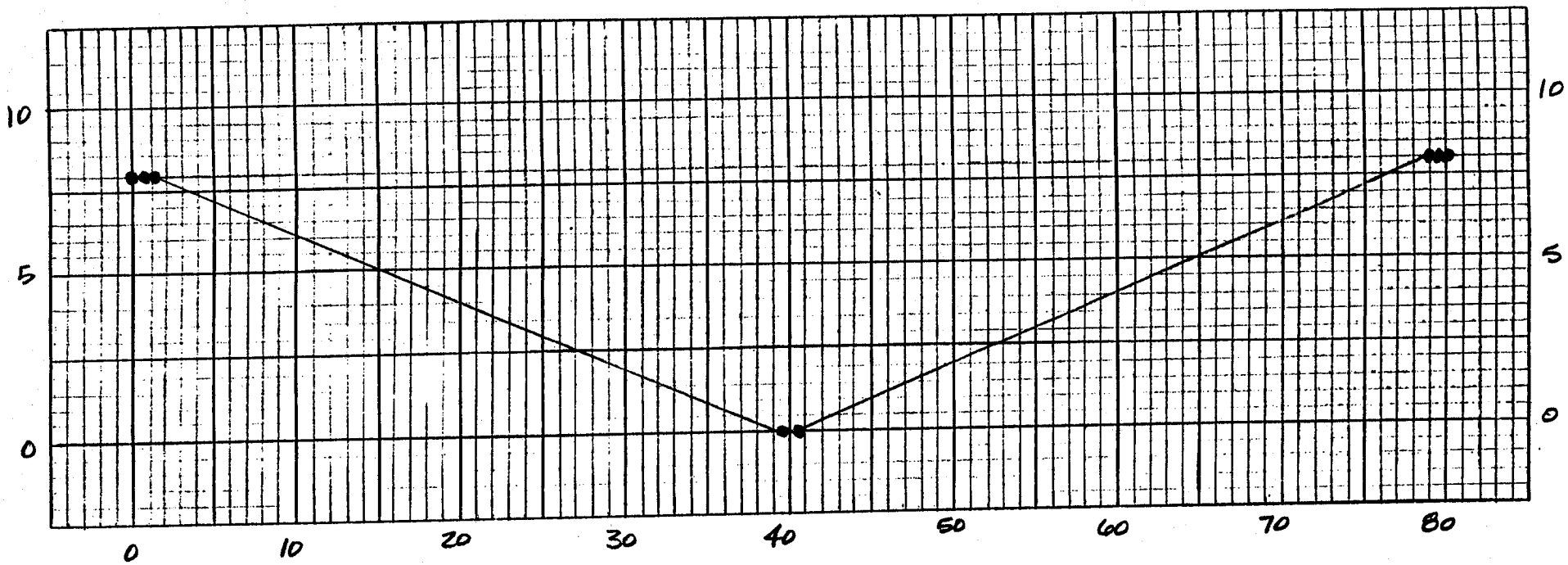
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1800	0.0268			
RX	0.0	0.5	20.0	30.0	40.0	60.0	68.0	80.0
RY	7.0	5.0	3.0	1.0	0.0	3.0	5.0	7.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R306



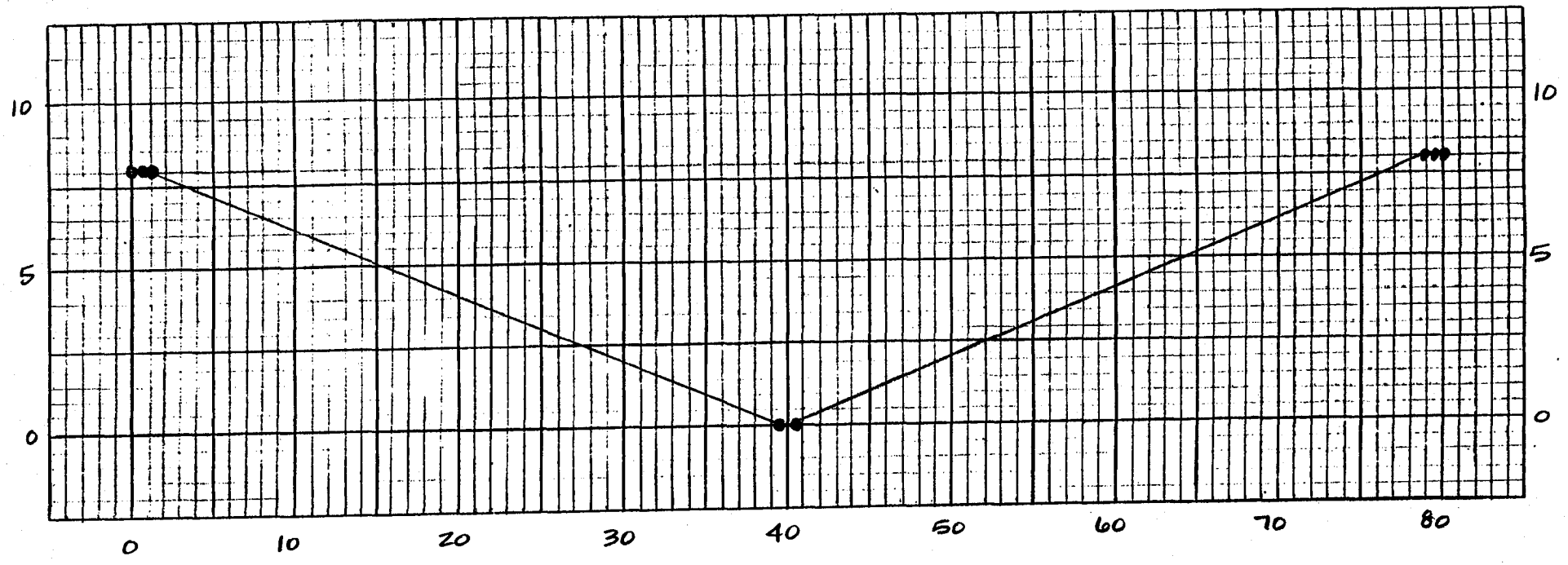
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	400	0.0250			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R311



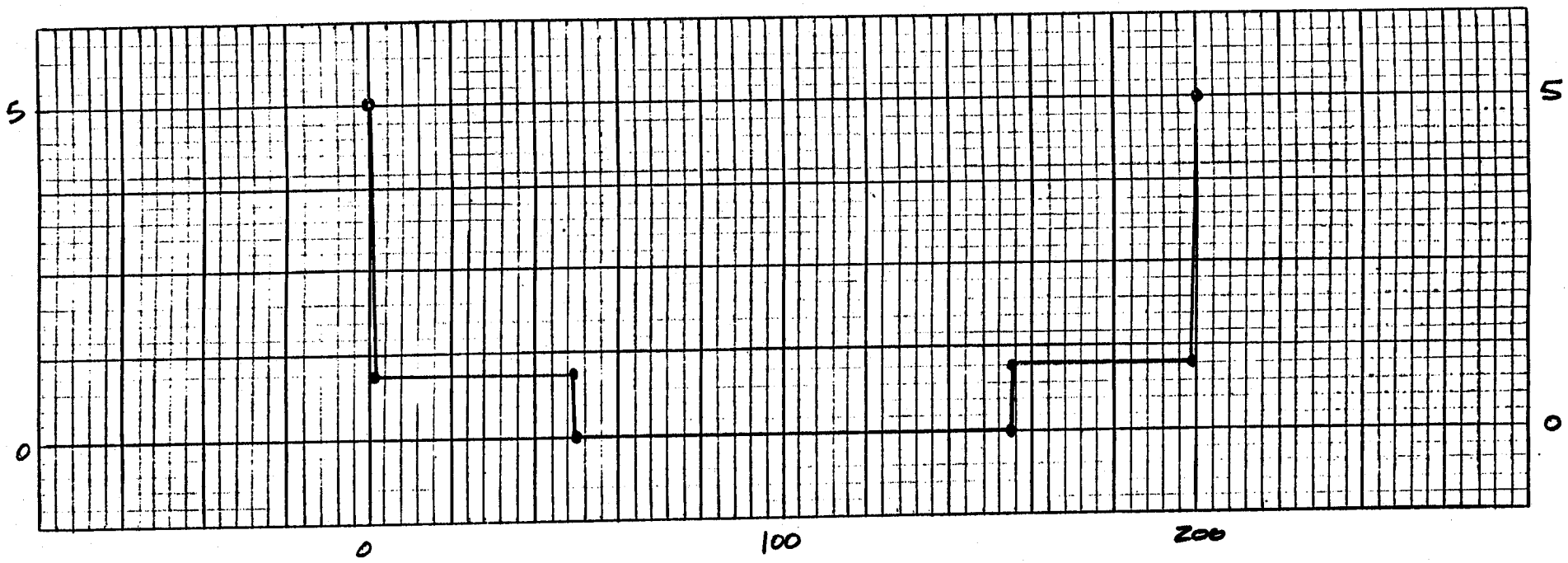
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	2800	0.0204			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R321



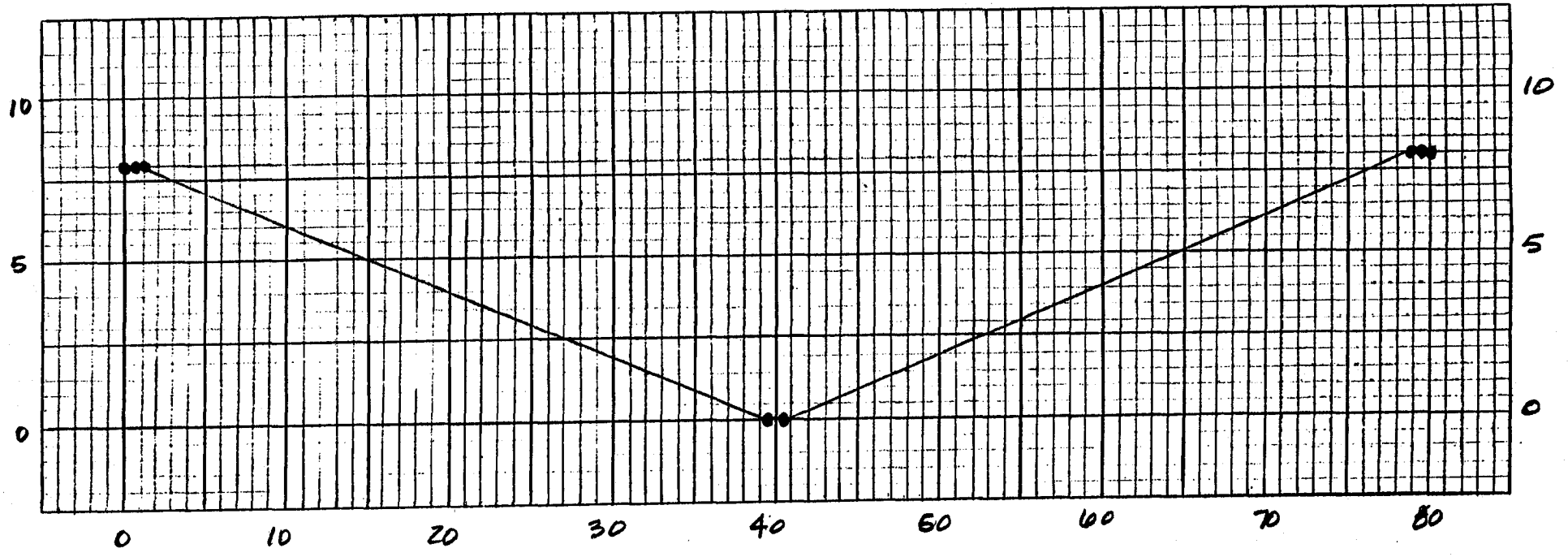
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1000	0.0100			
RX	0.0	0.5	49.5	50.0	155.0	155.5	199.5	200.0
RY	5.0	1.0	1.0	0.0	0.0	1.0	1.0	5.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R336



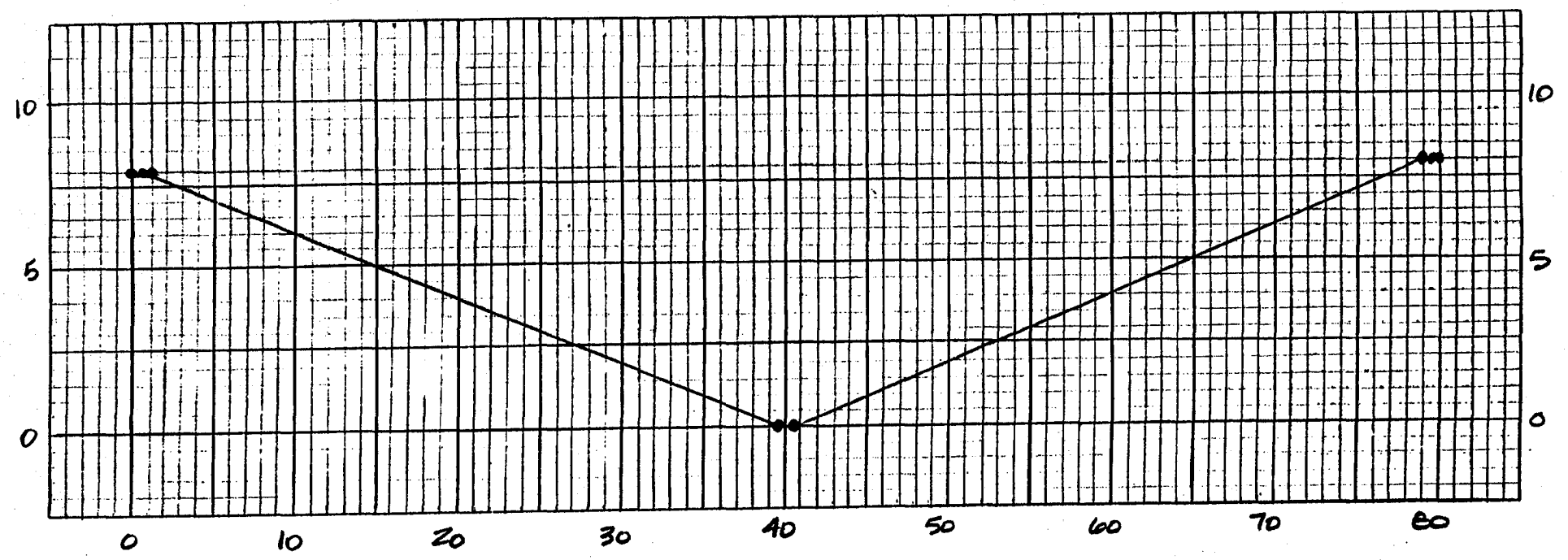
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	2400	0.0113			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* see NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R341



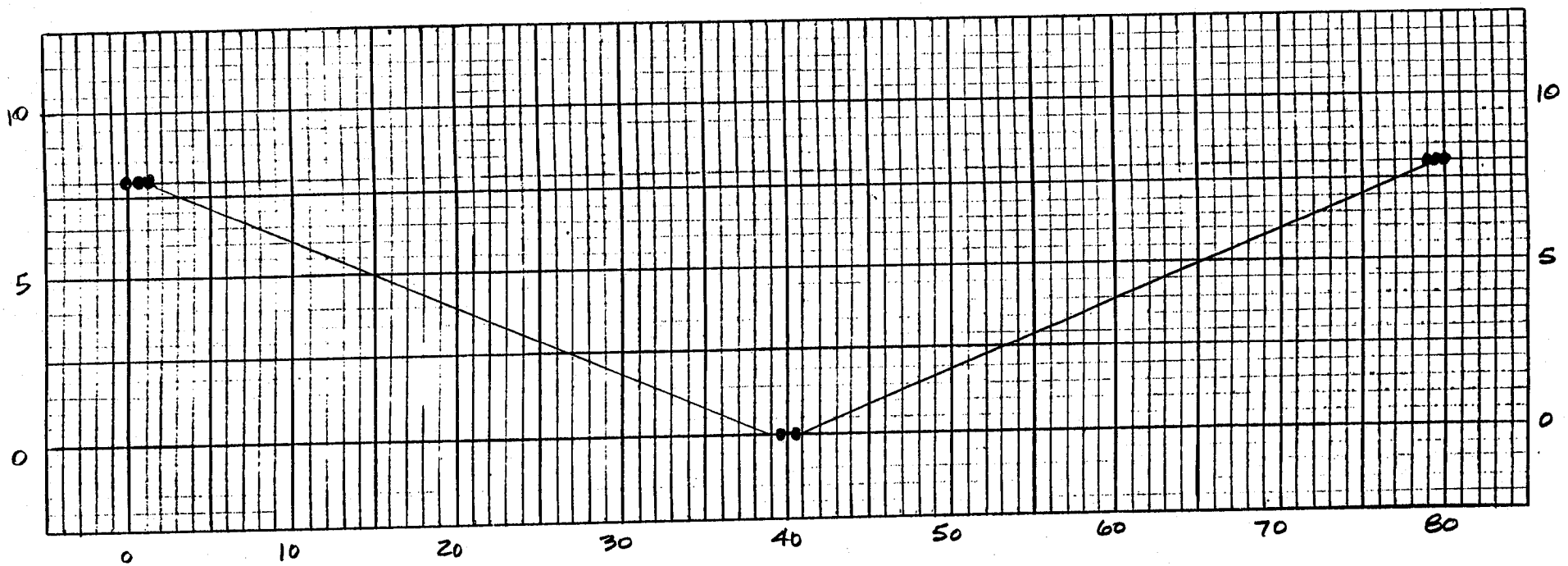
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	3600	0.0369			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R351



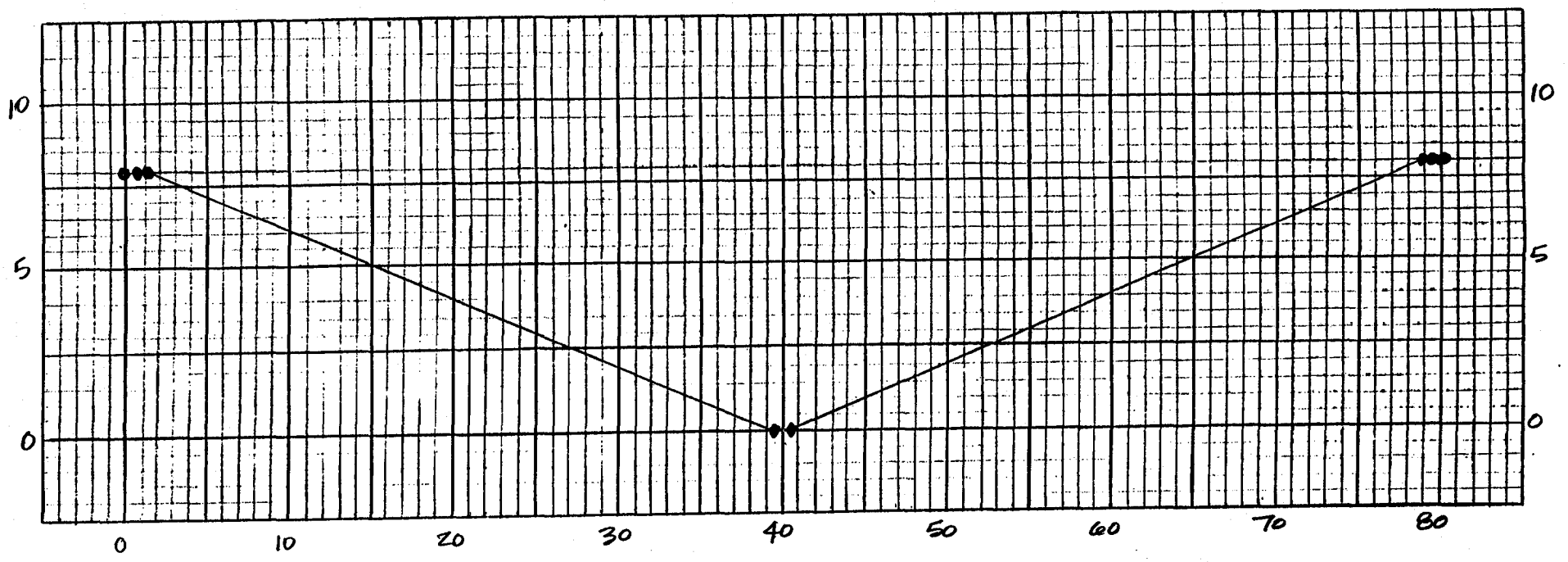
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	2600	0.0373			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R360



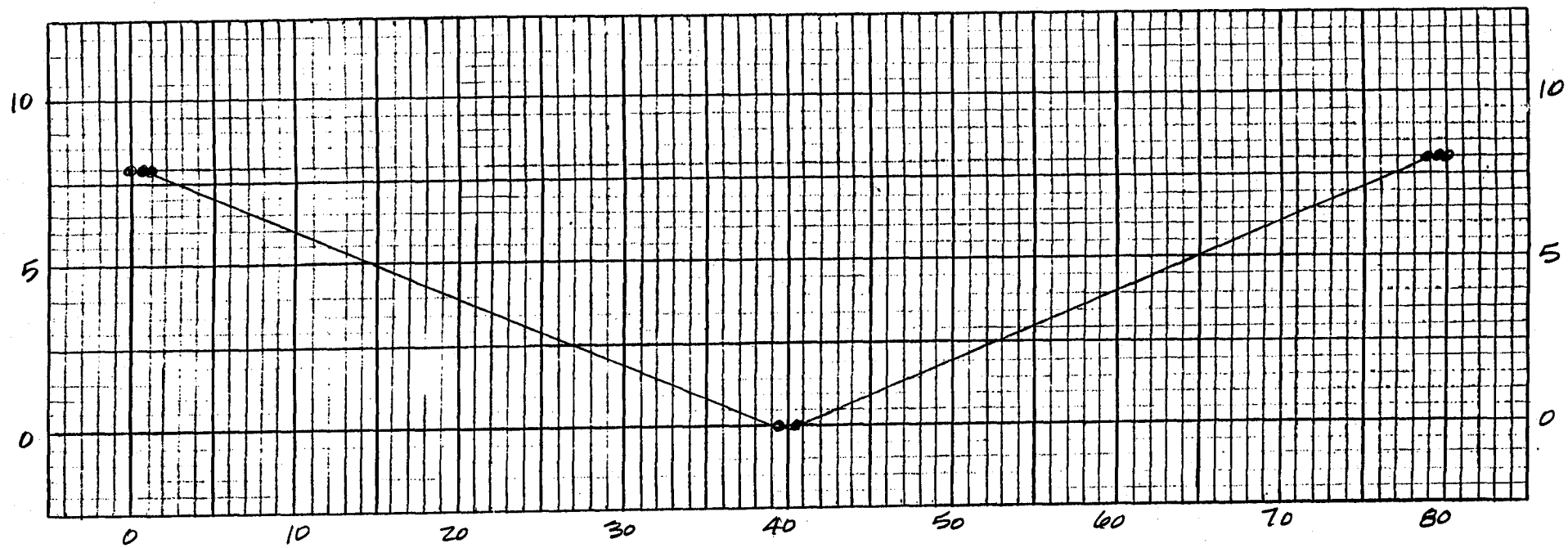
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1300	0.0135			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R371



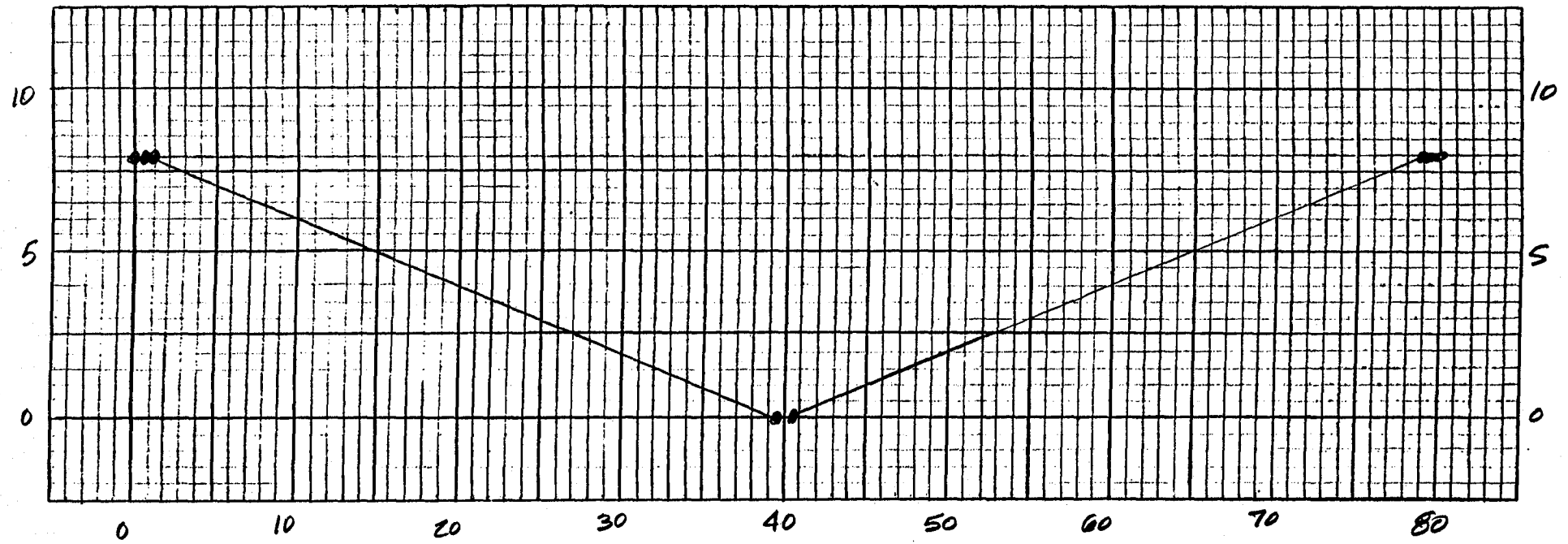
RS	*	FLOW	-1					
RC	0.100	0.030	0.100	3400	0.0135			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R386



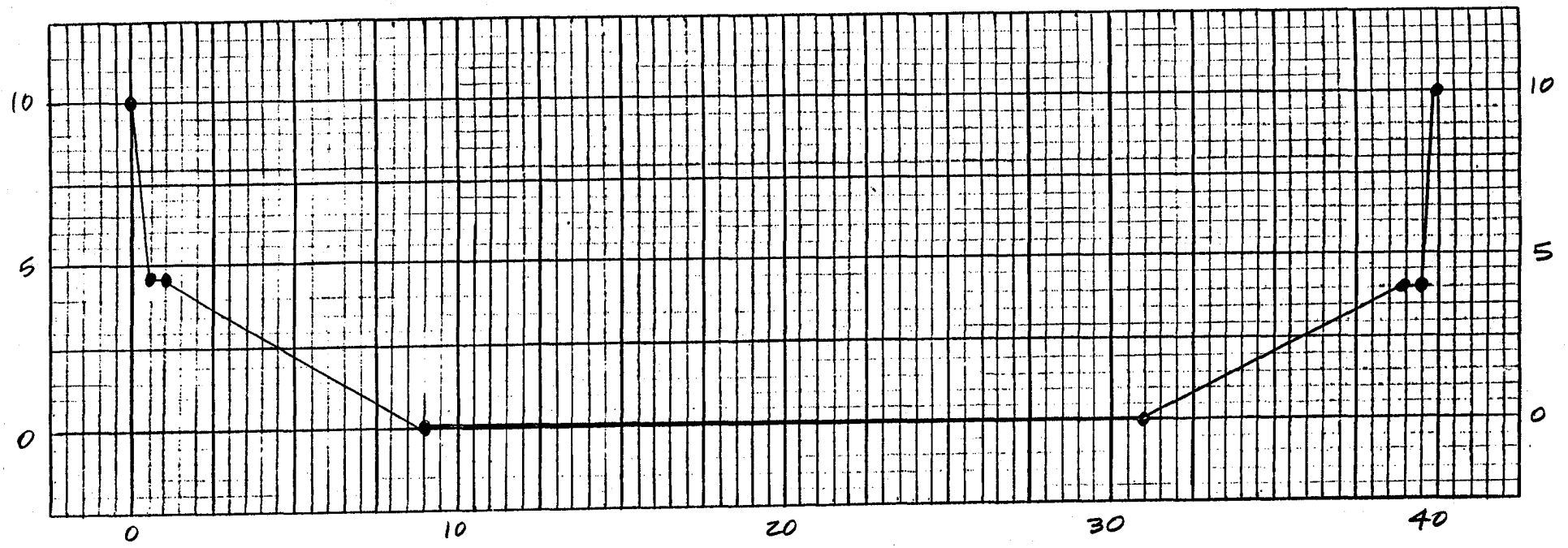
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1800	0.0061			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R396



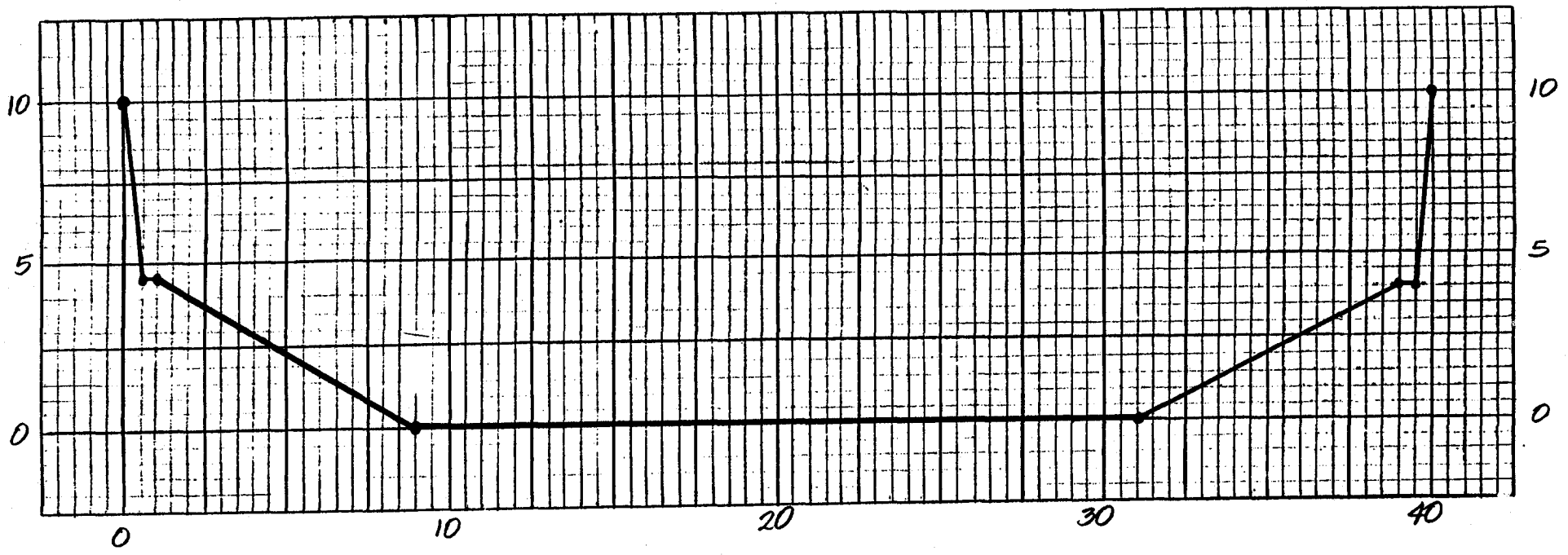
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	1600	0.0081			
RX	0.0	0.5	1.0	9.0	31.0	39.0	39.5	40.0
RY	10.0	4.0	4.0	0.0	0.0	4.0	4.0	10.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R406



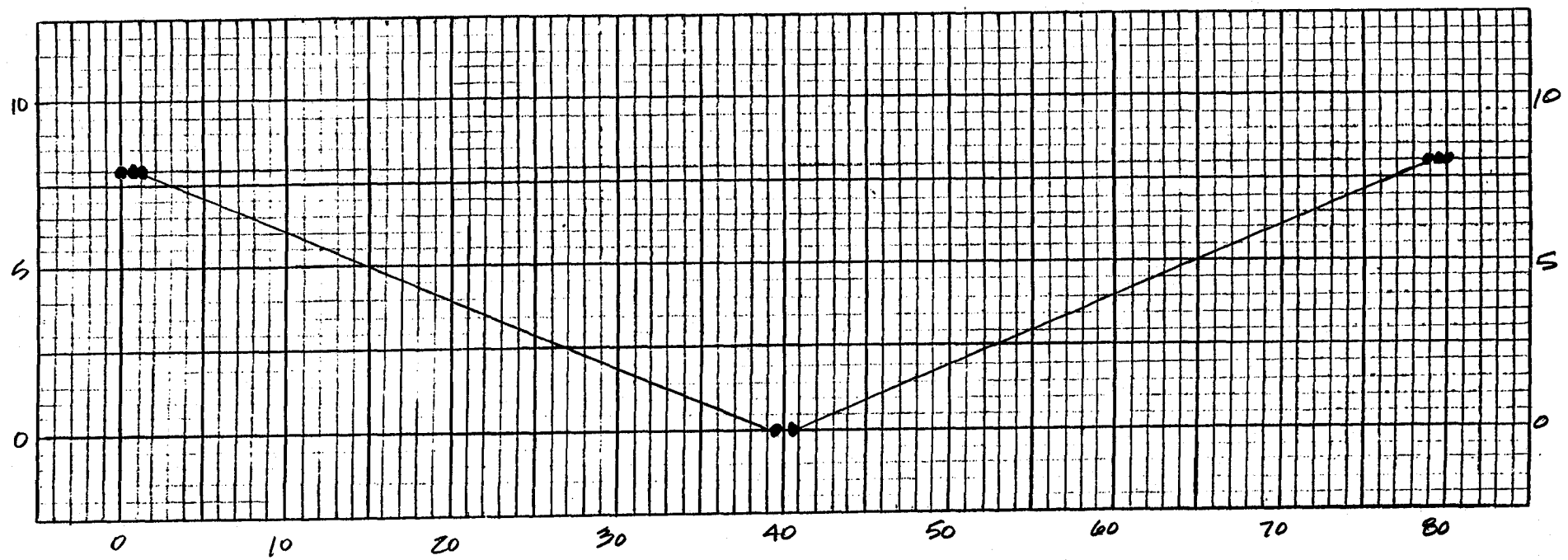
RS	*	FLOW	-1					
RC	0.035	0.030	0.035	4000	0.0055			
RX	0	0.5	1.0	9.0	31.0	39.0	39.5	40.0
RY	10.0	4.0	4.0	0.0	0.0	4.0	4.0	10.0

CALCULATED BY: D. Bradley

* See NTSPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R411



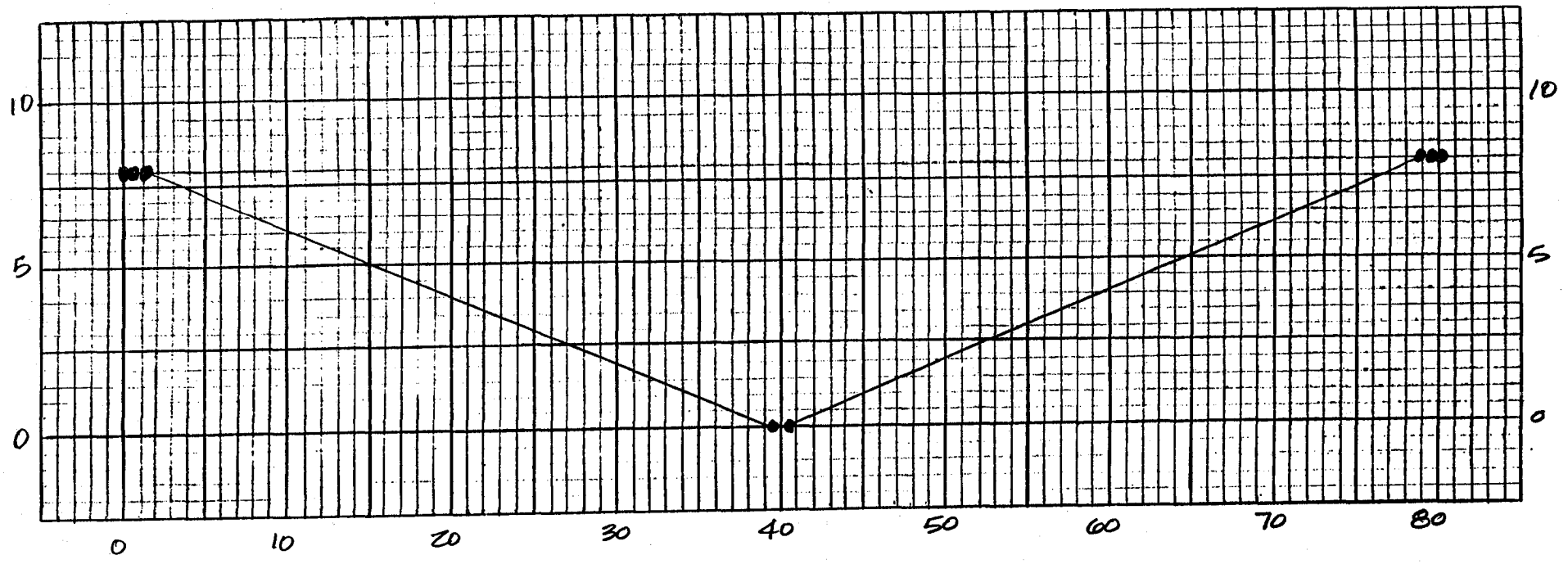
RS	*	FLOW	-1					
RC	0.100	0.030	0.100	4000	0.00160			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R421



RS	*	FLOW	-1					
RC	0.100	0.030	0.100	3000	0.00160			
RX	0.0	0.5	1.0	39.5	40.5	79.0	79.5	80.0
RY	8.0	8.0	8.0	0.0	0.0	8.0	8.0	8.0

CALCULATED BY: L. Thomas

* See NSTPS Calculations

NSTPS Calculations

The following equation was utilized to determine NSTPS:

$$NSTPS = RLNGTH / (V \times 60 \times NMIN)$$

where: RLNGTH = Reach Length, feet.

V = Average Velocity, feet per second

NMIN = Computation Interval, minutes

The average velocity was determined by performing normal depth calculations using the Mannings Equation. The normal depth calculations were applied to the eight point cross-section presented earlier in this section which was representative of the routing reach. The normal depth calculations were performed using one of two methods: (1) Hydraulic Computer Program developed by West Consultants; or (2) Detailed calculations using normal depth procedures. The average peak discharge used for the normal depth calculations was estimated for the various storm frequencies by running the HEC-1 computer model without the routing commands to obtain the peak discharge values upstream of the routing locations.

The Hydraulic Computer Program developed by West Consultants was utilized on eight point cross-sections that were either trapezoidal channels or could be approximated as trapezoidal channels. The computer program calculates the normal depth and velocity based on the channel parameters. The computer program requires the following channel parameters to perform the normal depth calculations:

(1) Average Peak Discharge, Q in CFS;

(2) Mannings Roughness Coefficient, n;

(3) Longitudinal Slope, S in feet per feet;

(4) Channel Bottom Width, b in feet (use 0.0 if Triangular Section); and

(5) Channel Side Slope, SS (use 0.0 if Rectangular Section).

Detailed hydraulic calculations using normal depth procedures were utilized on eight point cross-sections that were highly irregular and could not be approximated as trapezoidal channels. Since the computations were highly involved and laborious, we utilized a method where the average velocity was calculated based on a assumed depth of flow in the channel. The peak discharge was determined based on the average velocity and area computed for the assumed depth. This procedure was applied to a wide range of depths along each routed reach so that average peak discharge values could be determined. Upon determination of the average peak discharge for the various storm frequencies using the HEC-1 computer model, the average velocity was interpolated from the assumed depth/peak discharge computations.

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 3
	For		

Reach 101 (R101) (Used Hydraulic Computer Program)

n = 0.025 s = 0.0086 ft/ft SS = 0
L = 2800 ft b = 50 ft

	Storm Frequency (Years)			
	2	10	50	100
Q (cfs)	8	46	92	112
Depth, d (ft)	0.1	0.3	0.5	0.6
Avg. V (fps)	1.3	2.7	3.5	3.8
NSTPS	36	17	13	12

Reach 116 (R116) (Used Hydraulic Computer Program)

n = 0.025 s = 0.0055 SS = 0
L = 2200 ft b = 50 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	12	70	143	173
Depth, d (ft)	0.2	0.5	0.8	0.9
Avg. V (fps)	1.4	2.8	3.7	4.0
NSTPS	26	13	10	9

Reach 131 (R131) (Used Hydraulic Computer Program)

n = 0.015 s = 0.0156 ft/ft SS = 0
L = 1800 ft b = 30 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	4	16	29	35
Depth, d (ft)	0.1	0.2	0.2	0.24
Avg. V (fps)	2.0	3.5	4.4	4.8
NSTPS	15	9	7	6

101-0374-20M

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 4
	For		

Reach 146 (R146) (Used Hydraulic Computer Program)

$n = 0.035$ $S = 0.0081$ ft/ft $SS = 0$
$L = 1355$ ft $b = 30$ ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	22	90	171	206
Depth, d (ft)	0.4	0.9	1.3	1.5
Avg. V (fps)	2.0	3.4	4.3	4.7
NSTPS	11	7	5	5

Reach 156 (R156) (Used Hydraulic Computer Program)

$n = 0.035$ $S = 0.0046$ ft/ft $SS = 0$
$L = 4600$ ft $b = 30$ ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	27	133	266	324
Depth, d (ft)	0.5	1.3	2.1	2.3
Avg. V (fps)	2.0	3.3	4.3	4.6
NSTPS	38	23	18	17

Reach 171 (R171) (Used Hydraulic Computer Program)

$n = 0.035$ $S = 0.0250$ ft/ft $SS = 5$
$L = 1200$ ft $b = 0$

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	31	103	194	234
Depth, d (ft)	1.2	1.8	2.3	2.5
Avg. V (fps)	4.6	6.2	7.0	7.6
NSTPS	4	3	3	3

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 5
	For		

Reach 191 (R191) (Used Computer Program)

n = 0.035 S = 0.0400 ft/ft SS = 5
L = 1200 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	32	104	194	235
Depth, d (ft)	1.1	1.7	2.1	2.3
Avg. V (fps)	5.6	7.4	8.7	9.1
NSTPS	4	3	2	2

Reach 196 (R196) (Used Computer Program)

n = 0.035 S = 0.0500 ft/ft SS = 6
L = 200 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	71	239	456	555
Depth, d (ft)	1.3	2.0	2.6	2.8
Avg. V (fps)	7.1	9.6	11.2	11.8
NSTPS	1	1	1	1

Reach 206 (R206) (Used Computer Program)

n = 0.035 S = 0.0125 ft/ft SS = 2
L = 1600 ft b = 22 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	76	255	492	602
Depth, d (ft)	0.8	1.7	2.4	2.7
Avg. V (fps)	3.9	6.0	7.5	8.0
NSTPS	7	4	4	3

101-0374-20M

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	Checked by	Date	Sheet No. 6
	For		

NSTPS Calculations For Reach 212 (R212)

$n = 0.015$
$L = 2600$ ft
$S = 0.0092$ ft/ft

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

For $d = 1'$:

$A = (1/2)(1)(5) + (1/2)(1)(12.25) = 8.63 \text{ ft}^2$
$P = (1^2 + 5^2)^{1/2} + (1^2 + 12.25^2)^{1/2} = 17.39$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{8.63}{17.39}\right)^{2/3}(0.0092)^{1/2} = 6.0$ fps
$Q = 51$ cfs

For $d = 2'$:

$A = (1/2)(2)(10) + (1/2)(2)(24.5) = 34.50 \text{ ft}^2$
$P = (2^2 + 10^2)^{1/2} + (2^2 + 24.5^2)^{1/2} = 34.78$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{34.50}{34.78}\right)^{2/3}(0.0092)^{1/2} = 9.5$ fps
$Q = 326$ cfs

For $d = 2.3'$:

$A = 34.50 + 1/2(1)(15) + 1/2(1)(20) + (0.3)(100) = 82.0 \text{ ft}^2$
$P = (1^2 + 15^2)^{1/2} + (1^2 + 20^2)^{1/2} + 30 + 34.78 + 2(0.3) = 100.44$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{82.0}{100.44}\right)^{2/3}(0.0092)^{1/2} = 8.3$ fps
$Q = 681$ cfs

For $d = 2.2'$:

$A = 34.50 + 17.50 + (0.2)(100) = 72.0 \text{ ft}^2$
$P = 35.06 + 30 + 34.78 + (2)(0.2) = 100.2$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{72}{100.2}\right)^{2/3}(0.0092)^{1/2} = 7.6$ fps
$Q = 549$ cfs

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	85	285	560	687
Depth, d (ft)	1.0	2.0	2.2	2.3
Avg. V (fps)	6.0	9.5	7.6	8.3
NSTPS	7	5	6	5

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	Checked by	Date	Sheet No. 7
	For		

NSTPS Calculations For Reach 217 (R217)

$n = 0.015$
$L = 2600$ ft
$S = 0.0077$ ft/ft

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

For $d = 1.3'$:
$A = \frac{1}{2}(1.3)(6.5) + (\frac{1}{2})(1.3)(15.9) = 14.56$ ft^2
$P = (1.3^2 + 6.5^2)^{1/2} + (1.3^2 + 15.9^2)^{1/2} = 22.58$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{14.56}{22.58}\right)^{2/3}(0.0077)^{1/2} = 6.5$ fps
$Q = 94$ cfs

For $d = 2'$:
$A = (\frac{1}{2})(2)(10) + (\frac{1}{2})(2)(24.5) = 34.50$ ft^2
$P = (2^2 + 10^2)^{1/2} + (2^2 + 24.5^2)^{1/2} = 34.78$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{34.50}{34.78}\right)^{2/3}(0.0077)^{1/2} = 8.6$ fps
$Q = 298$ cfs

For $d = 2.3'$:
$A = 34.50 + 17.50 + (0.3)(100) = 82.0$ ft^2
$P = 35.06 + 30 + 34.78 + 2(0.3) = 100.44$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{82}{100.44}\right)^{2/3}(0.0077)^{1/2} = 7.6$ fps
$Q = 622$ cfs

For $d = 2.4'$:
$A = 34.50 + 17.50 + (0.4)(100) = 92.0$ ft^2
$P = 35.06 + 30 + 34.78 + (2)(0.4) = 100.64$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{92}{100.64}\right)^{2/3}(0.0077)^{1/2} = 8.2$ fps
$Q = 753$ cfs

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	86	292	576	708
Depth, d (ft)	1.3	2.0	2.3	2.4
Avg. V (fps)	6.5	8.6	7.6	8.2
NSTPS	7	5	6	5

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	For		

Reach 221 (R221) (Used Computer Program)

$n = 0.015$ $S = 0.0183$ ft/ft $SS = 0$
$L = 3000$ ft $b = 30$ ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	2	12	25	30
Depth, d (ft)	0.04	0.1	0.2	0.2
Avg. V (fps)	2.0	3.3	4.4	4.7
NSTPS	25	15	11	11

Reach 236 (R236) (Used Computer Program)

$n = 0.030$ $S = 0.0070$ ft/ft $SS = 0$
$L = 1000$ ft $b = 30$ ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	16	115	230	282
Depth, d (ft)	0.3	1.0	1.5	1.7
Avg. V (fps)	1.8	3.9	5.1	5.5
NSTPS	9	4	3	3

Reach 251 (R251) (Used Computer Program)

$n = 0.030$ $S = 0.0164$ ft/ft $SS = 0$
$L = 3200$ ft $b = 30$ ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	14	47	85	102
Depth, d (ft)	0.2	0.4	0.6	0.7
Avg. V (fps)	2.2	3.6	4.5	4.9
NSTPS	24	15	12	11

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 9
	For		

NSTPS Calculations For Reach 246 (R246)

$n = 0.015$
$L = 1800$ ft
$S = 0.0056$ ft/ft

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

For $d = 1.0'$:
$A = (1/2)(1)(5) + (1/2)(1)(12.25) = 8.63\ ft^2$
$P = (1^2+5^2)^{1/2} + (1^2+12.25^2)^{1/2} = 17.39$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{8.63}{17.39}\right)^{2/3}(0.0056)^{1/2} = 4.6$ fps
$Q = 40$ cfs

For $d = 2.0'$:
$A = (1/2)(2)(10) + (1/2)(2)(24.50) = 34.50\ ft^2$
$P = (2^2+10^2)^{1/2} + (2^2+24.5^2)^{1/2} = 34.78$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{34.50}{34.78}\right)^{2/3}(0.0056)^{1/2} = 7.4$ fps
$Q = 254$ cfs

For $d = 2.3'$:
$A = 34.5 + 17.5 + (0.3)(100) = 82.0\ ft^2$
$P = 35.06 + 30 + 34.78 + (2)(0.3) = 100.44$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{82}{100.44}\right)^{2/3}(0.0056)^{1/2} = 6.5$ fps
$Q = 531$ cfs

For $d = 2.4'$:
$A = 34.5 + 17.5 + (0.4)(100) = 92.0\ ft^2$
$P = 35.06 + 30 + 34.78 + (2)(0.4) = 100.64$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{92}{100.64}\right)^{2/3}(0.0056)^{1/2} = 7.0$ fps
$Q = 642$ cfs

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	36	241	499	609
Depth, d (ft)	1.0	2.0	2.3	2.4
Avg. V (fps)	4.6	7.4	6.5	7.0
NSTPS	7	4	5	4

SECTION VI

HEC-1 Hydrology Results, 100-year, 6-hour Storm (Existing Conditions)

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             MAY   1991                *
*          VERSION 4.0.1E               *
*                                       *
*  RUN DATE  09/07/95  TIME  16:15:44   *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748               *
*                                       *
*****************************************
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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
```

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. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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

  1           ID   DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY  FCD 94-28
  2           ID     FILENAME:  DT36E.DAT     KHE JOB NO. 298
  3           ID     100-YEAR 6-HOUR STORM DURATION EXISTING CONDITIONS
  4           ID   DDM MCUHP1 DOUBLETREE REGIONAL STUDY
              * DIAGRAM
  5           IT       1                    500
  6           IO       5
              * DDM   ***** Preserved *****

  7           KK    290S
  8           KM   SUB-BASIN 290
  9           KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 10           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 11           KM     L =  .38  Kb = .111  Adj. Slope =  315.0
 12           BA    .092
 13           IN      15
 14           KM   RAINFALL DEPTH OF 3.15 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
 15           KM   AN AREAL REDUCTION FACTOR OF .966
 16           PB   3.043
 17           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 2.22
 18           PC    .000    .010    .017    .026    .037    .047    .056    .066    .075    .085
 19           PC    .097    .111    .132    .176    .263    .456    .689    .828    .893    .932
 20           PC    .949    .962    .975    .988   1.000
 21           LG    .160    .250   4.150    .470  30.000
 22           UC    .204    .114
 23           UA       0       3       5       8      12      20      43      75      90      96
 24           UA     100
              * DDM   ***** Preserved *****

 25           KK    R291
 26           KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 290 THROUGH SUB-BASIN 300
 27           RS       4    FLOW      -1
 28           RC   0.035   0.030   0.035    1800  0.0268
 29           RX       0     0.5    20.0    30.0    40.0    60.0    68.0    80.0
 30           RY     7.0     5.0     3.0     1.0     0.0     3.0     5.0     7.0
              * DDM   ***** Preserved *****

 31           KK    300S
 32           KM   SUB-BASIN 300
 33           KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 34           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 35           KM     L =  .38  Kb = .059  Adj. Slope =  153.0
 36           BA    .052
 37           LG    .100    .250   3.950    .510  15.000
 38           UC    .183    .140
 39           UA       0       5      16      30      65      77      84      90      94      97
 40           UA     100
              * DDM   ***** Preserved *****

 41           KK   HC305
 42           KM   COMBINE FLOWS FROM SUB-BASIN 290 AND SUB-BASIN 300
 43           HC       2
              * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  44          KK    R306
  45          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 300 THROUGH SUB-BASIN 380
  46          RS       1    FLOW      -1
  47          RC   0.035   0.030   0.035     400  0.0250
  48          RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
  49          RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
              * DDM   ***** Preserved *****

  50          KK    310S
  51          KM   SUB-BASIN 310
  52          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
  53          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
  54          KM     L =  .95  Kb = .104  Adj. Slope =  315.0
  55          BA    .249
  56          LG    .170    .250   4.200    .460  40.000
  57          UC    .333    .232
  58          UA       0       3       5       8      12      20      43      75      90      96
  59          UA     100
              * DDM   ***** Preserved *****

  60          KK    R311
  61          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 310 THROUGH SUB-BASIN 360
  62          RS       6    FLOW      -1
  63          RC   0.035   0.030   0.035    2800  0.0204
  64          RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
  65          RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
              * DDM   ***** Preserved *****

  66          KK    320S
  67          KM   SUB-BASIN 320
  68          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
  69          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
  70          KM     L =  .68  Kb = .087  Adj. Slope =  315.0
  71          BA    .170
  72          LG    .140    .250   5.600    .230  30.000
  73          UC    .237    .151
  74          UA       0       5      16      30      65      77      84      90      94      97
  75          UA     100
              * DDM   ***** Preserved *****

  76          KK    R321
  77          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 320 THROUGH SUB-BASIN 330
  78          RS       5    FLOW      -1
  79          RC   0.035   0.030   0.035    1000  0.0100
  80          RX       0     0.5    49.5    50.0   155.0   155.5   199.5   200.0
  81          RY     5.0     1.0     1.0     0.0     0.0     1.0     1.0     5.0
              * DDM   ***** Preserved *****

  82          KK    330S
  83          KM   SUB-BASIN 330
  84          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
  85          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
  86          KM     L =  .49  Kb = .067  Adj. Slope =  264.4
  87          BA    .123
```

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

 88         LG    .110    .150   7.300    .120  17.000
 89         UC    .183    .105
 90         UA       0       5      16      30      65      77      84      90      94      97
 91         UA     100
            * DDM   ***** Preserved *****

 92         KK   HC335
 93         KM   COMBINE FLOWS FROM SUB-BASIN 320 AND SUB-BASIN 330
 94         HC       2
            * DDM   ***** Preserved *****

 95         KK    R336
 96         KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 330 THROUGH SUB-BASIN 360
 97         RS       5    FLOW      -1
 98         RC   0.035   0.030   0.035    2400  0.0113
 99         RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
100         RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****

101         KK    340S
102         KM   SUB-BASIN 340
103         KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
104         KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
105         KM     L =  .34  Kb = .132  Adj. Slope =  315.0
106         BA    .069
107         LG    .180    .250   4.800    .320  42.000
108         UC    .208    .126
109         UA       0       3       5       8      12      20      43      75      90      96
110         UA     100
            * DDM   ***** Preserved *****

111         KK    R341
112         KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 340 THROUGH SUB-BASIN 360
113         RS       7    FLOW      -1
114         RC   0.035   0.030   0.035    3600  0.0369
115         RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
116         RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****

117         KK    350S
118         KM   SUB-BASIN 350
119         KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
120         KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
121         KM     L =  .38  Kb = .093  Adj. Slope =  315.0
122         BA    .076
123         LG    .140    .250   4.800    .320  48.000
124         UC    .183    .113
125         UA       0       5      16      30      65      77      84      90      94      97
126         UA     100
            * DDM   ***** Preserved *****
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```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 127        KK    R351
 128        KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 350 THROUGH SUB-BASIN 360
 129        RS       5    FLOW      -1
 130        RC   0.035   0.030   0.035    2600  0.0373
 131        RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 132        RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****

 133        KK    360S
 134        KM   SUB-BASIN 360
 135        KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 136        KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
 137        KM     L =  .87  Kb = .054  Adj. Slope =  297.2
 138        BA    .255
 139        LG    .110    .250   4.100    .490  19.000
 140        UC    .217    .132
 141        UA       0       5      16      30      65      77      84      90      94      97
 142        UA     100
            * DDM   ***** Preserved *****

 143        KK   HC365
 144        KM   COMBINE FLOWS FROM SUB-BASINS 310, 340, 350, 360 & COMBINED FLOWS AT HC335
 145        HC       5
            * DDM   ***** Preserved *****

 146        KK    R366
 147        KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 360 THROUGH SUB-BASIN 380
 148        RS       2    FLOW      -1
 149        RC   0.035   0.030   0.035    1300  0.0135
 150        RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 151        RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****

 152        KK    370S
 153        KM   SUB-BASIN 370
 154        KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 155        KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 156        KM     L =  .64  Kb = .111  Adj. Slope =  315.0
 157        BA    .142
 158        LG    .160    .250   4.800    .320  42.000
 159        UC    .262    .178
 160        UA       0       3       5       8      12      20      43      75      90      96
 161        UA     100
            * DDM   ***** Preserved *****

 162        KK    R371
 163        KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 370 THROUGH SUB-BASIN 380
 164        RS       9    FLOW      -1
 165        RC   0.100   0.030   0.100    3400  0.0135
 166        RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 167        RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****
```

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 10
	For		

Reach 266 (R266) (Used Computer Program)

n = 0.030 s = 0.0086 ft/ft SS = 0
L = 1400 ft b = 30 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	20	106	219	268
Depth, d (ft)	0.3	0.9	1.4	1.6
Avg. V (fps)	2.1	4.0	5.3	5.8
NSTPS	11	6	4	4

Reach 291 (R291) (Used Computer Program)

n = 0.030 s = 0.0268 ft/ft SS = 7
L = 1800 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	15	55	103	123
Depth, d (ft)	0.7	1.2	1.5	1.6
Avg. V (fps)	4.1	5.7	6.6	6.9
NSTPS	7	5	5	4

Reach 306 (R306) (Used Computer Program)

n = 0.030 s = 0.0250 ft/ft SS = 5
L = 400 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	18	76	151	183
Depth, d (ft)	0.9	1.5	2.0	2.1
Avg. V (fps)	4.5	6.5	7.7	8.1
NSTPS	2	1	1	1

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 11
	For		

NSTPS Calculations For Reach 276 (R276)

$n = 0.015$
$L = 1400$ ft
$S = 0.0029$ ft/ft

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

For $d = 2.0'$: $A = 1/2(2)(10) + 1/2(2)(24.5) = 34.50\ ft^2$
$P = (2^2+10^2)^{1/2} + (2^2+24.5^2)^{1/2} = 34.78$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{34.5}{34.78}\right)^{2/3}(0.0029)^{1/2} = 5.3$ fps
$Q = 183$ cfs

For $d = 2.7'$: $A = 34.5 + 17.5 + (0.7)(100) = 122.0\ ft^2$
$P = 35.06 + 30 + 34.78 + (2)(0.7) = 101.24$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{122}{101.24}\right)^{2/3}(0.0029)^{1/2} = 6.0$ fps
$Q = 737$ cfs

For $d = 3.4'$: $A = 34.5 + 17.5 + (1.4)(100) = 192\ ft^2$
$P = 35.06 + 30 + 34.78 + (2)(1.4) = 102.64$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{192}{102.64}\right)^{2/3}(0.0029)^{1/2} = 8.1$ fps
$Q = 1555$ cfs

For $d = 3.6'$: $A = 34.5 + 17.5 + (1.6)(100) = 212\ ft^2$
$P = 35.06 + 30 + 34.78 + (2)(1.6) = 103.04$ ft
$V = Q/A = \frac{1.486}{0.015}\left(\frac{212}{103.04}\right)^{2/3}(0.0029)^{1/2} = 8.6$ fps
$Q = 1830$ cfs

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	165	725	1494	1848
Depth, d (ft)	2.0	2.7	3.4	3.6
Avg. V (fps)	5.3	6.0	8.1	8.6
NSTPS	4	4	3	3

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KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 12
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Reach 311 (R311) (Used Computer Program)

n = 0.030 S = 0.0204 ft/ft SS = 5
L = 2800 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	38	126	238	288
Depth, d (ft)	1.2	1.9	2.4	2.6
Avg. V (fps)	5.0	6.8	8.0	8.4
NSTPS	9	7	6	6

Reach 321 (R321) (Used Computer Program)

n = 0.030 S = 0.0100 ft/ft SS = 0
L = 1000 ft b = 100 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	34	120	207	244
Depth, d (ft)	0.2	0.4	0.6	0.7
Avg. V (fps)	1.7	2.8	3.5	3.7
NSTPS	10	6	5	5

Reach 336 (R336) (Used Computer Program)

n = 0.030 S = 0.0113 ft/ft SS = 5
L = 2400 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	70	223	374	437
Depth, d (ft)	1.7	2.7	3.2	3.4
Avg. V (fps)	4.7	6.3	7.2	7.5
NSTPS	9	6	6	5

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 13
	For		

Reach 341 (R341) (Used Computer Program)

n = 0.030 S = 0.0369 ft/ft SS = 5
L = 3600 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	16	51	86	101
Depth, d (ft)	0.8	1.2	1.5	1.6
Avg. V (fps)	5.1	6.8	7.7	8.1
NSTPS	12	9	8	7

Reach 351 (R351) (Used Computer Program)

n = 0.030 S = 0.0373 ft/ft SS = 5
L = 2600 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	22	62	100	117
Depth, d (ft)	0.9	1.3	1.6	1.7
Avg. V (fps)	5.5	7.2	8.1	8.4
NSTPS	8	6	5	5

Reach 366 (R366) (Used Computer Program)

n = 0.030 S = 0.0135 ft/ft SS = 5
L = 1300 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	147	535	991	1188
Depth, d (ft)	2.2	3.6	4.5	4.8
Avg. V (fps)	6.1	8.4	9.8	10.2
NSTPS	4	3	2	2

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 14
	For		

Reach 371 (R371) (Used Computer Program)

n = 0.030 s = 0.0135 ft/ft SS = 5
L = 3400 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	29	93	161	191
Depth, d (ft)	1.2	1.8	2.3	2.4
Avg. V (fps)	4.0	5.4	6.2	6.5
NSTPS	14	10	9	9

Reach 386 (R386) (Used Computer Program)

n = 0.030 s = 0.0061 ft/ft SS = 5
L = 1800 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	192	711	1335	1608
Depth, d (ft)	2.8	4.6	5.8	6.3
Avg. V (fps)	4.8	6.7	7.8	8.2
NSTPS	6	4	4	4

Reach 396 (R396) (Used Computer Program)

n = 0.030 s = 0.0081 ft/ft SS = 2
L = 1600 ft b = 22 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	194	729	1378	1662
Depth, d (ft)	1.5	3.2	4.5	5.0
Avg. V (fps)	5.3	8.2	9.9	10.5
NSTPS	5	3	3	3

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 9-6-95	Job No. 298
	Checked by	Date	Sheet No. 15
	For		

Reach 406 (R406) (Used Computer Program)

n = 0.030 s = 0.0055 ft/ft SS = 2
L = 4000 ft b = 22 ft

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	165	624	1160	1381
Depth, d (ft)	1.5	3.2	4.5	5.0
Avg. V (fps)	4.4	6.8	8.2	8.7
NSTPS	15	10	8	8

Reach 411 (R411) (Used Computer Program)

n = 0.030 s = 0.0060 ft/ft SS = 5
L = 4000 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	12	48	87	103
Depth, d (ft)	1.0	1.7	2.1	2.2
Avg. V (fps)	2.4	3.4	3.9	4.1
NSTPS	28	20	17	16

Reach 421 (R421) (Used Computer Program)

n = 0.030 s = 0.0060 ft/ft SS = 5
L = 3000 ft b = 0

	Storm Freq. (Years)			
	2	10	50	100
Q (cfs)	14	60	115	140
Depth, d (ft)	1.1	1.8	2.3	2.5
Avg. V (fps)	2.5	3.6	4.2	4.4
NSTPS	20	14	12	11

SECTION V

Divert Parameters

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by L. Thomas	Date 5/95	Job No.
	Checked by	Date	Sheet No.
	For Double tree Ranch Rd. Regional Drainage Study		

SUMMARY OF SPLIT FLOW ANALYSIS

56th Street & Cherokee Wash

WSE	Q_{PIPE}	Q_{WEIR}	Q_{STREET}	Q_{TOTAL}
46.5	64	0	0	64
47.0	80	59	31	170
47.5	100	283	123	506
48.0	116	708	196	1020
49.5	148	2084	784	3016

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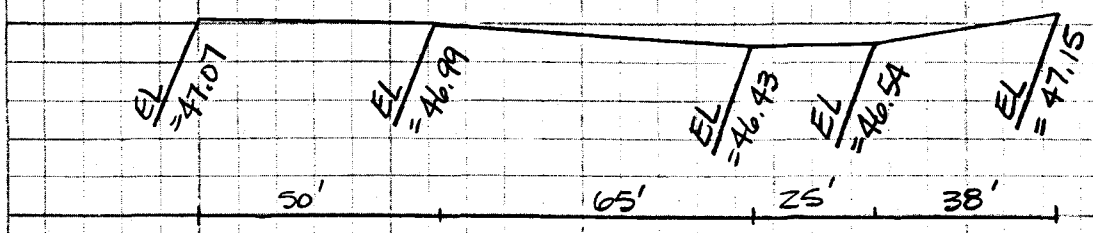
KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by L. Thomas	Date 5/95	Job No.
	Checked by	Date	Sheet No.
	For Doubletree Ranch Rd. Regional Drainage Study		

Broad-Crested Weir Analysis
56th Street & Cherokee Wash

$Q = CLH^{1.5}$ where: $C = 2.63$



WSE = 46.5

$Q \approx 0$

WSE = 47.0

$$Q = 2.63\left[\left(\frac{0.01}{0.08}\times 50\right)\left(\frac{0.01}{2}\right)^{1.5} + (65)\left(\frac{0.01+0.57}{2}\right)^{1.5} + (25)\left(\frac{0.57+0.46}{2}\right)^{1.5} + \left(\frac{0.46}{0.61}\times 38\right)\left(\frac{0.46}{2}\right.\right.$$

$= 59$ cfs

WSE = 47.5

$$Q = 2.63\left[\left(\frac{0.43+0.51}{2}\right)^{1.5}(50) + \left(\frac{0.51+1.07}{2}\right)^{1.5}(65) + \left(\frac{1.07+0.96}{2}\right)^{1.5}(25) + \left(\frac{0.96+0.35}{2}\right)^{1.5}(38)\right]$$

$= 283$ cfs

WSE = 48.0

$$Q = 2.63\left[\left(\frac{0.93+1.01}{2}\right)^{1.5}(50) + \left(\frac{1.01+1.57}{2}\right)^{1.5}(65) + \left(\frac{1.57+1.46}{2}\right)^{1.5}(25) + \left(\frac{1.46+0.85}{2}\right)^{1.5}(38)\right]$$

$= 708$ cfs

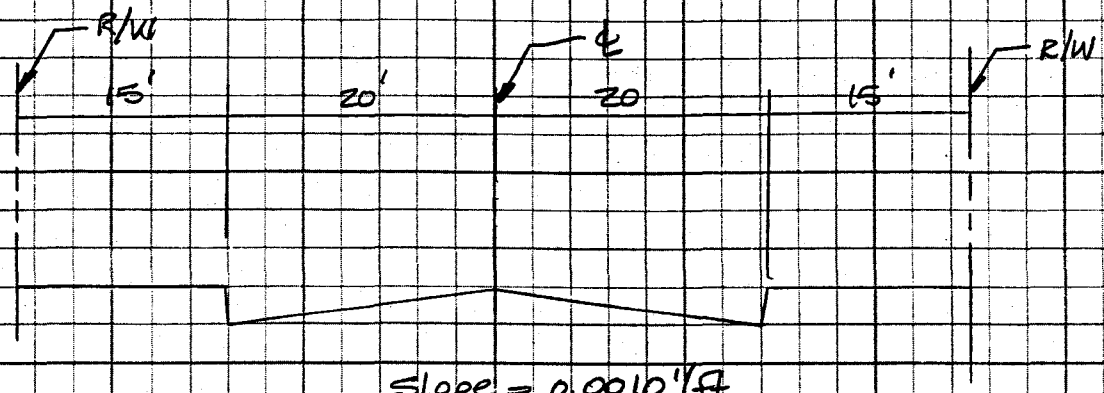
WSE = 49.5

$$Q = 2.63\left(\frac{2.43+2.51}{2}\right)^{1.5}(50) + \left(\frac{2.51+3.07}{2}\right)^{1.5}(65) + \left(\frac{3.07+2.96}{2}\right)^{1.5}(25) + \left(\frac{2.96+2.35}{2}\right)^{1.5}(38)$$

$= 2084$ cfs

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by L. Thomas	Date 5/95	Job No.
	Checked by	Date	Sheet No.
	For Doubletree Ranch Rd. Regional Drainage Study		

56th Street Capacity Analysis



Slope = 0.0010'/ft
n = 0.015

$$V = \frac{1.486}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

$$Q = VA$$

WSE = 46.5

Q = 0

WSE = 47.0

½A = 7.3 ½P = 17.3 V = 2.13 fps Q = 31.2 cfs

WSE = 47.5

½A = 24.8 ½P = 35 V = 2.50 fps Q = 123.4 cfs

WSE = 48.0

½A = 32.7 ½P = 35 V = 2.99 fps Q = 195.9 cfs

WSE = 49.5

½A = 75.2 ½P = 35 V = 5.22 Q = 784 cfs

PROJECT: Doubletree Ranch Road
Regional Drainage Study FCD94-28

STATION: 56th St. & Cherokee Wash
SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: L. Thomas 5/95
REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

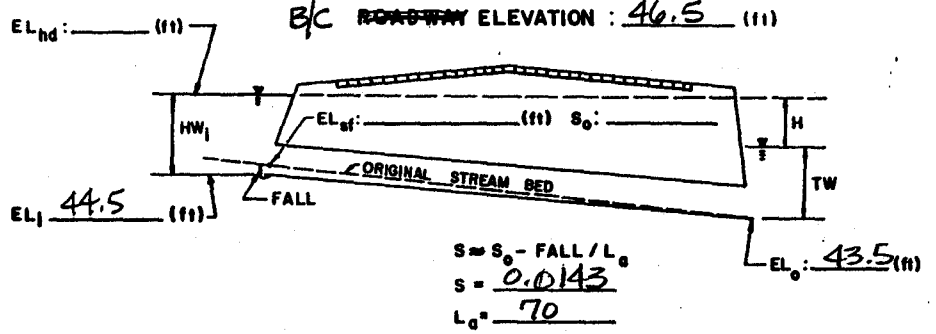
SEE ADD'L SHTS.

- ☐ METHOD: ____
- ☐ DRAINAGE AREA: ____ ☐ STREAM SLOPE: ____
- ☐ CHANNEL SHAPE: ____
- ☐ ROUTING: ____ ☐ OTHER: ____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
100	1891	

B/C ~~ROADWAY~~ ELEVATION: 46.5 (ft)



$S = S_o - FALL / L_a$
$S = 0.0143$
$L_a = 70$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
4-24"H x 34"W CMP	64	16	0.91	2.05												ASSUME WSE = 46.5
"	80	20	1.13	2.55												WSE = 47.0
"	100	25	1.36	3.05												WSE = 47.5
"	116	29	1.58	3.56												WSE = 48.0
"	148	37	2.22	5.00												WSE = 49.5

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_f/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29 n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

ASSUME EQUIVALENT PIPE DIAMETER = 27"

CULVERT BARREL SELECTED:

SIZE: ____
SHAPE: ____
MATERIAL: ____ n ____
ENTRANCE: ____

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

 168        KK    380S
 169        KM    SUB-BASIN 380
 170        KM    6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 171        KM    THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 172        KM      L =  .45  Kb = .057  Adj. Slope =  151.0
 173        BA    .068
 174        LG    .100    .250   4.000    .500  17.000
 175        UC    .200    .151
 176        UA       0       5      16      30      65      77      84      90      94      97
 177        UA     100
            * DDM   ***** Preserved *****

 178        KK    HC385
 179        KM    COMBINE FLOWS FROM SUB-BASIN 370 & 380 AND COMBINED FLOWS AT HC305 & HC365
 180        HC       4
            * DDM   ***** Preserved *****

 181        KK    R386
 182        KM    NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 380 THROUGH SUB-BASIN 390
 183        RS       4    FLOW      -1
 184        RC   0.035   0.030   0.035    1800  0.0061
 185        RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 186        RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
            * DDM   ***** Preserved *****

 187        KK    390S
 188        KM    SUB-BASIN 390
 189        KM    6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 190        KM    THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 191        KM      L =  .53  Kb = .058  Adj. Slope =   77.0
 192        BA    .066
 193        LG    .100    .250   4.450    .400  15.000
 194        UC    .271    .246
 195        UA       0       5      16      30      65      77      84      90      94      97
 196        UA     100
            * DDM   ***** Preserved *****

 197        KK    HC395
 198        KM    COMBINE FLOWS FROM SUB-BASIN 390 AND COMBINED FLOWS AT HC385
 199        HC       2
            * DDM   ***** Preserved *****

 200        KK    R396
 201        KM    NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 390 THROUGH SUB-BASIN 400
 202        RS       3    FLOW      -1
 203        RC   0.035   0.030   0.035    1600  0.0081
 204        RX       0     0.5     1.0     9.0    31.0    39.0    39.5    40.0
 205        RY    10.0     4.0     4.0     0.0     0.0     4.0     4.0    10.0
            * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 206          KK    400S
 207          KM   SUB-BASIN 400
 208          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 209          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 210          KM     L =  .91  Kb = .079  Adj. Slope =  303.0
 211          BA    .145
 212          LG    .130    .250   4.650    .350  25.000
 213          UC    .271    .242
 214          UA       0       5      16      30      65      77      84      90      94      97
 215          UA     100
              * DDM   ***** Preserved *****

 216          KK   HC405
 217          KM   COMBINE FLOWS FROM SUB-BASIN 400 AND COMBINED FLOWS AT HC395
 218          HC       2
              * DDM   ***** Preserved *****

 219          KK   DT405
 220          KM   SPLIT FLOW ANALYSIS AT CHEROKEE WASH AND 56TH STREET
 221          DT   281RE
 222          DI       0      64     170     506    1020    3016
 223          DQ       0       0      31     123     196     784
              * DDM   ***** Preserved *****

 224          KK    R406
 225          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 400 THROUGH SUB-BASIN 430
 226          RS       8    FLOW      -1
 227          RC   0.035   0.030   0.035    4000  0.0055
 228          RX       0     0.5     1.0     9.0    31.0    39.0    39.5    40.0
 229          RY    10.0     4.0     4.0     0.0     0.0     4.0     4.0    10.0
              * DDM   ***** Preserved *****

 230          KK    410S
 231          KM   SUB-BASIN 410
 232          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 233          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 234          KM     L =  .45  Kb = .094  Adj. Slope =  315.0
 235          BA    .075
 236          LG    .140    .250   4.550    .370  31.000
 237          UC    .200    .143
 238          UA       0       5      16      30      65      77      84      90      94      97
 239          UA     100
              * DDM   ***** Preserved *****

 240          KK    R411
 241          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 410 THROUGH SUB-BASIN 430
 242          RS      16    FLOW      -1
 243          RC   0.100   0.030   0.100    4000  0.0060
 244          RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 245          RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
              * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 246          KK    420S
 247          KM   SUB-BASIN 420
 248          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 249          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 250          KM     L =  .80  Kb = .099  Adj. Slope =  315.0
 251          BA    .123
 252          LG    .150    .250   4.550    .370  31.000
 253          UC    .283    .252
 254          UA       0       5      16      30      65      77      84      90      94      97
 255          UA     100
              * DDM   ***** Preserved *****

 256          KK    R421
 257          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 420 THROUGH SUB-BASIN 430
 258          RS      11    FLOW      -1
 259          RC   0.100   0.030   0.100    3000  0.0060
 260          RX       0     0.5     1.0    39.5    40.5    79.0    79.5    80.0
 261          RY     8.0     8.0     8.0     0.0     0.0     8.0     8.0     8.0
              * DDM   ***** Preserved *****

 262          KK    430S
 263          KM   SUB-BASIN 430
 264          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 265          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
 266          KM     L =  .98  Kb = .050  Adj. Slope =   29.0
 267          BA    .237
 268          LG    .100    .250   4.650    .350  15.000
 269          UC    .563    .437
 270          UA       0       5      16      30      65      77      84      90      94      97
 271          UA     100
              * DDM   ***** Preserved *****

 272          KK   HC435
 273          KM   COMBINE FLOWS FROM SUB-BASINS 410, 420, 430 & COMBINED FLOWS AT HC405
 274          HC       4
              * DDM   ***** Preserved *****

 275          KK    170S
 276          KM   SUB-BASIN 170
 277          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 278          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 279          KM     L =  .61  Kb = .138  Adj. Slope =  315.0
 280          BA    .187
 281          LG    .200    .250   4.250    .450  37.000
 282          UC    .300    .170
 283          UA       0       3       5       8      12      20      43      75      90      96
 284          UA     100
              * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 285          KK    R171
 286          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 170 THROUGH SUB-BASIN 180
 287          RS       3    FLOW      -1
 288          RC   0.035   0.030   0.035    1200  0.0250
 289          RX       0     8.0    16.0    24.0    32.0    50.0    60.0    80.0
 290          RY     8.0     6.0     4.0     2.0     0.0     2.0     4.0     6.0
              * DDM   ***** Preserved *****

 291          KK    180S
 292          KM   SUB-BASIN 180
 293          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 294          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 295          KM     L =  .68  Kb = .100  Adj. Slope =  315.0
 296          BA    .095
 297          LG    .150    .250   4.150    .470  28.000
 298          UC    .258    .231
 299          UA       0       5      16      30      65      77      84      90      94      97
 300          UA     100
              * DDM   ***** Preserved *****

 301          KK    190S
 302          KM   SUB-BASIN 190
 303          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 304          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
 305          KM     L =  .91  Kb = .115  Adj. Slope =  315.0
 306          BA    .208
 307          LG    .170    .250   4.250    .450  42.000
 308          UC    .342    .255
 309          UA       0       3       5       8      12      20      43      75      90      96
 310          UA     100
              * DDM   ***** Preserved *****

 311          KK    R191
 312          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 190 THROUGH SUB-BASIN 180
 313          RS       2    FLOW      -1
 314          RC   0.035   0.030   0.035    1200  0.0400
 315          RX       0    25.0    30.0    40.0    50.0    55.0    80.0   100.0
 316          RY     6.0     4.0     2.0     0.0     2.0     4.0     6.0     6.0
              * DDM   ***** Preserved *****

 317          KK   HC195
 318          KM   COMBINE FLOWS FROM SUB-BASIN 170, SUB-BASIN 180 & SUB-BASIN 190
 319          HC       3
              * DDM   ***** Preserved *****

 320          KK    R196
 321          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 180 THROUGH SUB-BASIN 200
 322          RS       1    FLOW      -1
 323          RC   0.035   0.030   0.035     200  0.0500
 324          RX       0     8.0    16.0    24.0    32.0    50.0    60.0    80.0
 325          RY     8.0     6.0     4.0     2.0     0.0     2.0     4.0     6.0
              * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 326          KK    200S
 327          KM   SUB-BASIN 200
 328          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 329          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 330          KM     L =  .38  Kb = .093  Adj. Slope =  315.0
 331          BA    .048
 332          LG    .150    .250   4.150    .470  35.000
 333          UC    .183    .147
 334          UA       0       5      16      30      65      77      84      90      94      97
 335          UA     100
              * DDM   ***** Preserved *****

 336          KK   HC205
 337          KM   COMBINE FLOW FROM SUB-BASIN 200 AND COMBINED FLOWS AT HC195
 338          HC       2
              * DDM   ***** Preserved *****

 339          KK    R206
 340          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 200 THROUGH SUB-BASIN 210
 341          RS       3    FLOW      -1
 342          RC   0.035   0.030   0.035    1600  0.0125
 343          RX       0     0.5     1.0     9.0    31.0    39.0    39.5    40.0
 344          RY    10.0     4.0     4.0     0.0     0.0     4.0     4.0    10.0
              * DDM   ***** Preserved *****

 345          KK    210S
 346          KM   SUB-BASIN 210
 347          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 348          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 349          KM     L =  .61  Kb = .043  Adj. Slope =  185.0
 350          BA    .080
 351          LG    .100    .250    .340    .490  21.000
 352          UC    .183    .160
 353          UA       0       5      16      30      65      77      84      90      94      97
 354          UA     100
              * DDM   ***** Preserved *****

 355          KK   HC211
 356          KM   COMBINE FLOWS FROM SUB-BASIN 210 AND COMBINED FLOWS AT HC205
 357          HC       2
              * DDM   ***** Preserved *****

 358          KK    R212
 359          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 210 THROUGH SUB-BASIN 215
 360          RS       5    FLOW      -1
 361          RC   0.015   0.015   0.015    2600  0.0092
 362          RX       0     0.5    15.0    35.0    65.0    75.0    99.5   100.0
 363          RY     5.0     2.0     1.0     2.0     2.0     0.0     2.0     5.0
              * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 364          KK    215S
 365          KM   SUB-BASIN 215
 366          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 367          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
 368          KM     L =  .51  Kb = .063  Adj. Slope =   51.0
 369          BA    .028
 370          LG    .100    .250   4.800    .320  15.000
 371          UC    .329    .483
 372          UA       0       5      16      30      65      77      84      90      94      97
 373          UA     100
              * DDM   ***** Preserved *****

 374          KK   HC216
 375          KM   COMBINE FLOWS FROM SUB-BASIN 215 AND COMBINED FLOWS AT HC211
 376          HC       2
              * DDM   ***** Preserved *****

 377          KK    R217
 378          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 215 THROUGH SUB-BASIN 270
 379          RS       5    FLOW      -1
 380          RC   0.015   0.015   0.015    2600  0.0077
 381          RX       0     0.5    15.0    35.0    65.0    75.0    99.5   100.0
 382          RY     5.0     2.0     1.0     2.0     2.0     0.0     2.0     5.0
              * DDM   ***** Preserved *****

 383          KK    220S
 384          KM   SUB-BASIN 220
 385          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 386          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
 387          KM     L =  .27  Kb = .064  Adj. Slope =  219.2
 388          BA    .024
 389          LG    .100    .250   3.950    .510  15.000
 390          UC    .146    .128
 391          UA       0       5      16      30      65      77      84      90      94      97
 392          UA     100
              * DDM   ***** Preserved *****

 393          KK    R221
 394          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 220 THROUGH SUB-BASIN 230
 395          RS      11    FLOW      -1
 396          RC   0.100   0.015   0.100    3000  0.0183
 397          RX       0     0.5   550.0   550.5   579.5   580.0  1999.5  2000.0
 398          RY     5.0     0.5     0.5     0.0     0.0     0.5     0.5     5.0
              * DDM   ***** Preserved *****

 399          KK    230S
 400          KM   SUB-BASIN 230
 401          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 402          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
 403          KM     L =  .72  Kb = .051  Adj. Slope =  104.0
 404          BA    .206
 405          LG    .100    .250   4.500    .380  15.000
 406          UC    .267    .161
 407          UA       0       5      16      30      65      77      84      90      94      97
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 408          UA     100
              * DDM   ***** Preserved *****

 409          KK   HC235
 410          KM   COMBINE FLOWS FROM SUB-BASIN 220 AND SUB-BASIN 230
 411          HC       2
              * DDM   ***** Preserved *****

 412          KK    R236
 413          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 230 THROUGH SUB-BASIN 240
 414          RS       3    FLOW      -1
 415          RC   0.100   0.030   0.100    1000  0.0070
 416          RX       0     0.5   235.0   235.5   264.5   265.0   499.5   500.0
 417          RY     5.0     2.0     2.0     0.0     0.0     2.0     2.0     5.0
              * DDM   ***** Preserved *****

 418          KK    240S
 419          KM   SUB-BASIN 240
 420          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 421          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 422          KM     L =  .38  Kb = .059  Adj. Slope =   34.0
 423          BA    .057
 424          LG    .100    .250   4.700    .330  15.000
 425          UC    .304    .233
 426          UA       0       5      16      30      65      77      84      90      94      97
 427          UA     100
              * DDM   ***** Preserved *****

 428          KK    250S
 429          KM   SUB-BASIN 250
 430          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 431          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 432          KM     L =  .45  Kb = .112  Adj. Slope =  315.0
 433          BA    .078
 434          LG    .160    .250   4.200    .460  37.000
 435          UC    .221    .156
 436          UA       0       3       5       8      12      20      43      75      90      96
 437          UA     100
              * DDM   ***** Preserved *****

 438          KK    R251
 439          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 250 THROUGH SUB-BASIN 260
 440          RS      11    FLOW      -1
 441          RC   0.100   0.030   0.100    3200  0.0164
 442          RX       0     0.5   235.0   235.5   264.5   265.0   499.5   500.0
 443          RY     5.0     2.0     2.0     0.0     0.0     2.0     2.0     5.0
              * DDM   ***** Preserved *****

 444          KK    260S
 445          KM   SUB-BASIN 260
 446          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 447          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 448          KM     L =  .64  Kb = .053  Adj. Slope =  103.0
 449          BA    .147
 450          LG    .100    .250   4.350    .420  15.000
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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 451        UC    .258    .172
 452        UA       0       5      16      30      65      77      84      90      94      97
 453        UA     100
            * DDM   ***** Preserved *****

 454        KK   HC265
 455        KM   COMBINE FLOWS FROM SUB-BASIN 250 AND SUB-BASIN 260
 456        HC       2
            * DDM   ***** Preserved *****

 457        KK    R266
 458        KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 260 THROUGH SUB-BASIN 240
 459        RS       4    FLOW      -1
 460        RC   0.100   0.030   0.100    1400  0.0086
 461        RX       0     0.5   235.0   235.5   264.5   265.0   499.5   500.0
 462        RY     5.0     2.0     2.0     0.0     0.0     2.0     2.0     5.0
            * DDM   ***** Preserved *****

 463        KK   HC245
 464        KM   COMBINE FLOWS FROM SUB-BASIN 240 AND COMBINED FLOWS AT HC265 & HC235
 465        HC       3
            * DDM   ***** Preserved *****

 466        KK    R246
 467        KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 240 THROUGH SUB-BASIN 270
 468        RS       4    FLOW      -1
 469        RC   0.015   0.015   0.015    1800  0.0056
 470        RX       0     0.5    15.0    35.0    65.0    75.0    99.5   100.0
 471        RY     5.0     2.0     1.0     2.0     2.0     0.0     2.0     5.0
            * DDM   ***** Preserved *****

 472        KK    270S
 473        KM   SUB-BASIN 270
 474        KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 475        KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 476        KM     L =  .72  Kb = .053  Adj. Slope =   36.0
 477        BA    .147
 478        LG    .100    .250   4.700    .330  15.000
 479        UC    .429    .332
 480        UA       0       5      16      30      65      77      84      90      94      97
 481        UA     100
            * DDM   ***** Preserved *****

 482        KK   RE281
 483        KM   RETRIEVE CHEROKEE WASH & 56TH STREET SPLIT FLOW
 484        DR   281RE
            * DDM   ***** Preserved *****

 485        KK   HC275
 486        KM   COMBINE FLOWS FROM SUB-BASIN 270, COMBINED FLOWS AT HC245 & HC215 AND
 487        KM   DIVERTED FLOW FROM 281RE
 488        HC       4
            * DDM   ***** Preserved *****
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 489          KK    R276
 490          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 270 THROUGH SUB-BASIN 160
 491          RS       3    FLOW      -1
 492          RC   0.015   0.015   0.015    1400  0.0029
 493          RX       0     0.5    15.0    35.0    65.0    75.0    99.5   100.0
 494          RY     5.0     2.0     1.0     2.0     2.0     0.0     2.0     5.0
              * DDM   ***** Preserved *****

 495          KK    130S
 496          KM   SUB-BASIN 130
 497          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 498          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
 499          KM     L =  .23  Kb = .163  Adj. Slope =  315.0
 500          BA    .027
 501          LG    .200    .250   4.250    .450  32.000
 502          UC    .192    .143
 503          UA       0       3       5       8      12      20      43      75      90      96
 504          UA     100
              * DDM   ***** Preserved *****

 505          KK    R131
 506          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 130 THROUGH SUB-BASIN 140
 507          RS       6    FLOW      -1
 508          RC   0.015   0.015   0.015    1800  0.0156
 509          RX       0     0.5     1.0     1.5    28.5    29.0    29.5    30.0
 510          RY     5.0     0.5     0.5     0.0     0.0     0.5     0.5     5.0
              * DDM   ***** Preserved *****

 511          KK    140S
 512          KM   SUB-BASIN 140
 513          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 514          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 515          KM     L =  .68  Kb = .074  Adj. Slope =  315.0
 516          BA    .134
 517          LG    .140    .250   4.300    .430  29.000
 518          UC    .221    .160
 519          UA       0       5      16      30      65      77      84      90      94      97
 520          UA     100
              * DDM   ***** Preserved *****

 521          KK   HC145
 522          KM   COMBINE FLOWS FROM SUB-BASIN 130 AND SUB-BASIN 140
 523          HC       2
              * DDM   ***** Preserved *****

 524          KK    R146
 525          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 140 THROUGH SUB-BASIN 150
 526          RS       5    FLOW      -1
 527          RC   0.100   0.035   0.100    1355  0.0081
 528          RX       0     0.5   100.0   100.5   129.5   130.0  1099.5  1100.0
 529          RY     5.0     3.0     3.0     0.0     0.0     3.0     3.0     5.0
              * DDM   ***** Preserved *****
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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

530         KK    150S
531         KM   SUB-BASIN 150
532         KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
533         KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
534         KM     L =  .62  Kb = .054  Adj. Slope =   39.0
535         BA    .121
536         LG    .100    .250   4.650    .350  15.000
537         UC    .379    .287
538         UA       0       5      16      30      65      77      84      90      94      97
539         UA     100
            * DDM   ***** Preserved *****

540         KK   HC155
541         KM   COMBINE FLOWS FROM SUB-BASIN 140 AND SUB-BASIN 150
542         HC       2
            * DDM   ***** Preserved *****

543         KK    R156
544         KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 150 THROUGH SUB-BASIN 160
545         RS      17    FLOW      -1
546         RC   0.100   0.035   0.100    4600  0.0046
547         RX       0     0.5   100.0   100.5   129.5   130.0  1099.5  1100.0
548         RY     5.0     3.0     3.0     0.0     0.0     3.0     3.0     5.0
            * DDM   ***** Preserved *****

549         KK    160S
550         KM   SUB-BASIN 160
551         KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
552         KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
553         KM     L =  .91  Kb = .053  Adj. Slope =   24.0
554         BA    .144
555         LG    .100    .250   4.650    .350  15.000
556         UC    .608    .596
557         UA       0       5      16      30      65      77      84      90      94      97
558         UA     100
            * DDM   ***** Preserved *****

559         KK   HC165
560         KM   COMBINE FLOWS FROM SUB-BASIN 150 AND SUB-BASIN 160
561         HC       2
            * DDM   ***** Preserved *****

562         KK    280S
563         KM   SUB-BASIN 280
564         KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
565         KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
566         KM     L =  .49  Kb = .054  Adj. Slope =   24.0
567         BA    .115
568         LG    .100    .250   4.650    .350  15.000
569         UC    .396    .256
570         UA       0       5      16      30      65      77      84      90      94      97
571         UA     100
            * DDM   ***** Preserved *****
```

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

 572          KK   HC277
 573          KM   COMBINE FLOWS FROM SUB-BASIN 160 & 280 AND COMBINED FLOWS AT HC275
 574          HC       3
              * DDM   ***** Preserved *****

 575          KK    100S
 576          KM   SUB-BASIN 100
 577          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 578          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 579          KM     L =  .45  Kb = .088  Adj. Slope =  315.0
 580          BA    .088
 581          LG    .140    .250   4.150    .470  18.000
 582          UC    .196    .128
 583          UA       0       5      16      30      65      77      84      90      94      97
 584          UA     100
              * DDM   ***** Preserved *****

 585          KK    R101
 586          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 100 THROUGH SUB-BASIN 110
 587          RS      12    FLOW      -1
 588          RC   0.100   0.025   0.100    2800  0.0086
 589          RX       0     0.0    25.0    25.0    75.0    75.0   100.0   100.0
 590          RY     5.0     0.5     0.5     0.0     0.0     0.5     0.5     5.0
              * DDM   ***** Preserved *****

 591          KK    110S
 592          KM   SUB-BASIN 110
 593          KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 594          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 595          KM     L =  .72  Kb = .054  Adj. Slope =   42.0
 596          BA    .115
 597          LG    .100    .250   4.450    .400  15.000
 598          UC    .412    .365
 599          UA       0       5      16      30      65      77      84      90      94      97
 600          UA     100
              * DDM   ***** Preserved *****

 601          KK   HC115
 602          KM   COMBINE FLOWS FROM SUB-BASIN 100 AND SUB-BASIN 110
 603          HC       2
              * DDM   ***** Preserved *****

 604          KK    R116
 605          KM   NORMAL DEPTH FLOW ROUTING FROM SUB-BASIN 110 THROUGH SUB-BASIN 120
 606          RS       9    FLOW      -1
 607          RC   0.100   0.025   0.100    2200  0.0055
 608          RX       0     0.0    25.0    25.0    75.0    75.0   100.0   100.0
 609          RY     5.0     0.5     0.5     0.0     0.0     0.5     0.5     5.0
              * DDM   ***** Preserved *****
```

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

 610        KK    120S
 611        KM   SUB-BASIN 120
 612        KM   6-HOUR RAINFALL, PATTERN NO. 1.00 WAS USED TO FIND TC & R FOR THIS BASIN
 613        KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
 614        KM     L =  .45  Kb = .056  Adj. Slope =   27.0
 615        BA    .086
 616        LG    .100    .250   4.650    .350  15.000
 617        UC    .367    .260
 618        UA       0       5      16      30      65      77      84      90      94      97
 619        UA     100
            * DDM   ***** Preserved *****

 620        KK   HC125
 621        KM   COMBINE FLOWS FROM SUB-BASIN 110 AND SUB-BASIN 120
 622        HC       2
 623        ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 7         290S
             V
             V
25         R291
             .
             .
31           .        300S
             .          .
             .          .
41       HC305............
             V
             V
44         R306
             .
             .
50           .        310S
             .          V
             .          V
60           .        R311
             .          .
             .          .
66           .          .        320S
             .          .          V
             .          .          V
76           .          .        R321
             .          .          .
             .          .          .
82           .          .          .        330S
             .          .          .          .
             .          .          .          .
92           .          .      HC335............
             .          .          V
             .          .          V
95           .          .        R336
             .          .          .
             .          .          .
101          .          .          .        340S
             .          .          .          V
             .          .          .          V
111          .          .          .        R341
             .          .          .          .
             .          .          .          .
117          .          .          .          .        350S
             .          .          .          .          V
             .          .          .          .          V
127          .          .          .          .        R351
             .          .          .          .          .
             .          .          .          .          .
133          .          .          .          .          .        360S
             .          .          .          .          .          .
             .          .          .          .          .          .
143          .        HC365.......................................
             .          V
```

```
            .          V
146         .       R366
            .          .
            .          .
152         .          .      370S
            .          .         V
            .          .         V
162         .          .      R371
            .          .         .
            .          .         .
168         .          .         .       380S
            .          .         .          .
            .          .         .          .
178      HC385.................................
            V
            V
181      R386
            .
            .
187         .       390S
            .          .
            .          .
197      HC395............
            V
            V
200      R396
            .
            .
206         .       400S
            .          .
            .          .
216      HC405............
            .
            .
221         .-------->  281RE
219      DT405
            V
            V
224      R406
            .
            .
230         .       410S
            .          V
            .          V
240         .       R411
            .          .
            .          .
246         .          .      420S
            .          .         V
            .          .         V
256         .          .      R421
            .          .         .
            .          .         .
262         .          .         .       430S
            .          .         .          .
            .          .         .          .
272      HC435.................................
            .
            .
275         .       170S
```

```
        .        V
        .        V
285     .      R171
        .        .
        .        .
291     .        .       180S
        .        .         .
        .        .         .
301     .        .         .       190S
        .        .         .         V
        .        .         .         V
311     .        .         .       R191
        .        .         .         .
        .        .         .         .
317     .      HC195.......................
        .        V
        .        V
320     .      R196
        .        .
        .        .
326     .        .       200S
        .        .         .
        .        .         .
336     .      HC205............
        .        V
        .        V
339     .      R206
        .        .
        .        .
345     .        .       210S
        .        .         .
        .        .         .
355     .      HC211............
        .        V
        .        V
358     .      R212
        .        .
        .        .
364     .        .       215S
        .        .         .
        .        .         .
374     .      HC216............
        .        V
        .        V
377     .      R217
        .        .
        .        .
383     .        .       220S
        .        .         V
        .        .         V
393     .        .       R221
        .        .         .
        .        .         .
399     .        .         .       230S
        .        .         .         .
        .        .         .         .
409     .        .      HC235............
        .        .         V
        .        .         V
412     .        .       R236
```

```
                .         .         .
                .         .         .
418             .         .         .        240S
                .         .         .          .
                .         .         .          .
428             .         .         .          .        250S
                .         .         .          .          V
                .         .         .          .          V
438             .         .         .          .        R251
                .         .         .          .          .
                .         .         .          .          .
444             .         .         .          .          .        260S
                .         .         .          .          .          .
                .         .         .          .          .          .
454             .         .         .          .       HC265............
                .         .         .          .          V
                .         .         .          .          V
457             .         .         .          .        R266
                .         .         .          .          .
                .         .         .          .          .
463             .         .      HC245........................
                .         .         V
                .         .         V
466             .         .      R246
                .         .         .
                .         .         .
472             .         .         .        270S
                .         .         .          .
                .         .         .          .
484             .         .         .          .          .<-------   281RE
482             .         .         .          .       RE281
                .         .         .          .          .
                .         .         .          .          .
485             .      HC275.................................
                .         V
                .         V
489             .      R276
                .         .
                .         .
495             .         .      130S
                .         .         V
                .         .         V
505             .         .      R131
                .         .         .
                .         .         .
511             .         .         .        140S
                .         .         .          .
                .         .         .          .
521             .         .      HC145............
                .         .         V
                .         .         V
524             .         .      R146
                .         .         .
                .         .         .
530             .         .         .        150S
                .         .         .          .
                .         .         .          .
540             .         .      HC155............
                .         .         V
                .         .         V
```

```
543          .          .        R156
             .          .          .
             .          .          .
549          .          .          .        160S
             .          .          .          .
             .          .          .          .
559          .          .      HC165............
             .          .          .
             .          .          .
562          .          .          .        280S
             .          .          .          .
             .          .          .          .
572          .       HC277........................
             .          .
             .          .
575          .          .        100S
             .          .          V
             .          .          V
585          .          .        R101
             .          .          .
             .          .          .
591          .          .          .        110S
             .          .          .          .
             .          .          .          .
601          .          .      HC115............
             .          .          V
             .          .          V
604          .          .        R116
             .          .          .
             .          .          .
610          .          .          .        120S
             .          .          .          .
             .          .          .          .
620          .          .      HC125............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             MAY   1991                *
*          VERSION 4.0.1E               *
*                                       *
*  RUN DATE  09/07/95  TIME  16:15:44   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748               *
*                                       *
*****************************************
```

```
                    DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY  FCD 94-28
                      FILENAME:  DT36E.DAT     KHE JOB NO. 298
                      100-YEAR 6-HOUR STORM DURATION EXISTING CONDITIONS
                    DDM MCUHP1 DOUBLETREE REGIONAL STUDY

 6 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT           HYDROGRAPH TIME DATA
                      NMIN          1  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        500  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1    0  ENDING DATE
                    NDTIME       0819  ENDING TIME
                     ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.02 HOURS
                   TOTAL TIME BASE    8.32 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
      WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	290S	120.	4.08	16.	11.	11.	0.09		
ROUTED TO	R291	119.	4.13	16.	11.	11.	0.09	1.46	4.13
HYDROGRAPH AT	300S	61.	4.03	7.	5.	5.	0.05		
2 COMBINED AT	HC305	175.	4.08	23.	17.	17.	0.14		
ROUTED TO	R306	175.	4.08	23.	17.	17.	0.14	2.01	4.08
HYDROGRAPH AT	310S	293.	4.20	48.	35.	35.	0.25		
ROUTED TO	R311	291.	4.27	48.	35.	35.	0.25	2.56	4.27
HYDROGRAPH AT	320S	238.	4.07	34.	25.	25.	0.17		
ROUTED TO	R321	237.	4.10	34.	25.	25.	0.17	0.62	4.10
HYDROGRAPH AT	330S	195.	4.03	27.	19.	19.	0.12		
2 COMBINED AT	HC335	425.	4.05	61.	44.	44.	0.29		
ROUTED TO	R336	421.	4.12	61.	44.	44.	0.29	3.32	4.12
HYDROGRAPH AT	340S	99.	4.10	15.	11.	11.	0.07		
ROUTED TO	R341	98.	4.17	15.	11.	11.	0.07	1.47	4.17
HYDROGRAPH AT	350S	114.	4.03	17.	12.	12.	0.08		
ROUTED TO	R351	113.	4.08	17.	12.	12.	0.08	1.55	4.08
HYDROGRAPH AT	360S	308.	4.05	38.	27.	27.	0.25		
5 COMBINED AT	HC365	1159.	4.10	178.	129.	129.	0.94		
ROUTED TO	R366	1156.	4.13	178.	129.	129.	0.94	4.73	4.13
HYDROGRAPH AT	370S	192.	4.13	30.	22.	22.	0.14		
ROUTED TO	R371	190.	4.25	30.	22.	22.	0.14	2.34	4.25
HYDROGRAPH AT	380S	80.	4.05	10.	7.	7.	0.07		
4 COMBINED AT	HC385	1574.	4.13	240.	174.	174.	1.30		
ROUTED TO	R386	1568.	4.18	240.	174.	174.	1.30	6.19	4.18
HYDROGRAPH AT	390S	70.	4.10	10.	7.	7.	0.07		
2 COMBINED AT	HC395	1634.	4.18	250.	181.	181.	1.36		

ROUTED TO	R396	1632.	4.20	250.	181.	181.	1.36	4.80	4.20
HYDROGRAPH AT	400S	167.	4.10	25.	18.	18.	0.14		
2 COMBINED AT	HC405	1786.	4.20	275.	200.	200.	1.51		
DIVERSION TO	281RE	422.	4.20	55.	40.	40.	1.51		
HYDROGRAPH AT	DT405	1365.	4.20	221.	160.	160.	1.51		
ROUTED TO	R406	1359.	4.27	220.	160.	160.	1.51	4.82	4.27
HYDROGRAPH AT	410S	101.	4.05	14.	10.	10.	0.08		
ROUTED TO	R411	98.	4.23	14.	10.	10.	0.08	2.12	4.23
HYDROGRAPH AT	420S	141.	4.10	23.	16.	16.	0.12		
ROUTED TO	R421	139.	4.25	23.	16.	16.	0.12	2.43	4.25
HYDROGRAPH AT	430S	196.	4.30	37.	27.	27.	0.24		
4 COMBINED AT	HC435	1790.	4.27	293.	213.	213.	1.94		
HYDROGRAPH AT	170S	234.	4.17	35.	25.	25.	0.19		
ROUTED TO	R171	233.	4.18	35.	25.	25.	0.19	2.09	4.18
HYDROGRAPH AT	180S	105.	4.08	16.	12.	12.	0.09		
HYDROGRAPH AT	190S	241.	4.22	41.	30.	30.	0.21		
ROUTED TO	R191	241.	4.23	41.	30.	30.	0.21	2.13	4.23
3 COMBINED AT	HC195	567.	4.20	92.	67.	67.	0.49		
ROUTED TO	R196	567.	4.20	92.	67.	67.	0.49	2.53	4.20
HYDROGRAPH AT	200S	62.	4.05	9.	6.	6.	0.05		
2 COMBINED AT	HC205	615.	4.18	101.	73.	73.	0.54		
ROUTED TO	R206	614.	4.22	101.	73.	73.	0.54	2.52	4.22
HYDROGRAPH AT	210S	112.	4.05	16.	11.	11.	0.08		
2 COMBINED AT	HC211	701.	4.20	116.	84.	84.	0.62		
ROUTED TO	R212	700.	4.25	116.	84.	84.	0.62	2.28	4.25
HYDROGRAPH AT	215S	23.	4.20	4.	3.	3.	0.03		
2 COMBINED AT	HC216	723.	4.25	121.	88.	88.	0.65		
ROUTED TO	R217	721.	4.32	121.	88.	88.	0.65	2.35	4.32
HYDROGRAPH AT	220S	29.	4.03	3.	2.	2.	0.02		
ROUTED TO	R221	28.	4.17	3.	2.	2.	0.02	0.17	4.17

HYDROGRAPH AT	230S	249.	4.07	31.	23.	23.	0.21		
2 COMBINED AT	HC235	275.	4.08	35.	25.	25.	0.23		
ROUTED TO	R236	273.	4.10	35.	25.	25.	0.23	1.68	4.10
HYDROGRAPH AT	240S	64.	4.10	9.	7.	7.	0.06		
HYDROGRAPH AT	250S	101.	4.12	15.	11.	11.	0.08		
ROUTED TO	R251	99.	4.22	15.	11.	11.	0.08	0.69	4.22
HYDROGRAPH AT	260S	171.	4.07	22.	16.	16.	0.15		
2 COMBINED AT	HC265	258.	4.10	36.	26.	26.	0.22		
ROUTED TO	R266	257.	4.15	36.	26.	26.	0.22	1.52	4.15
3 COMBINED AT	HC245	593.	4.12	80.	58.	58.	0.51		
ROUTED TO	R246	589.	4.17	80.	58.	58.	0.51	2.32	4.17
HYDROGRAPH AT	270S	142.	4.18	23.	17.	17.	0.15		
HYDROGRAPH AT	RE281	422.	4.20	55.	40.	40.	0.00		
4 COMBINED AT	HC275	1836.	4.22	279.	202.	202.	1.31		
ROUTED TO	R276	1833.	4.25	279.	202.	202.	1.31	3.60	4.25
HYDROGRAPH AT	130S	35.	4.10	5.	3.	3.	0.03		
ROUTED TO	R131	34.	4.18	5.	3.	3.	0.03	0.25	4.18
HYDROGRAPH AT	140S	169.	4.05	23.	17.	17.	0.13		
2 COMBINED AT	HC145	199.	4.07	28.	20.	20.	0.16		
ROUTED TO	R146	198.	4.12	28.	20.	20.	0.16	1.45	4.12
HYDROGRAPH AT	150S	123.	4.15	19.	14.	14.	0.12		
2 COMBINED AT	HC155	320.	4.12	47.	34.	34.	0.28		
ROUTED TO	R156	314.	4.30	47.	34.	34.	0.28	2.32	4.30
HYDROGRAPH AT	160S	103.	4.38	22.	16.	16.	0.14		
2 COMBINED AT	HC165	416.	4.32	69.	50.	50.	0.43		
HYDROGRAPH AT	280S	121.	4.15	18.	13.	13.	0.12		
3 COMBINED AT	HC277	2353.	4.25	366.	265.	265.	1.85		
HYDROGRAPH AT	100S	108.	4.03	13.	9.	9.	0.09		
ROUTED TO	R101	103.	4.23	13.	9.	9.	0.09	0.55	4.23
HYDROGRAPH AT	110S	102.	4.18	17.	12.	12.	0.12		

2 COMBINED AT	HC115	204.	4.22	30.	22.	22.	0.20		
ROUTED TO	R116	201.	4.37	30.	22.	22.	0.20	0.91	4.37
HYDROGRAPH AT	120S	91.	4.13	13.	10.	10.	0.09		
2 COMBINED AT	HC125	278.	4.33	43.	31.	31.	0.29		

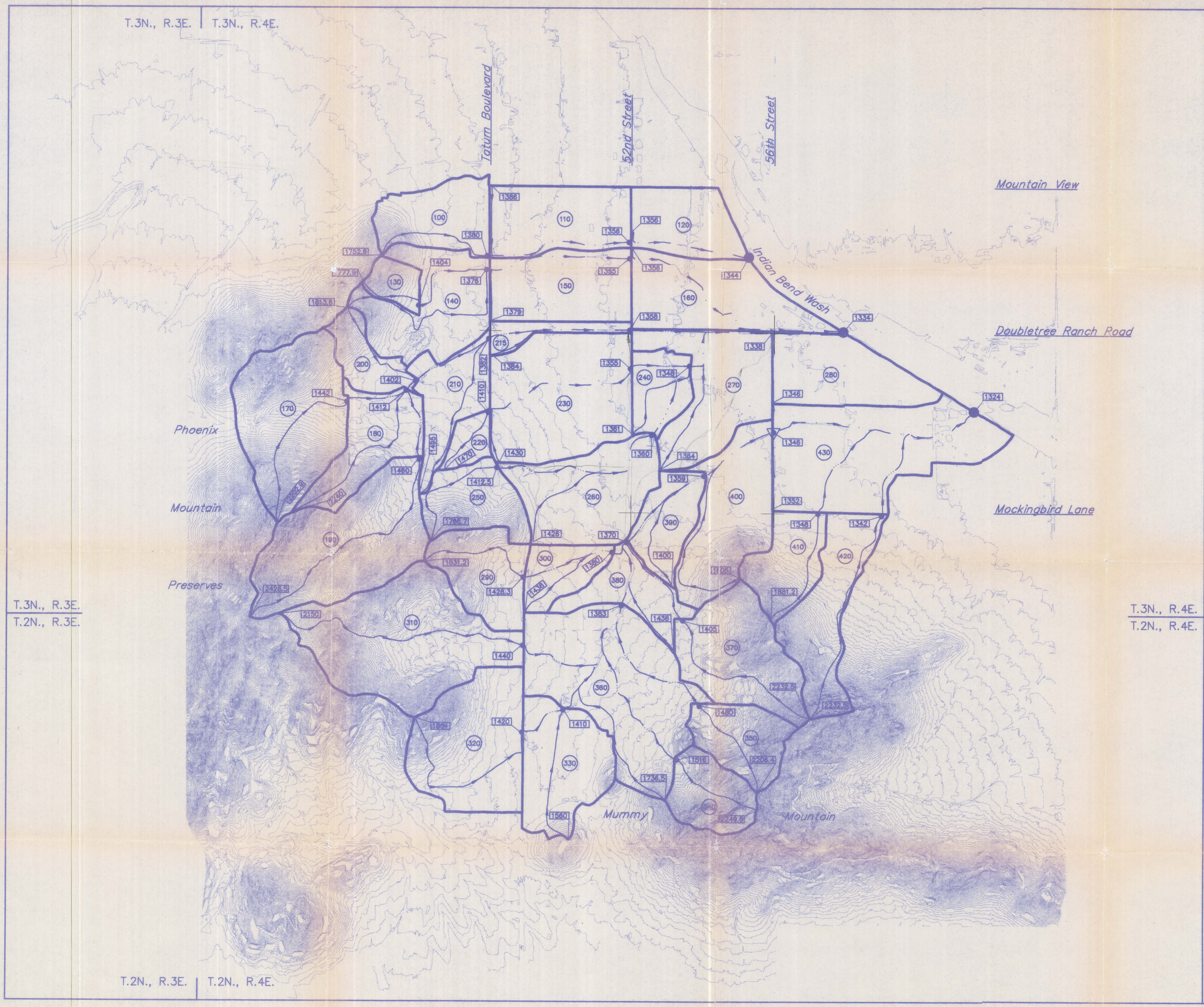
*** NORMAL END OF HEC-1 ***

SECTION VII

Plates

LIST OF PLATES

Plate 1	Drainage Area Map & HEC-1 Schematic (Existing Conditions)	Pocket
Plate 2	Drainage Basin Land Use Map (Existing Conditions)	Pocket
Plate 3	Soil Classification Map (Existing Conditions)	Pocket
Plate 4	Flow Routing Map (Existing Conditions)	Pocket



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY FCD 94-28

LEGEND

- Drainage Basin Boundary
- (150) Drainage Sub-Basin Number
- Major Drainage Basin Concentration Point
- Drainage Sub-Basin Concentration Point
- Flow Diversion Point
- Routing Flow Path
- Length of Longest Watercourse
- Length of Longest Watercourse and Routing Flow Path
- [1514] Elevation Along Flow Path

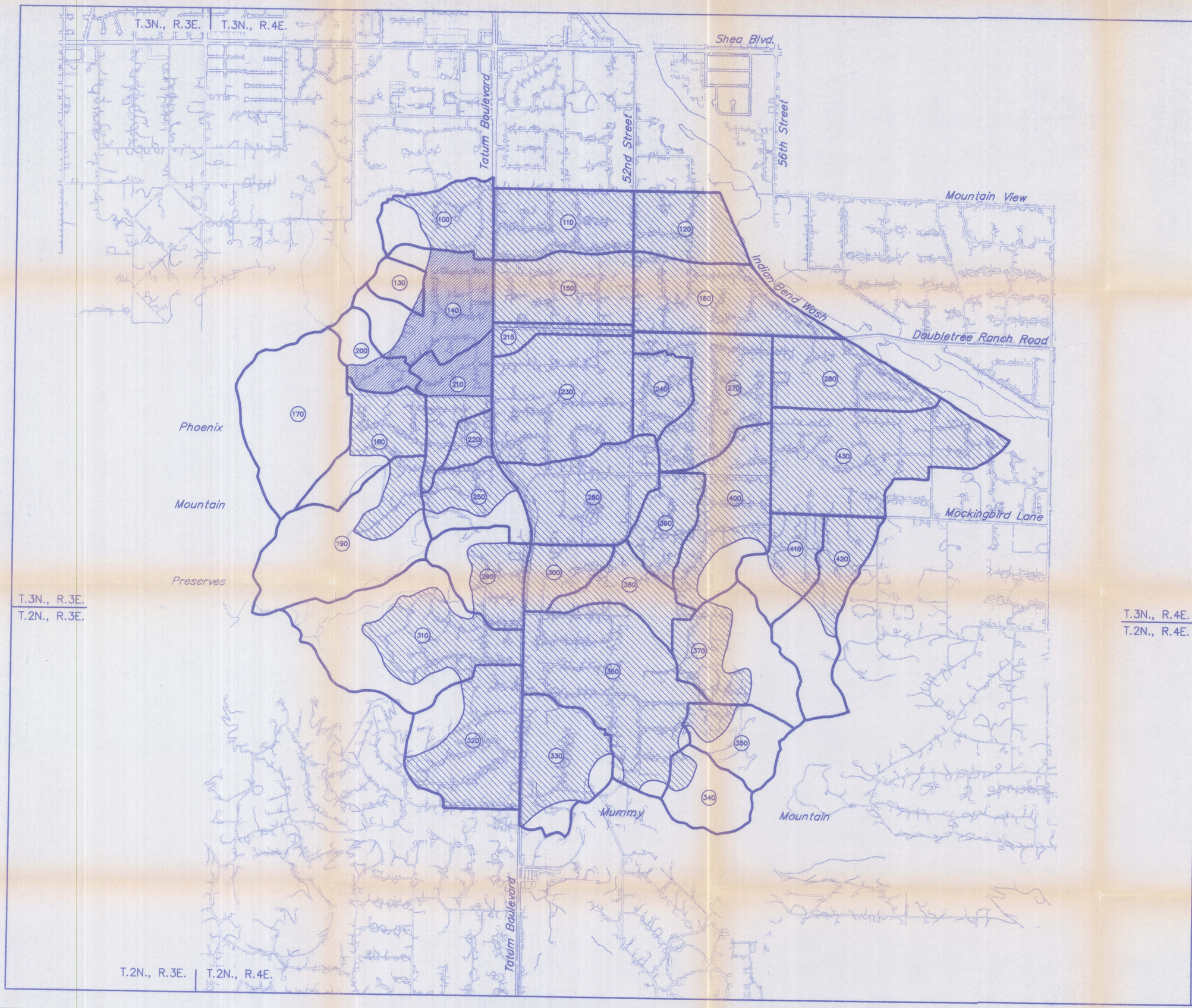
FLOW ROUTING MAP
EXISTING CONDITIONS

PLATE 4

KAMINSKI HUBBARD engineering, inc.
SURVEYING • CIVIL • HYDROLOGY
4550 N. BLACK CANYON HWY., SUITE C
PHOENIX, ARIZONA 85017
(602) 242-5588

N

SCALE
800 400 0 800 1600
FEET



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY FCD 94-28

LEGEND

- Drainage Basin Boundary
- Low Density Residential Land Use
- Medium Density Residential Land Use
- Desert Land Use
- (150) Drainage Sub-Basin Number

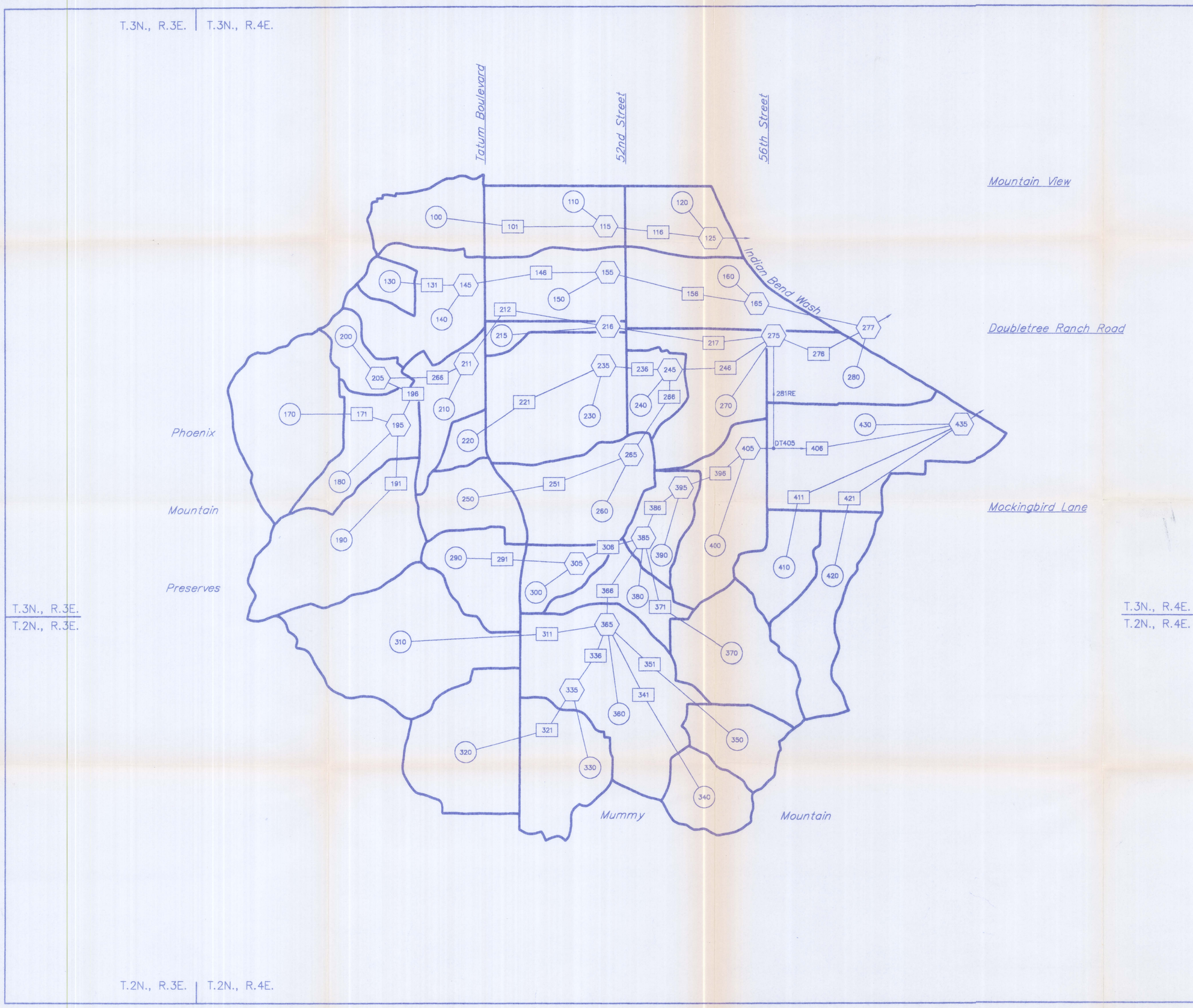
LAND USE MAP
EXISTING CONDITIONS

PLATE 2

KAMINSKI HUBBARD engineering, inc.
SURVEYING • CIVIL • HYDROLOGY
4550 N. BLACK CANYON HWY., SUITE C
PHOENIX, ARIZONA 85017
(602) 242-5588

N

SCALE
800 400 0 800 1600
FEET



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY FCD 94-28

LEGEND

- Drainage Basin Boundary
- (A) Compute Runoff from Sub-Basin A
- (B) Compute Runoff from Sub-Basin B
- (C) Combine Hydrographs
- [D] Route Hydrograph
- (E) Route Hydrograph through Retention Basin E
- G/F Divide Hydrograph into F and G

DRAINAGE AREA MAP & HEC-1 SCHEMATIC

EXISTING CONDITIONS

PLATE 1

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY FCD 94-28

LEGEND

Drainage Basin Boundary

150 Drainage Sub-Basin Number

Es Soil Unit Boundary

PvC **Soil Unit Identification**
Reference: USDA, Soil Conservation Service, Soil Survey of Eastern Maricopa and Northern Pinal Counties, Arizona

109 **Soil Unit Identification**
Reference: USDA, Soil Conservation Service, Soil Survey of Aguila-Carefree Area Parts of Maricopa and Pinal Counties, Arizona

SOILS MAP
EXISTING CONDITIONS

PLATE 3

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N

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SECTION VIII

HEC-1 Data Files On Computer Diskette