Hydrology Report

December 1989

16923-HPH

MORGAN CITY WASH
FLOODPLAIN DELINEATION STUDY
FCD 89-15

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Prepared for

Flood Control District
of
Maricopa County

Submitted by

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for the
Flood Control District of Maricopa County

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16923-HPH-04

HYDROLOGY REPORT
MORGAN CITY WASH
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1.0 Introduction

This report presents the results of a hydrologic analysis of the Morgan City Wash watershed in northern Maricopa County, Arizona. The hydrologic analysis is part of a floodplain delineation study of Morgan City Wash being conducted by Baker Engineers for the Flood Control District of Maricopa County. The reach of Morgan City Wash being evaluated is from the confluence with the Agua Fria River upstream to the Maricopa County boundary (See Figure 1).

1.1 Purpose of the Study

A hydrologic and hydraulic analysis of the Morgan City Wash watershed is being completed to determine 100-year peak discharges and associated floodplain and floodway limits. Water-surface profiles will be computed for Morgan City Wash to established base flood elevations. This information will be combined into a floodway and floodplain map which will be submitted by the Flood Control District to the Federal Emergency Management Agency (FEMA) for approval. Upon approval by FEMA, the maps will be used in establishing flood insurance rates and flood plain management requirements.

1.2 Authority for Study

This study was authorized by a contract for floodplain delineation services (FCD 89-15) with the Flood Control District of Maricopa County dated June 5, 1989.

1.3 Watershed Description

The Morgan City Wash watershed is comprised of approximately 23.0 square miles of land within the unincorporated area of northern Maricopa County and southern Yavapai County. Morgan City Wash is a tributary of the Agua Fria River, and its watershed lies with the Heiroglyphic Mountains. Direction of flow is generally east-southeast. The Heiroglyphic Mountains are a complex series of low hills and ridges, generally between 1500 and 3500 feet in elevation. The watershed is very highly eroded rock outcrop. Soils are typically well-drained but very shallow. Because of steep slopes throughout the watershed, the drainage is comprised of an intricate pattern of deep washes and sharp

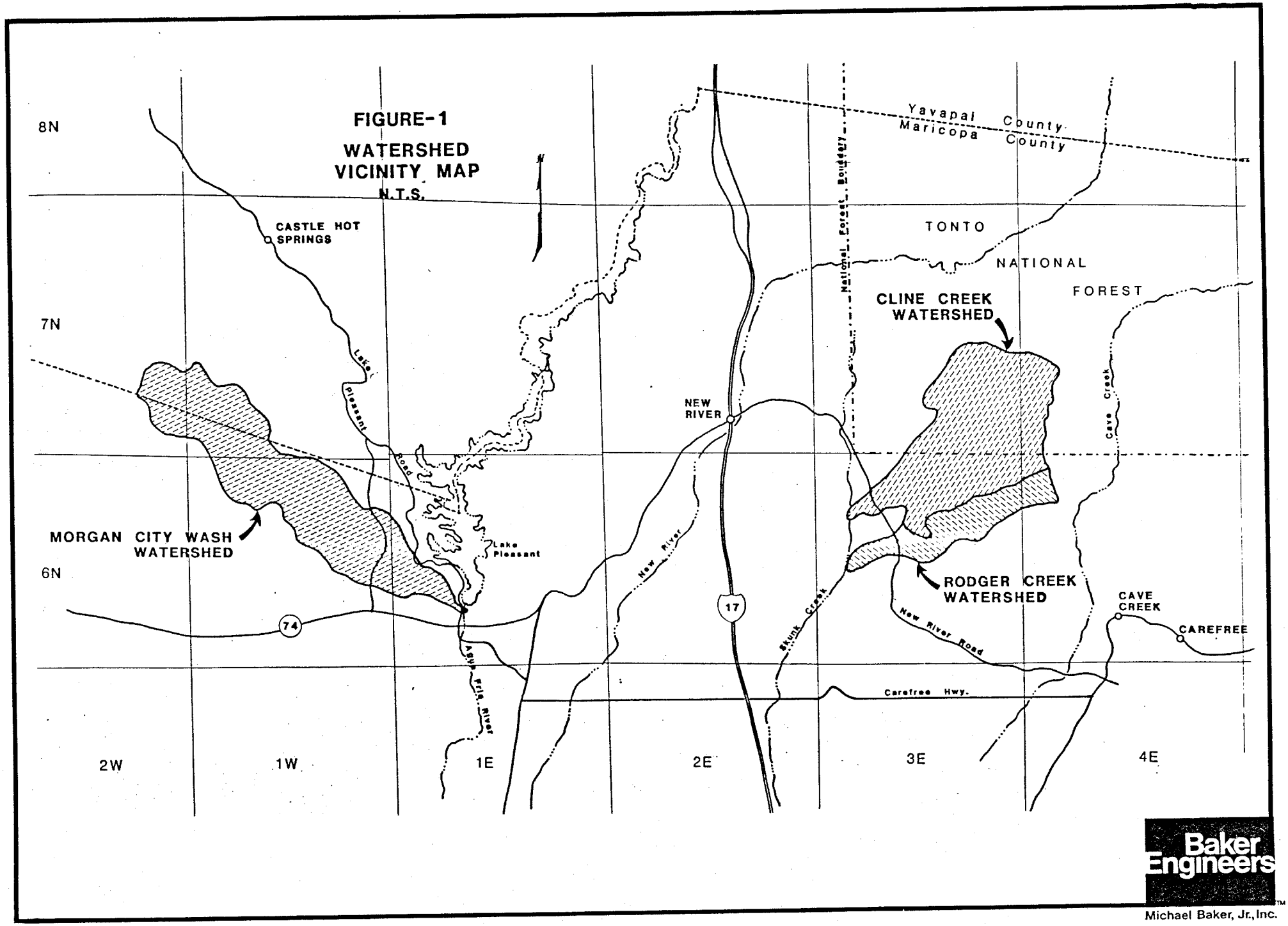
divides. The main stem of Morgan City Wash and its major tributaries are steep with one to five percent longitudinal slopes. These streams flow on gravel beds and have near-vertical banks in many reaches. Upland slopes exceeding 80% near the sharp divides are common in the west half of the watershed. The uplands tend to be slightly less steep and the divides are slightly more rounded in the east half of the watershed.

Vegetation is desert brush of light to moderate density. Stream channels contain moderate to very dense riparian vegetation in some reaches, although the well-defined gravel low-flow channel exists throughout almost all of Morgan City Wash.

Human habitation is extremely sparse. Scattered mining efforts represent the only significant permanent activity. There are no residential subdivisions present, although some development may result from enlargement of Lake Pleasant and the associated recreational improvements. The only drainage structures within the watershed are multi-barrel concrete box culvert crossings of the wash for the old and new access roads to Lake Pleasant (See Figure 2).

1.4 Previous Studies

A review of existing data for the Morgan City Wash watershed found no detailed hydrologic studies. The Morgan City Wash area is mapped as Zone B on the effective Flood Insurance Rate Map (FIRM) for Maricopa County [1].



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2.0 Engineering Methodology

The HEC-1 computer program of the U.S. Army Corps of Engineers [2] was used in the hydrologic analysis of the Morgan City Wash watershed. The program produces an incremental time-based record of storm runoff from a watershed. The watershed is modeled as a series of sub-basins connected by the watershed stream system. Hydrographs are computed for precipitation runoff from the sub-basins, as additions of several hydrographs at stream junctions and as hydrographs routed along stream reaches or through reservoirs. Sub-basins are selected of nearly-equal size (time of concentration) in order that the single value of time-interval chosen for computations produces accurate results with a reasonable amount of output. The Watershed Boundary Map (Figure 2) shows the sub-basins used for the Morgan City Wash hydrology.

The HEC-1 option utilizing the Soil Conservation Service (SCS) dimensionless hydrograph in combination with initial and uniform loss rate methodology was selected for computing sub-basin runoff. The Muskingum routing option was used for routing of flood hydrographs downstream through the various channel reaches of the watershed. The development of the various input parameters for the HEC-1 watershed model is presented in the following paragraphs.

2.1 Rainfall

Floodplains in Maricopa County are delineated for a peak 100-year flow. Runoff is simulated for storm durations of 2, 6 and 24 hours. The maximum peak flow from among the three storms is used for floodplain delineation of a stream segment. The source of precipitation depths is NOAA Atlas 2 [3]. The storm total precipitation values for this study are given in Table 1.

TABLE 1 Morgan City Wash 100-Year Storm Total Point Precipitation	
Duration (hours)	Precipitation (inches)
2	2.76
6	3.40
24	4.50

The SCS 100-year Type II Rainfall Distributions included in Appendix D were used to define temporal distribution for the three precipitation events (see Figure 3). Cumulative point precipitation at 15 minute intervals is presented in Table 2. Because of the input requirements of the 'JD' option, discussed below, the precipitation distribution was input as the cumulative percent of storm total precipitation for the 2, 6, and 24 hour events (see Appendix D).

The Morgan City Wash watershed area of approximately 23 square miles exceeds the maximum watershed area, 10 square miles, for which point precipitation may be considered average precipitation for the entire watershed under Flood Control District criteria. Areal reduction of precipitation was applied to the 2, 6, and 24 hour 100-year storms in accordance with the National Weather Service's HYDRO-40 [4]. The HEC-1 "JD" option was used to perform the areal reduction automatically. The "JD" option accounts for accumulated drainage area for each sub-basin and combination hydrograph computation and adjusts the hydrograph flows to compensate for areal reduction of precipitation. The input requirement is a minimum of five data pairs defining the relationship between average basin-wide precipitation and basin area. The areal reduction values also depend on storm duration, so each of the three storms in the study has separate "JD" input data pairs. The areal reduction values are given in Table 3.

Development of precipitation input data for the HEC-1 hydrology model is presented in Appendix E.

FIGURE - 3

MORGAN CITY WASH 100 YEAR STORM

SCS TYPE II PRECIPITATION DISTRIBUTION

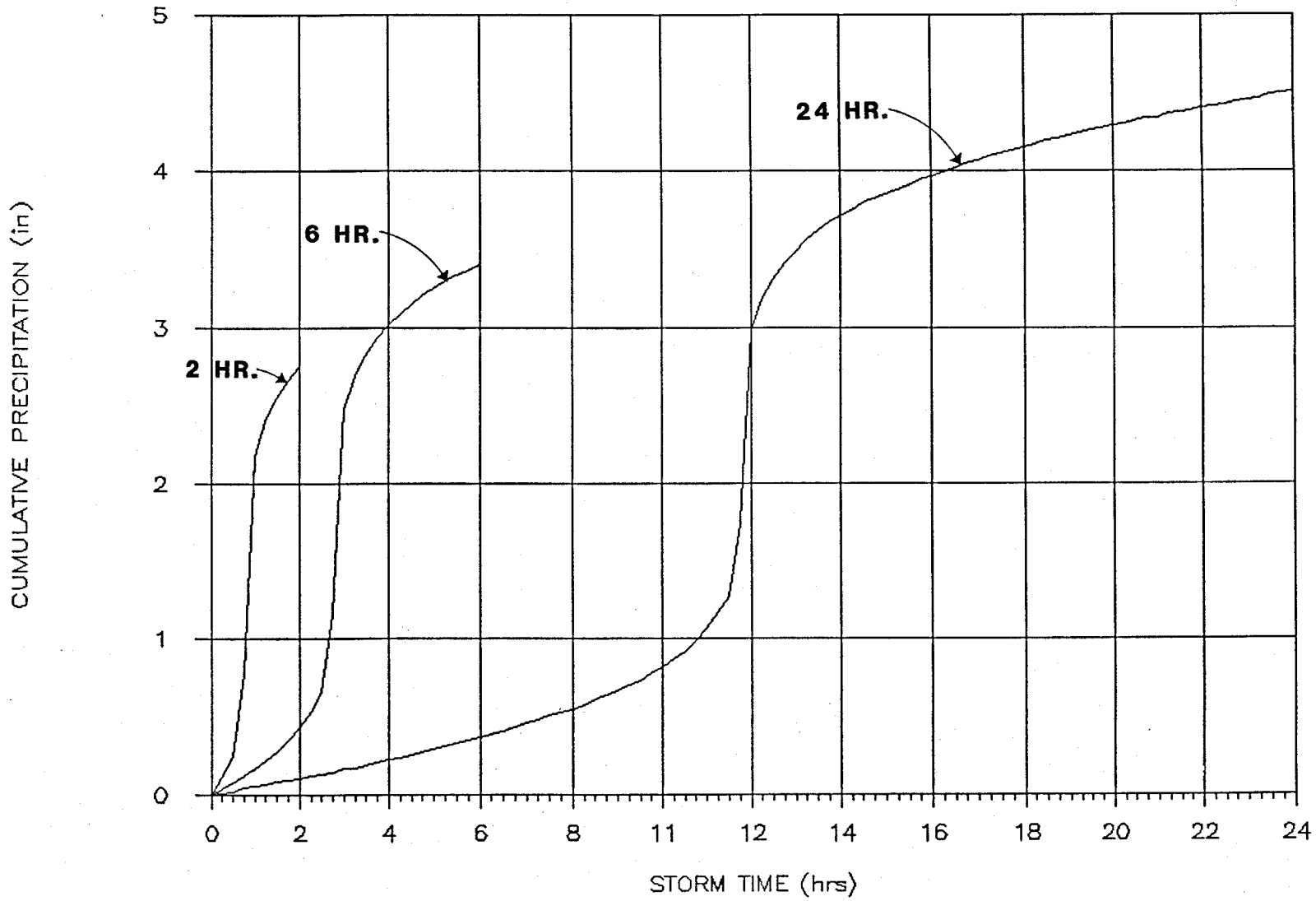

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TABLE - 2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY - FLOOD PLAIN DELINATION STUDY

MORGAN CITY WASH BAKER ENGINEERS PROJECT NUMBER 16923-HPH
100-YEAR POINT RAINFALL: 2 HR., 6 HR., & 24 HR.
SCS TYPE II PRECIPITATION DISTRIBUTION

		STORM-PRECIPITATION			
STORM TIME (hrs.)	2 HR. (in.)	6 HR. (in.)	24 HR. (in.)	STORM TIME (cont.)	24 HR. (cont.)
0.00	0.00	0.00	0.00	12.25	3.18
0.25	0.11	0.04	0.01	12.50	3.31
0.50	0.24	0.08	0.02	12.75	3.41
0.75	0.77	0.12	0.04	13.00	3.49
1.00	2.18	0.16	0.05	13.25	3.56
1.25	2.41	0.21	0.06	13.50	3.62
1.50	2.55	0.27	0.08	13.75	3.67
1.75	2.67	0.34	0.09	14.00	3.71
2.00	2.76	0.43	0.10	14.25	3.75
2.25		0.53	0.12	14.50	3.79
2.50		0.65	0.13	14.75	3.82
2.75		1.15	0.14	15.00	3.85
3.00		2.48	0.16	15.25	3.88
3.25		2.69	0.17	15.50	3.91
3.50		2.82	0.18	15.75	3.94
3.75		2.93	0.20	16.00	3.96
4.00		3.02	0.22	16.25	3.99
4.25		3.09	0.23	16.50	4.02
4.50		3.15	0.25	16.75	4.04
4.75		3.20	0.27	17.00	4.06
5.00		3.25	0.29	17.25	4.09
5.25		3.30	0.31	17.50	4.11
5.50		3.33	0.32	17.75	4.13
5.75		3.37	0.34	18.00	4.15
6.00		3.40	0.36	18.25	4.17
6.25			0.38	18.50	4.19
6.50			0.40	18.75	4.20
6.75			0.43	19.00	4.22
7.00			0.45	19.25	4.24
7.25			0.47	19.50	4.26
7.50			0.50	19.75	4.27
7.75			0.52	20.00	4.29
8.00			0.54	20.25	4.30
8.25			0.57	20.50	4.32
8.50			0.60	20.75	4.33
8.75			0.63	21.00	4.34
9.00			0.66	21.25	4.36
9.25			0.70	21.50	4.37
9.50			0.73	21.75	4.38
9.75			0.77	22.00	4.40
11.00			0.81	22.25	4.41
10.25			0.86	22.50	4.42
10.50			0.91	22.75	4.44
10.75			0.98	23.00	4.45
11.00			1.06	23.25	4.46
11.25			1.16	23.50	4.48
11.50			1.27	23.75	4.49
11.75			1.74	24.00	4.50
12.00			2.98		

TABLE 3
Areal Reduction of Precipitation
for Morgan City Wash 100-Year Storms

2 HOUR EVENT

(P_{100} = 2.76 inches)

Area (Miles ^{2})	Areal Reduction Factor	Total Storm Precipitation (inches)
0	1.00	2.76
10	0.79	2.18
20	0.73	2.01
30	0.69	1.90
40	0.66	1.82

6 HOUR EVENT

(P_{100} = 3.40 inches)

Area (Miles ^{2})	Areal Reduction Factor	Total Storm Precipitation (inches)
0	1.00	3.40
10	0.85	2.89
20	0.79	2.69
30	0.75	2.55
40	0.72	2.45

24 HOUR EVENT

(P_{100} = 4.50 inches)

Area (Miles ^{2})	Areal Reduction Factor	Total Storm Precipitation (inches)
0	1.00	4.50
10	0.95	4.28
20	0.92	4.14
30	0.90	4.05
40	0.89	4.01

2.2 Soil Losses

The SCS Aguila - Carefree Soil Survey [5] was used to determine soil characteristics and infiltration properties within the Morgan City Wash watershed. The watershed boundary and sub-basin locations were plotted on the soils maps, and the area of each soil group within the sub-basins was determined, (see Figure 4).

Soils were classified by their texture using data from the Aguila - Carefree Soil Survey [5] and loss rate correlations provided by the Flood Control District contained in Appendix D. The Initial and Uniform Loss Rate option of the HEC-1 computer program was selected to determine rainfall excess. Values of initial losses, uniform loss rates and percent impervious were computed for each sub-basin using the soil texture classifications and ground cover. Table 4 lists the soils groups found within the Morgan City Wash watershed and percentages of each soil group within each sub-basin. Initial and uniform loss rate parameter values for each sub-basin are listed in Table 5. Loss rate and impervious area calculations are presented in Appendix F.

TABLE 4
Morgan City Wash Watershed
Soil Groups

SCS Group Number	SCS Group Name	Area (acres)	Percent of Sub-Basin
Sub Basin M-1			
16	Cellar-Rock Outcrop	918	71.7
31	Dixaleta-Rock Outcrop Complex	273	21.3
72	Lehmans - Rock Outcrop Complex	90	7.0
		1281	100.0
Sub Basin M-2			
8	Arizo Cobbly Sandy Loam	6	0.6
16	Cellar-Rock Outcrop	156	15.6
31	Dixaleta-Rock Outcrop Complex	268	26.9
72	Lehmans - Rock Outcrop Complex	442	44.3
104	Rock Outcrop - Lehmans Complex	126	12.6
		998	100.0
Sub Basin M-3			
31	Dixaleta-Rock Outcrop Complex	1208	100.0
Sub Basin M-4			
8	Arizo Cobbly Sandy Loam	7	0.4
31	Dixaleta-Rock Outcrop Complex	1704	99.6
		1711	100.0

TABLE 4 (Cont'd)
Morgan City Wash Watershed
Soil Groups

SCS Group Number	SCS Group Name	Area (acres)	Percent of Sub-Basin
Sub Basin M-5			
8	Arizo Cobbly Sandy Loam	59	5.3
31	Dixaleta-Rock Outcrop Complex	936	84.2
41	Eba-Pinaleno Complex	22	2.0
104	Rock Outcrop-Lehmans Complex	95	8.5
		1112	100.0
Sub Basin M-6			
8	Arizo Cobbly Sandy Loam	127	7.6
31	Dixaleta-Rock Outcrop Complex	812	48.7
33	Eba Very Gravelly Loam	30	1.8
41	Eba-Pinaleno Complex	14	0.8
72	Lehmans - Rock Outcrop Complex	374	22.4
95	Ohoco Gravelly Loams	11	0.7
104	Rock Outcrop-Lehmans Complex	301	18.0
		1669	100.0
Sub Basin M-7			
31	Dixaleta-Rock Outcrop Complex	130	26.2
72	Lehmans Rock Outcrop Complex	367	73.8
		497	100.0

TABLE 4 (Cont'd)
Morgan City Wash Watershed
Soil Groups

SCS Group Number	SCS Group Name	Area (acres)	Percent of Sub-Basin
Sub Basin M-8			
8	Arizo Cobbly Sandy Loam	15	1.0
31	Dixaleta-Rock Outcrop Complex	776	50.8
72	Lehmans - Rock Outcrop Complex	166	10.9
104	Rock Outcrop-Lehmans Complex	20	1.3
109	Schenco - Rock Outcrop Complex	550	36.0
		1527	100.0
Sub Basin M-9			
10	Brios-Carrizo Complex	88	7.8
48	Ebon-Pinamt Complex	3	0.3
51	Gachado-Lomitas Complex	44	3.9
52	Gachado - Lomitas - Rock Outcrop Complex	149	13.2
68	Gunsight - Cipriano Complex	18	1.6
70	Gunsight - Rillito Complex	18	1.6
103	Rock Outcrop - Gachado Complex	43	3.8
104	Rock Outcrop - Lehmans Complex	56	5.0
108	Schenco Rock Outcrop Complex	209	18.6
109	Schenco Rock Outcrop Complex	498	44.2
		1126	100.0

TABLE 4 (Cont'd)
Morgan City Wash Watershed
Soil Groups

SCS Group Number	SCS Group Name	Area (acres)	Percent of Sub-Basin
Sub Basin M-10			
10	Brios-Carrizo Complex	9	0.9
21	Cipriano - Very Gravelly Loam	32	3.3
31	Dixaleta-Rock Outcrop Complex	30	3.1
48	Ebon-Pinamt Complex	12	1.3
51	Gachado-Lomitas Complex	113	11.8
52	Gachado - Lomitas Complex	25	2.6
72	Lehmans - Rock Outcrop Complex	89	9.3
104	Rock Outcrop-Lehmans Complex	651	67.7
		961	100.0
Sub Basin M-11			
10	Brios-Carrizo Complex	33	5.3
51	Gachado-Lomitas Complex	314	50.7
52	Gachado - Lomitas Complex	59	9.5
93	Nickel-Cave Complex	11	1.8
104	Rock Outcrop - Lehmans Complex	203	32.7
		620	100.0

TABLE 4 (Cont'd)
Morgan City Wash Watershed
Soil Groups

SCS Group Number	SCS Group Name	Area (acres)	Percent of Sub-Basin
Sub Basin M-12			
51	Gachado-Lomitas Complex	52	6.3
52	Gachado - Lomitas Complex	9	1.1
66	Greyeagle - Sun City Variant Complex	29	3.5
72	Lehmans - Rock Outcrop Complex	201	24.3
93	Nickel-Cave Complex	65	7.9
95	Ohaco Gravelly Loam	91	11.0
103	Rock Outcrop-Gachado Complex	21	2.5
104	Rock Outcrop-Lehmans Complex	358	43.4
		826	100.0
Sub Basin M-13			
10	Brios-Carrizo Complex	77	6.6
51	Gachado-Lomitas Complex	913	78.6
52	Gachado - Lomitas Complex	170	14.7
103	Rock Outcrop - Gachado Complex	1	0.1
		1161	100.0

2.3 Sub-basin Lag Time Determinations

For the dimensionless unit hydrograph option HEC-1 requires the input of the lag time for each sub-basin. Lag time for each sub-basin was computed using the length, slope and roughness of the longest watercourse within the sub-basin. Procedures used were adapted from Chapter 3 of SCS's TR-55 [6]. A copy of the chapter is included in Appendix G to provide detailed theory. The adaptations used for this study were as follows:

Sheet Flow - The upstream reach of each water course was designated Range (natural), Manning's n = 0.13. The TR-55 procedure was followed.

Shallow Concentrated Flow - TR-55 contains a graphical method to solve for velocity of shallow concentrated flow in the urban setting. The method was adapted for variable Manning's "n" values found in the high desert. Appendix G contains a series of graphs solving Manning's equation for "n" factors from 0.050 to 0.100.

The two designations CS-1 and CS-2 were used for shallow concentrated flow reaches representing average estimated depth of flow of 3" and 6", respectively. In each case the engineer considered the topography of the drainage area along the stream, topographic evidence of the stream cross-section shape and engineering judgment to estimate the upstream and downstream limits of CS-1 and/or CS-2 reaches. The wide rectangular channel approximation, "hydraulic radius equals depth", and Manning's equation graphs were used to determine velocity based on values of Manning's "n", depth and stream slope.

Channel Flow - Channel velocities were calculated for one of two channel reaches designated CH-1 or CH-2 using a computer program for Manning's equation assuming a rectangular channel. Preliminary HEC-1 runs for Morgan City Wash were used to estimate average reach flows, or to estimate "per square mile" flows for sub-areas draining to a

reach. Once updated HEC-1 runs were completed, the approximations were reviewed to be sure that no "order of magnitude" errors had been introduced.

Manning's "n" - The most subjective variable in computing lag times has always been the "n" factor. These values were estimated based on engineering judgment, experience, field review and two reports previously submitted for this study: Summary of Field Inspection, Cline Creek and Rodger Creek; Summary of Field Inspection, Morgan City Wash. These reports were used to estimate composite values of "n" for channel velocities. Shallow concentrated flow roughness values were estimated using topographic mapping and aerial photography where coverage was available.

Unit hydrograph parameters for the Morgan City Wash sub-basins are listed in Table 5. Computations of sub-basins lag time are presented in Appendix G.

TABLE 5
Morgan City Wash
Sub-basin Hydrologic Parameters

Sub-Basin	Area (miles 2)	Uniform Loss Rate CNSTL (in./hr.)	Initial Loss STRTL (inches)	Percent Impervious	LagTime (Hours)
M-1	2.00	0.38	0.95	20.3	0.34
M-2	1.56	0.28	0.92	32.6	0.46
M-3	1.89	0.40	0.95	35.0	0.63
M-4	2.67	0.40	0.95	34.9	0.62
M-5	1.74	0.38	0.95	34.6	0.53
M-6	2.61	0.32	0.93	34.6	0.89
M-7	0.78	0.24	0.81	31.3	0.56
M-8	2.39	0.37	0.84	34.4	0.80
M-9	1.76	0.55	0.87	29.2	0.69
M-10	1.50	0.26	0.81	45.0	0.81
M-11	0.97	0.45	0.85	21.5	0.51
M-12	1.29	0.27	0.81	35.2	0.78
M-13	1.81	0.53	0.87	3.0	0.86

2.4 Streamflow Routing

Hydrographs from upper watershed sub-basins were routed through the watershed stream system using the Muskingum Routing option of HEC-1. Muskingum routing is a stream storage method which calculates reach outflow based on inflow and a previous value of outflow. A stream reach is divided into a number sub-reaches calculated to avoid negative routing coefficients, which are internally generated. Input parameters are: travel time through a channel reach, (AMSKK); a weighting factor to account for the relative effect of inflow and outflow on stream storage, (X); and the number of sub-reaches, (NSTPS).

The travel time (AMSKK) determination followed the same TR55 procedures [6] as were used to determine sub-basin lag times. The value of the Muskingum "X" has a theoretical mathematical range of 0.0 to 0.5. For the relatively steep channel reaches of Morgan City Wash, a value of X = 0.3 was estimated to give significant weight to reach inflows in determining stream storage. This reflects a judgment that: 1. backwater curves probably do not extend very far upstream and 2. rapid changes in flow can cause significant wedge storage to exist in a reach. Muskingum channel routing parameters are listed in Table 6. Travel time calculations are included in Appendix G following sub-basin lag time calculations. Calculations to determine the number of sub-reaches are presented in Appendix H.

TABLE 6
Morgan City Wash Watershed
Muskingum Channel Routing Parameters

Routing Reach	NSTPS*	AMSKK (hours)	X
RO - 1	3	0.28	0.3
RO - 2	3	0.25	0.3
RO - 3	5	0.48	0.3
RO - 4	5	0.49	0.3
RO - 5	1	0.11	0.3
RO - 6	6	0.53	0.3

* NSTPS based on computation interval of 6 minutes.

2.5 HEC-1 Model Sequence

Since the purpose of the hydrology study for Morgan City Wash is determination of 100-year flood flows for delineation of the wash, the calculation sequence was selected to produce representative flows on a reach-by-reach basis. A schematic of the watershed model is shown in Figure 5.

The sequence is a fairly straight-forward series of hydrograph combinations and routings. The reach of Morgan City Wash between hydrograph combination points CO-6 and CO-7 is approximately $\frac{1}{4}$ mile in length, which is too long to ignore and too short to perform Muskingum routing with the 6 minute computation interval. To account for the travel time, the reach is included in the downstream routing reach RO-4.

3.0 Summary and Conclusions

3.1 Summary

Using the HEC-1 SCS dimensionless hydrograph option, hydrology was simulated for the 2, 6 and 24 hour storms on the Morgan City Wash watershed. Hydrographs were computed for the 13 sub-basins that comprise the watershed, for 12 tributary combination points and for 6 stream flow routing reaches which make up the Morgan City Wash mainstream between the Agua Fria River and the Maricopa-Yavapai County line.

The computation interval of 6 minutes was chosen as the smallest interval which could accommodate the 28.5 hour hydrograph resulting from a 24 hour storm. The 6 minute interval was used for 2 and 6 hour storm hydrographs to maintain consistency for comparing all three storm durations. Areal reduction of precipitation was applied because of the 23 square mile watershed area.

Watershed conditions were modeled which reflect the complete lack of development in the watershed. Precipitation losses were simulated by initial and uniform loss rates and percent impervious areas. Likewise, routing parameters were computed based on existing conditions, a naturally occurring combination of gravel-bed channel and desert riparian overbanks.

3.2 Results of the HEC-1 Model

Peak discharges for the 2, 6 and 24 hour 100 year events are listed in Table 7. Flows are tabulated for the 13 sub-basins and 12 combination points shown in the schematic (Figure 5). Copies of the HEC-1 output for the 2, 6 and 24 hour events are presented in Appendices A, B and C, respectively.

TABLE 7
Morgan City Wash Watershed 100-Year Runoff Summary

Location	Peak Discharge (cfs) Event		
	2 Hour	6 Hour	24 Hour
Sub-basin M-1	2256	2766	3173
Sub-basin M-2	1675	1950	2201
Combination Point CO-1	3453	4183	4817
Sub-basin M-3	1572	1835	2082
Combination Point CO-2	4840	5887	6828
Sub-basin M-5	1649	1927	2174
Combination Point CO-3	5650	6903	8134
Sub-basin M-4	2236	2622	2990
Combination Point CO-4	7387	9012	10868
Sub-basin M-6	1688	1975	2274
Combination Point CO-5	7949	9797	11989
Sub-basin M-7	801	910	986
Combination Point CO-6	8123	9999	12285
Sub-basin M-8	1732	1998	2210
Combination Point CO-7	8974	11028	13863
Sub-basin M-9	1319	1533	1700
Combination Point CO-8	8683	10764	13651
Sub-basin M-10	1230	1370	1482
Combination Point CO-9	8965	11106	14155
Sub-basin M-11	936	1095	1183
Combination Point CO-10	8891	11014	14099
Sub-basin M-12	1009	1146	1250
Combination Point CO-11	9010	11196	14441
Sub-basin M-13	894	1151	1345
Combination Point CO-12 (Discharge to Agua Fria River)	8769	10892	14168

3.3 Conclusions

By comparison of peak flows for the 2, 6 and 24 hour events (Table 7), it is seen that the 24 hour event produces the maximum peak runoff from each sub-basin and at each combination point in the watershed.

Two factors favor maximum peak runoff from the 24 hour storm on Morgan City Wash. The first is an average initial loss of nearly 0.9 inch for the watershed. In the 24 hour storm early precipitation can completely satisfy the initial loss prior to the most intense precipitation, which results in a high percentage of runoff during the heaviest rainfall.

The second factor is that the peak 15 minute rainfall intensity for the SCS Type II 24 hour storm is only slightly less than the 15 minute peak intensities of the 2 and 6 hour storm distributions. Comparison of the graphs of the three precipitation distributions (Figure 3) shows the similarity of peak intensity. Since the 24 hour storm simulation produced the largest peaks throughout the watershed, all of the floodplain delineation flows were selected from the 24 hour flow values.

Because of the long narrow watershed, mainstream peak flows remain nearly constant downstream from combination point CO-7. As sub-basin hydrographs are added and combined flows are routed, some slight fluctuation occurs, i.e. peaks decrease from CO-7 to CO-8, from CO-9 to CO-10 and from CO-11 to CO-12. The delineation flows selected for the various reaches were chosen such that flows do not decrease from an upstream location to a downstream location.

3.4 100-Year Floodplain Delineation Flows

The flows used to delineate the 100-year floodplain of the various reaches Morgan City Wash are presented in Table 8.

TABLE 8
Morgan City Wash
100-Year Floodplain Delineation Discharges

Reach			Discharge (cfs)
Agua Fria River	to	SUBM12 Confluence	14,400
SUBM12 Confluence	to	SUBM10 Confluence	14,200
SUBM10 Confluence	to	SUBM8 Confluence	13,900
SUBM8 Confluence	to	SUBM7 Confluence	12,300
SUBM7 Confluence	to	SUBM4 Confluence	12,000
SUBM4 Confluence	to	SUBM3 Confluence	8,130
SUBM3 Confluence	to	SUBM1* Confluence	4,820

*Upstream Limit of Study, Maricopa County Line

4.0 References

1. Flood Insurance Study, Flood Insurance Rate Maps; Flood Boundary and Floodway Maps, Federal Emergency Management Agency, Effective date - April 15, 1988.

2. United States Army Corps of Engineers, Hydrologic Engineering Center, "HEC-1 Flood Hydrograph Package Users Manual," March, 1987 and "Flood Hydrograph Package HEC-1 (IBM XT 512k Version) February 1, 1985.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Atlas 2, "Precipitation Frequency Atlas of the Western United States, Volume 8, Arizona," 1973.

4. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NWS HYDRO-40, "Depth-Area Ratios in the Semi-Arid Southwest United States," August 1984.

5. U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Aguila - Carefree Area, Parts of Maricopa and Pinal Counties, Arizona," April 1986.

6. U.S. Department of Agriculture, Soil Conservation Service, "Urban Hydrology for Small Watersheds, " Technical Release 55, June 1986.

APPENDIX A

MORGAN CITY WASH

HEC-1

100-YEAR 2 HOUR STORM

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

  1           ID                  FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
  2           ID
  3           ID                                FILE:    MC-02
  4           ID
  5           ID        HYDROLOGY FOR:    100-YEAR 2 HOUR EVENT
  6           ID
  7           ID        PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF
  8           ID                          MORGAN CITY WASH, AGUA FRIA RIVER TO THE
  9           ID                          MARICOPA COUNTY BOUNDARY
 10           ID
 11           ID        METHODS OF STUDY: HEC-1   DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
 12           ID                          PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
 13           ID                                       -AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
 14           ID                          EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
 15           ID                                       &  PERCENT IMPERVIOUS
 16           ID                          STREAM ROUTING- MUSKINGUM METHOD
 17           ID
 18           ID        WATERSHED NAME:   MORGAN CITY WASH
 19           ID
 20           ID        CONTRACT NUMBER:  FCD 89-15
 21           ID
 22           ID        COMPUTED BY:      BAKER ENGINEERS          DATE:12/07/89
 23           ID                          COMP: SSO 12/07/89       CKD: 12-7-89
 24           IT      6 01AUG89    1100      80
             *DIAGRAM
 25           IN     15
 26           IO      5
 27           JD   2.76     .01
 28           PC     .0    .039    .087    .280    .791    .872    .924    .967   1.000
 29           JD   2.18      10
 30           JD   2.01      20
 31           JD   1.90      30
 32           JD   1.82      40

 33           KK   SUBM1
 34           KM        RUNOFF FROM SUBBASIN M-1
 35           BA   2.00
 36           LU    .95     .38    20.3
 37           UD    .35

 38           KK   RO-1
 39           KM        ROUTE M-1 THROUGH M-2
 40           RM      3     .28      .3

 41           KK   SUBM2
 42           KM        RUNOFF FROM SUBBASIN M-2
 43           BA   1.56
 44           LU    .92     .28    32.6
 45           UD    .46
```

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

  46          KK   CO-1
  47          KM        COMBINE RUNOFF FROM SUBBASINS M-  1  AND      M-2
  48          HC       2

  49          KK   SUBM3
  50          KM        RUNOFF FROM SUBBASIN M-3
  51          BA    1.89
  52          LU     .95     .40    35.0
  53          UD     .63

  54          KK   CO-2
  55          KM        COMBINE RUNOFF FROM SUBBASINS M-1, 2 AND      M-3
  56          HC       2

  57          KK   RO-2
  58          KM        ROUTE M-1,2,3 THROUGH M-5
  59          RM       3     .25      .3

  60          KK   SUBM5
  61          KM        RUNOFF FROM SUBBASIN M-5
  62          BA    1.74
  63          LU     .95     .38    34.6
  64          UD     .53

  65          KK   CO-3
  66          KM         COMBINE RUNOFF FROM SUBBASINS M-1, 2, 3 AND  M-5
  67          HC       2

  68          KK   SUBM4
  69          KM        RUNOFF FROM SUBBASIN M-4
  70          BA    2.67
  71          LU     .95     .40    34.9
  72          UD     .61

  73          KK   CO-4
  74          KM         COMBINE RUNOFF FROM SUBBASINS M-1,2,3,5 AND  M-4
  75          HC       2

  76          KK   RO-3
  77          KM        ROUTE M-1,2,3,4,5 THROUGH M-6
  78          RM       5     .48      .3

  79          KK   SUBM6
  80          KM        RUNOFF FROM SUBBASIN M-6
  81          BA    2.61
  82          LU     .93     .32    34.6
  83          UD     .89

  84          KK   CO-5
  85          KM         COMBINE RUNOFF FROM SUBBASINS M-12345   AND  M-6
  86          HC       2
```

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

  87          KK   SUBM7
  88          KM        RUNOFF FROM SUBBASIN M-7
  89          BA     .78
  90          LU     .81      .24    31.3
  91          UD     .56

  92          KK   CO-6
  93          KM         COMBINE RUNOFF FROM SUBBASINS M-123456  AND  M-7
  94          HC       2

  95          KK   SUBM8
  96          KM        RUNOFF FROM SUBBASIN M-8
  97          BA    2.39
  98          LU     .84      .37    34.4
  99          UD     .80

 100          KK   CO-7
 101          KM         COMBINE RUNOFF FROM SUBBASINS M-1234567 AND  M-8
 102          HC       2

 103          KK   RO-4
 104          KM        ROUTE M-1..8 THROUGH M-9
 105          RM       5      .49      .3

 106          KK   SUBM9
 107          KM        RUNOFF FROM SUBBASIN M-9
 108          BA    1.76
 109          LU     .87      .55    29.2
 110          UD     .69

 111          KK   CO-8
 112          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU 8 AND M-9
 113          HC       2

 114          KK  SUBM10
 115          KM        RUNOFF FROM SUBBASIN M-10
 116          BA    1.50
 117          LU     .81      .26    45.0
 118          UD     .80

 119          KK   CO-9
 120          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU 9 AND M-10
 121          HC       2

 122          KK   RO-5
 123          KM        ROUTE M-1..10 THROUGH M-11
 124          RM       1      .11      .3

 125          KK  SUBM11
 126          KM        RUNOFF FROM SUBBASIN M-11
 127          BA     .97
 128          LU     .85      .45    21.5
 129          UD     .51
```

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

 130          KK   CO-10
 131          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-10 AND    M-11
 132          HC       2

 133          KK  SUBM12
 134          KM        RUNOFF FROM SUBBASIN M-12
 135          BA    1.29
 136          LU     .81     .27    35.2
 137          UD     .80

 138          KK   CO-11
 139          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-11 AND    M-12
 140          HC       2

 141          KK   RO-6
 142          KM        ROUTE M-1..12 THROUGH M-13
 143          RM       6     .53      .3

 144          KK  SUBM13
 145          KM        RUNOFF FROM SUBBASIN M-13
 146          BA    1.81
 147          LU     .87     .53     3.0
 148          UD     .86

 149          KK   CO-12
 150          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-12 AND    M-13
 151          KO       1
 152          HC       2
 153          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

          (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 33        SUBM1
               V
               V
 38        RO-1
               .
               .
 41            .        SUBM2
               .            .
               .            .
 46        CO-1 ............
               .
               .
 49            .        SUBM3
               .            .
               .            .
 54        CO-2 ............
               V
               V
 57        RO-2
               .
               .
 60            .        SUBM5
               .            .
               .            .
 65        CO-3 ............
               .
               .
 68            .        SUBM4
               .            .
               .            .
 73        CO-4 ............
               V
               V
 76        RO-3
               .
               .
 79            .        SUBM6
               .            .
               .            .
 84        CO-5 ............
               .
               .
 87            .        SUBM7
               .            .
               .            .
 92        CO-6 ............
               .
               .
 95            .        SUBM8
               .            .
               .            .
100        CO-7 ............
               V
               V
           RO-4
               .
               .
106            .        SUBM9
               .            .
```

```
                .          .
111         CO-8 ............
                .
                .
114             .      SUBM10
                .          .
                .          .
119         CO-9 ............
                V
                V
122         RO-5
                .
                .
125             .      SUBM11
                .          .
                .          .
130         CO-10............
                .
                .
133             .      SUBM12
                .          .
                .          .
138         CO-11............
                V
                V
141         RO-6
                .
                .
144             .      SUBM13
                .          .
                .          .
149         CO-12............
```

) RUNOFF ALSO COMPUTED AT THIS LOCATION

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FILE: MC-02

HYDROLOGY FOR: 100-YEAR 2 HOUR EVENT

PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF MORGAN CITY WASH, AGUA FRIA RIVER TO THE MARICOPA COUNTY BOUNDARY

METHODS OF STUDY: HEC-1 DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
-AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
& PERCENT IMPERVIOUS
STREAM ROUTING- MUSKINGUM METHOD

WATERSHED NAME: MORGAN CITY WASH

CONTRACT NUMBER: FCD 89-15

COMPUTED BY: BAKER ENGINEERS DATE:12/07/89
COMP: _____ CKD: _____

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

IT        HYDROGRAPH TIME DATA
                NMIN          6  MINUTES IN COMPUTATION INTERVAL
               IDATE     1AUG89  STARTING DATE
               ITIME       1100  STARTING TIME
                  NQ         80  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE     1AUG89  ENDING DATE
              NDTIME       1854  ENDING TIME

          COMPUTATION INTERVAL     .10 HOURS
               TOTAL TIME BASE    7.90 HOURS

     ENGLISH UNITS

27 JD     INDEX STORM NO. 1
               STRM       2.76  PRECIPITATION DEPTH
               TRDA        .01  TRANSPOSITION DRAINAGE AREA

28 PI       PRECIPITATION PATTERN
              .02       .02       .02       .02       .02       .08       .08       .14       .20       .20
              .03       .03       .03       .02       .02       .02       .02       .02       .01       .01

29 JD     INDEX STORM NO. 2
               STRM       2.18  PRECIPITATION DEPTH
               TRDA      10.00  TRANSPOSITION DRAINAGE AREA

 0 PI       PRECIPITATION PATTERN
              .02       .02       .02       .02       .02       .08       .08       .14       .20       .20
              .03       .03       .03       .02       .02       .02       .02       .02       .01       .01
```

```
 30 JD          INDEX STORM NO. 3
                      STRM        2.01  PRECIPITATION DEPTH
                      TRDA       20.00  TRANSPOSITION DRAINAGE AREA

  0 PI           PRECIPITATION PATTERN
                    .02       .02       .02       .02       .02       .08       .08       .14       .20       .20
                    .03       .03       .03       .02       .02       .02       .02       .02       .01       .01

 31 JD          INDEX STORM NO. 4
                      STRM        1.90  PRECIPITATION DEPTH
                      TRDA       30.00  TRANSPOSITION DRAINAGE AREA

  0 PI           PRECIPITATION PATTERN
                    .02       .02       .02       .02       .02       .08       .08       .14       .20       .20
                    .03       .03       .03       .02       .02       .02       .02       .02       .01       .01

 32 JD          INDEX STORM NO. 5
                      STRM        1.82  PRECIPITATION DEPTH
                      TRDA       40.00  TRANSPOSITION DRAINAGE AREA

  0 PI           PRECIPITATION PATTERN
                    .02       .02       .02       .02       .02       .08       .08       .14       .20       .20
                    .03       .03       .03       .02       .02       .02       .02       .02       .01       .01


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
149 KK    *    CO-12   *
          *            *
          **************

151 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

152 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

*****************************************************************************************************************************************

                                                HYDROGRAPH AT    CO-12
                                            TRANSPOSITION AREA      .0 SQ MI

*****************************************************************************************************************************************
                                 *                                 *                                 *
  DA MON HRMN  ORD      FLOW     *  DA MON HRMN  ORD      FLOW     *  DA MON HRMN  ORD      FLOW     *  DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
   1 AUG 1100   1        0.      *   1 AUG 1300  21      6640.     *   1 AUG 1500  41      5376.     *   1 AUG 1700  61        50.
   1 AUG 1106   2        0.      *   1 AUG 1306  22      7451.     *   1 AUG 1506  42      4400.     *   1 AUG 1706  62        38.
   1 AUG 1112   3        0.      *   1 AUG 1312  23      8184.     *   1 AUG 1512  43      3574.     *   1 AUG 1712  63        29.
   1 AUG 1118   4        1.      *   1 AUG 1318  24      8887.     *   1 AUG 1518  44      2885.     *   1 AUG 1718  64        21.
   1 AUG 1124   5        1.      *   1 AUG 1324  25      9620.     *   1 AUG 1524  45      2316.     *   1 AUG 1724  65        16.
   1 AUG 1130   6        3.      *   1 AUG 1330  26     10416.     *   1 AUG 1530  46      1850.     *   1 AUG 1730  66        11.
   1 AUG 1136   7        6.      *   1 AUG 1336  27     11266.     *   1 AUG 1536  47      1472.     *   1 AUG 1736  67         8.
   1 AUG 1142   8       14.      *   1 AUG 1342  28     12146.     *   1 AUG 1542  48      1167.     *   1 AUG 1742  68         5.
   1 AUG 1148   9       34.      *   1 AUG 1348  29     13010.     *   1 AUG 1548  49       923.     *   1 AUG 1748  69         4.
   1 AUG 1154  10       88.      *   1 AUG 1354  30     13782.     *   1 AUG 1554  50       729.     *   1 AUG 1754  70         2.
   1 AUG 1200  11      199.      *   1 AUG 1400  31     14363.     *   1 AUG 1600  51       575.     *   1 AUG 1800  71         2.
   1 AUG 1206  12      372.      *   1 AUG 1406  32     14647.     *   1 AUG 1606  52       453.     *   1 AUG 1806  72         1.
```

1 AUG 1212	13	623.	*	1 AUG 1412	33	14552.	*	1 AUG 1612	53	357.	*	1 AUG 1812	73	1.
1 AUG 1218	14	988.	*	1 AUG 1418	34	14043.	*	1 AUG 1618	54	281.	*	1 AUG 1818	74	0.
1 AUG 1224	15	1488.	*	1 AUG 1424	35	13151.	*	1 AUG 1624	55	221.	*	1 AUG 1824	75	0.
1 AUG 1230	16	2131.	*	1 AUG 1430	36	11961.	*	1 AUG 1630	56	173.	*	1 AUG 1830	76	0.
1 AUG 1236	17	2916.	*	1 AUG 1436	37	10593.	*	1 AUG 1636	57	136.	*	1 AUG 1836	77	0.
1 AUG 1242	18	3819.	*	1 AUG 1442	38	9168.	*	1 AUG 1642	58	107.	*	1 AUG 1842	78	0.
1 AUG 1248	19	4787.	*	1 AUG 1448	39	7783.	*	1 AUG 1648	59	83.	*	1 AUG 1848	79	0.
1 AUG 1254	20	5747.	*	1 AUG 1454	40	6507.	*	1 AUG 1654	60	65.	*	1 AUG 1854	80	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
14647.	3.10	(CFS)	4478.	3402.	3402.	3402.
		(INCHES)	1.813	1.813	1.813	1.813
		(AC-FT)	2221.	2221.	2221.	2221.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 10.0 SQ MI

DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 AUG 1100	1	0.	*	1 AUG 1300	21	4619.	*	1 AUG 1500	41	3718.	*	1 AUG 1700	61	35.
1 AUG 1106	2	0.	*	1 AUG 1306	22	5217.	*	1 AUG 1506	42	3037.	*	1 AUG 1706	62	27.
1 AUG 1112	3	0.	*	1 AUG 1312	23	5758.	*	1 AUG 1512	43	2463.	*	1 AUG 1712	63	20.
1 AUG 1118	4	0.	*	1 AUG 1318	24	6269.	*	1 AUG 1518	44	1986.	*	1 AUG 1718	64	15.
1 AUG 1124	5	1.	*	1 AUG 1324	25	6797.	*	1 AUG 1524	45	1593.	*	1 AUG 1724	65	11.
1 AUG 1130	6	2.	*	1 AUG 1330	26	7364.	*	1 AUG 1530	46	1273.	*	1 AUG 1730	66	8.
1 AUG 1136	7	5.	*	1 AUG 1336	27	7962.	*	1 AUG 1536	47	1014.	*	1 AUG 1736	67	5.
1 AUG 1142	8	11.	*	1 AUG 1342	28	8573.	*	1 AUG 1542	48	805.	*	1 AUG 1742	68	4.
1 AUG 1148	9	23.	*	1 AUG 1348	29	9164.	*	1 AUG 1548	49	638.	*	1 AUG 1748	69	3.
1 AUG 1154	10	54.	*	1 AUG 1354	30	9686.	*	1 AUG 1554	50	505.	*	1 AUG 1754	70	2.
1 AUG 1200	11	125.	*	1 AUG 1400	31	10073.	*	1 AUG 1600	51	399.	*	1 AUG 1800	71	1.
1 AUG 1206	12	237.	*	1 AUG 1406	32	10256.	*	1 AUG 1606	52	314.	*	1 AUG 1806	72	1.
1 AUG 1212	13	400.	*	1 AUG 1412	33	10178.	*	1 AUG 1612	53	248.	*	1 AUG 1812	73	0.
1 AUG 1218	14	638.	*	1 AUG 1418	34	9813.	*	1 AUG 1618	54	195.	*	1 AUG 1818	74	0.
1 AUG 1224	15	973.	*	1 AUG 1424	35	9183.	*	1 AUG 1624	55	153.	*	1 AUG 1824	75	0.
1 AUG 1230	16	1410.	*	1 AUG 1430	36	8346.	*	1 AUG 1630	56	121.	*	1 AUG 1830	76	0.
1 AUG 1236	17	1951.	*	1 AUG 1436	37	7383.	*	1 AUG 1636	57	95.	*	1 AUG 1836	77	0.
1 AUG 1242	18	2583.	*	1 AUG 1442	38	6380.	*	1 AUG 1642	58	74.	*	1 AUG 1842	78	0.
1 AUG 1248	19	3274.	*	1 AUG 1448	39	5406.	*	1 AUG 1648	59	58.	*	1 AUG 1848	79	0.
1 AUG 1254	20	3968.	*	1 AUG 1454	40	4510.	*	1 AUG 1654	60	45.	*	1 AUG 1854	80	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
10256.	3.10	(CFS)	3124.	2373.	2373.	2373.
		(INCHES)	1.264	1.265	1.265	1.265
		(AC-FT)	1549.	1549.	1549.	1549.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 20.0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 AUG 1100	1	0.	1 AUG 1300	21	4039.	1 AUG 1500	41	3249.	1 AUG 1700	61	31.
1 AUG 1106	2	0.	1 AUG 1306	22	4572.	1 AUG 1506	42	2656.	1 AUG 1706	62	23.
1 AUG 1112	3	0.	1 AUG 1312	23	5057.	1 AUG 1512	43	2156.	1 AUG 1712	63	18.
1 AUG 1118	4	0.	1 AUG 1318	24	5516.	1 AUG 1518	44	1740.	1 AUG 1718	64	13.
1 AUG 1124	5	1.	1 AUG 1324	25	5986.	1 AUG 1524	45	1398.	1 AUG 1724	65	10.
1 AUG 1130	6	2.	1 AUG 1330	26	6487.	1 AUG 1530	46	1118.	1 AUG 1730	66	7.
1 AUG 1136	7	5.	1 AUG 1336	27	7013.	1 AUG 1536	47	891.	1 AUG 1736	67	5.
1 AUG 1142	8	10.	1 AUG 1342	28	7544.	1 AUG 1542	48	708.	1 AUG 1742	68	3.
1 AUG 1148	9	21.	1 AUG 1348	29	8054.	1 AUG 1548	49	561.	1 AUG 1748	69	2.
1 AUG 1154	10	48.	1 AUG 1354	30	8500.	1 AUG 1554	50	444.	1 AUG 1754	70	1.
1 AUG 1200	11	108.	1 AUG 1400	31	8826.	1 AUG 1600	51	351.	1 AUG 1800	71	1.
1 AUG 1206	12	205.	1 AUG 1406	32	8974.	1 AUG 1606	52	277.	1 AUG 1806	72	1.
1 AUG 1212	13	344.	1 AUG 1412	33	8896.	1 AUG 1612	53	218.	1 AUG 1812	73	0.
1 AUG 1218	14	549.	1 AUG 1418	34	8571.	1 AUG 1618	54	172.	1 AUG 1818	74	0.
1 AUG 1224	15	838.	1 AUG 1424	35	8017.	1 AUG 1624	55	135.	1 AUG 1824	75	0.
1 AUG 1230	16	1217.	1 AUG 1430	36	7284.	1 AUG 1630	56	106.	1 AUG 1830	76	0.
1 AUG 1236	17	1688.	1 AUG 1436	37	6444.	1 AUG 1636	57	83.	1 AUG 1836	77	0.
1 AUG 1242	18	2240.	1 AUG 1442	38	5569.	1 AUG 1642	58	65.	1 AUG 1842	78	0.
1 AUG 1248	19	2847.	1 AUG 1448	39	4720.	1 AUG 1648	59	51.	1 AUG 1848	79	0.
1 AUG 1254	20	3460.	1 AUG 1454	40	3940.	1 AUG 1654	60	40.	1 AUG 1854	80	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
8974.	3.10	(CFS)	2735.	2078.	2078.	2078.
		(INCHES)	1.107	1.107	1.107	1.107
		(AC-FT)	1356.	1356.	1356.	1356.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 30.0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 AUG 1100	1	0.	1 AUG 1300	21	3669.	1 AUG 1500	41	2951.	1 AUG 1700	61	28.
1 AUG 1106	2	0.	1 AUG 1306	22	4161.	1 AUG 1506	42	2414.	1 AUG 1706	62	21.
1 AUG 1112	3	0.	1 AUG 1312	23	4610.	1 AUG 1512	43	1961.	1 AUG 1712	63	16.
1 AUG 1118	4	0.	1 AUG 1318	24	5034.	1 AUG 1518	44	1584.	1 AUG 1718	64	12.
1 AUG 1124	5	1.	1 AUG 1324	25	5466.	1 AUG 1524	45	1274.	1 AUG 1724	65	9.
1 AUG 1130	6	2.	1 AUG 1330	26	5924.	1 AUG 1530	46	1019.	1 AUG 1730	66	6.
1 AUG 1136	7	4.	1 AUG 1336	27	6402.	1 AUG 1536	47	813.	1 AUG 1736	67	4.
1 AUG 1142	8	10.	1 AUG 1342	28	6882.	1 AUG 1542	48	646.	1 AUG 1742	68	3.
1 AUG 1148	9	20.	1 AUG 1348	29	7340.	1 AUG 1548	49	513.	1 AUG 1748	69	2.
1 AUG 1154	10	44.	1 AUG 1354	30	7737.	1 AUG 1554	50	406.	1 AUG 1754	70	1.
1 AUG 1200	11	97.	1 AUG 1400	31	8025.	1 AUG 1600	51	321.	1 AUG 1800	71	1.
1 AUG 1206	12	184.	1 AUG 1406	32	8151.	1 AUG 1606	52	253.	1 AUG 1806	72	1.
1 AUG 1212	13	309.	1 AUG 1412	33	8074.	1 AUG 1612	53	200.	1 AUG 1812	73	0.
1 AUG 1218	14	492.	1 AUG 1418	34	7774.	1 AUG 1618	54	157.	1 AUG 1818	74	0.
1 AUG 1224	15	752.	1 AUG 1424	35	7269.	1 AUG 1624	55	124.	1 AUG 1824	75	0.
1 AUG 1230	16	1094.	1 AUG 1430	36	6604.	1 AUG 1630	56	97.	1 AUG 1830	76	0.
1 AUG 1236	17	1521.	1 AUG 1436	37	5843.	1 AUG 1636	57	76.	1 AUG 1836	77	0.
1 AUG 1242	18	2024.	1 AUG 1442	38	5050.	1 AUG 1642	58	60.	1 AUG 1842	78	0.
1 AUG 1248	19	2576.	1 AUG 1448	39	4282.	1 AUG 1648	59	47.	1 AUG 1848	79	0.
1 AUG 1254	20	3138.	1 AUG 1454	40	3575.	1 AUG 1654	60	36.	1 AUG 1854	80	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
8151.	3.10	(CFS)	2486.	1889.	1889.	1889.
		(INCHES)	1.006	1.007	1.007	1.007
		(AC-FT)	1233.	1233.	1233.	1233.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 40.0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 AUG 1100	1	0.	1 AUG 1300	21	3402.	1 AUG 1500	41	2740.	1 AUG 1700	61	26.
1 AUG 1106	2	0.	1 AUG 1306	22	3864.	1 AUG 1506	42	2243.	1 AUG 1706	62	20.
1 AUG 1112	3	0.	1 AUG 1312	23	4286.	1 AUG 1512	43	1824.	1 AUG 1712	63	15.
1 AUG 1118	4	0.	1 AUG 1318	24	4685.	1 AUG 1518	44	1475.	1 AUG 1718	64	11.
1 AUG 1124	5	1.	1 AUG 1324	25	5089.	1 AUG 1524	45	1186.	1 AUG 1724	65	8.
1 AUG 1130	6	2.	1 AUG 1330	26	5517.	1 AUG 1530	46	950.	1 AUG 1730	66	6.
1 AUG 1136	7	4.	1 AUG 1336	27	5960.	1 AUG 1536	47	758.	1 AUG 1736	67	4.
1 AUG 1142	8	9.	1 AUG 1342	28	6402.	1 AUG 1542	48	603.	1 AUG 1742	68	3.
1 AUG 1148	9	19.	1 AUG 1348	29	6823.	1 AUG 1548	49	478.	1 AUG 1748	69	2.
1 AUG 1154	10	41.	1 AUG 1354	30	7185.	1 AUG 1554	50	379.	1 AUG 1754	70	1.
1 AUG 1200	11	90.	1 AUG 1400	31	7446.	1 AUG 1600	51	299.	1 AUG 1800	71	1.
1 AUG 1206	12	169.	1 AUG 1406	32	7557.	1 AUG 1606	52	236.	1 AUG 1806	72	1.
1 AUG 1212	13	283.	1 AUG 1412	33	7481.	1 AUG 1612	53	186.	1 AUG 1812	73	0.
1 AUG 1218	14	451.	1 AUG 1418	34	7201.	1 AUG 1618	54	147.	1 AUG 1818	74	0.
1 AUG 1224	15	690.	1 AUG 1424	35	6732.	1 AUG 1624	55	116.	1 AUG 1824	75	0.
1 AUG 1230	16	1006.	1 AUG 1430	36	6116.	1 AUG 1630	56	91.	1 AUG 1830	76	0.
1 AUG 1236	17	1401.	1 AUG 1436	37	5412.	1 AUG 1636	57	71.	1 AUG 1836	77	0.
1 AUG 1242	18	1867.	1 AUG 1442	38	4680.	1 AUG 1642	58	56.	1 AUG 1842	78	0.
1 AUG 1248	19	2380.	1 AUG 1448	39	3970.	1 AUG 1648	59	44.	1 AUG 1848	79	0.
1 AUG 1254	20	2905.	1 AUG 1454	40	3317.	1 AUG 1654	60	34.	1 AUG 1854	80	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
7557.	3.10	(CFS)	2307.	1753.	1753.	1753.
		(INCHES)	.934	.934	.934	.934
		(AC-FT)	1144.	1144.	1144.	1144.

CUMULATIVE AREA = 22.97 SQ MI

INTERPOLATED HYDROGRAPH AT CO-12

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 AUG 1100	1	0.	1 AUG 1300	21	3947.	1 AUG 1500	41	3175.	1 AUG 1700	61	30.
1 AUG 1106	2	0.	1 AUG 1306	22	4470.	1 AUG 1506	42	2596.	1 AUG 1706	62	23.
1 AUG 1112	3	0.	1 AUG 1312	23	4946.	1 AUG 1512	43	2107.	1 AUG 1712	63	17.
1 AUG 1118	4	0.	1 AUG 1318	24	5396.	1 AUG 1518	44	1701.	1 AUG 1718	64	13.
1 AUG 1124	5	1.	1 AUG 1324	25	5856.	1 AUG 1524	45	1367.	1 AUG 1724	65	9.
1 AUG 1130	6	2.	1 AUG 1330	26	6347.	1 AUG 1530	46	1093.	1 AUG 1730	66	7.

1 AUG 1136	7	5.	*	1 AUG 1336	27	6860.	*	1 AUG 1536	47	872.	*	1 AUG 1736	67	5.
1 AUG 1142	8	10.	*	1 AUG 1342	28	7379.	*	1 AUG 1542	48	693.	*	1 AUG 1742	68	3.
1 AUG 1148	9	21.	*	1 AUG 1348	29	7876.	*	1 AUG 1548	49	549.	*	1 AUG 1748	69	2.
1 AUG 1154	10	47.	*	1 AUG 1354	30	8310.	*	1 AUG 1554	50	434.	*	1 AUG 1754	70	1.
1 AUG 1200	11	106.	*	1 AUG 1400	31	8627.	*	1 AUG 1600	51	343.	*	1 AUG 1800	71	1.
AUG 1206	12	200.	*	1 AUG 1406	32	8769.	*	1 AUG 1606	52	271.	*	1 AUG 1806	72	1.
1 AUG 1212	13	336.	*	1 AUG 1412	33	8691.	*	1 AUG 1612	53	214.	*	1 AUG 1812	73	0.
1 AUG 1218	14	535.	*	1 AUG 1418	34	8373.	*	1 AUG 1618	54	168.	*	1 AUG 1818	74	0.
1 AUG 1224	15	816.	*	1 AUG 1424	35	7831.	*	1 AUG 1624	55	132.	*	1 AUG 1824	75	0.
1 AUG 1230	16	1186.	*	1 AUG 1430	36	7115.	*	1 AUG 1630	56	104.	*	1 AUG 1830	76	0.
1 AUG 1236	17	1646.	*	1 AUG 1436	37	6294.	*	1 AUG 1636	57	82.	*	1 AUG 1836	77	0.
1 AUG 1242	18	2186.	*	1 AUG 1442	38	5440.	*	1 AUG 1642	58	64.	*	1 AUG 1842	78	0.
1 AUG 1248	19	2779.	*	1 AUG 1448	39	4611.	*	1 AUG 1648	59	50.	*	1 AUG 1848	79	0.
1 AUG 1254	20	3380.	*	1 AUG 1454	40	3849.	*	1 AUG 1654	60	39.	*	1 AUG 1854	80	0.
			*				*				*			

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	7.90-HR
8769.	3.10	(CFS)	2673.	2030.	2030.	2030.
		(INCHES)	1.082	1.082	1.082	1.082
		(AC-FT)	1326.	1326.	1326.	1326.

CUMULATIVE AREA = 22.97 SQ MI

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	SUBM1	2256.	1.30	261.	198.	198.	2.00		
ROUTED TO	RO-1	2060.	1.60	261.	198.	198.	2.00		
HYDROGRAPH AT	SUBM2	1675.	1.40	250.	190.	190.	1.56		
2 COMBINED AT	CO-1	3453.	1.50	490.	372.	372.	3.56		
HYDROGRAPH AT	SUBM3	1572.	1.50	287.	218.	218.	1.89		
2 COMBINED AT	CO-2	4840.	1.50	747.	567.	567.	5.45		
ROUTED TO	RO-2	4607.	1.80	747.	567.	567.	5.45		
HYDROGRAPH AT	SUBM5	1649.	1.40	266.	202.	202.	1.74		
2 COMBINED AT	CO-3	5650.	1.70	979.	743.	743.	7.19		
HYDROGRAPH AT	SUBM4	2236.	1.50	397.	302.	302.	2.67		
2 COMBINED AT	CO-4	7387.	1.70	1327.	1008.	1008.	9.86		
ROUTED TO	RO-3	6931.	2.20	1327.	1008.	1008.	9.86		
HYDROGRAPH AT	SUBM6	1688.	1.80	404.	307.	307.	2.61		
2 COMBINED AT	CO-5	7949.	2.10	1631.	1239.	1239.	12.47		
HYDROGRAPH AT	SUBM7	801.	1.50	137.	104.	104.	.78		
2 COMBINED AT	CO-6	8123.	2.10	1726.	1311.	1311.	13.25		
HYDROGRAPH AT	SUBM8	1732.	1.70	377.	286.	286.	2.39		
2 COMBINED AT	CO-7	8974.	2.10	1993.	1514.	1514.	15.64		
ROUTED TO	RO-4	8604.	2.60	1993.	1514.	1514.	15.64		
HYDROGRAPH AT	SUBM9	1319.	1.60	250.	190.	190.	1.76		
2 COMBINED AT	CO-8	8683.	2.50	2155.	1637.	1637.	17.40		
HYDROGRAPH AT	SUBM10	1230.	1.70	277.	211.	211.	1.50		
2 COMBINED AT	CO-9	8965.	2.50	2347.	1782.	1782.	18.90		
ROUTED TO	RO-5	8891.	2.60	2347.	1782.	1782.	18.90		
HYDROGRAPH AT	SUBM11	936.	1.40	137.	104.	104.	.97		
2 COMBINED AT	CO-10	8891.	2.60	2436.	1850.	1850.	19.87		
HYDROGRAPH AT	SUBM12	1009.	1.70	224.	170.	170.	1.29		
2 COMBINED AT	CO-11	9010.	2.60	2568.	1951.	1951.	21.16		
ROUTED TO	RO-6	8769.	3.10	2568.	1951.	1951.	21.16		

HYDROGRAPH AT	SUBM13	894.	1.80	186.	141.	141.	1.81
2 COMBINED AT	CO-12	8769.	3.10	2673.	2030.	2030.	22.97

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

APPENDIX B

MORGAN CITY WASH

HEC-1

100-YEAR 6 HOUR STORM

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

  1           ID                  FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
  2           ID
  3           ID                              FILE:  MC-06
  4           ID
  5           ID        HYDROLOGY FOR:    100-YEAR 6 HOUR EVENT
  6           ID
  7           ID        PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF
  8           ID                          MORGAN CITY WASH, AGUA FRIA RIVER TO THE
  9           ID                          MARICOPA COUNTY BOUNDARY
 10           ID
 11           ID        METHODS OF STUDY: HEC-1   DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
 12           ID                          PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
 13           ID                                       -AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
 14           ID                          EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
 15           ID                                       &  PERCENT IMPERVIOUS
 16           ID                          STREAM ROUTING- MUSKINGUM METHOD
 17           ID
 18           ID        WATERSHED NAME:   MORGAN CITY WASH
 19           ID
 20           ID        CONTRACT NUMBER:  FCD 89-15
 21           ID
 22           ID        COMPUTED BY:      BAKER ENGINEERS          DATE:12/07/89
 23           ID                          COMP: SSO 12/07/89       CKD: 12-8-89
 24           IT      6 01OCT89     900     120
              *DIAGRAM
 25           IN     15
 26           IO      5
 27           JD   3.40     .01
 28           PC     .0    .011    .022    .035    .048    .062    .079    .100    .125    .155
 29           PC    .192   .339    .729    .791    .830    .862    .887    .908    .926    .942
 30           PC    .956   .969    .980    .990   1.000
 31           JD   2.89      10
 32           JD   2.69      20
 33           JD   2.55      30
 34           JD   2.45      40

 35           KK   SUBM1
 36           KM        RUNOFF FROM SUBBASIN M-1
 37           BA   2.00
 38           LU    .95     .38    20.3
 39           UD    .35

 40           KK   RO-1
 41           KM        ROUTE M-1 THROUGH M-2
 42           RM      3     .28      .3

 43           KK   SUBM2
 44           KM        RUNOFF FROM SUBBASIN M-2
 45           BA   1.56
 46           LU    .92     .28    32.6
 47           UD    .46
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  48          KK   CO-1
  49          KM        COMBINE RUNOFF FROM SUBBASINS M-  1  AND      M-2
  50          HC       2

  51          KK   SUBM3
  52          KM        RUNOFF FROM SUBBASIN M-3
  53          BA    1.89
  54          LU     .95     .40    35.0
  55          UD     .63

  56          KK   CO-2
  57          KM        COMBINE RUNOFF FROM SUBBASINS M-1, 2 AND      M-3
  58          HC       2

  59          KK   RO-2
  60          KM        ROUTE M-1,2,3 THROUGH M-5
  61          RM       3     .25      .3

  62          KK   SUBM5
  63          KM        RUNOFF FROM SUBBASIN M-5
  64          BA    1.74
  65          LU     .95     .38    34.6
  66          UD     .53

  67          KK   CO-3
  68          KM         COMBINE RUNOFF FROM SUBBASINS M-1, 2, 3 AND  M-5
  69          HC       2

  70          KK   SUBM4
  71          KM        RUNOFF FROM SUBBASIN M-4
  72          BA    2.67
  73          LU     .95     .40    34.9
  74          UD     .61

  75          KK   CO-4
  76          KM         COMBINE RUNOFF FROM SUBBASINS M-1,2,3,5 AND  M-4
  77          HC       2

  78          KK   RO-3
  79          KM        ROUTE M-1,2,3,4,5 THROUGH M-6
  80          RM       5     .48      .3

  81          KK   SUBM6
  82          KM        RUNOFF FROM SUBBASIN M-6
  83          BA    2.61
  84          LU     .93     .32    34.6
  85          UD     .89

  86          KK   CO-5
  87          KM         COMBINE RUNOFF FROM SUBBASINS M-12345   AND  M-6
  88          HC       2
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  89          KK   SUBM7
  90          KM        RUNOFF FROM SUBBASIN M-7
  91          BA     .78
  92          LU     .81     .24    31.3
  93          UD     .56

  94          KK   CO-6
  95          KM         COMBINE RUNOFF FROM SUBBASINS M-123456  AND  M-7
  96          HC       2

  97          KK   SUBM8
  98          KM        RUNOFF FROM SUBBASIN M-8
  99          BA    2.39
 100          LU     .84     .37    34.4
 101          UD     .80

 102          KK   CO-7
 103          KM         COMBINE RUNOFF FROM SUBBASINS M-1234567 AND  M-8
 104          HC       2

 105          KK   RO-4
 106          KM        ROUTE M-1..8 THROUGH M-9
 107          RM       5     .49      .3

 108          KK   SUBM9
 109          KM        RUNOFF FROM SUBBASIN M-9
 110          BA    1.76
 111          LU     .87     .55    29.2
 112          UD     .69

 113          KK   CO-8
 114          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU 8 AND M-9
 115          HC       2

 116          KK  SUBM10
 117          KM        RUNOFF FROM SUBBASIN M-10
 118          BA    1.50
 119          LU     .81     .26    45.0
 120          UD     .80

 121          KK   CO-9
 122          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU 9 AND M-10
 123          HC       2

 124          KK   RO-5
 125          KM        ROUTE M-1..10 THROUGH M-11
 126          RM       1     .11      .3

 127          KK  SUBM11
 128          KM        RUNOFF FROM SUBBASIN M-11
 129          BA     .97
 130          LU     .85     .45    21.5
 131          UD     .51
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  132         KK   CO-10
  133         KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-10 AND    M-11
  134         HC       2

  135         KK  SUBM12
  136         KM        RUNOFF FROM SUBBASIN M-12
  137         BA    1.29
  138         LU     .81     .27    35.2
  139         UD     .80

  140         KK   CO-11
  141         KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-11 AND    M-12
  142         HC       2

  143         KK   RO-6
  144         KM        ROUTE M-1..12 THROUGH M-13
  145         RM       6     .53      .3

  146         KK  SUBM13
  147         KM        RUNOFF FROM SUBBASIN M-13
  148         BA    1.81
  149         LU     .87     .53     3.0
  150         UD     .86

  151         KK   CO-12
  152         KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-12 AND    M-13
  153         KO       1
  154         HC       2
  155         ZZ
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SCHEMATIC DIAGRAM OF STREAM NETWORK

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

          (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  35       SUBM1
               V
               V
  40       RO-1
               .
               .
  43           .       SUBM2
               .           .
               .           .
  48       CO-1 ............
               .
               .
  51           .       SUBM3
               .           .
               .           .
  56       CO-2 ............
               V
               V
  59       RO-2
               .
               .
  62           .       SUBM5
               .           .
               .           .
  67       CO-3 ............
               .
               .
  70           .       SUBM4
               .           .
               .           .
  75       CO-4 ............
               V
               V
  78       RO-3
               .
               .
  81           .       SUBM6
               .           .
               .           .
  86       CO-5 ............
               .
               .
  89           .       SUBM7
               .           .
               .           .
  94       CO-6 ............
               .
               .
  97           .       SUBM8
               .           .
               .           .
 102       CO-7 ............
               V
               V
  [illegible]5 RO-4
               .
               .
 108           .       SUBM9
               .           .
```

```
                .          .
113         CO-8 ............
                .
                .
116             .      SUBM10
                .          .
                .          .
121         CO-9 ............
                V
                V
124         RO-5
                .
                .
127             .      SUBM11
                .          .
                .          .
132         CO-10............
                .
                .
135             .      SUBM12
                .          .
                .          .
140         CO-11............
                V
                V
143         RO-6
                .
                .
146             .      SUBM13
                .          .
                .          .
151         CO-12............
```

RUNOFF ALSO COMPUTED AT THIS LOCATION

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FILE: MC-06

HYDROLOGY FOR: 100-YEAR 6 HOUR EVENT

PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF
MORGAN CITY WASH, AGUA FRIA RIVER TO THE
MARICOPA COUNTY BOUNDARY

METHODS OF STUDY: HEC-1 DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
-AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
& PERCENT IMPERVIOUS
STREAM ROUTING- MUSKINGUM METHOD

WATERSHED NAME: MORGAN CITY WASH

CONTRACT NUMBER: FCD 89-15

COMPUTED BY: BAKER ENGINEERS DATE:12/07/89
COMP: _____ CKD: _____

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

IT        HYDROGRAPH TIME DATA
                NMIN          6  MINUTES IN COMPUTATION INTERVAL
               IDATE     1OCT89  STARTING DATE
               ITIME       0900  STARTING TIME
                  NQ        120  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE     1OCT89  ENDING DATE
              NDTIME       2054  ENDING TIME

          COMPUTATION INTERVAL     .10 HOURS
               TOTAL TIME BASE   11.90 HOURS

     ENGLISH UNITS

27 JD     INDEX STORM NO. 1
               STRM       3.40  PRECIPITATION DEPTH
               TRDA        .01  TRANSPOSITION DRAINAGE AREA

28 PI      PRECIPITATION PATTERN
              .00       .00       .00       .00       .00       .01       .01       .01       .01       .01
              .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
              .01       .01       .01       .01       .01       .06       .06       .11       .16       .16
              .02       .02       .02       .02       .02       .01       .01       .01       .01       .01
              .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
              .01       .01       .00       .00       .00       .00       .00       .00       .00       .00

31 JD     INDEX STORM NO. 2
               STRM       2.89  PRECIPITATION DEPTH
               TRDA      10.00  TRANSPOSITION DRAINAGE AREA
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 0 PI          PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .06      .06      .11      .16      .16
                .02      .02      .02      .02      .02      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .00      .00      .00      .00      .00      .00      .00      .00

32 JD         INDEX STORM NO. 3
                STRM        2.69  PRECIPITATION DEPTH
                TRDA       20.00  TRANSPOSITION DRAINAGE AREA

 0 PI          PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .06      .06      .11      .16      .16
                .02      .02      .02      .02      .02      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .00      .00      .00      .00      .00      .00      .00      .00

33 JD         INDEX STORM NO. 4
                STRM        2.55  PRECIPITATION DEPTH
                TRDA       30.00  TRANSPOSITION DRAINAGE AREA

 0 PI          PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .06      .06      .11      .16      .16
                .02      .02      .02      .02      .02      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .00      .00      .00      .00      .00      .00      .00      .00

 JD           INDEX STORM NO. 5
                STRM        2.45  PRECIPITATION DEPTH
                TRDA       40.00  TRANSPOSITION DRAINAGE AREA

 0 PI          PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .06      .06      .11      .16      .16
                .02      .02      .02      .02      .02      .01      .01      .01      .01      .01
                .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                .01      .01      .00      .00      .00      .00      .00      .00      .00      .00


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
151 KK    *     CO-12  *
          *            *
          **************

153 KO        OUTPUT CONTROL VARIABLES
                IPRNT           1  PRINT CONTROL
                IPLOT           0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE

 HC           HYDROGRAPH COMBINATION
                ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA .0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	1 OCT 1200	31	1052.	1 OCT 1500	61	5747.	1 OCT 1800	91	65.
1 OCT 0906	2	0.	1 OCT 1206	32	1289.	1 OCT 1506	62	4815.	1 OCT 1806	92	51.
1 OCT 0912	3	0.	1 OCT 1212	33	1612.	1 OCT 1512	63	4044.	1 OCT 1812	93	40.
1 OCT 0918	4	0.	1 OCT 1218	34	2053.	1 OCT 1518	64	3416.	1 OCT 1818	94	31.
1 OCT 0924	5	0.	1 OCT 1224	35	2633.	1 OCT 1524	65	2906.	1 OCT 1824	95	25.
1 OCT 0930	6	1.	1 OCT 1230	36	3353.	1 OCT 1530	66	2495.	1 OCT 1830	96	19.
1 OCT 0936	7	2.	1 OCT 1236	37	4203.	1 OCT 1536	67	2161.	1 OCT 1836	97	15.
1 OCT 0942	8	5.	1 OCT 1242	38	5149.	1 OCT 1542	68	1889.	1 OCT 1842	98	12.
1 OCT 0948	9	9.	1 OCT 1248	39	6126.	1 OCT 1548	69	1664.	1 OCT 1848	99	9.
1 OCT 0954	10	16.	1 OCT 1254	40	7067.	1 OCT 1554	70	1477.	1 OCT 1854	100	7.
1 OCT 1000	11	26.	1 OCT 1300	41	7914.	1 OCT 1600	71	1318.	1 OCT 1900	101	6.
1 OCT 1006	12	39.	1 OCT 1306	42	8665.	1 OCT 1606	72	1182.	1 OCT 1906	102	5.
1 OCT 1012	13	55.	1 OCT 1312	43	9341.	1 OCT 1612	73	1064.	1 OCT 1912	103	4.
1 OCT 1018	14	75.	1 OCT 1318	44	10000.	1 OCT 1618	74	960.	1 OCT 1918	104	3.
1 OCT 1024	15	97.	1 OCT 1324	45	10703.	1 OCT 1624	75	868.	1 OCT 1924	105	2.
1 OCT 1030	16	123.	1 OCT 1330	46	11484.	1 OCT 1630	76	786.	1 OCT 1930	106	2.
1 OCT 1036	17	151.	1 OCT 1336	47	12337.	1 OCT 1636	77	711.	1 OCT 1936	107	1.
1 OCT 1042	18	183.	1 OCT 1342	48	13232.	1 OCT 1642	78	641.	1 OCT 1942	108	1.
1 OCT 1048	19	219.	1 OCT 1348	49	14111.	1 OCT 1648	79	576.	1 OCT 1948	109	1.
1 OCT 1054	20	259.	1 OCT 1354	50	14884.	1 OCT 1654	80	515.	1 OCT 1954	110	0.
1 OCT 1100	21	303.	1 OCT 1400	51	15436.	1 OCT 1700	81	455.	1 OCT 2000	111	0.
1 OCT 1106	22	351.	1 OCT 1406	52	15655.	1 OCT 1706	82	398.	1 OCT 2006	112	0.
1 OCT 1112	23	403.	1 OCT 1412	53	15460.	1 OCT 1712	83	344.	1 OCT 2012	113	0.
1 OCT 1118	24	457.	1 OCT 1418	54	14827.	1 OCT 1718	84	292.	1 OCT 2018	114	0.
1 OCT 1124	25	514.	1 OCT 1424	55	13805.	1 OCT 1724	85	245.	1 OCT 2024	115	0.
1 OCT 1130	26	571.	1 OCT 1430	56	12497.	1 OCT 1730	86	201.	1 OCT 2030	116	0.
1 OCT 1136	27	629.	1 OCT 1436	57	11035.	1 OCT 1736	87	164.	1 OCT 2036	117	0.
1 OCT 1142	28	691.	1 OCT 1442	58	9545.	1 OCT 1742	88	131.	1 OCT 2042	118	0.
1 OCT 1148	29	769.	1 OCT 1448	59	8130.	1 OCT 1748	89	104.	1 OCT 2048	119	0.
1 OCT 1154	30	883.	1 OCT 1454	60	6854.	1 OCT 1754	90	82.	1 OCT 2054	120	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
15655.	5.10	(CFS)	5257.	2683.	2683.	2683.
		(INCHES)	2.128	2.154	2.154	2.154
		(AC-FT)	2607.	2638.	2638.	2638.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 10.0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	1 OCT 1200	31	856.	1 OCT 1500	61	4565.	1 OCT 1800	91	55.
1 OCT 0906	2	0.	1 OCT 1206	32	1033.	1 OCT 1506	62	3825.	1 OCT 1806	92	43.
1 OCT 0912	3	0.	1 OCT 1212	33	1275.	1 OCT 1512	63	3218.	1 OCT 1812	93	34.
1 OCT 0918	4	0.	1 OCT 1218	34	1610.	1 OCT 1518	64	2724.	1 OCT 1818	94	27.
1 OCT 0924	5	0.	1 OCT 1224	35	2055.	1 OCT 1524	65	2326.	1 OCT 1824	95	21.
1 OCT 0930	6	1.	1 OCT 1230	36	2615.	1 OCT 1530	66	2005.	1 OCT 1830	96	16.
1 OCT 0936	7	2.	1 OCT 1236	37	3283.	1 OCT 1536	67	1746.	1 OCT 1836	97	13.

1 OCT 0942	8	4.	*	1 OCT 1242	38	4038.	*	1 OCT 1542	68	1534.	*	1 OCT 1842	98	10.
1 OCT 0948	9	8.	*	1 OCT 1248	39	4826.	*	1 OCT 1548	69	1358.	*	1 OCT 1848	99	8.
1 OCT 0954	10	13.	*	1 OCT 1254	40	5590.	*	1 OCT 1554	70	1211.	*	1 OCT 1854	100	6.
1 OCT 1000	11	22.	*	1 OCT 1300	41	6280.	*	1 OCT 1600	71	1086.	*	1 OCT 1900	101	5.
1 OCT 1006	12	33.	*	1 OCT 1306	42	6891.	*	1 OCT 1606	72	978.	*	1 OCT 1906	102	4.
1 OCT 1012	13	47.	*	1 OCT 1312	43	7433.	*	1 OCT 1612	73	884.	*	1 OCT 1912	103	3.
1 OCT 1018	14	64.	*	1 OCT 1318	44	7955.	*	1 OCT 1618	74	800.	*	1 OCT 1918	104	2.
1 OCT 1024	15	83.	*	1 OCT 1324	45	8509.	*	1 OCT 1624	75	725.	*	1 OCT 1924	105	2.
1 OCT 1030	16	104.	*	1 OCT 1330	46	9122.	*	1 OCT 1630	76	658.	*	1 OCT 1930	106	1.
1 OCT 1036	17	128.	*	1 OCT 1336	47	9789.	*	1 OCT 1636	77	596.	*	1 OCT 1936	107	1.
1 OCT 1042	18	156.	*	1 OCT 1342	48	10488.	*	1 OCT 1642	78	539.	*	1 OCT 1942	108	1.
1 OCT 1048	19	186.	*	1 OCT 1348	49	11178.	*	1 OCT 1648	79	485.	*	1 OCT 1948	109	1.
1 OCT 1054	20	220.	*	1 OCT 1354	50	11789.	*	1 OCT 1654	80	434.	*	1 OCT 1954	110	0.
1 OCT 1100	21	257.	*	1 OCT 1400	51	12233.	*	1 OCT 1700	81	384.	*	1 OCT 2000	111	0.
1 OCT 1106	22	298.	*	1 OCT 1406	52	12419.	*	1 OCT 1706	82	337.	*	1 OCT 2006	112	0.
1 OCT 1112	23	342.	*	1 OCT 1412	53	12280.	*	1 OCT 1712	83	291.	*	1 OCT 2012	113	0.
1 OCT 1118	24	389.	*	1 OCT 1418	54	11791.	*	1 OCT 1718	84	247.	*	1 OCT 2018	114	0.
1 OCT 1124	25	437.	*	1 OCT 1424	55	10988.	*	1 OCT 1724	85	207.	*	1 OCT 2024	115	0.
1 OCT 1130	26	486.	*	1 OCT 1430	56	9951.	*	1 OCT 1730	86	171.	*	1 OCT 2030	116	0.
1 OCT 1136	27	534.	*	1 OCT 1436	57	8786.	*	1 OCT 1736	87	138.	*	1 OCT 2036	117	0.
1 OCT 1142	28	584.	*	1 OCT 1442	58	7596.	*	1 OCT 1742	88	111.	*	1 OCT 2042	118	0.
1 OCT 1148	29	643.	*	1 OCT 1448	59	6465.	*	1 OCT 1748	89	88.	*	1 OCT 2048	119	0.
1 OCT 1154	30	729.	*	1 OCT 1454	60	5446.	*	1 OCT 1754	90	70.	*	1 OCT 2054	120	0.
			*				*				*			

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
12419.	5.10	(CFS)	4185.	2137.	2137.	2137.
		(INCHES)	1.694	1.716	1.716	1.716
		(AC-FT)	2075.	2102.	2102.	2102.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 20.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	*	1 OCT 1200	31	783.	*	1 OCT 1500	61	4112.	*	1 OCT 1800	91	51.
1 OCT 0906	2	0.	*	1 OCT 1206	32	938.	*	1 OCT 1506	62	3450.	*	1 OCT 1806	92	40.
1 OCT 0912	3	0.	*	1 OCT 1212	33	1150.	*	1 OCT 1512	63	2906.	*	1 OCT 1812	93	31.
1 OCT 0918	4	0.	*	1 OCT 1218	34	1443.	*	1 OCT 1518	64	2465.	*	1 OCT 1818	94	25.
1 OCT 0924	5	0.	*	1 OCT 1224	35	1836.	*	1 OCT 1524	65	2109.	*	1 OCT 1824	95	19.
1 OCT 0930	6	1.	*	1 OCT 1230	36	2333.	*	1 OCT 1530	66	1823.	*	1 OCT 1830	96	15.
1 OCT 0936	7	2.	*	1 OCT 1236	37	2931.	*	1 OCT 1536	67	1591.	*	1 OCT 1836	97	12.
1 OCT 0942	8	4.	*	1 OCT 1242	38	3610.	*	1 OCT 1542	68	1401.	*	1 OCT 1842	98	9.
1 OCT 0948	9	7.	*	1 OCT 1248	39	4322.	*	1 OCT 1548	69	1243.	*	1 OCT 1848	99	7.
1 OCT 0954	10	13.	*	1 OCT 1254	40	5015.	*	1 OCT 1554	70	1111.	*	1 OCT 1854	100	6.
1 OCT 1000	11	20.	*	1 OCT 1300	41	5644.	*	1 OCT 1600	71	998.	*	1 OCT 1900	101	5.
1 OCT 1006	12	31.	*	1 OCT 1306	42	6201.	*	1 OCT 1606	72	900.	*	1 OCT 1906	102	4.
1 OCT 1012	13	44.	*	1 OCT 1312	43	6694.	*	1 OCT 1612	73	814.	*	1 OCT 1912	103	3.
1 OCT 1018	14	59.	*	1 OCT 1318	44	7166.	*	1 OCT 1618	74	738.	*	1 OCT 1918	104	2.
1 OCT 1024	15	77.	*	1 OCT 1324	45	7665.	*	1 OCT 1624	75	670.	*	1 OCT 1924	105	2.
1 OCT 1030	16	97.	*	1 OCT 1330	46	8214.	*	1 OCT 1630	76	609.	*	1 OCT 1930	106	1.
1 OCT 1036	17	120.	*	1 OCT 1336	47	8809.	*	1 OCT 1636	77	552.	*	1 OCT 1936	107	1.
1 OCT 1042	18	145.	*	1 OCT 1342	48	9430.	*	1 OCT 1642	78	499.	*	1 OCT 1942	108	1.
1 OCT 1048	19	173.	*	1 OCT 1348	49	10041.	*	1 OCT 1648	79	450.	*	1 OCT 1948	109	1.
1 OCT 1054	20	205.	*	1 OCT 1354	50	10582.	*	1 OCT 1654	80	402.	*	1 OCT 1954	110	0.
1 OCT 1100	21	240.	*	1 OCT 1400	51	10977.	*	1 OCT 1700	81	357.	*	1 OCT 2000	111	0.
1 OCT 1106	22	278.	*	1 OCT 1406	52	11143.	*	1 OCT 1706	82	312.	*	1 OCT 2006	112	0.

1 OCT 1112	23	319.	*	1 OCT 1412	53	11019.	*	1 OCT 1712	83	270.	*	1 OCT 2012	113	0.
1 OCT 1118	24	362.	*	1 OCT 1418	54	10584.	*	1 OCT 1718	84	230.	*	1 OCT 2018	114	0.
1 OCT 1124	25	407.	*	1 OCT 1424	55	9867.	*	1 OCT 1724	85	192.	*	1 OCT 2024	115	0.
1 OCT 1130	26	452.	*	1 OCT 1430	56	8940.	*	1 OCT 1730	86	159.	*	1 OCT 2030	116	0.
1 OCT 1136	27	497.	*	1 OCT 1436	57	7897.	*	1 OCT 1736	87	129.	*	1 OCT 2036	117	0.
1 OCT 1142	28	543.	*	1 OCT 1442	58	6830.	*	1 OCT 1742	88	103.	*	1 OCT 2042	118	0.
1 OCT 1148	29	596.	*	1 OCT 1448	59	5816.	*	1 OCT 1748	89	82.	*	1 OCT 2048	119	0.
1 OCT 1154	30	671.	*	1 OCT 1454	60	4902.	*	1 OCT 1754	90	65.	*	1 OCT 2054	120	0.
			*				*				*			

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
11143.	5.10	(CFS)	3769.	1925.	1925.	1925.
		(INCHES)	1.525	1.546	1.546	1.546
		(AC-FT)	1869.	1894.	1894.	1894.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 30.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	*	1 OCT 1200	31	734.	*	1 OCT 1500	61	3798.	*	1 OCT 1800	91	48.
1 OCT 0906	2	0.	*	1 OCT 1206	32	874.	*	1 OCT 1506	62	3189.	*	1 OCT 1806	92	38.
1 OCT 0912	3	0.	*	1 OCT 1212	33	1065.	*	1 OCT 1512	63	2690.	*	1 OCT 1812	93	30.
1 OCT 0918	4	0.	*	1 OCT 1218	34	1331.	*	1 OCT 1518	64	2286.	*	1 OCT 1818	94	23.
1 OCT 0924	5	0.	*	1 OCT 1224	35	1688.	*	1 OCT 1524	65	1959.	*	1 OCT 1824	95	18.
1 OCT 0930	6	1.	*	1 OCT 1230	36	2141.	*	1 OCT 1530	66	1696.	*	1 OCT 1830	96	14.
1 OCT 0936	7	2.	*	1 OCT 1236	37	2688.	*	1 OCT 1536	67	1483.	*	1 OCT 1836	97	11.
1 OCT 0942	8	3.	*	1 OCT 1242	38	3312.	*	1 OCT 1542	68	1308.	*	1 OCT 1842	98	9.
1 OCT 0948	9	7.	*	1 OCT 1248	39	3971.	*	1 OCT 1548	69	1163.	*	1 OCT 1848	99	7.
1 OCT 0954	10	12.	*	1 OCT 1254	40	4613.	*	1 OCT 1554	70	1041.	*	1 OCT 1854	100	6.
1 OCT 1000	11	19.	*	1 OCT 1300	41	5198.	*	1 OCT 1600	71	937.	*	1 OCT 1900	101	4.
1 OCT 1006	12	29.	*	1 OCT 1306	42	5716.	*	1 OCT 1606	72	846.	*	1 OCT 1906	102	3.
1 OCT 1012	13	42.	*	1 OCT 1312	43	6176.	*	1 OCT 1612	73	766.	*	1 OCT 1912	103	3.
1 OCT 1018	14	56.	*	1 OCT 1318	44	6613.	*	1 OCT 1618	74	695.	*	1 OCT 1918	104	2.
1 OCT 1024	15	73.	*	1 OCT 1324	45	7072.	*	1 OCT 1624	75	632.	*	1 OCT 1924	105	2.
1 OCT 1030	16	92.	*	1 OCT 1330	46	7576.	*	1 OCT 1630	76	574.	*	1 OCT 1930	106	1.
1 OCT 1036	17	113.	*	1 OCT 1336	47	8120.	*	1 OCT 1636	77	521.	*	1 OCT 1936	107	1.
1 OCT 1042	18	137.	*	1 OCT 1342	48	8686.	*	1 OCT 1642	78	472.	*	1 OCT 1942	108	1.
1 OCT 1048	19	164.	*	1 OCT 1348	49	9243.	*	1 OCT 1648	79	425.	*	1 OCT 1948	109	1.
1 OCT 1054	20	194.	*	1 OCT 1354	50	9736.	*	1 OCT 1654	80	380.	*	1 OCT 1954	110	0.
1 OCT 1100	21	227.	*	1 OCT 1400	51	10097.	*	1 OCT 1700	81	337.	*	1 OCT 2000	111	0.
1 OCT 1106	22	263.	*	1 OCT 1406	52	10249.	*	1 OCT 1706	82	296.	*	1 OCT 2006	112	0.
1 OCT 1112	23	302.	*	1 OCT 1412	53	10138.	*	1 OCT 1712	83	255.	*	1 OCT 2012	113	0.
1 OCT 1118	24	343.	*	1 OCT 1418	54	9741.	*	1 OCT 1718	84	217.	*	1 OCT 2018	114	0.
1 OCT 1124	25	385.	*	1 OCT 1424	55	9085.	*	1 OCT 1724	85	182.	*	1 OCT 2024	115	0.
1 OCT 1130	26	428.	*	1 OCT 1430	56	8235.	*	1 OCT 1730	86	150.	*	1 OCT 2030	116	0.
1 OCT 1136	27	472.	*	1 OCT 1436	57	7277.	*	1 OCT 1736	87	122.	*	1 OCT 2036	117	0.
1 OCT 1142	28	515.	*	1 OCT 1442	58	6297.	*	1 OCT 1742	88	98.	*	1 OCT 2042	118	0.
1 OCT 1148	29	563.	*	1 OCT 1448	59	5364.	*	1 OCT 1748	89	78.	*	1 OCT 2048	119	0.
1 OCT 1154	30	632.	*	1 OCT 1454	60	4524.	*	1 OCT 1754	90	61.	*	1 OCT 2054	120	0.
			*				*				*			

****

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
10249.	5.10	(CFS)	3478.	1777.	1777.	1777.
		(INCHES)	1.408	1.427	1.427	1.427

(AC-FT) 1725. 1748. 1748. 1748.

CUMULATIVE AREA = 22.97 SQ MI

HYDROGRAPH AT CO-12
TRANSPOSITION AREA 40.0 SQ MI

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	1 OCT 1200	31	699.	1 OCT 1500	61	3578.	1 OCT 1800	91	46.
1 OCT 0906	2	0.	1 OCT 1206	32	829.	1 OCT 1506	62	3008.	1 OCT 1806	92	36.
1 OCT 0912	3	0.	1 OCT 1212	33	1005.	1 OCT 1512	63	2540.	1 OCT 1812	93	29.
1 OCT 0918	4	0.	1 OCT 1218	34	1252.	1 OCT 1518	64	2161.	1 OCT 1818	94	23.
1 OCT 0924	5	0.	1 OCT 1224	35	1584.	1 OCT 1524	65	1855.	1 OCT 1824	95	18.
1 OCT 0930	6	1.	1 OCT 1230	36	2007.	1 OCT 1530	66	1608.	1 OCT 1830	96	14.
1 OCT 0936	7	2.	1 OCT 1236	37	2518.	1 OCT 1536	67	1408.	1 OCT 1836	97	11.
1 OCT 0942	8	3.	1 OCT 1242	38	3103.	1 OCT 1542	68	1244.	1 OCT 1842	98	9.
1 OCT 0948	9	6.	1 OCT 1248	39	3723.	1 OCT 1548	69	1107.	1 OCT 1848	99	7.
1 OCT 0954	10	11.	1 OCT 1254	40	4329.	1 OCT 1554	70	992.	1 OCT 1854	100	5.
1 OCT 1000	11	19.	1 OCT 1300	41	4882.	1 OCT 1600	71	894.	1 OCT 1900	101	4.
1 OCT 1006	12	28.	1 OCT 1306	42	5373.	1 OCT 1606	72	808.	1 OCT 1906	102	3.
1 OCT 1012	13	40.	1 OCT 1312	43	5807.	1 OCT 1612	73	732.	1 OCT 1912	103	3.
1 OCT 1018	14	54.	1 OCT 1318	44	6218.	1 OCT 1618	74	665.	1 OCT 1918	104	2.
1 OCT 1024	15	70.	1 OCT 1324	45	6648.	1 OCT 1624	75	605.	1 OCT 1924	105	2.
1 OCT 1030	16	88.	1 OCT 1330	46	7119.	1 OCT 1630	76	550.	1 OCT 1930	106	1.
1 OCT 1036	17	109.	1 OCT 1336	47	7627.	1 OCT 1636	77	499.	1 OCT 1936	107	1.
1 OCT 1042	18	132.	1 OCT 1342	48	8155.	1 OCT 1642	78	452.	1 OCT 1942	108	1.
1 OCT 1048	19	158.	1 OCT 1348	49	8674.	1 OCT 1648	79	407.	1 OCT 1948	109	0.
1 OCT 1054	20	186.	1 OCT 1354	50	9133.	1 OCT 1654	80	365.	1 OCT 1954	110	0.
1 OCT 1100	21	218.	1 OCT 1400	51	9470.	1 OCT 1700	81	323.	1 OCT 2000	111	0.
1 OCT 1106	22	253.	1 OCT 1406	52	9614.	1 OCT 1706	82	284.	1 OCT 2006	112	0.
1 OCT 1112	23	290.	1 OCT 1412	53	9513.	1 OCT 1712	83	245.	1 OCT 2012	113	0.
1 OCT 1118	24	330.	1 OCT 1418	54	9144.	1 OCT 1718	84	209.	1 OCT 2018	114	0.
1 OCT 1124	25	370.	1 OCT 1424	55	8533.	1 OCT 1724	85	175.	1 OCT 2024	115	0.
1 OCT 1130	26	412.	1 OCT 1430	56	7738.	1 OCT 1730	86	144.	1 OCT 2030	116	0.
1 OCT 1136	27	453.	1 OCT 1436	57	6841.	1 OCT 1736	87	117.	1 OCT 2036	117	0.
1 OCT 1142	28	494.	1 OCT 1442	58	5922.	1 OCT 1742	88	94.	1 OCT 2042	118	0.
1 OCT 1148	29	540.	1 OCT 1448	59	5047.	1 OCT 1748	89	75.	1 OCT 2048	119	0.
1 OCT 1154	30	604.	1 OCT 1454	60	4259.	1 OCT 1754	90	59.	1 OCT 2054	120	0.

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
9614.	5.10	(CFS)	3272.	1673.	1673.	1673.
		(INCHES)	1.324	1.343	1.343	1.343
		(AC-FT)	1623.	1645.	1645.	1645.

CUMULATIVE AREA = 22.97 SQ MI

INTERPOLATED HYDROGRAPH AT CO-12

DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 OCT 0900	1	0.	1 OCT 1200	31	769.	1 OCT 1500	61	4024.	1 OCT 1800	91	50.
1 OCT 0906	2	0.	1 OCT 1206	32	920.	1 OCT 1506	62	3377.	1 OCT 1806	92	40.

1 OCT 0912	3	0.	*	1 OCT 1212	33	1126.	*	1 OCT 1512	63	2845.	*	1 OCT 1812	93	31.
1 OCT 0918	4	0.	*	1 OCT 1218	34	1412.	*	1 OCT 1518	64	2415.	*	1 OCT 1818	94	24.
1 OCT 0924	5	0.	*	1 OCT 1224	35	1794.	*	1 OCT 1524	65	2067.	*	1 OCT 1824	95	19.
1 OCT 0930	6	1.	*	1 OCT 1230	36	2279.	*	1 OCT 1530	66	1787.	*	1 OCT 1830	96	15.
1 OCT 0936	7	2.	*	1 OCT 1236	37	2863.	*	1 OCT 1536	67	1560.	*	1 OCT 1836	97	12.
1 OCT 0942	8	4.	*	1 OCT 1242	38	3526.	*	1 OCT 1542	68	1375.	*	1 OCT 1842	98	9.
1 OCT 0948	9	7.	*	1 OCT 1248	39	4223.	*	1 OCT 1548	69	1221.	*	1 OCT 1848	99	7.
1 OCT 0954	10	12.	*	1 OCT 1254	40	4902.	*	1 OCT 1554	70	1091.	*	1 OCT 1854	100	6.
1 OCT 1000	11	20.	*	1 OCT 1300	41	5519.	*	1 OCT 1600	71	981.	*	1 OCT 1900	101	5.
1 OCT 1006	12	30.	*	1 OCT 1306	42	6065.	*	1 OCT 1606	72	885.	*	1 OCT 1906	102	4.
1 OCT 1012	13	43.	*	1 OCT 1312	43	6549.	*	1 OCT 1612	73	801.	*	1 OCT 1912	103	3.
1 OCT 1018	14	58.	*	1 OCT 1318	44	7011.	*	1 OCT 1618	74	726.	*	1 OCT 1918	104	2.
1 OCT 1024	15	76.	*	1 OCT 1324	45	7498.	*	1 OCT 1624	75	659.	*	1 OCT 1924	105	2.
1 OCT 1030	16	96.	*	1 OCT 1330	46	8035.	*	1 OCT 1630	76	599.	*	1 OCT 1930	106	1.
1 OCT 1036	17	118.	*	1 OCT 1336	47	8615.	*	1 OCT 1636	77	543.	*	1 OCT 1936	107	1.
1 OCT 1042	18	143.	*	1 OCT 1342	48	9221.	*	1 OCT 1642	78	492.	*	1 OCT 1942	108	1.
1 OCT 1048	19	171.	*	1 OCT 1348	49	9817.	*	1 OCT 1648	79	443.	*	1 OCT 1948	109	1.
1 OCT 1054	20	202.	*	1 OCT 1354	50	10345.	*	1 OCT 1654	80	396.	*	1 OCT 1954	110	0.
1 OCT 1100	21	236.	*	1 OCT 1400	51	10729.	*	1 OCT 1700	81	351.	*	1 OCT 2000	111	0.
1 OCT 1106	22	274.	*	1 OCT 1406	52	10892.	*	1 OCT 1706	82	308.	*	1 OCT 2006	112	0.
1 OCT 1112	23	314.	*	1 OCT 1412	53	10771.	*	1 OCT 1712	83	266.	*	1 OCT 2012	113	0.
1 OCT 1118	24	357.	*	1 OCT 1418	54	10347.	*	1 OCT 1718	84	226.	*	1 OCT 2018	114	0.
1 OCT 1124	25	401.	*	1 OCT 1424	55	9648.	*	1 OCT 1724	85	189.	*	1 OCT 2024	115	0.
1 OCT 1130	26	445.	*	1 OCT 1430	56	8742.	*	1 OCT 1730	86	156.	*	1 OCT 2030	116	0.
1 OCT 1136	27	490.	*	1 OCT 1436	57	7723.	*	1 OCT 1736	87	127.	*	1 OCT 2036	117	0.
1 OCT 1142	28	535.	*	1 OCT 1442	58	6680.	*	1 OCT 1742	88	102.	*	1 OCT 2042	118	0.
1 OCT 1148	29	587.	*	1 OCT 1448	59	5689.	*	1 OCT 1748	89	81.	*	1 OCT 2048	119	0.
1 OCT 1154	30	660.	*	1 OCT 1454	60	4796.	*	1 OCT 1754	90	64.	*	1 OCT 2054	120	0.
			*				*				*			

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	11.90-HR
10892.	5.10	(CFS)	3687.	1884.	1884.	1884.
		(INCHES)	1.492	1.512	1.512	1.512
		(AC-FT)	1828.	1853.	1853.	1853.

CUMULATIVE AREA = 22.97 SQ MI

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	SUBM1	2766.	3.20	344.	174.	174.	2.00		
ROUTED TO	RO-1	2547.	3.50	344.	174.	174.	2.00		
HYDROGRAPH AT	SUBM2	1950.	3.30	322.	163.	163.	1.56		
2 COMBINED AT	CO-1	4183.	3.50	649.	329.	329.	3.56		
HYDROGRAPH AT	SUBM3	1835.	3.50	374.	190.	190.	1.89		
2 COMBINED AT	CO-2	5887.	3.50	999.	507.	507.	5.45		
ROUTED TO	RO-2	5623.	3.70	999.	507.	507.	5.45		
HYDROGRAPH AT	SUBM5	1927.	3.40	347.	176.	176.	1.74		
2 COMBINED AT	CO-3	6903.	3.70	1317.	669.	669.	7.19		
HYDROGRAPH AT	SUBM4	2622.	3.50	522.	265.	265.	2.67		
2 COMBINED AT	CO-4	9012.	3.60	1800.	914.	914.	9.86		
ROUTED TO	RO-3	8531.	4.10	1799.	914.	914.	9.86		
HYDROGRAPH AT	SUBM6	1975.	3.80	524.	268.	268.	2.61		
2 COMBINED AT	CO-5	9797.	4.10	2224.	1132.	1132.	12.47		
HYDROGRAPH AT	SUBM7	910.	3.40	172.	87.	87.	.78		
2 COMBINED AT	CO-6	9999.	4.10	2354.	1198.	1198.	13.25		
HYDROGRAPH AT	SUBM8	1998.	3.70	485.	247.	247.	2.39		
2 COMBINED AT	CO-7	11028.	4.10	2729.	1389.	1389.	15.64		
ROUTED TO	RO-4	10607.	4.50	2727.	1389.	1389.	15.64		
HYDROGRAPH AT	SUBM9	1533.	3.60	324.	165.	165.	1.76		
2 COMBINED AT	CO-8	10764.	4.50	2960.	1510.	1510.	17.40		
HYDROGRAPH AT	SUBM10	1370.	3.70	351.	179.	179.	1.50		
2 COMBINED AT	CO-9	11106.	4.50	3223.	1645.	1645.	18.90		
ROUTED TO	RO-5	11014.	4.60	3222.	1645.	1645.	18.90		
HYDROGRAPH AT	SUBM11	1095.	3.40	175.	89.	89.	.97		
2 COMBINED AT	CO-10	11014.	4.60	3344.	1708.	1708.	19.87		
HYDROGRAPH AT	SUBM12	1146.	3.70	282.	144.	144.	1.29		
2 COMBINED AT	CO-11	11196.	4.60	3535.	1806.	1806.	21.16		
ROUTED TO	RO-6	10892.	5.10	3534.	1806.	1806.	21.16		

HYDROGRAPH AT	SUBM13	1151.	3.70	244.	123.	123.	1.81
2 COMBINED AT	CO-12	10892.	5.10	3687.	1884.	1884.	22.97

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

APPENDIX C

MORGAN CITY WASH

HEC-1

100-YEAR 24 HOUR STORM

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

  1           ID                  FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
  2           ID
  3           ID                              FILE:    MC-24
  4           ID
  5           ID        HYDROLOGY FOR:    100-YEAR 24 HOUR EVENT
  6           ID
  7           ID        PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF
  8           ID                          MORGAN CITY WASH, AGUA FRIA RIVER TO THE
  9           ID                          MARICOPA COUNTY BOUNDARY
 10           ID
 11           ID        METHODS OF STUDY: HEC-1   DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
 12           ID                          PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
 13           ID                                      -AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
 14           ID                          EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
 15           ID                                      &  PERCENT IMPERVIOUS
 16           ID                          STREAM ROUTING- MUSKINGUM METHOD
 17           ID
 18           ID        WATERSHED NAME:   MORGAN CITY WASH
 19           ID
 20           ID        CONTRACT NUMBER:  FCD 89-15
 21           ID
 22           ID        COMPUTED BY:      BAKER ENGINEERS          DATE:12/07/89
 23           ID                          COMP: SSO 12/07/89       CKD: 12-8-89
 24           IT      6 01JAN89       0     300
              *DIAGRAM
 25           IN     15
 26           IO      5
 27           JD    4.5     .01
 28           PC      0    .002    .005    .008    .011    .014    .017    .020    .023    .026
 29           PC   .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
 30           PC   .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
 31           PC   .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
 32           PC   .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
 33           PC   .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
 34           PC   .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
 35           PC   .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
 36           PC   .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
 37           PC   .983    .986    .989    .992    .995    .998   1.000
 38           JD   4.28      10
 39           JD   4.14      20
 40           JD   4.05      30
 41           JD   4.01      40

 42           KK   SUBM1
 43           KM        RUNOFF FROM SUBBASIN M-1
 44           BA   2.00
 45           LU    .95     .38    20.3
 46           UD    .35

 47           KK   RO-1
 48           KM        ROUTE M-1 THROUGH M-2
 49           RM      3     .28      .3
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  50          KK   SUBM2
  51          KM        RUNOFF FROM SUBBASIN M-2
  52          BA    1.56
  53          LU     .92     .28    32.6
  54          UD     .46

  55          KK   CO-1
  56          KM        COMBINE RUNOFF FROM SUBBASINS M-  1  AND      M-2
  57          HC       2

  58          KK   SUBM3
  59          KM        RUNOFF FROM SUBBASIN M-3
  60          BA    1.89
  61          LU     .95     .40    35.0
  62          UD     .63

  63          KK   CO-2
  64          KM        COMBINE RUNOFF FROM SUBBASINS M-1, 2 AND      M-3
  65          HC       2

  66          KK   RO-2
  67          KM        ROUTE M-1,2,3 THROUGH M-5
  68          RM       3     .25      .3

  69          KK   SUBM5
  70          KM        RUNOFF FROM SUBBASIN M-5
  71          BA    1.74
  72          LU     .95     .38    34.6
  73          UD     .53

  74          KK   CO-3
  75          KM         COMBINE RUNOFF FROM SUBBASINS M-1, 2, 3 AND  M-5
  76          HC       2

  77          KK   SUBM4
  78          KM        RUNOFF FROM SUBBASIN M-4
  79          BA    2.67
  80          LU     .95     .40    34.9
  81          UD     .61

  82          KK   CO-4
  83          KM         COMBINE RUNOFF FROM SUBBASINS M-1,2,3,5 AND  M-4
  84          HC       2

  85          KK   RO-3
  86          KM        ROUTE M-1,2,3,4,5 THROUGH M-6
  87          RM       5     .48      .3

  88          KK   SUBM6
  89          KM        RUNOFF FROM SUBBASIN M-6
  90          BA    2.61
  91          LU     .93     .32    34.6
  92          UD     .89
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  93          KK   CO-5
  94          KM        COMBINE RUNOFF FROM SUBBASINS M-12345   AND  M-6
  95          HC      2

  96          KK   SUBM7
  97          KM       RUNOFF FROM SUBBASIN M-7
  98          BA    .78
  99          LU    .81     .24    31.3
 100          UD    .56

 101          KK   CO-6
 102          KM        COMBINE RUNOFF FROM SUBBASINS M-123456  AND  M-7
 103          HC      2

 104          KK   SUBM8
 105          KM       RUNOFF FROM SUBBASIN M-8
 106          BA   2.39
 107          LU    .84     .37    34.4
 108          UD    .80

 109          KK   CO-7
 110          KM        COMBINE RUNOFF FROM SUBBASINS M-1234567 AND  M-8
 111          HC      2

 112          KK   RO-4
 113          KM       ROUTE M-1..8 THROUGH M-9
 114          RM      5     .49      .3

 115          KK   SUBM9
 116          KM       RUNOFF FROM SUBBASIN M-9
 117          BA   1.76
 118          LU    .87     .55    29.2
 119          UD    .69

 120          KK   CO-8
 121          KM        COMBINE RUNOFF FROM SUBBASINS M-1 THRU 8 AND M-9
 122          HC      2

 123          KK  SUBM10
 124          KM       RUNOFF FROM SUBBASIN M-10
 125          BA   1.50
 126          LU    .81     .26    45.0
 127          UD    .80

 128          KK   CO-9
 129          KM        COMBINE RUNOFF FROM SUBBASINS M-1 THRU 9 AND M-10
 130          HC      2

 131          KK   RO-5
 132          KM       ROUTE M-1..10 THROUGH M-11
 133          RM      1     .11      .3
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 134          KK  SUBM11
 135          KM        RUNOFF FROM SUBBASIN M-11
 136          BA     .97
 137          LU     .85     .45    21.5
 138          UD     .51

 139          KK   CO-10
 140          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-10 AND    M-11
 141          HC       2

 142          KK  SUBM12
 143          KM        RUNOFF FROM SUBBASIN M-12
 144          BA    1.29
 145          LU     .81     .27    35.2
 146          UD     .80

 147          KK   CO-11
 148          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-11 AND    M-12
 149          HC       2

 150          KK   RO-6
 151          KM        ROUTE M-1..12 THROUGH M-13
 152          RM       6     .53      .3

 153          KK  SUBM13
 154          KM        RUNOFF FROM SUBBASIN M-13
 155          BA    1.81
 156          LU     .87     .53     3.0
 157          UD     .86

 158          KK   CO-12
 159          KM         COMBINE RUNOFF FROM SUBBASINS M-1 THRU M-12 AND    M-13
 160          KO       1
 161          HC       2
 162          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

          (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  42       SUBM1
               V
               V
  47       RO-1
               .
               .
  50           .       SUBM2
               .           .
               .           .
  55       CO-1 ............
               .
               .
  58           .       SUBM3
               .           .
               .           .
  63       CO-2 ............
               V
               V
  66       RO-2
               .
               .
  69           .       SUBM5
               .           .
               .           .
  74       CO-3 ............
               .
               .
  77           .       SUBM4
               .           .
               .           .
  82       CO-4 ............
               V
               V
  85       RO-3
               .
               .
  88           .       SUBM6
               .           .
               .           .
  93       CO-5 ............
               .
               .
  96           .       SUBM7
               .           .
               .           .
 101       CO-6 ............
               .
               .
 104           .       SUBM8
               .           .
               .           .
 109       CO-7 ............
               V
               V
           RO-4
               .
               .
 115           .       SUBM9
               .           .
```

```
                .          .
120         CO-8 ............
                .
                .
123             .      SUBM10
                .          .
                .          .
128         CO-9 ............
                V
                V
131         RO-5
                .
                .
134             .      SUBM11
                .          .
                .          .
139         CO-10............
                .
                .
142             .      SUBM12
                .          .
                .          .
147         CO-11............
                V
                V
150         RO-6
                .
                .
153             .      SUBM13
                .          .
                .          .
158         CO-12............
```

RUNOFF ALSO COMPUTED AT THIS LOCATION

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FILE: MC-24

HYDROLOGY FOR: 100-YEAR 24 HOUR EVENT

PURPOSE OF STUDY: DELINEATION OF THE 100-YEAR FLOODPLAIN OF
MORGAN CITY WASH, AGUA FRIA RIVER TO THE
MARICOPA COUNTY BOUNDARY

METHODS OF STUDY: HEC-1 DIMENSIONLESS SCS HYDROGRAPH 6 MIN. INTERVALS
PRECIPITATION- SCS TYPE II STORM BY 15 MIN. INCREMENTS
-AREAL REDUCTION BY "JD" DEPTH-AREA OPTION
EXCESS PRECIPITATION- INITIAL AND UNIFORM LOSS RATES
& PERCENT IMPERVIOUS
STREAM ROUTING- MUSKINGUM METHOD

WATERSHED NAME: MORGAN CITY WASH

CONTRACT NUMBER: FCD 89-15

COMPUTED BY: BAKER ENGINEERS DATE:12/07/89
COMP: _____ CKD: _____

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

 IT        HYDROGRAPH TIME DATA
                 NMIN          6  MINUTES IN COMPUTATION INTERVAL
                IDATE     1JAN89  STARTING DATE
                ITIME       0000  STARTING TIME
                   NQ        300  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE     2JAN89  ENDING DATE
               NDTIME       0554  ENDING TIME

          COMPUTATION INTERVAL     .10 HOURS
               TOTAL TIME BASE   29.90 HOURS

     ENGLISH UNITS

27 JD        INDEX STORM NO. 1
                 STRM       4.50  PRECIPITATION DEPTH
                 TRDA        .01  TRANSPOSITION DRAINAGE AREA

28 PI          PRECIPITATION PATTERN
                .00    .00    .00    .00    .00    .00    .00    .00    .00    .00
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38 JD INDEX STORM NO. 2

STRM 4.28 PRECIPITATION DEPTH

TRDA 10.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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39 JD INDEX STORM NO. 3

STRM 4.14 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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.01	.01	.01	.01	.01	.04	.04	.08	.11	.11
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40 JD INDEX STORM NO. 4

STRM 4.05 PRECIPITATION DEPTH

TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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41 JD INDEX STORM NO. 5

STRM 4.01 PRECIPITATION DEPTH

TRDA 40.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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.01	.01	.01	.01	.01	.04	.04	.08	.11	.11
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158 KK    *    CO-12   *
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160 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

161 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT CO-12
TRANSPOSITION AREA .0 SQ MI

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DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	1 JAN 0730	76	337.	1 JAN 1500	151	5495.	1 JAN 2230	226	257.
JAN 0006	2	0.	1 JAN 0736	77	341.	1 JAN 1506	152	4591.	1 JAN 2236	227	255.
1 JAN 0012	3	0.	1 JAN 0742	78	345.	1 JAN 1512	153	3848.	1 JAN 2242	228	252.
1 JAN 0018	4	0.	1 JAN 0748	79	349.	1 JAN 1518	154	3244.	1 JAN 2248	229	250.
1 JAN 0024	5	0.	1 JAN 0754	80	353.	1 JAN 1524	155	2757.	1 JAN 2254	230	249.
1 JAN 0030	6	0.	1 JAN 0800	81	357.	1 JAN 1530	156	2364.	1 JAN 2300	231	248.
1 JAN 0036	7	1.	1 JAN 0806	82	362.	1 JAN 1536	157	2046.	1 JAN 2306	232	247.
1 JAN 0042	8	1.	1 JAN 0812	83	367.	1 JAN 1542	158	1789.	1 JAN 2312	233	246.
1 JAN 0048	9	2.	1 JAN 0818	84	373.	1 JAN 1548	159	1578.	1 JAN 2318	234	246.
1 JAN 0054	10	4.	1 JAN 0824	85	378.	1 JAN 1554	160	1405.	1 JAN 2324	235	245.
1 JAN 0100	11	7.	1 JAN 0830	86	382.	1 JAN 1600	161	1262.	1 JAN 2330	236	245.
1 JAN 0106	12	11.	1 JAN 0836	87	387.	1 JAN 1606	162	1143.	1 JAN 2336	237	244.
1 JAN 0112	13	16.	1 JAN 0842	88	391.	1 JAN 1612	163	1043.	1 JAN 2342	238	244.
1 JAN 0118	14	21.	1 JAN 0848	89	395.	1 JAN 1618	164	959.	1 JAN 2348	239	244.
1 JAN 0124	15	28.	1 JAN 0854	90	398.	1 JAN 1624	165	889.	1 JAN 2354	240	244.
1 JAN 0130	16	36.	1 JAN 0900	91	402.	1 JAN 1630	166	828.	2 JAN 0000	241	244.
1 JAN 0136	17	45.	1 JAN 0906	92	406.	1 JAN 1636	167	777.	2 JAN 0006	242	244.
1 JAN 0142	18	54.	1 JAN 0912	93	410.	1 JAN 1642	168	733.	2 JAN 0012	243	244.
1 JAN 0148	19	65.	1 JAN 0918	94	415.	1 JAN 1648	169	696.	2 JAN 0018	244	243.
1 JAN 0154	20	77.	1 JAN 0924	95	420.	1 JAN 1654	170	664.	2 JAN 0024	245	243.
1 JAN 0200	21	89.	1 JAN 0930	96	425.	1 JAN 1700	171	636.	2 JAN 0030	246	242.
1 JAN 0206	22	103.	1 JAN 0936	97	431.	1 JAN 1706	172	612.	2 JAN 0036	247	242.
1 JAN 0212	23	117.	1 JAN 0942	98	438.	1 JAN 1712	173	592.	2 JAN 0042	248	240.
1 JAN 0218	24	132.	1 JAN 0948	99	446.	1 JAN 1718	174	574.	2 JAN 0048	249	237.
1 JAN 0224	25	147.	1 JAN 0954	100	455.	1 JAN 1724	175	558.	2 JAN 0054	250	234.
1 JAN 0230	26	161.	1 JAN 1000	101	464.	1 JAN 1730	176	544.	2 JAN 0100	251	230.
1 JAN 0236	27	175.	1 JAN 1006	102	475.	1 JAN 1736	177	531.	2 JAN 0106	252	224.
1 JAN 0242	28	187.	1 JAN 1012	103	487.	1 JAN 1742	178	520.	2 JAN 0112	253	218.
1 JAN 0248	29	197.	1 JAN 1018	104	499.	1 JAN 1748	179	510.	2 JAN 0118	254	210.
1 JAN 0254	30	206.	1 JAN 1024	105	513.	1 JAN 1754	180	501.	2 JAN 0124	255	202.
1 JAN 0300	31	214.	1 JAN 1030	106	526.	1 JAN 1800	181	493.	2 JAN 0130	256	192.
1 JAN 0306	32	220.	1 JAN 1036	107	541.	1 JAN 1806	182	485.	2 JAN 0136	257	182.
1 JAN 0312	33	225.	1 JAN 1042	108	555.	1 JAN 1812	183	478.	2 JAN 0142	258	171.
1 JAN 0318	34	229.	1 JAN 1048	109	569.	1 JAN 1818	184	472.	2 JAN 0148	259	159.

1 JAN 0324	35	232.	*	1 JAN 1054	110	584.	*	1 JAN 1824	185	465.	*	2 JAN 0154	260	145.
1 JAN 0330	36	234.	*	1 JAN 1100	111	599.	*	1 JAN 1830	186	459.	*	2 JAN 0200	261	131.
1 JAN 0336	37	236.	*	1 JAN 1106	112	615.	*	1 JAN 1836	187	452.	*	2 JAN 0206	262	116.
1 JAN 0342	38	238.	*	1 JAN 1112	113	632.	*	1 JAN 1842	188	445.	*	2 JAN 0212	263	102.
1 JAN 0348	39	239.	*	1 JAN 1118	114	651.	*	1 JAN 1848	189	438.	*	2 JAN 0218	264	87.
1 JAN 0354	40	240.	*	1 JAN 1124	115	672.	*	1 JAN 1854	190	430.	*	2 JAN 0224	265	73.
1 JAN 0400	41	241.	*	1 JAN 1130	116	696.	*	1 JAN 1900	191	423.	*	2 JAN 0230	266	61.
1 JAN 0406	42	241.	*	1 JAN 1136	117	728.	*	1 JAN 1906	192	416.	*	2 JAN 0236	267	49.
1 JAN 0412	43	242.	*	1 JAN 1142	118	775.	*	1 JAN 1912	193	409.	*	2 JAN 0242	268	40.
1 JAN 0418	44	242.	*	1 JAN 1148	119	847.	*	1 JAN 1918	194	403.	*	2 JAN 0248	269	32.
1 JAN 0424	45	243.	*	1 JAN 1154	120	963.	*	1 JAN 1924	195	397.	*	2 JAN 0254	270	25.
1 JAN 0430	46	243.	*	1 JAN 1200	121	1147.	*	1 JAN 1930	196	391.	*	2 JAN 0300	271	20.
1 JAN 0436	47	244.	*	1 JAN 1206	122	1407.	*	1 JAN 1936	197	385.	*	2 JAN 0306	272	16.
1 JAN 0442	48	245.	*	1 JAN 1212	123	1759.	*	1 JAN 1942	198	380.	*	2 JAN 0312	273	12.
1 JAN 0448	49	247.	*	1 JAN 1218	124	2230.	*	1 JAN 1948	199	374.	*	2 JAN 0318	274	10.
1 JAN 0454	50	249.	*	1 JAN 1224	125	2835.	*	1 JAN 1954	200	368.	*	2 JAN 0324	275	8.
1 JAN 0500	51	251.	*	1 JAN 1230	126	3572.	*	1 JAN 2000	201	362.	*	2 JAN 0330	276	6.
1 JAN 0506	52	253.	*	1 JAN 1236	127	4422.	*	1 JAN 2006	202	357.	*	2 JAN 0336	277	5.
1 JAN 0512	53	256.	*	1 JAN 1242	128	5353.	*	1 JAN 2012	203	352.	*	2 JAN 0342	278	4.
1 JAN 0518	54	259.	*	1 JAN 1248	129	6305.	*	1 JAN 2018	204	347.	*	2 JAN 0348	279	3.
1 JAN 0524	55	262.	*	1 JAN 1254	130	7218.	*	1 JAN 2024	205	342.	*	2 JAN 0354	280	2.
1 JAN 0530	56	266.	*	1 JAN 1300	131	8047.	*	1 JAN 2030	206	338.	*	2 JAN 0400	281	2.
1 JAN 0536	57	270.	*	1 JAN 1306	132	8799.	*	1 JAN 2036	207	335.	*	2 JAN 0406	282	1.
1 JAN 0542	58	274.	*	1 JAN 1312	133	9497.	*	1 JAN 2042	208	331.	*	2 JAN 0412	283	1.
1 JAN 0548	59	279.	*	1 JAN 1318	134	10194.	*	1 JAN 2048	209	328.	*	2 JAN 0418	284	1.
1 JAN 0554	60	284.	*	1 JAN 1324	135	10947.	*	1 JAN 2054	210	325.	*	2 JAN 0424	285	1.
1 JAN 0600	61	289.	*	1 JAN 1330	136	11780.	*	1 JAN 2100	211	321.	*	2 JAN 0430	286	1.
1 JAN 0606	62	294.	*	1 JAN 1336	137	12676.	*	1 JAN 2106	212	318.	*	2 JAN 0436	287	0.
1 JAN 0612	63	299.	*	1 JAN 1342	138	13591.	*	1 JAN 2112	213	315.	*	2 JAN 0442	288	0.
1 JAN 0618	64	303.	*	1 JAN 1348	139	14458.	*	1 JAN 2118	214	311.	*	2 JAN 0448	289	0.
1 JAN 0624	65	307.	*	1 JAN 1354	140	15178.	*	1 JAN 2124	215	307.	*	2 JAN 0454	290	0.
1 JAN 0630	66	311.	*	1 JAN 1400	141	15642.	*	1 JAN 2130	216	303.	*	2 JAN 0500	291	0.
1 JAN 0636	67	314.	*	1 JAN 1406	142	15748.	*	1 JAN 2136	217	299.	*	2 JAN 0506	292	0.
1 JAN 0642	68	316.	*	1 JAN 1412	143	15432.	*	1 JAN 2142	218	294.	*	2 JAN 0512	293	0.
1 JAN 0648	69	319.	*	1 JAN 1418	144	14689.	*	1 JAN 2148	219	289.	*	2 JAN 0518	294	0.
1 JAN 0654	70	321.	*	1 JAN 1424	145	13580.	*	1 JAN 2154	220	284.	*	2 JAN 0524	295	0.
1 JAN 0700	71	323.	*	1 JAN 1430	146	12214.	*	1 JAN 2200	221	279.	*	2 JAN 0530	296	0.
1 JAN 0706	72	326.	*	1 JAN 1436	147	10724.	*	1 JAN 2206	222	274.	*	2 JAN 0536	297	0.
1 JAN 0712	73	328.	*	1 JAN 1442	148	9230.	*	1 JAN 2212	223	269.	*	2 JAN 0542	298	0.
1 JAN 0718	74	331.	*	1 JAN 1448	149	7827.	*	1 JAN 2218	224	265.	*	2 JAN 0548	299	0.
1 JAN 0724	75	334.	*	1 JAN 1454	150	6574.	*	1 JAN 2224	225	261.	*	2 JAN 0554	300	0.
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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
15748.	14.10	(CFS)	5307.	1571.	1265.	1265.
		(INCHES)	2.148	2.543	2.551	2.551
		(AC-FT)	2631.	3116.	3125.	3125.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 10.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	*	1 JAN 0730	76	321.	*	1 JAN 1500	151	5154.	*	1 JAN 2230	226	245.
1 JAN 0006	2	0.	*	1 JAN 0736	77	324.	*	1 JAN 1506	152	4304.	*	1 JAN 2236	227	242.
1 JAN 0012	3	0.	*	1 JAN 0742	78	328.	*	1 JAN 1512	153	3607.	*	1 JAN 2242	228	240.
1 JAN 0018	4	0.	*	1 JAN 0748	79	331.	*	1 JAN 1518	154	3042.	*	1 JAN 2248	229	238.

1 JAN 0024	5	0.	*	1 JAN 0754	80	336.	*	1 JAN 1524	155	2587.	*	1 JAN 2254	230	237.
1 JAN 0030	6	0.	*	1 JAN 0800	81	340.	*	1 JAN 1530	156	2220.	*	1 JAN 2300	231	236.
1 JAN 0036	7	1.	*	1 JAN 0806	82	345.	*	1 JAN 1536	157	1924.	*	1 JAN 2306	232	235.
1 JAN 0042	8	1.	*	1 JAN 0812	83	350.	*	1 JAN 1542	158	1683.	*	1 JAN 2312	233	234.
1 JAN 0048	9	2.	*	1 JAN 0818	84	354.	*	1 JAN 1548	159	1487.	*	1 JAN 2318	234	234.
1 JAN 0054	10	4.	*	1 JAN 0824	85	359.	*	1 JAN 1554	160	1326.	*	1 JAN 2324	235	233.
1 JAN 0100	11	7.	*	1 JAN 0830	86	364.	*	1 JAN 1600	161	1192.	*	1 JAN 2330	236	233.
1 JAN 0106	12	10.	*	1 JAN 0836	87	368.	*	1 JAN 1606	162	1081.	*	1 JAN 2336	237	232.
1 JAN 0112	13	15.	*	1 JAN 0842	88	372.	*	1 JAN 1612	163	987.	*	1 JAN 2342	238	232.
1 JAN 0118	14	20.	*	1 JAN 0848	89	375.	*	1 JAN 1618	164	909.	*	1 JAN 2348	239	232.
1 JAN 0124	15	27.	*	1 JAN 0854	90	379.	*	1 JAN 1624	165	842.	*	1 JAN 2354	240	232.
1 JAN 0130	16	34.	*	1 JAN 0900	91	382.	*	1 JAN 1630	166	785.	*	2 JAN 0000	241	232.
1 JAN 0136	17	43.	*	1 JAN 0906	92	386.	*	1 JAN 1636	167	737.	*	2 JAN 0006	242	232.
1 JAN 0142	18	52.	*	1 JAN 0912	93	390.	*	1 JAN 1642	168	696.	*	2 JAN 0012	243	232.
1 JAN 0148	19	62.	*	1 JAN 0918	94	394.	*	1 JAN 1648	169	661.	*	2 JAN 0018	244	231.
1 JAN 0154	20	73.	*	1 JAN 0924	95	399.	*	1 JAN 1654	170	630.	*	2 JAN 0024	245	231.
1 JAN 0200	21	85.	*	1 JAN 0930	96	405.	*	1 JAN 1700	171	604.	*	2 JAN 0030	246	231.
1 JAN 0206	22	98.	*	1 JAN 0936	97	410.	*	1 JAN 1706	172	582.	*	2 JAN 0036	247	230.
1 JAN 0212	23	112.	*	1 JAN 0942	98	417.	*	1 JAN 1712	173	562.	*	2 JAN 0042	248	228.
1 JAN 0218	24	126.	*	1 JAN 0948	99	424.	*	1 JAN 1718	174	545.	*	2 JAN 0048	249	226.
1 JAN 0224	25	140.	*	1 JAN 0954	100	432.	*	1 JAN 1724	175	530.	*	2 JAN 0054	250	223.
1 JAN 0230	26	153.	*	1 JAN 1000	101	441.	*	1 JAN 1730	176	517.	*	2 JAN 0100	251	218.
1 JAN 0236	27	166.	*	1 JAN 1006	102	452.	*	1 JAN 1736	177	505.	*	2 JAN 0106	252	213.
1 JAN 0242	28	178.	*	1 JAN 1012	103	463.	*	1 JAN 1742	178	494.	*	2 JAN 0112	253	207.
1 JAN 0248	29	188.	*	1 JAN 1018	104	475.	*	1 JAN 1748	179	485.	*	2 JAN 0118	254	200.
1 JAN 0254	30	196.	*	1 JAN 1024	105	488.	*	1 JAN 1754	180	476.	*	2 JAN 0124	255	192.
1 JAN 0300	31	204.	*	1 JAN 1030	106	501.	*	1 JAN 1800	181	468.	*	2 JAN 0130	256	183.
1 JAN 0306	32	209.	*	1 JAN 1036	107	514.	*	1 JAN 1806	182	461.	*	2 JAN 0136	257	173.
1 JAN 0312	33	214.	*	1 JAN 1042	108	528.	*	1 JAN 1812	183	455.	*	2 JAN 0142	258	162.
1 JAN 0318	34	218.	*	1 JAN 1048	109	541.	*	1 JAN 1818	184	449.	*	2 JAN 0148	259	151.
1 JAN 0324	35	221.	*	1 JAN 1054	110	555.	*	1 JAN 1824	185	442.	*	2 JAN 0154	260	138.
1 JAN 0330	36	223.	*	1 JAN 1100	111	570.	*	1 JAN 1830	186	436.	*	2 JAN 0200	261	125.
1 JAN 0336	37	225.	*	1 JAN 1106	112	585.	*	1 JAN 1836	187	430.	*	2 JAN 0206	262	111.
1 JAN 0342	38	226.	*	1 JAN 1112	113	601.	*	1 JAN 1842	188	423.	*	2 JAN 0212	263	97.
1 JAN 0348	39	227.	*	1 JAN 1118	114	619.	*	1 JAN 1848	189	416.	*	2 JAN 0218	264	83.
1 JAN 0354	40	228.	*	1 JAN 1124	115	639.	*	1 JAN 1854	190	409.	*	2 JAN 0224	265	70.
1 JAN 0400	41	229.	*	1 JAN 1130	116	661.	*	1 JAN 1900	191	402.	*	2 JAN 0230	266	58.
1 JAN 0406	42	230.	*	1 JAN 1136	117	691.	*	1 JAN 1906	192	396.	*	2 JAN 0236	267	47.
1 JAN 0412	43	230.	*	1 JAN 1142	118	735.	*	1 JAN 1912	193	389.	*	2 JAN 0242	268	38.
1 JAN 0418	44	230.	*	1 JAN 1148	119	801.	*	1 JAN 1918	194	383.	*	2 JAN 0248	269	30.
1 JAN 0424	45	231.	*	1 JAN 1154	120	910.	*	1 JAN 1924	195	378.	*	2 JAN 0254	270	24.
1 JAN 0430	46	232.	*	1 JAN 1200	121	1081.	*	1 JAN 1930	196	372.	*	2 JAN 0300	271	19.
1 JAN 0436	47	232.	*	1 JAN 1206	122	1324.	*	1 JAN 1936	197	367.	*	2 JAN 0306	272	15.
1 JAN 0442	48	233.	*	1 JAN 1212	123	1654.	*	1 JAN 1942	198	361.	*	2 JAN 0312	273	12.
1 JAN 0448	49	235.	*	1 JAN 1218	124	2096.	*	1 JAN 1948	199	356.	*	2 JAN 0318	274	9.
1 JAN 0454	50	237.	*	1 JAN 1224	125	2665.	*	1 JAN 1954	200	350.	*	2 JAN 0324	275	7.
1 JAN 0500	51	239.	*	1 JAN 1230	126	3360.	*	1 JAN 2000	201	345.	*	2 JAN 0330	276	6.
1 JAN 0506	52	241.	*	1 JAN 1236	127	4161.	*	1 JAN 2006	202	339.	*	2 JAN 0336	277	5.
1 JAN 0512	53	244.	*	1 JAN 1242	128	5039.	*	1 JAN 2012	203	334.	*	2 JAN 0342	278	4.
1 JAN 0518	54	246.	*	1 JAN 1248	129	5938.	*	1 JAN 2018	204	330.	*	2 JAN 0348	279	3.
1 JAN 0524	55	250.	*	1 JAN 1254	130	6799.	*	1 JAN 2024	205	326.	*	2 JAN 0354	280	2.
1 JAN 0530	56	253.	*	1 JAN 1300	131	7580.	*	1 JAN 2030	206	322.	*	2 JAN 0400	281	2.
1 JAN 0536	57	257.	*	1 JAN 1306	132	8289.	*	1 JAN 2036	207	318.	*	2 JAN 0406	282	1.
1 JAN 0542	58	261.	*	1 JAN 1312	133	8947.	*	1 JAN 2042	208	315.	*	2 JAN 0412	283	1.
1 JAN 0548	59	265.	*	1 JAN 1318	134	9604.	*	1 JAN 2048	209	312.	*	2 JAN 0418	284	1.
1 JAN 0554	60	270.	*	1 JAN 1324	135	10314.	*	1 JAN 2054	210	309.	*	2 JAN 0424	285	1.
1 JAN 0600	61	275.	*	1 JAN 1330	136	11101.	*	1 JAN 2100	211	306.	*	2 JAN 0430	286	0.
1 JAN 0606	62	280.	*	1 JAN 1336	137	11949.	*	1 JAN 2106	212	302.	*	2 JAN 0436	287	0.
1 JAN 0612	63	284.	*	1 JAN 1342	138	12815.	*	1 JAN 2112	213	299.	*	2 JAN 0442	288	0.
1 JAN 0618	64	289.	*	1 JAN 1348	139	13636.	*	1 JAN 2118	214	296.	*	2 JAN 0448	289	0.
1 JAN 0624	65	292.	*	1 JAN 1354	140	14318.	*	1 JAN 2124	215	292.	*	2 JAN 0454	290	0.
1 JAN 0630	66	296.	*	1 JAN 1400	141	14758.	*	1 JAN 2130	216	288.	*	2 JAN 0500	291	0.
1 JAN 0636	67	298.	*	1 JAN 1406	142	14857.	*	1 JAN 2136	217	284.	*	2 JAN 0506	292	0.
1 JAN 0642	68	301.	*	1 JAN 1412	143	14557.	*	1 JAN 2142	218	280.	*	2 JAN 0512	293	0.
1 JAN 0648	69	303.	*	1 JAN 1418	144	13851.	*	1 JAN 2148	219	275.	*	2 JAN 0518	294	0.
1 JAN 0654	70	305.	*	1 JAN 1424	145	12799.	*	1 JAN 2154	220	271.	*	2 JAN 0524	295	0.

1 JAN 0700	71	308.	*	1 JAN 1430	146	11505.	*	1 JAN 2200	221	266.	*	2 JAN 0530	296	0.
1 JAN 0706	72	310.	*	1 JAN 1436	147	10093.	*	1 JAN 2206	222	261.	*	2 JAN 0536	297	0.
1 JAN 0712	73	312.	*	1 JAN 1442	148	8679.	*	1 JAN 2212	223	256.	*	2 JAN 0542	298	0.
1 JAN 0718	74	315.	*	1 JAN 1448	149	7353.	*	1 JAN 2218	224	252.	*	2 JAN 0548	299	0.
1 JAN 0724	75	318.	*	1 JAN 1454	150	6170.	*	1 JAN 2224	225	248.	*	2 JAN 0554	300	0.

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
14857.	14.10	(CFS)	5000.	1482.	1193.	1193.
		(INCHES)	2.024	2.400	2.407	2.407
		(AC-FT)	2479.	2940.	2949.	2949.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 20.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	*	1 JAN 0730	76	310.	*	1 JAN 1500	151	4941.	*	1 JAN 2230	226	237.
1 JAN 0006	2	0.	*	1 JAN 0736	77	314.	*	1 JAN 1506	152	4125.	*	1 JAN 2236	227	234.
1 JAN 0012	3	0.	*	1 JAN 0742	78	317.	*	1 JAN 1512	153	3457.	*	1 JAN 2242	228	232.
1 JAN 0018	4	0.	*	1 JAN 0748	79	321.	*	1 JAN 1518	154	2916.	*	1 JAN 2248	229	230.
1 JAN 0024	5	0.	*	1 JAN 0754	80	325.	*	1 JAN 1524	155	2481.	*	1 JAN 2254	230	229.
1 JAN 0030	6	0.	*	1 JAN 0800	81	329.	*	1 JAN 1530	156	2130.	*	1 JAN 2300	231	228.
1 JAN 0036	7	0.	*	1 JAN 0806	82	333.	*	1 JAN 1536	157	1848.	*	1 JAN 2306	232	227.
1 JAN 0042	8	1.	*	1 JAN 0812	83	338.	*	1 JAN 1542	158	1618.	*	1 JAN 2312	233	226.
1 JAN 0048	9	2.	*	1 JAN 0818	84	343.	*	1 JAN 1548	159	1430.	*	1 JAN 2318	234	226.
1 JAN 0054	10	4.	*	1 JAN 0824	85	347.	*	1 JAN 1554	160	1276.	*	1 JAN 2324	235	225.
1 JAN 0100	11	6.	*	1 JAN 0830	86	352.	*	1 JAN 1600	161	1148.	*	1 JAN 2330	236	225.
1 JAN 0106	12	10.	*	1 JAN 0836	87	356.	*	1 JAN 1606	162	1042.	*	1 JAN 2336	237	225.
1 JAN 0112	13	14.	*	1 JAN 0842	88	360.	*	1 JAN 1612	163	952.	*	1 JAN 2342	238	225.
1 JAN 0118	14	20.	*	1 JAN 0848	89	363.	*	1 JAN 1618	164	877.	*	1 JAN 2348	239	225.
1 JAN 0124	15	26.	*	1 JAN 0854	90	366.	*	1 JAN 1624	165	813.	*	1 JAN 2354	240	224.
1 JAN 0130	16	33.	*	1 JAN 0900	91	370.	*	1 JAN 1630	166	758.	*	2 JAN 0000	241	224.
1 JAN 0136	17	41.	*	1 JAN 0906	92	373.	*	1 JAN 1636	167	712.	*	2 JAN 0006	242	224.
1 JAN 0142	18	50.	*	1 JAN 0912	93	377.	*	1 JAN 1642	168	672.	*	2 JAN 0012	243	224.
1 JAN 0148	19	60.	*	1 JAN 0918	94	381.	*	1 JAN 1648	169	638.	*	2 JAN 0018	244	224.
1 JAN 0154	20	70.	*	1 JAN 0924	95	386.	*	1 JAN 1654	170	609.	*	2 JAN 0024	245	224.
1 JAN 0200	21	82.	*	1 JAN 0930	96	391.	*	1 JAN 1700	171	584.	*	2 JAN 0030	246	223.
1 JAN 0206	22	95.	*	1 JAN 0936	97	397.	*	1 JAN 1706	172	562.	*	2 JAN 0036	247	222.
1 JAN 0212	23	108.	*	1 JAN 0942	98	403.	*	1 JAN 1712	173	544.	*	2 JAN 0042	248	221.
1 JAN 0218	24	122.	*	1 JAN 0948	99	410.	*	1 JAN 1718	174	527.	*	2 JAN 0048	249	218.
1 JAN 0224	25	135.	*	1 JAN 0954	100	418.	*	1 JAN 1724	175	513.	*	2 JAN 0054	250	215.
1 JAN 0230	26	148.	*	1 JAN 1000	101	427.	*	1 JAN 1730	176	500.	*	2 JAN 0100	251	211.
1 JAN 0236	27	161.	*	1 JAN 1006	102	437.	*	1 JAN 1736	177	488.	*	2 JAN 0106	252	206.
1 JAN 0242	28	172.	*	1 JAN 1012	103	448.	*	1 JAN 1742	178	478.	*	2 JAN 0112	253	200.
1 JAN 0248	29	182.	*	1 JAN 1018	104	459.	*	1 JAN 1748	179	469.	*	2 JAN 0118	254	193.
1 JAN 0254	30	190.	*	1 JAN 1024	105	472.	*	1 JAN 1754	180	461.	*	2 JAN 0124	255	186.
1 JAN 0300	31	197.	*	1 JAN 1030	106	484.	*	1 JAN 1800	181	453.	*	2 JAN 0130	256	177.
1 JAN 0306	32	203.	*	1 JAN 1036	107	497.	*	1 JAN 1806	182	446.	*	2 JAN 0136	257	168.
1 JAN 0312	33	207.	*	1 JAN 1042	108	510.	*	1 JAN 1812	183	440.	*	2 JAN 0142	258	157.
1 JAN 0318	34	211.	*	1 JAN 1048	109	524.	*	1 JAN 1818	184	434.	*	2 JAN 0148	259	146.
1 JAN 0324	35	213.	*	1 JAN 1054	110	537.	*	1 JAN 1824	185	428.	*	2 JAN 0154	260	134.
1 JAN 0330	36	216.	*	1 JAN 1100	111	551.	*	1 JAN 1830	186	422.	*	2 JAN 0200	261	121.
1 JAN 0336	37	217.	*	1 JAN 1106	112	566.	*	1 JAN 1836	187	416.	*	2 JAN 0206	262	107.
1 JAN 0342	38	219.	*	1 JAN 1112	113	581.	*	1 JAN 1842	188	409.	*	2 JAN 0212	263	93.
1 JAN 0348	39	220.	*	1 JAN 1118	114	598.	*	1 JAN 1848	189	403.	*	2 JAN 0218	264	80.
1 JAN 0354	40	221.	*	1 JAN 1124	115	618.	*	1 JAN 1854	190	396.	*	2 JAN 0224	265	67.

1 JAN 0400	41	221.	*	1 JAN 1130	116	639.	*	1 JAN 1900	191	389.	*	2 JAN 0230	266	56.
1 JAN 0406	42	222.	*	1 JAN 1136	117	668.	*	1 JAN 1906	192	383.	*	2 JAN 0236	267	45.
1 JAN 0412	43	222.	*	1 JAN 1142	118	710.	*	1 JAN 1912	193	377.	*	2 JAN 0242	268	37.
1 JAN 0418	44	223.	*	1 JAN 1148	119	773.	*	1 JAN 1918	194	371.	*	2 JAN 0248	269	29.
1 JAN 0424	45	223.	*	1 JAN 1154	120	876.	*	1 JAN 1924	195	365.	*	2 JAN 0254	270	23.
1 JAN 0430	46	224.	*	1 JAN 1200	121	1040.	*	1 JAN 1930	196	360.	*	2 JAN 0300	271	18.
1 JAN 0436	47	225.	*	1 JAN 1206	122	1273.	*	1 JAN 1936	197	355.	*	2 JAN 0306	272	14.
1 JAN 0442	48	226.	*	1 JAN 1212	123	1589.	*	1 JAN 1942	198	349.	*	2 JAN 0312	273	11.
1 JAN 0448	49	227.	*	1 JAN 1218	124	2013.	*	1 JAN 1948	199	344.	*	2 JAN 0318	274	9.
1 JAN 0454	50	229.	*	1 JAN 1224	125	2559.	*	1 JAN 1954	200	339.	*	2 JAN 0324	275	7.
1 JAN 0500	51	231.	*	1 JAN 1230	126	3227.	*	1 JAN 2000	201	333.	*	2 JAN 0330	276	6.
1 JAN 0506	52	233.	*	1 JAN 1236	127	3997.	*	1 JAN 2006	202	328.	*	2 JAN 0336	277	4.
1 JAN 0512	53	236.	*	1 JAN 1242	128	4842.	*	1 JAN 2012	203	324.	*	2 JAN 0342	278	3.
1 JAN 0518	54	238.	*	1 JAN 1248	129	5706.	*	1 JAN 2018	204	319.	*	2 JAN 0348	279	3.
1 JAN 0524	55	241.	*	1 JAN 1254	130	6535.	*	1 JAN 2024	205	315.	*	2 JAN 0354	280	2.
1 JAN 0530	56	245.	*	1 JAN 1300	131	7286.	*	1 JAN 2030	206	311.	*	2 JAN 0400	281	2.
1 JAN 0536	57	248.	*	1 JAN 1306	132	7967.	*	1 JAN 2036	207	308.	*	2 JAN 0406	282	1.
1 JAN 0542	58	252.	*	1 JAN 1312	133	8600.	*	1 JAN 2042	208	305.	*	2 JAN 0412	283	1.
1 JAN 0548	59	257.	*	1 JAN 1318	134	9231.	*	1 JAN 2048	209	302.	*	2 JAN 0418	284	1.
1 JAN 0554	60	261.	*	1 JAN 1324	135	9915.	*	1 JAN 2054	210	299.	*	2 JAN 0424	285	1.
1 JAN 0600	61	266.	*	1 JAN 1330	136	10673.	*	1 JAN 2100	211	296.	*	2 JAN 0430	286	0.
1 JAN 0606	62	271.	*	1 JAN 1336	137	11489.	*	1 JAN 2106	212	293.	*	2 JAN 0436	287	0.
1 JAN 0612	63	275.	*	1 JAN 1342	138	12324.	*	1 JAN 2112	213	289.	*	2 JAN 0442	288	0.
1 JAN 0618	64	279.	*	1 JAN 1348	139	13115.	*	1 JAN 2118	214	286.	*	2 JAN 0448	289	0.
1 JAN 0624	65	283.	*	1 JAN 1354	140	13773.	*	1 JAN 2124	215	283.	*	2 JAN 0454	290	0.
1 JAN 0630	66	286.	*	1 JAN 1400	141	14197.	*	1 JAN 2130	216	279.	*	2 JAN 0500	291	0.
1 JAN 0636	67	289.	*	1 JAN 1406	142	14292.	*	1 JAN 2136	217	275.	*	2 JAN 0506	292	0.
1 JAN 0642	68	291.	*	1 JAN 1412	143	14001.	*	1 JAN 2142	218	271.	*	2 JAN 0512	293	0.
1 JAN 0648	69	293.	*	1 JAN 1418	144	13320.	*	1 JAN 2148	219	266.	*	2 JAN 0518	294	0.
1 JAN 0654	70	295.	*	1 JAN 1424	145	12305.	*	1 JAN 2154	220	262.	*	2 JAN 0524	295	0.
1 JAN 0700	71	297.	*	1 JAN 1430	146	11056.	*	1 JAN 2200	221	257.	*	2 JAN 0530	296	0.
1 JAN 0706	72	300.	*	1 JAN 1436	147	9695.	*	1 JAN 2206	222	252.	*	2 JAN 0536	297	0.
1 JAN 0712	73	302.	*	1 JAN 1442	148	8333.	*	1 JAN 2212	223	248.	*	2 JAN 0542	298	0.
1 JAN 0718	74	305.	*	1 JAN 1448	149	7056.	*	1 JAN 2218	224	244.	*	2 JAN 0548	299	0.
1 JAN 0724	75	308.	*	1 JAN 1454	150	5918.	*	1 JAN 2224	225	240.	*	2 JAN 0554	300	0.
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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
14292.	14.10	(CFS)	4806.	1426.	1148.	1148.
		(INCHES)	1.945	2.309	2.316	2.316
		(AC-FT)	2383.	2829.	2838.	2838.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 30.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	*	1 JAN 0730	76	304.	*	1 JAN 1500	151	4806.	*	1 JAN 2230	226	232.
1 JAN 0006	2	0.	*	1 JAN 0736	77	307.	*	1 JAN 1506	152	4013.	*	1 JAN 2236	227	229.
1 JAN 0012	3	0.	*	1 JAN 0742	78	310.	*	1 JAN 1512	153	3363.	*	1 JAN 2242	228	227.
1 JAN 0018	4	0.	*	1 JAN 0748	79	314.	*	1 JAN 1518	154	2837.	*	1 JAN 2248	229	225.
1 JAN 0024	5	0.	*	1 JAN 0754	80	318.	*	1 JAN 1524	155	2414.	*	1 JAN 2254	230	224.
1 JAN 0030	6	0.	*	1 JAN 0800	81	322.	*	1 JAN 1530	156	2074.	*	1 JAN 2300	231	223.
1 JAN 0036	7	0.	*	1 JAN 0806	82	326.	*	1 JAN 1536	157	1800.	*	1 JAN 2306	232	222.
1 JAN 0042	8	1.	*	1 JAN 0812	83	331.	*	1 JAN 1542	158	1577.	*	1 JAN 2312	233	221.
1 JAN 0048	9	2.	*	1 JAN 0818	84	335.	*	1 JAN 1548	159	1395.	*	1 JAN 2318	234	221.
1 JAN 0054	10	4.	*	1 JAN 0824	85	340.	*	1 JAN 1554	160	1245.	*	1 JAN 2324	235	221.

1	JAN	0100	11	6.	*	1	JAN	0830	86	344.	*	1	JAN	1600	161	1120.	*	1	JAN	2330	236	220.
1	JAN	0106	12	10.	*	1	JAN	0836	87	348.	*	1	JAN	1606	162	1017.	*	1	JAN	2336	237	220.
1	JAN	0112	13	14.	*	1	JAN	0842	88	352.	*	1	JAN	1612	163	929.	*	1	JAN	2342	238	220.
1	JAN	0118	14	19.	*	1	JAN	0848	89	355.	*	1	JAN	1618	164	856.	*	1	JAN	2348	239	220.
1	JAN	0124	15	25.	*	1	JAN	0854	90	358.	*	1	JAN	1624	165	794.	*	1	JAN	2354	240	220.
1	JAN	0130	16	32.	*	1	JAN	0900	91	362.	*	1	JAN	1630	166	741.	*	2	JAN	0000	241	219.
1	JAN	0136	17	40.	*	1	JAN	0906	92	365.	*	1	JAN	1636	167	696.	*	2	JAN	0006	242	219.
1	JAN	0142	18	49.	*	1	JAN	0912	93	369.	*	1	JAN	1642	168	657.	*	2	JAN	0012	243	219.
1	JAN	0148	19	58.	*	1	JAN	0918	94	373.	*	1	JAN	1648	169	624.	*	2	JAN	0018	244	219.
1	JAN	0154	20	69.	*	1	JAN	0924	95	378.	*	1	JAN	1654	170	596.	*	2	JAN	0024	245	219.
1	JAN	0200	21	80.	*	1	JAN	0930	96	383.	*	1	JAN	1700	171	571.	*	2	JAN	0030	246	218.
1	JAN	0206	22	93.	*	1	JAN	0936	97	388.	*	1	JAN	1706	172	550.	*	2	JAN	0036	247	217.
1	JAN	0212	23	106.	*	1	JAN	0942	98	394.	*	1	JAN	1712	173	532.	*	2	JAN	0042	248	216.
1	JAN	0218	24	119.	*	1	JAN	0948	99	401.	*	1	JAN	1718	174	516.	*	2	JAN	0048	249	214.
1	JAN	0224	25	132.	*	1	JAN	0954	100	409.	*	1	JAN	1724	175	502.	*	2	JAN	0054	250	211.
1	JAN	0230	26	145.	*	1	JAN	1000	101	418.	*	1	JAN	1730	176	489.	*	2	JAN	0100	251	207.
1	JAN	0236	27	157.	*	1	JAN	1006	102	427.	*	1	JAN	1736	177	478.	*	2	JAN	0106	252	202.
1	JAN	0242	28	168.	*	1	JAN	1012	103	438.	*	1	JAN	1742	178	468.	*	2	JAN	0112	253	196.
1	JAN	0248	29	178.	*	1	JAN	1018	104	449.	*	1	JAN	1748	179	459.	*	2	JAN	0118	254	189.
1	JAN	0254	30	186.	*	1	JAN	1024	105	461.	*	1	JAN	1754	180	451.	*	2	JAN	0124	255	182.
1	JAN	0300	31	193.	*	1	JAN	1030	106	474.	*	1	JAN	1800	181	443.	*	2	JAN	0130	256	173.
1	JAN	0306	32	198.	*	1	JAN	1036	107	486.	*	1	JAN	1806	182	437.	*	2	JAN	0136	257	164.
1	JAN	0312	33	203.	*	1	JAN	1042	108	499.	*	1	JAN	1812	183	430.	*	2	JAN	0142	258	154.
1	JAN	0318	34	206.	*	1	JAN	1048	109	512.	*	1	JAN	1818	184	424.	*	2	JAN	0148	259	143.
1	JAN	0324	35	209.	*	1	JAN	1054	110	525.	*	1	JAN	1824	185	419.	*	2	JAN	0154	260	131.
1	JAN	0330	36	211.	*	1	JAN	1100	111	539.	*	1	JAN	1830	186	413.	*	2	JAN	0200	261	118.
1	JAN	0336	37	213.	*	1	JAN	1106	112	553.	*	1	JAN	1836	187	407.	*	2	JAN	0206	262	105.
1	JAN	0342	38	214.	*	1	JAN	1112	113	569.	*	1	JAN	1842	188	400.	*	2	JAN	0212	263	91.
1	JAN	0348	39	215.	*	1	JAN	1118	114	585.	*	1	JAN	1848	189	394.	*	2	JAN	0218	264	78.
1	JAN	0354	40	216.	*	1	JAN	1124	115	604.	*	1	JAN	1854	190	387.	*	2	JAN	0224	265	66.
1	JAN	0400	41	217.	*	1	JAN	1130	116	625.	*	1	JAN	1900	191	381.	*	2	JAN	0230	266	54.
1	JAN	0406	42	217.	*	1	JAN	1136	117	653.	*	1	JAN	1906	192	374.	*	2	JAN	0236	267	44.
1	JAN	0412	43	218.	*	1	JAN	1142	118	693.	*	1	JAN	1912	193	368.	*	2	JAN	0242	268	36.
1	JAN	0418	44	218.	*	1	JAN	1148	119	755.	*	1	JAN	1918	194	363.	*	2	JAN	0248	269	29.
1	JAN	0424	45	219.	*	1	JAN	1154	120	855.	*	1	JAN	1924	195	357.	*	2	JAN	0254	270	23.
1	JAN	0430	46	219.	*	1	JAN	1200	121	1014.	*	1	JAN	1930	196	352.	*	2	JAN	0300	271	18.
1	JAN	0436	47	220.	*	1	JAN	1206	122	1240.	*	1	JAN	1936	197	347.	*	2	JAN	0306	272	14.
1	JAN	0442	48	221.	*	1	JAN	1212	123	1547.	*	1	JAN	1942	198	342.	*	2	JAN	0312	273	11.
1	JAN	0448	49	222.	*	1	JAN	1218	124	1960.	*	1	JAN	1948	199	337.	*	2	JAN	0318	274	9.
1	JAN	0454	50	224.	*	1	JAN	1224	125	2492.	*	1	JAN	1954	200	331.	*	2	JAN	0324	275	7.
1	JAN	0500	51	226.	*	1	JAN	1230	126	3142.	*	1	JAN	2000	201	326.	*	2	JAN	0330	276	5.
1	JAN	0506	52	228.	*	1	JAN	1236	127	3892.	*	1	JAN	2006	202	321.	*	2	JAN	0336	277	4.
1	JAN	0512	53	230.	*	1	JAN	1242	128	4715.	*	1	JAN	2012	203	316.	*	2	JAN	0342	278	3.
1	JAN	0518	54	233.	*	1	JAN	1248	129	5558.	*	1	JAN	2018	204	312.	*	2	JAN	0348	279	3.
1	JAN	0524	55	236.	*	1	JAN	1254	130	6365.	*	1	JAN	2024	205	308.	*	2	JAN	0354	280	2.
1	JAN	0530	56	239.	*	1	JAN	1300	131	7097.	*	1	JAN	2030	206	305.	*	2	JAN	0400	281	2.
1	JAN	0536	57	243.	*	1	JAN	1306	132	7760.	*	1	JAN	2036	207	301.	*	2	JAN	0406	282	1.
1	JAN	0542	58	247.	*	1	JAN	1312	133	8376.	*	1	JAN	2042	208	298.	*	2	JAN	0412	283	1.
1	JAN	0548	59	251.	*	1	JAN	1318	134	8991.	*	1	JAN	2048	209	295.	*	2	JAN	0418	284	1.
1	JAN	0554	60	256.	*	1	JAN	1324	135	9658.	*	1	JAN	2054	210	292.	*	2	JAN	0424	285	1.
1	JAN	0600	61	260.	*	1	JAN	1330	136	10397.	*	1	JAN	2100	211	289.	*	2	JAN	0430	286	0.
1	JAN	0606	62	265.	*	1	JAN	1336	137	11194.	*	1	JAN	2106	212	286.	*	2	JAN	0436	287	0.
1	JAN	0612	63	269.	*	1	JAN	1342	138	12009.	*	1	JAN	2112	213	283.	*	2	JAN	0442	288	0.
1	JAN	0618	64	273.	*	1	JAN	1348	139	12781.	*	1	JAN	2118	214	280.	*	2	JAN	0448	289	0.
1	JAN	0624	65	277.	*	1	JAN	1354	140	13423.	*	1	JAN	2124	215	277.	*	2	JAN	0454	290	0.
1	JAN	0630	66	280.	*	1	JAN	1400	141	13836.	*	1	JAN	2130	216	273.	*	2	JAN	0500	291	0.
1	JAN	0636	67	282.	*	1	JAN	1406	142	13929.	*	1	JAN	2136	217	269.	*	2	JAN	0506	292	0.
1	JAN	0642	68	285.	*	1	JAN	1412	143	13645.	*	1	JAN	2142	218	265.	*	2	JAN	0512	293	0.
1	JAN	0648	69	287.	*	1	JAN	1418	144	12980.	*	1	JAN	2148	219	261.	*	2	JAN	0518	294	0.
1	JAN	0654	70	289.	*	1	JAN	1424	145	11988.	*	1	JAN	2154	220	256.	*	2	JAN	0524	295	0.
1	JAN	0700	71	291.	*	1	JAN	1430	146	10769.	*	1	JAN	2200	221	251.	*	2	JAN	0530	296	0.
1	JAN	0706	72	293.	*	1	JAN	1436	147	9440.	*	1	JAN	2206	222	247.	*	2	JAN	0536	297	0.
1	JAN	0712	73	296.	*	1	JAN	1442	148	8112.	*	1	JAN	2212	223	242.	*	2	JAN	0542	298	0.
1	JAN	0718	74	298.	*	1	JAN	1448	149	6867.	*	1	JAN	2218	224	238.	*	2	JAN	0548	299	0.
1	JAN	0724	75	301.	*	1	JAN	1454	150	5758.	*	1	JAN	2224	225	235.	*	2	JAN	0554	300	0.
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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
13929.	14.10	(CFS)	4682.	1390.	1119.	1119.
		(INCHES)	1.895	2.251	2.258	2.258
		(AC-FT)	2322.	2758.	2766.	2766.

CUMULATIVE AREA = 22.97 SQ MI

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HYDROGRAPH AT CO-12
TRANSPOSITION AREA 40.0 SQ MI

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	*	1 JAN 0730	76	301.	*	1 JAN 1500	151	4747.	*	1 JAN 2230	226	229.
1 JAN 0006	2	0.	*	1 JAN 0736	77	304.	*	1 JAN 1506	152	3963.	*	1 JAN 2236	227	227.
1 JAN 0012	3	0.	*	1 JAN 0742	78	307.	*	1 JAN 1512	153	3321.	*	1 JAN 2242	228	225.
1 JAN 0018	4	0.	*	1 JAN 0748	79	311.	*	1 JAN 1518	154	2803.	*	1 JAN 2248	229	223.
1 JAN 0024	5	0.	*	1 JAN 0754	80	314.	*	1 JAN 1524	155	2385.	*	1 JAN 2254	230	222.
1 JAN 0030	6	0.	*	1 JAN 0800	81	319.	*	1 JAN 1530	156	2049.	*	1 JAN 2300	231	221.
1 JAN 0036	7	0.	*	1 JAN 0806	82	323.	*	1 JAN 1536	157	1778.	*	1 JAN 2306	232	220.
1 JAN 0042	8	1.	*	1 JAN 0812	83	327.	*	1 JAN 1542	158	1558.	*	1 JAN 2312	233	219.
1 JAN 0048	9	2.	*	1 JAN 0818	84	332.	*	1 JAN 1548	159	1379.	*	1 JAN 2318	234	219.
1 JAN 0054	10	4.	*	1 JAN 0824	85	337.	*	1 JAN 1554	160	1231.	*	1 JAN 2324	235	218.
1 JAN 0100	11	6.	*	1 JAN 0830	86	341.	*	1 JAN 1600	161	1108.	*	1 JAN 2330	236	218.
1 JAN 0106	12	10.	*	1 JAN 0836	87	345.	*	1 JAN 1606	162	1005.	*	1 JAN 2336	237	218.
1 JAN 0112	13	14.	*	1 JAN 0842	88	348.	*	1 JAN 1612	163	919.	*	1 JAN 2342	238	218.
1 JAN 0118	14	19.	*	1 JAN 0848	89	352.	*	1 JAN 1618	164	847.	*	1 JAN 2348	239	217.
1 JAN 0124	15	25.	*	1 JAN 0854	90	355.	*	1 JAN 1624	165	785.	*	1 JAN 2354	240	217.
1 JAN 0130	16	32.	*	1 JAN 0900	91	358.	*	1 JAN 1630	166	733.	*	2 JAN 0000	241	217.
1 JAN 0136	17	40.	*	1 JAN 0906	92	362.	*	1 JAN 1636	167	689.	*	2 JAN 0006	242	217.
1 JAN 0142	18	48.	*	1 JAN 0912	93	365.	*	1 JAN 1642	168	651.	*	2 JAN 0012	243	217.
1 JAN 0148	19	58.	*	1 JAN 0918	94	369.	*	1 JAN 1648	169	618.	*	2 JAN 0018	244	217.
1 JAN 0154	20	68.	*	1 JAN 0924	95	374.	*	1 JAN 1654	170	590.	*	2 JAN 0024	245	217.
1 JAN 0200	21	80.	*	1 JAN 0930	96	379.	*	1 JAN 1700	171	565.	*	2 JAN 0030	246	216.
1 JAN 0206	22	92.	*	1 JAN 0936	97	384.	*	1 JAN 1706	172	545.	*	2 JAN 0036	247	215.
1 JAN 0212	23	105.	*	1 JAN 0942	98	391.	*	1 JAN 1712	173	526.	*	2 JAN 0042	248	214.
1 JAN 0218	24	118.	*	1 JAN 0948	99	397.	*	1 JAN 1718	174	511.	*	2 JAN 0048	249	212.
1 JAN 0224	25	131.	*	1 JAN 0954	100	405.	*	1 JAN 1724	175	497.	*	2 JAN 0054	250	209.
1 JAN 0230	26	144.	*	1 JAN 1000	101	414.	*	1 JAN 1730	176	484.	*	2 JAN 0100	251	205.
1 JAN 0236	27	156.	*	1 JAN 1006	102	423.	*	1 JAN 1736	177	473.	*	2 JAN 0106	252	200.
1 JAN 0242	28	167.	*	1 JAN 1012	103	434.	*	1 JAN 1742	178	463.	*	2 JAN 0112	253	194.
1 JAN 0248	29	176.	*	1 JAN 1018	104	445.	*	1 JAN 1748	179	454.	*	2 JAN 0118	254	187.
1 JAN 0254	30	184.	*	1 JAN 1024	105	457.	*	1 JAN 1754	180	446.	*	2 JAN 0124	255	180.
1 JAN 0300	31	191.	*	1 JAN 1030	106	469.	*	1 JAN 1800	181	439.	*	2 JAN 0130	256	171.
1 JAN 0306	32	196.	*	1 JAN 1036	107	482.	*	1 JAN 1806	182	432.	*	2 JAN 0136	257	162.
1 JAN 0312	33	201.	*	1 JAN 1042	108	494.	*	1 JAN 1812	183	426.	*	2 JAN 0142	258	152.
1 JAN 0318	34	204.	*	1 JAN 1048	109	507.	*	1 JAN 1818	184	420.	*	2 JAN 0148	259	141.
1 JAN 0324	35	207.	*	1 JAN 1054	110	520.	*	1 JAN 1824	185	415.	*	2 JAN 0154	260	129.
1 JAN 0330	36	209.	*	1 JAN 1100	111	534.	*	1 JAN 1830	186	409.	*	2 JAN 0200	261	117.
1 JAN 0336	37	211.	*	1 JAN 1106	112	548.	*	1 JAN 1836	187	403.	*	2 JAN 0206	262	104.
1 JAN 0342	38	212.	*	1 JAN 1112	113	563.	*	1 JAN 1842	188	396.	*	2 JAN 0212	263	91.
1 JAN 0348	39	213.	*	1 JAN 1118	114	580.	*	1 JAN 1848	189	390.	*	2 JAN 0218	264	78.
1 JAN 0354	40	214.	*	1 JAN 1124	115	598.	*	1 JAN 1854	190	383.	*	2 JAN 0224	265	65.
1 JAN 0400	41	214.	*	1 JAN 1130	116	619.	*	1 JAN 1900	191	377.	*	2 JAN 0230	266	54.
1 JAN 0406	42	215.	*	1 JAN 1136	117	646.	*	1 JAN 1906	192	371.	*	2 JAN 0236	267	44.
1 JAN 0412	43	215.	*	1 JAN 1142	118	686.	*	1 JAN 1912	193	365.	*	2 JAN 0242	268	35.
1 JAN 0418	44	216.	*	1 JAN 1148	119	747.	*	1 JAN 1918	194	359.	*	2 JAN 0248	269	28.
1 JAN 0424	45	216.	*	1 JAN 1154	120	845.	*	1 JAN 1924	195	354.	*	2 JAN 0254	270	22.
1 JAN 0430	46	217.	*	1 JAN 1200	121	1002.	*	1 JAN 1930	196	349.	*	2 JAN 0300	271	18.

1 JAN 0436	47	218.	*	1 JAN 1206	122	1225.	*	1 JAN 1936	197	343.	*	2 JAN 0306	272	14.
1 JAN 0442	48	219.	*	1 JAN 1212	123	1529.	*	1 JAN 1942	198	338.	*	2 JAN 0312	273	11.
1 JAN 0448	49	220.	*	1 JAN 1218	124	1936.	*	1 JAN 1948	199	333.	*	2 JAN 0318	274	9.
1 JAN 0454	50	222.	*	1 JAN 1224	125	2461.	*	1 JAN 1954	200	328.	*	2 JAN 0324	275	7.
1 JAN 0500	51	224.	*	1 JAN 1230	126	3104.	*	1 JAN 2000	201	323.	*	2 JAN 0330	276	5.
1 JAN 0506	52	226.	*	1 JAN 1236	127	3846.	*	1 JAN 2006	202	318.	*	2 JAN 0336	277	4.
1 JAN 0512	53	228.	*	1 JAN 1242	128	4659.	*	1 JAN 2012	203	313.	*	2 JAN 0342	278	3.
1 JAN 0518	54	231.	*	1 JAN 1248	129	5492.	*	1 JAN 2018	204	309.	*	2 JAN 0348	279	3.
1 JAN 0524	55	234.	*	1 JAN 1254	130	6289.	*	1 JAN 2024	205	305.	*	2 JAN 0354	280	2.
1 JAN 0530	56	237.	*	1 JAN 1300	131	7013.	*	1 JAN 2030	206	302.	*	2 JAN 0400	281	2.
1 JAN 0536	57	241.	*	1 JAN 1306	132	7669.	*	1 JAN 2036	207	298.	*	2 JAN 0406	282	1.
1 JAN 0542	58	245.	*	1 JAN 1312	133	8277.	*	1 JAN 2042	208	295.	*	2 JAN 0412	283	1.
1 JAN 0548	59	249.	*	1 JAN 1318	134	8885.	*	1 JAN 2048	209	292.	*	2 JAN 0418	284	1.
1 JAN 0554	60	253.	*	1 JAN 1324	135	9544.	*	1 JAN 2054	210	289.	*	2 JAN 0424	285	1.
1 JAN 0600	61	258.	*	1 JAN 1330	136	10275.	*	1 JAN 2100	211	286.	*	2 JAN 0430	286	0.
1 JAN 0606	62	262.	*	1 JAN 1336	137	11063.	*	1 JAN 2106	212	283.	*	2 JAN 0436	287	0.
1 JAN 0612	63	266.	*	1 JAN 1342	138	11869.	*	1 JAN 2112	213	280.	*	2 JAN 0442	288	0.
1 JAN 0618	64	270.	*	1 JAN 1348	139	12633.	*	1 JAN 2118	214	277.	*	2 JAN 0448	289	0.
1 JAN 0624	65	274.	*	1 JAN 1354	140	13268.	*	1 JAN 2124	215	274.	*	2 JAN 0454	290	0.
1 JAN 0630	66	277.	*	1 JAN 1400	141	13677.	*	1 JAN 2130	216	270.	*	2 JAN 0500	291	0.
1 JAN 0636	67	280.	*	1 JAN 1406	142	13768.	*	1 JAN 2136	217	266.	*	2 JAN 0506	292	0.
1 JAN 0642	68	282.	*	1 JAN 1412	143	13487.	*	1 JAN 2142	218	262.	*	2 JAN 0512	293	0.
1 JAN 0648	69	284.	*	1 JAN 1418	144	12829.	*	1 JAN 2148	219	258.	*	2 JAN 0518	294	0.
1 JAN 0654	70	286.	*	1 JAN 1424	145	11848.	*	1 JAN 2154	220	253.	*	2 JAN 0524	295	0.
1 JAN 0700	71	288.	*	1 JAN 1430	146	10642.	*	1 JAN 2200	221	249.	*	2 JAN 0530	296	0.
1 JAN 0706	72	290.	*	1 JAN 1436	147	9328.	*	1 JAN 2206	222	244.	*	2 JAN 0536	297	0.
1 JAN 0712	73	293.	*	1 JAN 1442	148	8014.	*	1 JAN 2212	223	240.	*	2 JAN 0542	298	0.
1 JAN 0718	74	295.	*	1 JAN 1448	149	6783.	*	1 JAN 2218	224	236.	*	2 JAN 0548	299	0.
1 JAN 0724	75	298.	*	1 JAN 1454	150	5687.	*	1 JAN 2224	225	232.	*	2 JAN 0554	300	0.
			*				*				*			

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
13768.	14.10	(CFS)	4628.	1375.	1107.	1107.
		(INCHES)	1.873	2.226	2.232	2.232
		(AC-FT)	2295.	2726.	2735.	2735.

CUMULATIVE AREA = 22.97 SQ MI

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INTERPOLATED HYDROGRAPH AT CO-12

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 JAN 0000	1	0.	*	1 JAN 0730	76	308.	*	1 JAN 1500	151	4895.	*	1 JAN 2230	226	235.
1 JAN 0006	2	0.	*	1 JAN 0736	77	311.	*	1 JAN 1506	152	4087.	*	1 JAN 2236	227	232.
1 JAN 0012	3	0.	*	1 JAN 0742	78	315.	*	1 JAN 1512	153	3425.	*	1 JAN 2242	228	230.
1 JAN 0018	4	0.	*	1 JAN 0748	79	318.	*	1 JAN 1518	154	2889.	*	1 JAN 2248	229	229.
1 JAN 0024	5	0.	*	1 JAN 0754	80	322.	*	1 JAN 1524	155	2458.	*	1 JAN 2254	230	227.
1 JAN 0030	6	0.	*	1 JAN 0800	81	326.	*	1 JAN 1530	156	2111.	*	1 JAN 2300	231	226.
1 JAN 0036	7	0.	*	1 JAN 0806	82	331.	*	1 JAN 1536	157	1831.	*	1 JAN 2306	232	225.
1 JAN 0042	8	1.	*	1 JAN 0812	83	336.	*	1 JAN 1542	158	1604.	*	1 JAN 2312	233	225.
1 JAN 0048	9	2.	*	1 JAN 0818	84	340.	*	1 JAN 1548	159	1418.	*	1 JAN 2318	234	224.
1 JAN 0054	10	4.	*	1 JAN 0824	85	345.	*	1 JAN 1554	160	1265.	*	1 JAN 2324	235	224.
1 JAN 0100	11	6.	*	1 JAN 0830	86	349.	*	1 JAN 1600	161	1139.	*	1 JAN 2330	236	223.
1 JAN 0106	12	10.	*	1 JAN 0836	87	353.	*	1 JAN 1606	162	1033.	*	1 JAN 2336	237	223.
1 JAN 0112	13	14.	*	1 JAN 0842	88	357.	*	1 JAN 1612	163	944.	*	1 JAN 2342	238	223.
1 JAN 0118	14	20.	*	1 JAN 0848	89	360.	*	1 JAN 1618	164	870.	*	1 JAN 2348	239	223.
1 JAN 0124	15	26.	*	1 JAN 0854	90	364.	*	1 JAN 1624	165	806.	*	1 JAN 2354	240	223.
1 JAN 0130	16	33.	*	1 JAN 0900	91	367.	*	1 JAN 1630	166	752.	*	2 JAN 0000	241	223.
1 JAN 0136	17	41.	*	1 JAN 0906	92	370.	*	1 JAN 1636	167	707.	*	2 JAN 0006	242	223.

1 JAN 0142	18	50.	*	1 JAN 0912	93	374.	*	1 JAN 1642	168	667.	*	2 JAN 0012	243	222.
1 JAN 0148	19	59.	*	1 JAN 0918	94	379.	*	1 JAN 1648	169	634.	*	2 JAN 0018	244	222.
1 JAN 0154	20	70.	*	1 JAN 0924	95	383.	*	1 JAN 1654	170	605.	*	2 JAN 0024	245	222.
1 JAN 0200	21	82.	*	1 JAN 0930	96	388.	*	1 JAN 1700	171	580.	*	2 JAN 0030	246	221.
1 JAN 0206	22	94.	*	1 JAN 0936	97	394.	*	1 JAN 1706	172	558.	*	2 JAN 0036	247	221.
1 JAN 0212	23	107.	*	1 JAN 0942	98	400.	*	1 JAN 1712	173	540.	*	2 JAN 0042	248	219.
1 JAN 0218	24	121.	*	1 JAN 0948	99	407.	*	1 JAN 1718	174	523.	*	2 JAN 0048	249	217.
1 JAN 0224	25	134.	*	1 JAN 0954	100	415.	*	1 JAN 1724	175	509.	*	2 JAN 0054	250	214.
1 JAN 0230	26	147.	*	1 JAN 1000	101	424.	*	1 JAN 1730	176	496.	*	2 JAN 0100	251	210.
1 JAN 0236	27	160.	*	1 JAN 1006	102	434.	*	1 JAN 1736	177	485.	*	2 JAN 0106	252	205.
1 JAN 0242	28	171.	*	1 JAN 1012	103	444.	*	1 JAN 1742	178	474.	*	2 JAN 0112	253	199.
1 JAN 0248	29	180.	*	1 JAN 1018	104	456.	*	1 JAN 1748	179	465.	*	2 JAN 0118	254	192.
1 JAN 0254	30	189.	*	1 JAN 1024	105	468.	*	1 JAN 1754	180	457.	*	2 JAN 0124	255	184.
1 JAN 0300	31	195.	*	1 JAN 1030	106	481.	*	1 JAN 1800	181	450.	*	2 JAN 0130	256	176.
1 JAN 0306	32	201.	*	1 JAN 1036	107	494.	*	1 JAN 1806	182	443.	*	2 JAN 0136	257	166.
1 JAN 0312	33	205.	*	1 JAN 1042	108	507.	*	1 JAN 1812	183	437.	*	2 JAN 0142	258	156.
1 JAN 0318	34	209.	*	1 JAN 1048	109	520.	*	1 JAN 1818	184	431.	*	2 JAN 0148	259	145.
1 JAN 0324	35	212.	*	1 JAN 1054	110	533.	*	1 JAN 1824	185	425.	*	2 JAN 0154	260	133.
1 JAN 0330	36	214.	*	1 JAN 1100	111	547.	*	1 JAN 1830	186	419.	*	2 JAN 0200	261	120.
1 JAN 0336	37	216.	*	1 JAN 1106	112	561.	*	1 JAN 1836	187	413.	*	2 JAN 0206	262	106.
1 JAN 0342	38	217.	*	1 JAN 1112	113	577.	*	1 JAN 1842	188	406.	*	2 JAN 0212	263	93.
1 JAN 0348	39	218.	*	1 JAN 1118	114	594.	*	1 JAN 1848	189	400.	*	2 JAN 0218	264	79.
1 JAN 0354	40	219.	*	1 JAN 1124	115	613.	*	1 JAN 1854	190	393.	*	2 JAN 0224	265	67.
1 JAN 0400	41	220.	*	1 JAN 1130	116	634.	*	1 JAN 1900	191	386.	*	2 JAN 0230	266	55.
1 JAN 0406	42	220.	*	1 JAN 1136	117	663.	*	1 JAN 1906	192	380.	*	2 JAN 0236	267	45.
1 JAN 0412	43	221.	*	1 JAN 1142	118	704.	*	1 JAN 1912	193	374.	*	2 JAN 0242	268	36.
1 JAN 0418	44	221.	*	1 JAN 1148	119	767.	*	1 JAN 1918	194	368.	*	2 JAN 0248	269	29.
1 JAN 0424	45	222.	*	1 JAN 1154	120	869.	*	1 JAN 1924	195	363.	*	2 JAN 0254	270	23.
1 JAN 0430	46	222.	*	1 JAN 1200	121	1031.	*	1 JAN 1930	196	357.	*	2 JAN 0300	271	18.
1 JAN 0436	47	223.	*	1 JAN 1206	122	1262.	*	1 JAN 1936	197	352.	*	2 JAN 0306	272	14.
1 JAN 0442	48	224.	*	1 JAN 1212	123	1575.	*	1 JAN 1942	198	347.	*	2 JAN 0312	273	11.
1 JAN 0448	49	225.	*	1 JAN 1218	124	1995.	*	1 JAN 1948	199	341.	*	2 JAN 0318	274	9.
1 JAN 0454	50	227.	*	1 JAN 1224	125	2536.	*	1 JAN 1954	200	336.	*	2 JAN 0324	275	7.
1 JAN 0500	51	229.	*	1 JAN 1230	126	3198.	*	1 JAN 2000	201	331.	*	2 JAN 0330	276	5.
1 JAN 0506	52	231.	*	1 JAN 1236	127	3962.	*	1 JAN 2006	202	326.	*	2 JAN 0336	277	4.
1 JAN 0512	53	234.	*	1 JAN 1242	128	4798.	*	1 JAN 2012	203	321.	*	2 JAN 0342	278	3.
1 JAN 0518	54	237.	*	1 JAN 1248	129	5656.	*	1 JAN 2018	204	317.	*	2 JAN 0348	279	3.
1 JAN 0524	55	240.	*	1 JAN 1254	130	6477.	*	1 JAN 2024	205	313.	*	2 JAN 0354	280	2.
1 JAN 0530	56	243.	*	1 JAN 1300	131	7222.	*	1 JAN 2030	206	309.	*	2 JAN 0400	281	2.
1 JAN 0536	57	247.	*	1 JAN 1306	132	7897.	*	1 JAN 2036	207	306.	*	2 JAN 0406	282	1.
1 JAN 0542	58	251.	*	1 JAN 1312	133	8523.	*	1 JAN 2042	208	303.	*	2 JAN 0412	283	1.
1 JAN 0548	59	255.	*	1 JAN 1318	134	9149.	*	1 JAN 2048	209	299.	*	2 JAN 0418	284	1.
1 JAN 0554	60	259.	*	1 JAN 1324	135	9827.	*	1 JAN 2054	210	296.	*	2 JAN 0424	285	1.
1 JAN 0600	61	264.	*	1 JAN 1330	136	10578.	*	1 JAN 2100	211	293.	*	2 JAN 0430	286	0.
1 JAN 0606	62	269.	*	1 JAN 1336	137	11388.	*	1 JAN 2106	212	290.	*	2 JAN 0436	287	0.
1 JAN 0612	63	273.	*	1 JAN 1342	138	12216.	*	1 JAN 2112	213	287.	*	2 JAN 0442	288	0.
1 JAN 0618	64	277.	*	1 JAN 1348	139	13001.	*	1 JAN 2118	214	284.	*	2 JAN 0448	289	0.
1 JAN 0624	65	281.	*	1 JAN 1354	140	13653.	*	1 JAN 2124	215	281.	*	2 JAN 0454	290	0.
1 JAN 0630	66	284.	*	1 JAN 1400	141	14074.	*	1 JAN 2130	216	277.	*	2 JAN 0500	291	0.
1 JAN 0636	67	286.	*	1 JAN 1406	142	14168.	*	1 JAN 2136	217	273.	*	2 JAN 0506	292	0.
1 JAN 0642	68	289.	*	1 JAN 1412	143	13880.	*	1 JAN 2142	218	269.	*	2 JAN 0512	293	0.
1 JAN 0648	69	291.	*	1 JAN 1418	144	13204.	*	1 JAN 2148	219	264.	*	2 JAN 0518	294	0.
1 JAN 0654	70	293.	*	1 JAN 1424	145	12197.	*	1 JAN 2154	220	260.	*	2 JAN 0524	295	0.
1 JAN 0700	71	295.	*	1 JAN 1430	146	10958.	*	1 JAN 2200	221	255.	*	2 JAN 0530	296	0.
1 JAN 0706	72	298.	*	1 JAN 1436	147	9608.	*	1 JAN 2206	222	250.	*	2 JAN 0536	297	0.
1 JAN 0712	73	300.	*	1 JAN 1442	148	8257.	*	1 JAN 2212	223	246.	*	2 JAN 0542	298	0.
1 JAN 0718	74	303.	*	1 JAN 1448	149	6991.	*	1 JAN 2218	224	242.	*	2 JAN 0548	299	0.
1 JAN 0724	75	305.	*	1 JAN 1454	150	5863.	*	1 JAN 2224	225	238.	*	2 JAN 0554	300	0.
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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	29.90-HR
14168.	14.10	(CFS)	4764.	1414.	1138.	1138.
		(INCHES)	1.928	2.289	2.296	2.296
		(AC-FT)	2362.	2805.	2813.	2813.

CUMULATIVE AREA = 22.97 SQ MI

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	SUBM1	3173.	12.20	408.	116.	93.	2.00		
ROUTED TO	RO-1	2929.	12.50	408.	116.	93.	2.00		
HYDROGRAPH AT	SUBM2	2201.	12.30	371.	110.	88.	1.56		
2 COMBINED AT	CO-1	4817.	12.40	774.	224.	180.	3.56		
HYDROGRAPH AT	SUBM3	2082.	12.50	426.	129.	103.	1.89		
2 COMBINED AT	CO-2	6828.	12.50	1192.	351.	282.	5.45		
ROUTED TO	RO-2	6643.	12.70	1192.	351.	282.	5.45*		
HYDROGRAPH AT	SUBM5	2174.	12.40	395.	119.	96.	1.74		
2 COMBINED AT	CO-3	8134.	12.70	1579.	467.	376.	7.19		
HYDROGRAPH AT	SUBM4	2990.	12.50	599.	181.	146.	2.67		
2 COMBINED AT	CO-4	10868.	12.60	2167.	645.	519.	9.86		
ROUTED TO	RO-3	10268.	13.10	2167.	645.	519.	9.86		
HYDROGRAPH AT	SUBM6	2274.	12.70	608.	182.	147.	2.61		
2 COMBINED AT	CO-5	11989.	13.10	2733.	815.	656.	12.47		
HYDROGRAPH AT	SUBM7	986.	12.40	191.	56.	45.	.78		
2 COMBINED AT	CO-6	12285.	13.10	2907.	866.	697.	13.25		
HYDROGRAPH AT	SUBM8	2210.	12.70	542.	163.	131.	2.39		
2 COMBINED AT	CO-7	13863.	13.00	3401.	1016.	817.	15.64		
ROUTED TO	RO-4	13335.	13.50	3401.	1016.	817.	15.64		
HYDROGRAPH AT	SUBM9	1700.	12.50	360.	107.	86.	1.76		
2 COMBINED AT	CO-8	13651.	13.50	3723.	1112.	895.	17.40		
HYDROGRAPH AT	SUBM10	1482.	12.70	386.	119.	96.	1.50		
2 COMBINED AT	CO-9	14155.	13.50	4071.	1220.	982.	18.90		
ROUTED TO	RO-5	14051.	13.60	4071.	1220.	982.	18.90		
HYDROGRAPH AT	SUBM11	1183.	12.40	194.	55.	45.	.97		
2 COMBINED AT	CO-10	14099.	13.60	4241.	1269.	1021.	19.87		
HYDROGRAPH AT	SUBM12	1250.	12.70	313.	94.	75.	1.29		
2 COMBINED AT	CO-11	14441.	13.60	4518.	1352.	1088.	21.16		
ROUTED TO	RO-6	14077.	14.10	4518.	1352.	1088.	21.16		

HYDROGRAPH AT	SUBM13	1345.	12.70	289.	74.	60.	1.81
2 COMBINED AT	CO-12	14168.	14.10	4764.	1414.	1138.	22.97

NORMAL END OF HEC-1 ***

APPENDIX D

MORGAN CITY WASH

DATA SUPPLIED

BY

FLOOD CONTROL DISTRICT OF

MARICOPA COUNTY

D-1

SCS TYPE II DISTRIBUTION

2-HOUR DISTRIBUTION

Time Inc.(Hr)	Cumulative ppt
0.00	0.000
0.25	0.039
0.50	0.087
0.75	0.280
1.00	0.791
1.25	0.872
1.50	0.924
1.75	0.967
2.00	1.000

6-HOUR DISTRIBUTION

Time Inc.(Hr)	Cumulative ppt
0.00	0.000
0.25	0.011
0.50	0.022
0.75	0.035
1.00	0.048
1.25	0.062
1.50	0.079
1.75	0.100
2.00	0.125
2.25	0.155
2.50	0.192
2.75	0.339
3.00	0.729
3.25	0.791
3.50	0.830
3.75	0.862
4.00	0.887
4.25	0.908
4.50	0.926
4.75	0.942
5.00	0.956
5.25	0.969
5.50	0.980
5.75	0.990
6.00	1.000

Rec'd 10-12-81
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From Flood Control
District of Maricopa
County

24-HOUR DISTRIBUTION

Time Inc.(Hr)	Cumulative ppt	Time Inc.(Hr)	Cumulative ppt
0.00	0.000	12.00	0.663
0.25	0.002	12.25	0.707
0.50	0.005	12.50	0.735
0.75	0.008	12.75	0.758
1.00	0.011	13.00	0.776
1.25	0.014	13.25	0.791
1.50	0.017	13.50	0.804
1.75	0.020	13.75	0.815
2.00	0.023	14.00	0.825
2.25	0.026	14.25	0.834
2.50	0.029	14.50	0.842
2.75	0.032	14.75	0.849
3.00	0.035	15.00	0.856
3.25	0.038	15.25	0.863
3.50	0.041	15.50	0.869
3.75	0.044	15.75	0.875
4.00	0.048	16.00	0.881
4.25	0.052	16.25	0.887
4.50	0.056	16.50	0.893
4.75	0.060	16.75	0.898
5.00	0.064	17.00	0.903
5.25	0.068	17.25	0.908
5.50	0.072	17.50	0.913
5.75	0.076	17.75	0.918
6.00	0.080	18.00	0.922
6.25	0.085	18.25	0.926
6.50	0.090	18.50	0.930
6.75	0.095	18.75	0.934
7.00	0.100	19.00	0.938
7.25	0.105	19.25	0.942
7.50	0.110	19.50	0.946
7.75	0.115	19.75	0.950
8.00	0.120	20.00	0.953
8.25	0.126	20.25	0.956
8.50	0.133	20.50	0.959
8.75	0.140	20.75	0.962
9.00	0.147	21.00	0.965
9.25	0.155	21.25	0.968
9.50	0.163	21.50	0.971
9.75	0.172	21.75	0.974
10.00	0.181	22.00	0.977
10.20	0.191	22.25	0.980
10.50	0.203	22.50	0.983
10.75	0.218	22.75	0.986
11.00	0.236	23.00	0.989
11.25	0.257	23.25	0.992
11.50	0.283	23.50	0.995
11.75	0.387	23.75	0.998
		24.00	1.000

Rec'd 10-13-
BAKER ENG
Flood Control Dis
Maricopa Co

FLOOD CONTROL DISTRICT of Maricopa County

D-3

Interoffice Memorandum

CMT. NO.	SUBJECT: Areal ~~Aerial~~ Reduction	☒ FILE ☐ DESTROY

TO: DJP

FROM: ~~VAR~~ JAL

DATE: 4/11/89

A question had come up regarding which areal reduction curve should be used. NOAA in their Technical Memorandum NWS HYDRO-40 entitled "Depth-Area Ratios in the Semi-Arid Southwest United States" has utilized the data from the Walnut Gulch Experimental watershed to develop the curves to be used for the Southwest region of the United States. The memo does not provide a regression equation for the curves, but only a graph. Because of the shape and the scale for the curves, it is difficult to achieve accurate values for the smaller watersheds. Therefore, Tom Hieb and I conducted independent determinations of the values for less than 100 square miles for a uniform set of ratios for a storm with a duration of 24 hours.

The ratios should be used for any watershed greater than 10 square miles. The following are the values to be used for a storm with a duration of 24 hours.

Square Mile	Ratio
10	.95
20	.92
30	.90
40	.89
50	.88
60	.87
70	.86
80	.86
90	.85
100	.85

I have not looked at values for other durations, ~~if~~ if there is a need to have these values, then we should determine a set of uniform ratios for that specific duration that can be used.

6900-003
11/78

TABLE 1

Surface retention loss for various land surfaces in Maricopa County (addition to STRTL for IL+ULR method and IA for Green and Ampt method)

Land-Use and/or Surface Cover	Surface Retention Loss inches
(1)	(2)
Natural	
Desert and rangeland, flat slope	.35
Hillslopes, Sonoran desert	.15
Mountain, brush	.25
Developed (Residential and Commercial)	
Lawn and turf	.20
Desert landscape	.10
Pavement	.05
Agricultural	
Tilled	1.00
Irrigated pasture	.50

TABLE 4

D-5

Initial Loss plus Uniform Loss Rate parameter values
for bare ground according to soil texture classification

Soil texture Classification	Uniform Loss Rate CNSTL	Initial Loss, in inches STRTL[1]		
		Dry	Normal	Saturated
(1)	(2)	(3)	(4)	(5)
sand	4.6	1.3	1.3	0
loamy sand	1.2	.8	.8	0
sandy loam	.4	.7	.6	0
loam	.15	.6	.5	0
silty loam	.25	.8	.7	0
sandy clay loam	.06	.6	.5	0
clay loam	.04	.5	.4	0
silty clay loam	.04	.6	.5	0
sandy clay	.02	.4	.3	0
silty clay	.02	.4	.3	0
clay	.01	.3	.2	0

[1] Selection of STRTL:

Dry - for nonirrigated lands such as desert and rangeland

Normal - for irrigated lawn, turf, and permanent pasture

Saturated - for irrigated agricultural land

APPENDIX E

MORGAN CITY WASH

CALCULATIONS:

PRECIPITATION DATA

Baker Engineers

S.O. No. 16923-HPH

Subject: FCD Floodplain Delineation
Morgan City Wash Hydrology
Input Data Summary

Sheet No. ____ of ____
Drawing No. ____

Computed by [illegible] 11/3/89 Checked By TEX 11/5/89 Date ____

Precipitation 100-year (in.)	2 hr.	6 hr.	24 hr
	2.76	3.4	4.5

Sub-basin Data	Area (Mi^2)	LOSS RATES Uniform (In./Hr)	Initial (inches)	Percent Impervious	Lag Time (Hours)
M-1	2.00	0.38	0.95	20.3	0.35
M-2	1.56	0.28	0.92	32.6	0.46
M-3	1.89	0.40	0.95	35.0	0.63
M-4	2.67	0.40	0.95	34.9	0.61
M-5	1.74	0.38	0.95	34.6	0.53
M-6	2.61	0.32	0.93	34.6	0.89
M-7	0.78	0.24	0.81	31.3	0.56
M-8	2.39	0.37	0.84	34.4	0.80
M-9	1.76	0.55	0.87	29.2	0.69
M-10	1.50	0.26	0.81	45.0	0.80
M-11	0.97	0.45	0.85	21.5	0.51
M-12	1.29	0.27	0.81	35.2	0.80
M-13	1.81	0.53	0.87	3.0	0.86

Routing Reach Data	Travel Time (Hr)	Weighting Factor X	No. Sub-reaches
RO-1	0.28	0.3	3
RO-2	0.25	0.3	3
RO-3	0.48	0.3	5
RO-4	0.49	0.3	5
RO-5	0.11	0.3	1
RO-6	0.53	0.3	6

Baker Engineers

S.O. No.

Subject: FCD Flood Delin. Study
Precipitation - 2 Hour Storm
Point Precip. Values

Sheet No. ___ of ___

Drawing No.

Computed by BRJ 10-12-89 Checked By DRD Date 18 Oct 89

Rodger Creek - Cline Creek

NOAA Atlas 100-year Precipitation

* P-24 hr = 4.8"

** P-6hr = 3.5"

$$P\text{-}1hr = 0.494 + 0.755 \frac{(P\text{-}6hr)^2}{P\text{-}24hr}$$

$$= 2.42''$$

$$P\text{-}2\,hr = 0.341 * P\text{-}6hr + 0.659 * P\text{-}1hr$$

$$= \underline{\underline{2.79''}}$$

Morgan City Wash

* P-24hr = 4.5"

** P-6hr = 3.4"

$$P\text{-}1hr = 0.494 + 0.755 \frac{(3.4'')^2}{4.5''}$$

$$= 2.43''$$

$$P\text{-}2hr = 0.341 * 3.4'' + 0.659 * 2.43''$$

$$= 2.76''$$

*NOAA Atlas 2 Vol. VIII fig. 29

** " " " " " fig. 23

Table 11. *Equations for estimating 1-hr values in Arizona with statistical parameters for each equation*

Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
$Y_2 = -0.011 + 0.942[(X_1)(X_1/X_2)]$	0.95	86	0.72	0.085
$Y_{100} = 0.494 + 0.755[(X_3)(X_3/X_4)]$	.90	85	1.96	.290

List of variables

Y_2 = 2-yr 1-hr estimated value

Y_{100} = 100-yr 1-hr estimated value

X_1 = 2-yr 6-hr value from precipitation-frequency maps

X_2 = 2-yr 24-hr value from precipitation-frequency maps

X_3 = 100-yr 6-hr value from precipitation-frequency maps

X_4 = 100-yr 24-hr value from precipitation-frequency maps

Procedures for estimating 1-hr (60-min) precipitation-frequency values. Multiple-regression screening techniques were used to develop equations for estimating 1-hr values. Factors considered in the screening process were restricted to those that could be determined easily from the maps of this Atlas or from generally available topographic maps.

The 11 western states were separated into several geographic regions. The regions were chosen on the basis of meteorological and climatological homogeneity and are generally combinations of river basins separated by prominent divides. Arizona is located wholly within a region that extends from the crest of the Continental Divide, the Sangre de Cristo Range, and the Sacramento Mountains in Colorado and New Mexico westward to southwestern California, the Virgin River Basin in Nevada, and the Wasatch divide in Utah. Equations to provide estimates for the 1-hr duration for 2- and 100-yr return periods are shown in table 11. Also listed are the statistical parameters associated with each equation. In these equations, the variable $[(X_1)(X_1/X_2)]$ or $[(X_3)(X_3/X_4)]$ can be regarded as the 6-hr value times the slope of the line connecting the 6- and 24-hr values for the appropriate return period.

Estimates of 1-hr precipitation-frequency values for return periods between 2 and 100 yrs. The 1-hr values for the 2- and 100-yr return periods can be plotted on the nomogram of figure 6 to obtain values for return periods greater than 2 yrs or less than 100 yrs. Draw a straight line connecting the 2- and 100-yr values and read the desired return-period value from the nomogram.

Estimates for 2- and 3-hr (120- and 180-min) precipitation-frequency values. To obtain estimates of precipitation-frequency values for 2 or 3 hrs, plot the 1- and 6-hr values from the Atlas on the appropriate nomogram of figure 15. Draw a straight line connecting the 1- and 6-hr values, and read the 2- and 3-hr values from the nomogram. This nomogram is independent of return period. It was developed using data from the same regions used to develop the 1-hr equations.

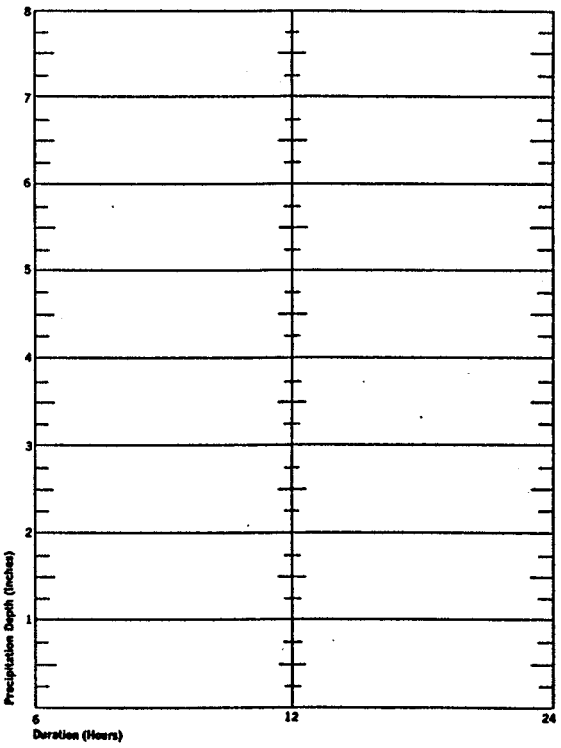


Figure 16. *Precipitation depth-duration diagram (6- to 24-hr).*

Table 12. *Adjustment fro*

Duration (min)	
Ratio to 1-hr	C

(Adopted from *U.S. W* 1961.)

The mathematical solution from the data used to develop figure 15 gives the following equations for estimating the 2- and 3-hr values in Arizona;

$$2\text{-hr} = 0.341\ (6\text{-hr}) + 0.659\ (1\text{-hr}) \quad (3)$$

$$3\text{-hr} = 0.569\ (6\text{-hr}) + 0.431\ (1\text{-hr}) \quad (4)$$

Estimates for 12-hr (720-min) precipitation-frequency values. To obtain estimates for the 12-hr duration, plot values from the 6- and 24-hr maps in figure 16. Read the 12-hr estimates at the intersection of the line connecting these points with the 12-hr duration line of the nomogram.

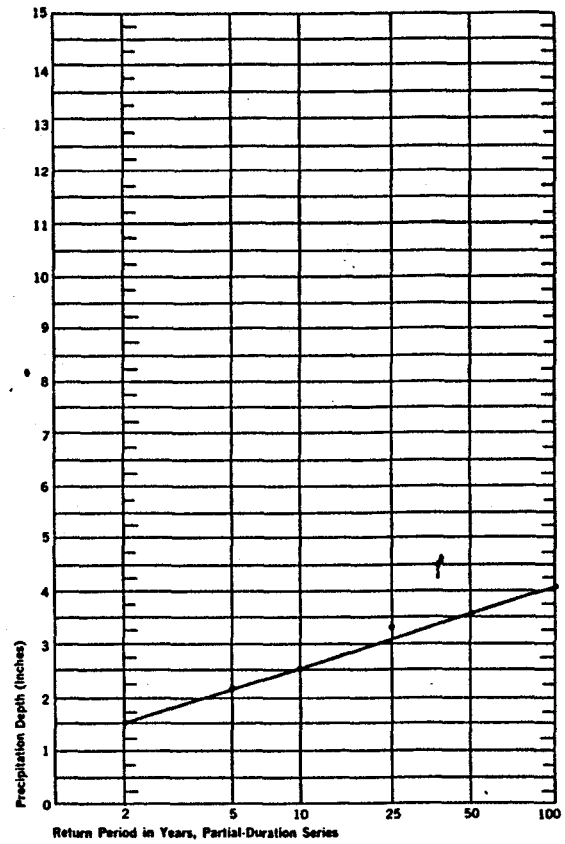
Estimates for less than 1 hr. To obtain estimates for durations of less than 1 hr, apply the values in table 12 to the 1-hr value for the return period of interest.

Illustration of Use of Precipitation-Frequency Maps, Diagrams, and Equations

To illustrate the use of these maps, values were read from figures 18 to 29 for the point at 34°00′ N. and 113°00′ W. These values are shown in boldface type in table 13. The values read from the maps should be plotted on the return-period diagram of figure 6 because (1) not all points are as easy to locate on a series of maps as are latitude-longitude intersections, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. This has been done for the 24-hr values in table 13 (fig. 17a) and a line of best fit has been drawn subjectively. On this nomogram, the 25-yr return-period value appears somewhat off the line, so the value read from the maps is corrected (as shown by the strikeout in table 13); such corrected values are adopted in preference to the original readings.

The 2- and 100-yr 1-hr values for the point were computed from the equations in table 11. The 2-yr 1-hr value is estimated at 1.08 in. (2-yr 6- and 24-hr values from table 13); the estimated 100-yr 1-hr value is 2.52 in. (100-yr 6- and 24-hr values from table 13). By plotting these 1-hr values on figure 6 and connecting them with a straight line, one can obtain estimates for return periods of 5, 10, 25, and 50 yrs.

The 2- and 3-hr values can be estimated by using the nomogram of figure 15 or equations (3) and (4). The 1- and 6-hr values for the desired return period are obtained as above. Plot these points on the nomogram of figure 15 and connect them with a straight line. Read the estimates for 2 and 3 hrs at the intersections of the connecting line and the 2- and 3-hr vertical lines. An example is shown in figure 17b for the 2-yr return period. The 2-yr 2-hr (1.17 in.) and 2-yr 3-hr (1.23 in.) values are in italics in table 13.



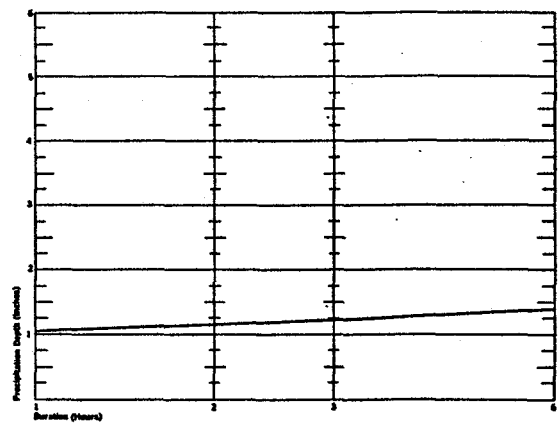


Figure 17. *Illustration of use of precipitation-frequency diagrams using values from precipitation-frequency maps and relations.*

Baker Engineers

S.O. No.

Subject: Project # 16923

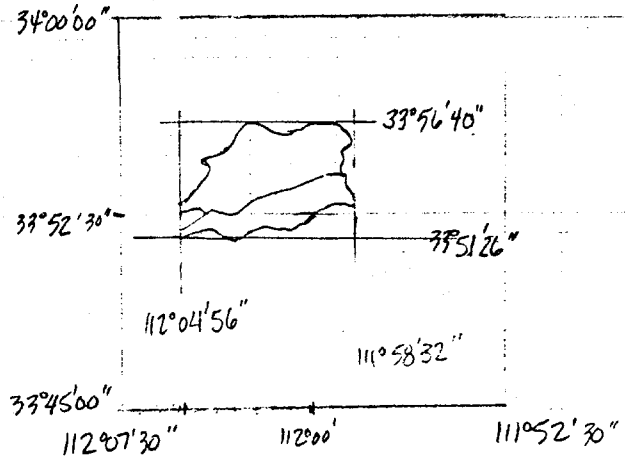
Sheet No. ____ of ____

Drawing No.

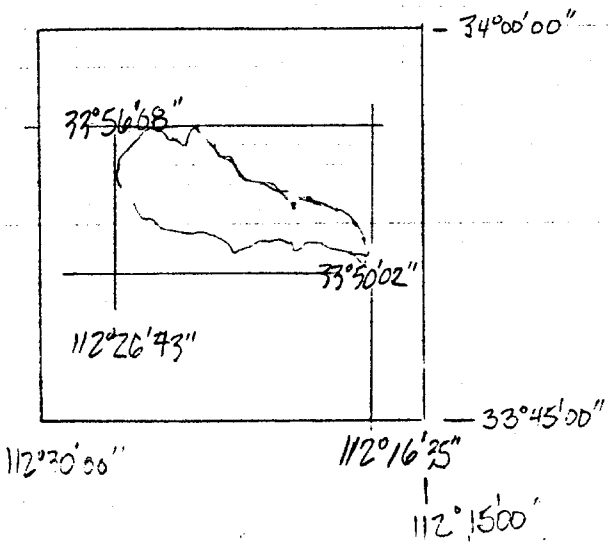
Computed by SAR Checked By 10-12-89 Date 6/16/89

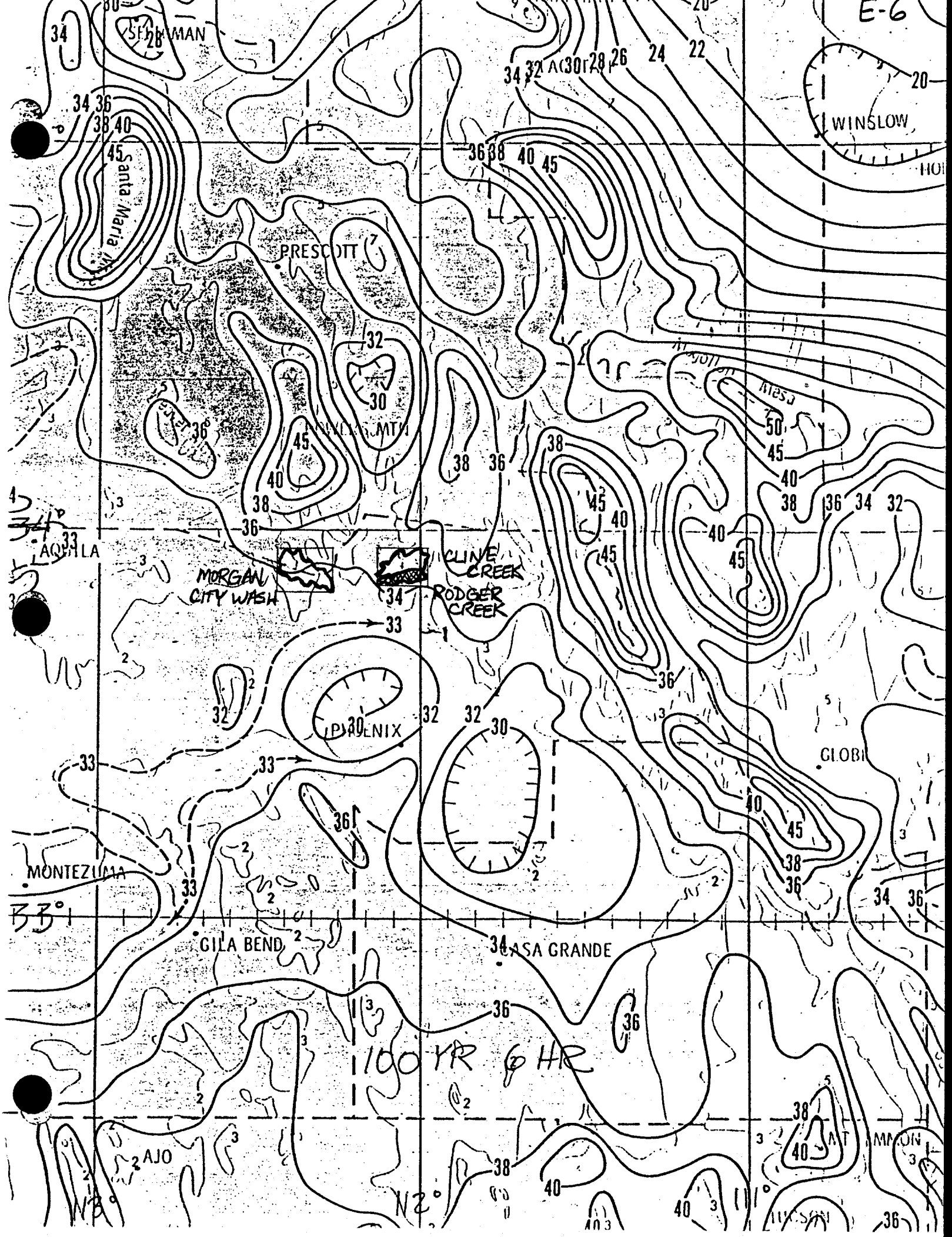
Cline Creek / Rodger Creek

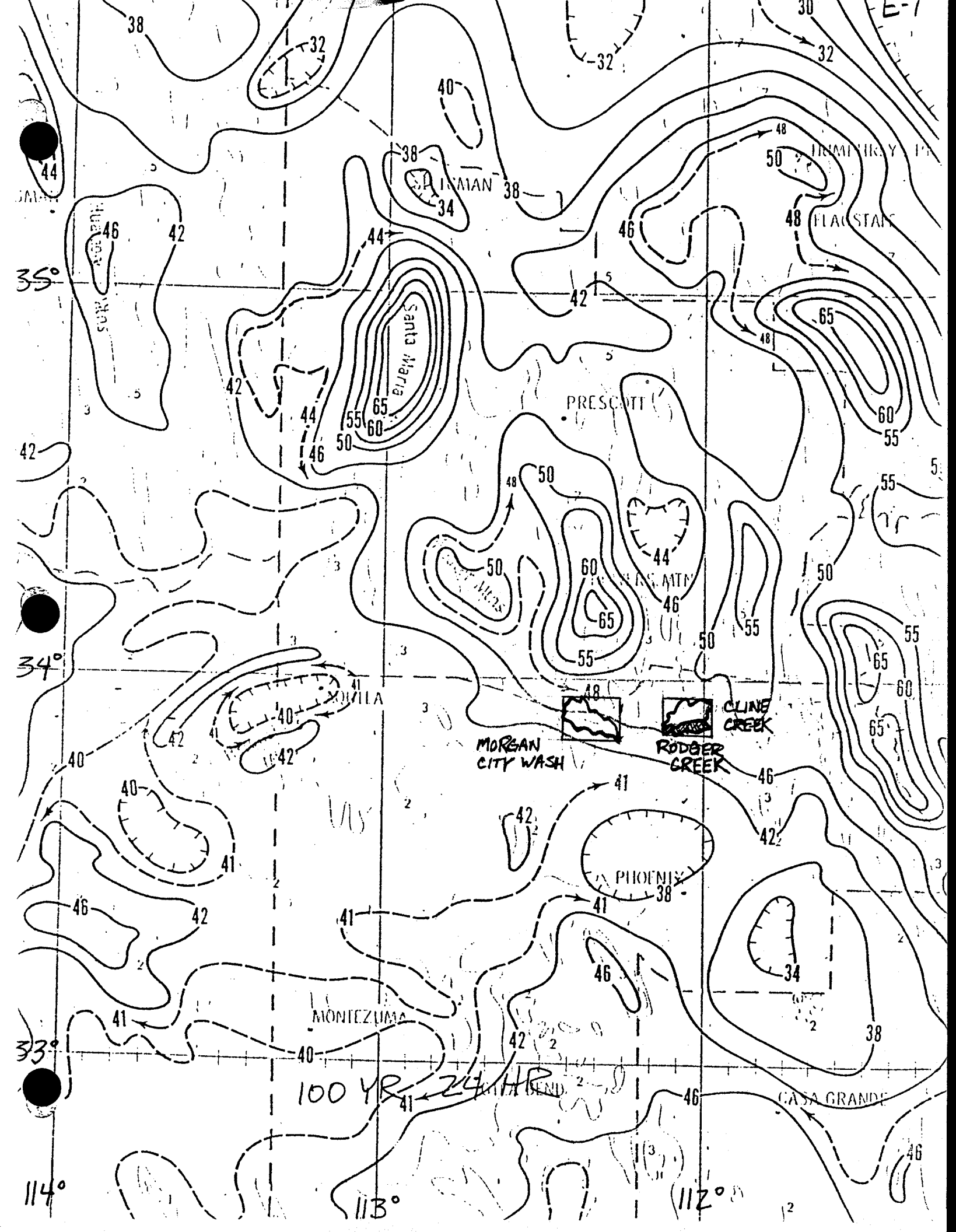
Exact Locations



Morgan City Wash




E-6
WINSLOW
PRESCOTT
Santa Maria
Mesa
AQUILA
MORGAN CITY WASH
CLINE CREEK
RODGER CREEK
PHOENIX
GLOBE
MONTEZUMA
GILA BEND
CASA GRANDE
AJO
100 YR 6 HR


E-7
PRESCOTT
FLAGSTAFF
PHOENIX
MONTEZUMA
CASA GRANDE
Santa Maria
MORGAN CITY WASH
RODGER CREEK
CLINE CREEK
35°
34°
33°
114°
113°
112°
100 YR 24 HR

Baker Engineers

S.O. No. 16723-HPH-04

Subject: Cline Creek & Morgan City Wash
Precipitation Areal Reduction
FCDMC · FDS Hydrology

Sheet No. ____ of ____
Drawing No. ____
Computed by BEJ 10/24/89 Checked By SSO 10/26/89 Date ____

Precipitation Areal Reductions

After NOAA Technical Memorandum NWS-HYDRO-40

Figure 15. Areal Reductions for Central Arizona

Reduction Factor

Watershed Area (Mi^2)	2 Hour	6 Hour	24 Hour
0	1.00 ①	1.00 ②	1.00 ③
10	0.79	0.85	0.95
20	0.73	0.79	0.92
30	0.69	0.75	0.90
40	0.66	0.72	0.89
50	0.64	0.70	0.88
70	0.62	0.68	0.86
100	0.58	0.65	0.85
200	0.53	0.60	0.82 ④
400	0.49	0.56	0.79

① Values for 3 hour storm read from Fig. 15 graph
② Values for 6 hour storm read from Fig. 15 graph
③ Values from FCD Memo in Data package
④ Values for 24 hour storm read from Fig 15 graph

E-9

FLOOD CONTROL DISTRICT of Maricopa County

Interoffice Memorandum

CMT. NO.	SUBJECT: Areal Aerial Reduction	☒ FILE ☐ DESTROY

TO: DJP FROM: VAR JAR DATE: 4/11/89

A question had come up regarding which areal reduction curve should be used. NOAA in their Technical Memorandum NWS HYDRO-40 entitled "Depth-Area Ratios in the Semi-Arid Southwest United States" has utilized the data from the Walnut Gulch Experimental watershed to develop the curves to be used for the Southwest region of the United States. The memo does not provide a regression equation for the curves, but only a graph. Because of the shape and the scale for the curves, it is difficult to achieve accurate values for the smaller watersheds. Therefore, Tom Hieb and I conducted independent determinations of the values for less than 100 square miles for a uniform set of ratios for a storm with a duration of 24 hours.

The ratios should be used for any watershed greater than 10 square miles. The following are the values to be used for a storm with a duration of 24 hours.

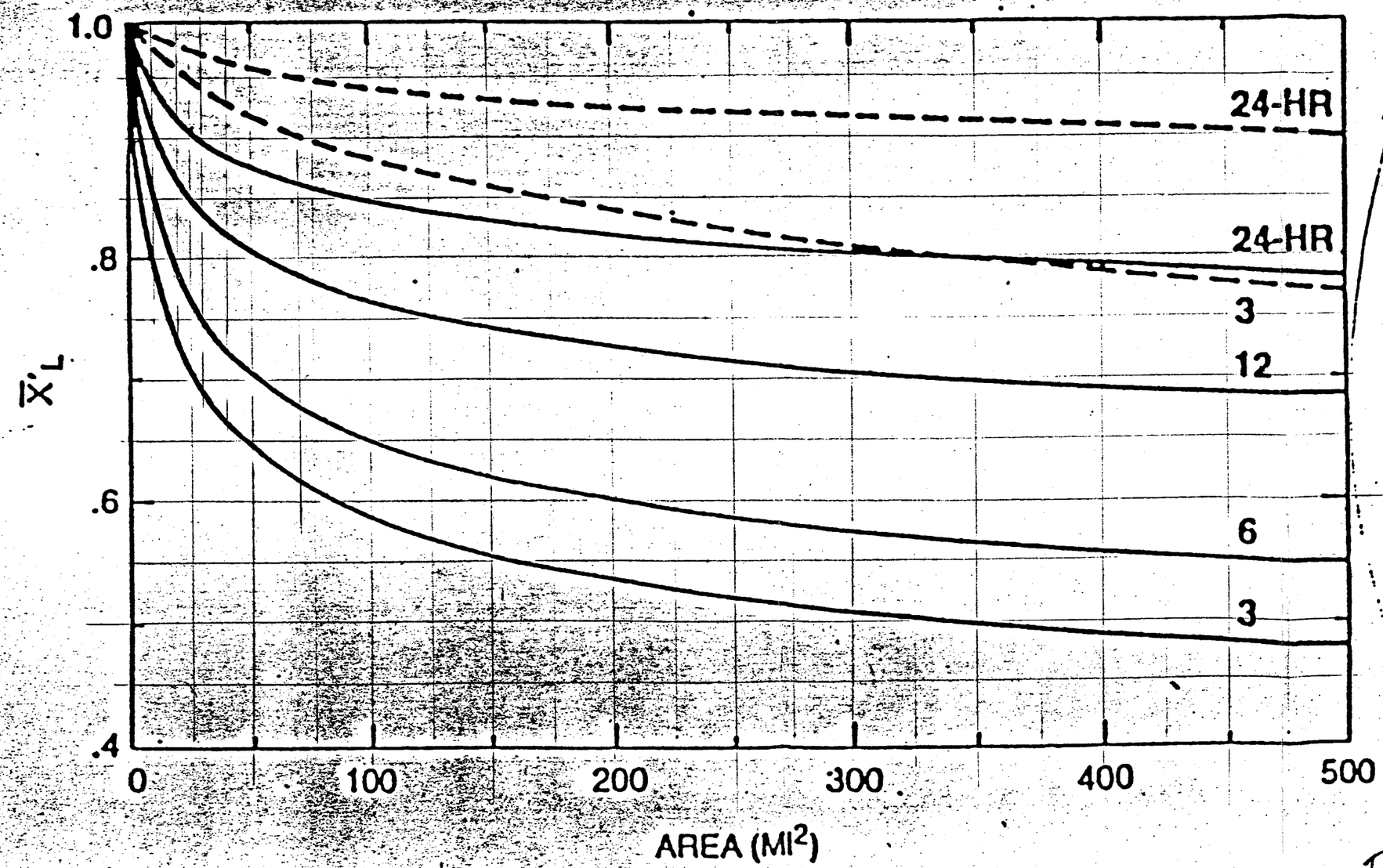
Square Mile	Ratio
10	.95
20	.92
30	.90
40	.89
50	.88
60	.87
70	.86
80	.86
90	.85
100	.85

I have not looked at values for other durations, ~~if~~ if there is a need to have these values, then we should determine a set of uniform ratios for that specific duration that can be used.

6900-003

AREA (MI^2)

Figure 14.--$\bar{X}'_L$ (2.54-yr depth-area ratio, see sec. 4.3) for 3-, 6-, 12-, and 24-hr in southeast Arizona. Dashed lines are 3-hr and 24-hr Chicago $\bar{X}'_L$ (from TR 24)



Recommended for use in Central AZ

Figure 15.--Same as figure 14, but for central Arizona.

PRECIPITATION Areal Reductions for Central AZ By Duration

Baker Engineers

S.O. No.

Subject: Morgan City Wash Precipitation Input - HEC-1 "JD" Routine for Areal Reduction

Sheet No. ____ of ____

FCD MC FDS

Drawing No.

Computed by BBJ 10/26/89 Checked By SAP 10/26/89 Date

Data Pairs for JD option

100-Year 2 Hour Storm Total Point Precip. = 2.76"

Reduction Factor for Point Precip. to Area	DATA ID	PRECIP (in.)	AREA (MI²)
1.00	JD	2.76	0.01
0.79	JD	2.18	10.
0.73	JD	2.01	20.
0.69	JD	1.90	30.
0.66	JD	1.82	40.

100-Year 6 Hour Storm Total Point Precip. = 3.40"

Reduction Factor	DATA ID	PRECIP (in.)	AREA (MI²)
1.00	JD	3.40	0.01
0.85	JD	2.89	10.
0.79	JD	2.69	20.
0.75	JD	2.55	30.
0.72	JD	2.45	40.

100-Year 24 Hour Storm Total Point Precip. = 4.50"

Reduction Factor	DATA ID	PRECIP. (in)	AREA (MI²)
1.00	JD	4.50	0.01
0.95	JD	4.28	10.
0.92	JD	4.14	20.
0.90	JD	4.05	30.
0.89	JD	4.01	40.

APPENDIX F

MORGAN CITY WASH

CALCULATIONS:

LOSS RATES AND

PERCENT IMPERVIOUS

F-1

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash

Sheet No. 2 of 21

Drawing No.

Computed by SAR Checked By [illegible] Date 07/20/89

((Corrected Areas, BAA 11-2-89)) 11/8/89

Determination of Sub Basin Areas

Morgan City Wash

Sub M-1

1280
1284
1282
1278

1281 Ac = 2.00 mi²

Sub M-2

998
998
999

998 Ac = 1.56 mi²

Sub M-3

1210
1211
1206
1207

1208 Ac = 1.89 mi²

Sub M-4

1704
1707
1705

1705 = ~~2.66~~ mi²

((+6 Acres))

((1711 Acres = 2.67 mi²))

Sub M-5

1110
1113
1113

1112 Ac = 1.74 mi²

Sub M-6

1666
1668
1671
1671

1669 = 2.61 mi²

Sub M-7

497
497
495
498

497 Ac = .78 mi²

Sub M-8 ((+7 Acres))

1519
1520
1521
1520

~~1520~~ = ~~2.37~~ mi²

((1527 Acres))
((2.39 mi²))

((+52 Acres)) = ((14,697 Acres = 22.96 mi²))

Total = ~~16,685~~ Ac = ~~22.88~~ mi²

Sub M-9

1080
1082
1086
1078
1085
1080

1082 Ac = ~~1.69~~ mi²

((+44 Acres))
((1126 Acres))
((1.76 mi²))

Sub M-10

958
962
961
962

961 = 1.50 mi²

Sub M-11

621
619
621
619

620 = .97 mi²

Sub M-12

827
826
~~834~~
826

826 = 1.29 mi²

Sub M-13 ((-5 Acres))

1167
1166
1166
1166

= ~~1.82~~ mi²

((1161 Acres))
((1.81 mi²))

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash

Sheet No. 4 of 21

Drawing No.

Computed by SAR Checked By CMH Date 07/20/89

Determination of Uniform and Initial Loss Rates (CNSTL and STRTL) in each Sub Area, by Hydrologic Group, for use in HEC-1 (LU card.)

SUPERSEDED PMG 11/04/89

Soil Type	CNSTL	STRTL
A	.40	.6
B	.25	.5
C	.15	.5
D	.05	.4

For Sub Basins 1-6, Land Use/Surface Cover is "Natural-Mountain Brush", add .25 to STRTL

For Sub Basins 7-13, Land Use/Surface Cover is "Natural-Hillslopes, Sonoran Desert", add .15 to STRTL

Sub M-1

100% Type D Soil

CNSTL = .05

STRTL' = .40

STRTL = .40+.25 = .65 ✓

Superseded PMG 11/04/89

Sub M-2

$$CNSTL = \frac{(4)(.40)+(994)(.05)}{998} = .05$$

$$STRTL' = \frac{(4)(.6)+(994)(.4)}{998} = .40$$

STRTL = .40+.25 = .65 ✓

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash

Sheet No. 2 of 22

Drawing No. (1 of 7)

Computed by SAR Checked By [illegible] Date 08/08/89

Determination of Composite Initial & Uniform Loss Rates for each Sub-Basin, based on SCS Soil Texture Classification and Flood Control District Guidelines.

Sub M-1 (Area = 1281 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
16	.40	.70	918
31	.40	.70	273
72	.18	.64	90

$$CNSTL = \frac{(918)(.40)+(273)(.40)+(90)(.18)}{1281} = .38 \checkmark$$

$$STRTL' = \frac{(918)(.70)+(273)(.70)+(90)(.64)}{1281} = .70 \checkmark$$

$$STRTL = .70 + .25 = .95 \checkmark$$

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Uniform & Initial loss Rates by SCS Soil Texture Classification

Sheet No. 3 of 22
~~Drawing No.~~ (2 of 7)

Computed by SAB Checked By CMR Date 08/08/89

Sub M-2 (Area = 998 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
16	.40	.70	156
31	.40	.70	268
72	.18	.64	442
104	.23	.65	50+76 = 126
8	.40	.70	6

$$CNSTL = \frac{(156+268+6)(.40)+(442)(.18)+(126)(.23)}{998} = .28$$

$$STRTL' = \frac{(156+268+6)(.70)+(442)(.64)+(126)(.65)}{998} = .67$$

STRTL = .67 + .25 = .92

Sub M-3 (Area = 1208 Acres)

100% 31 Soil

CNSTL = .40

STRTL' = .70

STRTL = .70 + .25 = .95

F-5

S.O. No. 16923-04

Baker Engineers

Subject: Morgan City Wash
Uniform & Initial Loss Rates by SCS Soil Texture Classification

Sheet No. 4 of 22
Drawing No. (3 of 7)

Computed by SAK Checked By CMff Date 08/08/87

((CORRECTED AREAS 10/17/89 SAK)) Ck BRJ 10-18-89

Sub M-4 (Area = 1705 Acres). ((Area = 1711 Acres))

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area.
8	.40	.70	7
31	.40	.70	1698 ((1704)) ✓

CNSTL = .40 ✓ no change

STRTL' = .70 ✓ no change

STRTL = .70 + .25 = .95 ✓

Sub M-5 (Area = 1112 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
8	.40	.70	59
31	.40	.70	150 + 782 + 4 = 936
41	.28	.67	22
104	.23	.65	95

$$CNSTL = \frac{(59+936)(.40) + (22)(.28) + (95)(.23)}{1112} = .38 \checkmark$$

$$STRTL' = \frac{(59+936)(.70) + (22)(.67) + (95)(.67)}{1112} = .70 \checkmark$$

STRTL = .70 + .25 = .95 ✓

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Initial & Uniform Loss Rates by SCS Soil Texture Classification

Sheet No. 5 of 22
~~Drawing No.~~ (4 of 7)

Computed by SAR Checked By [illegible] Date 08/08/89

Sub M-6 (Area = 1669 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
8	.40	.70	127
31	.40	.70	234+319+187+72 = 812
33	.33	.66	30
41	.28	.67	4+10 = 14
72	.18	.64	270+91+13 = 374
95	.35	.69	11
104	.23	.65	57+10+201+33 = 301

$$CNSTL = \frac{(127+812)(.40)+(30)(.33)+(14)(.28)+(374)(.18)+(11)(.35)+(301)(.23)}{1669} = .32 \checkmark$$

$$STRTL' = \frac{(127+812)(.70)+(30)(.66)+(14)(.67)+(374)(.64)+(11)(.69)+(301)(.65)}{1669} = .68 \checkmark$$

$$STRTL = .68 + .25 = .93 \checkmark$$

Sub M-7 (Area = 497 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
31	.40	.70	115+15 = 130
72	.18	.64	367

$$CNSTL = \frac{(130)(.40)+(367)(.18)}{497} = .24 \checkmark$$

$$STRTL' = \frac{(130)(.70)+(367)(.64)}{497} = .66 \checkmark$$

$$STRTL = .66 + .15 = .81 \checkmark$$

F-7

S.O. No. 16923-04

Baker Engineers

Subject: Morgan City Wash
Uniform & Initial Loss Rates by SCS Soil Texture Classification

Sheet No. 6 of 22
Drawing No. (5 of 7)

Computed by SAR Checked By [illegible] Date 08/08/89

((Correct areas 10/17/89 [illegible])) Check BRG 10-18-89

Sub M-8 (Area = 1520 Acres) ((Area = 1527 Acres))

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
8	.40	.70	15
81	.40	.70	769 ((776))
72	.18	.64	166
104	.23	.65	20
109	.40	.70	550

$$CNSTL = \frac{(15+769+550)(.40)+(166)(.18)+(20)(.23)}{1520\ ((1527))} = .37$$

((15+776+550))

$$STRTL' = \frac{(15+769+550)(.70)+(166)(.64)+(20)(.65)}{1520\ ((1527))} = .69$$

((15+776+550))

STRTL = .69 + .15 = .84

Sub M-9 (Area = 1082 Acres) ((1126))

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
10	2.40	.98	88
48	.33	.68	3
51	.40	.70	17+16+11 = 44
52	.40	.70	48+13+88 = 149
68	.40	.70	18
70	.40	.70	7+11 = 18
104	.23	.65	56
108	.40	.70	72+53+84 = 209
109	.40	.70	364+90 = 454 ((498))
103	.40	.70	43

((+ 498))

$$CNSTL = \frac{(88)(2.40)+(3)(.33)+(44+149+18+18+209+454+43)(.40)+(56)(.23)}{((1126))\ 1082} = .55$$ no change

((+ 498))

$$STRTL' = \frac{(88)(.98)+(3)(.68)+(44+149+18+18+209+454+43)(.70)+(56)(.65)}{((1126))\ 1082} = .72$$ no change

STRTL = .72 + .15 = .87

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Uniform & Initial Loss Rates by SCS Soil Texture Classification

Sheet No. 7 of 22
~~Drawing No.~~ (6 of 7)

Computed by SAR Checked By [illegible] Date 08/08/89

Sub M-10 (Area = 961 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
10	.40	.70	9
21	.40	.70	32
31	.40	.70	30
48	.33	.68	12
51	.40	.70	81+32 = 113
52	.40	.70	5+12+1+7 = 25
72	.18	.64	20+20+49 = 89
104	.23	.65	651

$$CNSTL = \frac{(9+32+30+113+25)(.40)+(12)(.33)+(89)(.18)+(651)(.23)}{961} = .26 \checkmark$$

$$STRTL' = \frac{(9+32+30+113+25)(.70)+(12)(.68)+(89)(.64)+(651)(.65)}{961} = .66 \checkmark$$

$$STRTL = .66 + .15 = .81 \checkmark$$

Sub M-11 (Area = 620 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
10	2.40	.98	33
51	.40	.70	21+253+40 = 314
52	.40	.70	59
93	.40	.70	11
104	.23	.65	201+2 = 203

$$CNSTL = \frac{(33)(2.40)+(314+59+11)(.40)+(203)(.23)}{620} = .45 \checkmark$$

$$STRTL' = \frac{(33)(.98)+(314+59+11)(.70)+(203)(.65)}{620} = .70 \checkmark$$

$$STRTL = .70 + .15 = .85 \checkmark$$

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Uniform & Initial loss Rates by SCS Soil Texture Classification

Sheet No. 8 of 22
~~Drawing No.~~ (7 of 7)

Computed by SAR Checked By CMH Date 08/08/89

((correct areas (✓) 10/17/89/ SRO))
Check BRG 10/18/89

Sub M-12 (Area = 826 Acres)

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
51	.40	.70	6+46=52
52	.40	.70	9
66	.40	.70	29
72	.18	.64	45+37+119 = 201
93	.40	.70	39+24+2 = 65
95	.35	.69	39+52 = 91
103	.40	.70	21
104	.23	.65	358

$$CNSTL = \frac{(52+9+29+65+21)(.40)+(201)(.18)+(91)(.35)+(358)(.23)}{826} = .27 \checkmark$$

$$STRTL' = \frac{(52+9+29+65+21)(.70)+(201)(.64)+(91)(.69)+(358)(.65)}{826} = .66 \checkmark$$

$$STRTL = .66 + .15 = .81 \checkmark$$

Sub M-13 (Area = 1166 Acres) ((1161))

Soil Map Symbol	Uniform (CNSTL)	Initial (STRTL)	Area
10	2.40	.98	77
51	.40	.70	462+438+13 = 913 ((170))
52	.40	.70	4+16+93+28+12+1+21 = ~~175~~
103	.40	.70	1

((913+170+1))

$$CNSTL = \frac{(77)(2.40)+(913+175+1)(.40)}{1166\ ((1161))} = .53 \checkmark\checkmark \text{ no change}$$

((913+170+1))

$$STRTL' = \frac{(77)(.98)+(913+175+1)(.70)}{1166\ ((1161))} = .72 \checkmark\checkmark \text{ no change}$$

$$STRTL = .72 + .15 = .87 \checkmark$$

Baker Engineers

S.O. No. 16923-04

Subject: Floodplain Delineation Study
Morgan City Wash
Area Corrections

Sheet No. 1 of 1

Drawing No.

Computed by SiL Checked By BRJ 10-17-89 Date 10/17/89

SCALE: 1" = 24,000"

Area	M-4	map unit 31	+ 5.6933	acres	6
Area	M-8	map unit 31	+ 7.1166	acres	7
Area	M-9	map unit 109	+ 43.6486	acres	44
Area	M-13	map unit 52	(-) 4.8393	acres	5

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash.

Sheet No. 14 of 22

~~Drawing No.~~ (1 of 4)

Computed by SAK Checked By [illegible] Date 08/09/89

Percent Impervious in each Sub-Basin:

Sub M-1

Soil #16, 15% Imp., Area = 918
Soil #31, 35% Imp., Area = 273
Soil #72, 30% Imp, Area = 90

$$RTIMP = \frac{(.15)(918)+(.35)(273)+(.30)(90)}{1281} = 20.3\% \checkmark$$

Sub M-2

Soil #16, 15% Imp, Area = 156
#31, 35% = 268
#72, 30% = 442
#104, 60% = 126

$$RTIMP = \frac{(.15)(156)+(.35)(268)+(.30)(442)+(.60)(126)}{998} = 32.6\% \checkmark$$

Sub M-3

Soil #31, 35% Imp.
(100% #31 soil)
RTIMP = 35.0% ✓

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Percent Impervious values

Sheet No. 15 of 22
~~Drawing No.~~ (2 of 4)

Computed by SAR Checked By MHH Date 08/09/89

((Corrected areas 10/27/89 BRG))
TSR 11/5/89

Sub M-4

Soil #31, 35% Imp. Area = 1698
((1704))

RTIMP = $\frac{(.35)(\cancel{1698})}{\cancel{1705}}$ = ~~34.8%~~ ✓ 34.9%
((1711))

Sub M-5

Soil # 31, 35% Imp, Area = 936
Soil # 104, 60% Imp, Area = 95

RTIMP = $\frac{(.35)(936)+(.60)(95)}{1112}$ = 34.6% ✓

Sub M-6

Soil # 31, 35% Imp, Area = 812
Soil # 72, 30% Imp, Area = 374
Soil # 104, 60% Imp, Area = 301

RTIMP = $\frac{(.35)(812)+(.30)(374)+(.60)(301)}{1669}$ = 34.6% ✓

Sub M-7

Soil #31, 35% Imp. Area = 130
Soil #72, 30% Imp, Area = 367

RTIMP = $\frac{(.35)(130)+(.30)(367)}{497}$ = 31.3% ✓

Baker Engineers

S.O. No. 16923-04

Subject: Cline Creek
Percent Impervious Values

Sheet No. 16 of 23 (3 of 4)

~~Drawing No.~~

Computed by SAR Checked By [illegible] Date 08/09/89

((Corrected Areas BTC 10-27-89)) 11/5/89 11/5/89

Sub M-8

Soil # 31, 35% Imp, Area = 769 ((776))
Soil # 72, 30% Imp, Area = 166
Soil # 104, 60% Imp, Area = 20
Soil # 109 35% Imp, Area = 550

$$RTIMP = \frac{(.35)(\cancel{769})(776) + (.30)(166) + (.60)(20) + (.35)(550)}{\cancel{1520}\ ((1527))} = 34.4\%$$ ✓

no change

Sub M-9

Soil # 52, 20% Imp, Area = 149
Soil # 103, 65% Imp, Area = 43
Soil # 104, 60% Imp, Area = 56
Soil # 108, 30% Imp, Area = 209
Soil # 109, 35% Imp, Area = 454 ((498))

$$RTIMP = \frac{(.20)(149) + (.65)(43) + (.60)(56) + (.30)(209) + (.35)(\cancel{454})((498))}{1082\ ((1126))} = \cancel{28.9\%}\ 29.2\%$$ ✓

Sub M-10

Soil # 31, 35% Imp, Area = 30
Soil # 52, 20% Imp, Area = 25
Soil # 72, 30% Imp, Area = 89
Soil # 104, 60% Imp, Area = 651

$$RTIMP = \frac{(.35)(30) + (.20)(25) + (.30)(89) + (.60)(651)}{961} = 45.0\%$$ ✓

Baker Engineers

S.O. No. 16923-04

Subject: Morgan City Wash
Percent Impervious Values

Sheet No. 17 of 22
~~Drawing No.~~ (4 of 4)

Computed by SAR Checked By ~~[illegible]~~ 11/3/89 Date 08/09/89

((Corrected Areas Pg (10-27-89))

Sub M-11

Soil #52, 20% Imp, Area = 59
Soil #104, 60% Imp, Area = 203

$$RTIMP = \frac{(.20)(59)+(.60)(203)}{620} = 21.5\% \checkmark$$

Sub M-12

Soil # 52, 20% Imp, Area = 9
Soil # 72, 30% Imp, Area = 201
Soil # 103, 65% Imp, Area = 21
Soil # 104, 60% Imp, Area = 358

$$RTIMP = \frac{(.20)(9)+(.30)(201)+(.65)(21)+(.60)(358)}{826} = 35.2\% \checkmark$$

Sub M-13

Soil # 52, 20% Imp, Area = ~~175~~ ((170))
Soil # 103, 65% Imp, Area = 1

$$RTIMP = \frac{(.20)(\cancel{175})+(.65)(1)}{\cancel{1166}} = \cancel{3.1\%} \checkmark$$

((170)) 3.0%

((1161))

Baker Engineers

S.O. No. 16923-04

Subject: SCS Soil Texture Classification

Sheet No. 1 of 3

Drawing No.

Computed by SAK Checked By CMH Date 08/04/89

From Flood Control District: Initial and Uniform Loss Rates

Soil Texture Classification	Uniform (CNSTL)	Initial (Dry Bare Ground) (STRTL)
Sand	4.6	1.3
Loamy Sand	1.2	0.8
Sandy Loam	0.4	0.7
Sandy Clay Loam	0.06	0.6
Clay Loam	0.04	0.5
Sandy Clay	0.02	0.4
Clay	0.01	0.3

Unadjusted for ground cover.

Soil Map Symbol	Percent Area	Soil Classification	Composite CNSTL	Composite STRTL
3	(35+20)=55	Sandy Loam	1.78	.90
	15	Loamy Sand		
	30	Sand		
6	100	Sandy Loam	.40	.70
8	100	Sandy Loam	.40	.70
10	20	Sandy Loam	2.40	.98
	40	Loamy Sand		
	40	Sand		
12	100	Clay Loam	.04	.50
13	50	Clay	.06	.42
	40	Clay Loam		
	10	Sandy Loam		
*16	65 → 76	Sandy Loam		
	15 → 0	Impervious (Ignore)	.40	.70
	20 → 24	Sandy Loam		

F-16

Baker Engineers

S.O. No. 16923-04

Subject:

Sheet No. 2 of 3

Drawing No.

Computed by SAR Checked By [illegible] Date 08/04/89

Soil Map Symbol	Percent Area	Soil Classification	Composite CNSTL	Composite STRTL
21	100	Sandy Loam	.40	.70
26	85	Clay Loam	.09	.53
	15	Sandy Loam		
28	70	Clay Loam	.15	.56
	(20+10)=30	Sandy Loam		
*31	55 → 85	Sandy Loam	.40	.70
	35 → 0	Impervious		
	10 → 15	Sandy Loam		
33	80	Sandy Loam	.33	.66
	20	Clay Loam		
41	(45+20)=65	Sandy Loam	.28	.67
	35	Sandy Clay Loam		
44	80	Sandy Loam		
	20	Clay Loam	.33	.66
48	(45+35)=80	Sandy Loam	.33	.68
	20	Sandy Clay Loam		
51	100	Sandy Loam	.40	.70
*52	45	Sandy Loam	.40	.70
	20	Sandy Loam		
	20	Impervious		
	15	Sandy Loam		
66	100	Sandy Loam	.40	.70
68	100	Sandy Loam	.40	.70
70	100	Sandy Loam	.40	.70

Baker Engineers

S.O. No. 16923-04 F-17

Subject:

Sheet No. 3 of 3

Drawing No.

Computed by SAR Checked By MKK Date 08/04/89

Soil Map Symbol	Percent Area	Soil Classification	Composite CNSTL	Composite STTCTL
*72	45→64	Sandy Clay Loam	.18	.64
	30→0	Impervious		
	25→36	Sandy Loam		
93	100	Sandy Loam	.40	.70
95	85	Sandy Loam	.35	.69
	15	Sandy Clay Loam		
96	45	Sandy Clay Loam	.25	.66
	(40+15)=55	Sandy Loam		
98	100	Sandy Loam	.40	.70
*103	65→0	Impervious	.40	.70
	25→71	Sandy Loam		
	10→29	Sandy Loam		
*104	60→0	Impervious	.23	.65
	20→50	Sandy Clay Loam		
	20→50	Sandy Loam		
*108	50→71	Sandy Loam	.40	.70
	30→0	Impervious		
	20→29	Sandy Loam		
*109	55→85	Sandy Loam	.40	.70
	35→0	Impervious		
	10→15	Sandy Loam		
110	100	Sandy Loam	.40	.70

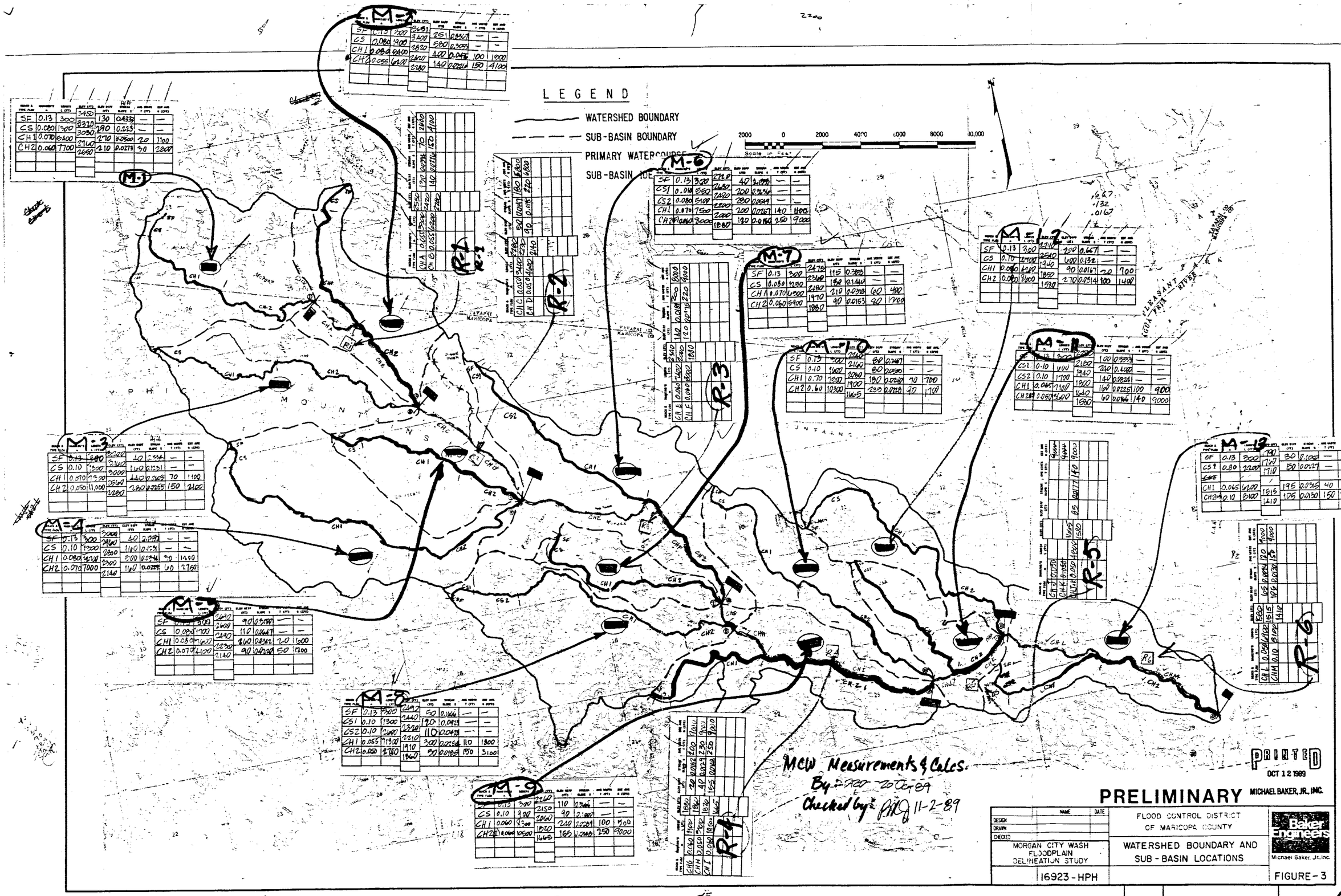
APPENDIX G

MORGAN CITY WASH

CALCULATIONS:

SUB-BASIN LAG TIMES,

ROUTING TRAVEL TIMES


LEGEND
WATERSHED BOUNDARY
SUB-BASIN BOUNDARY
PRIMARY WATERCOURSE
SUB-BASIN TIE
2000 0 2000 4000 6000 8000 10,000
Scale in Feet
M-1
M-2
M-3
M-4
M-5
M-6
M-7
M-8
M-9
M-10
M-11
M-12
M-13
R-1
R-2
R-3
R-4
R-5
R-6
MARICOPA
PINAL
MCW Measurements & Calcs.
By: 20 Oct 89
Checked by: 11-2-89
PRINTED
OCT 12 1989
PRELIMINARY
MICHAEL BAKER, JR., INC.
DESIGN
DRAWN
CHECKED
NAME
DATE
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
MORGAN CITY WASH
FLOODPLAIN
DELINEATION STUDY
WATERSHED BOUNDARY AND
SUB - BASIN LOCATIONS
Baker Engineers
Michael Baker, Jr. Inc.
16923 - HPH
FIGURE - 3
MCW Tc/Tt Map

G-1

Time of concentration (T_c) or travel time (T_t)

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct '89

Location **Morgan City Wash** Checked [illegible] Date 10-26-89

T_c for Subarea M-1

T_t for Routing Reach

Assumed Watershed Conditions: UNDEVELOPED - ALL SUBAREAS

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID			
		SF		
1. Surface description (table 3-1, TR-55)		OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)		0.13		
3. Flow length, L (total L ≤ 300 ft) ft		300		
4. Two-yr 24-hr rainfall, P2 in		1.8		
5. Land slope, s ft/ft		0.4333		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	0.13	=	0.13

Shallow concentrated flow	Segment ID			
		CS		
7. Manning's roughness coeff., n		0.08		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25		
9. Flow Length, L ft		1300		
10. Watercourse slope, s ft/ft		0.223		
11. Average velocity, V (Figure CHT 8) ft/s		3.4		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	0.11	=	0.11

Channel flow	Segment ID			
		CH-1	CH-2	
13. Approximate flow rate, Q ft³/sec		1100	2800	
14. Top width, T ft		20	30	
15. ~~Hydraulic radius, r~~ = d = A/T Estimate ft		5.1	7.7	
16. Channel slope, s ft/ft		0.050	0.0273	
17. Manning's roughness coeff., n		0.070	0.060	
18. Average velocity, V (Figure SEE NOTE) ft/s		10.7	12.1	
19 Flow length, L ft		5400	7700	
20. Check r estimate: Q = V x T x r = _____ compare to line 13		1091	2795	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	0.14	0.18	= 0.32
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				0.56

NOTE: ALL VELOCITY CALCS. BY MANNING NORMAL DEPTH USING LINE 15 AS FLOW DEPTH AND RECTANGULAR CHANNEL OF WIDTH T (LINE 14)

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

for $\Delta t = 6$ min $T_{L_{MIN}} = 0.35$ hr

$T_L = 0.34$ hr

SAY 0.35 hr!

Time of concentration (T_c) or travel time (T_t)

G-2

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10-26-89

T_c for Subarea M-2

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID			
		SF		
1. Surface description (table 3-1, TR-55)		OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)		0.13		
3. Flow length, L (total L ≤ 300 ft) ft		300		
4. Two-yr 24-hr rainfall, P2 in		1.8		
5. Land slope, s ft/ft		0.8367		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	0.11	=	0.11

Shallow concentrated flow	Segment ID			
		CS		
7. Manning's roughness coeff., n		0.080		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25		
9. Flow Length, L ft		1900		
10. Watercourse slope, s ft/ft		0.3053		
11. Average velocity, V (Figure CHT 8) ft/s		4.1		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	0.13	=	0.13

Channel flow	Segment ID			
		CH-1	CH-2	
13. Approximate flow rate, Q ft³/sec		1800	4100	
14. Top width, T ft		100	150	
15. Hydraulic radius, r = d = A/T Estimate ft		2.5	3.2	
16. Channel slope, s ft/ft		0.0476	0.0226	
17. Manning's roughness coeff., n		0.080	0.055	
18. Average velocity, V (Figure ____) ft/s		7.2	8.6	
19 Flow length, L ft		8400	6200	
20. Check r estimate: Q = V x T x r = _____ compare to line 13		1800	4128	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		0.32 +	0.20 =	0.52
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				0.76

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.46$

Time of concentration (T_c) or travel time (T_t)

G-3

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked RRJ Date 10-26-89

T_c for Subarea M-3

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	SF		
1. Surface description (table 3-1, TR-55)		OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)		0.13		
3. Flow length, L (total L ≤ 300 ft) ft		300		
4. Two-yr 24-hr rainfall, P2 in		1.8		
5. Land slope, s ft/ft		0.1333		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+ 0.22	=	0.22

Shallow concentrated flow	Segment ID	CS		
7. Manning's roughness coeff., n		0.100		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25		
9. Flow Length, L ft		1300		
10. Watercourse slope, s ft/ft		0.1231		
11. Average velocity, V (Figure AHT 10) ft/s		2.2		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+ 0.16	=	0.16

Channel flow	Segment ID	CH-1	CH-2	
13. Approximate flow rate, Q ft^3/sec		1100	2100	
14. Top width, T ft		70	150	
15. Hydraulic radius, r = d = A/T Estimate ft		2.0	1.9	
16. Channel slope, s ft/ft		0.0603	0.0255	
17. Manning's roughness coeff., n		0.070	0.050	
18. Average velocity, V (Figure ____) ft/s		7.9	7.2	
19 Flow length, L ft		7300	11,000	
20. Check r estimate: Q = V x T x r = _____ compare to line 13		1106	2052	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		0.25 +	0.42 =	0.67
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				1.05

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

T_c = 0.63 hr

Time of concentration (T_c) or travel time (T_t)

G-4

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked BRJ Date 10-26-89

T_c for Subarea M-4

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
				SF		
1.	Surface description (table 3-1, TR-55)			OPEN RANGE		
2.	Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3.	Flow length, L (total L ≤ 300 ft)	ft		300		
4.	Two-yr 24-hr rainfall, P2	in		1.8		
5.	Land slope, s	ft/ft		0.1333		
6.	$T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	+	0.22	=	0.22

Shallow concentrated flow		Segment ID				
				CS		
7.	Manning's roughness coeff., n			0.100		
8.	Hydraulic radius r (appx - avg. depth) Est.			0.25		
9.	Flow Length, L	ft		1300		
10.	Watercourse slope, s	ft/ft		0.1231		
11.	Average velocity, V (Figure CHT 10)	ft/s		2.1		
12.	$T_t = \frac{L}{3600\,V}$ Compute T_t	hr	+	0.17	=	0.17

Channel flow		Segment ID	CH-1	CH-2		
13.	Approximate flow rate, Q	ft^3/sec	1200	2750		
14.	Top width, T	ft	30	60		
15.	Hydraulic radius, r = d = A/T	Estimate ft	4.7	5.3		
16.	Channel slope, s	ft/ft	0.0394	0.0229		
17.	Manning's roughness coeff., n		0.080	0.070		
18.	Average velocity, V (Figure ____)	ft/s	8.6	8.1		
19	Flow length, L	ft	12,700	7,000		
20.	Check r estimate: Q = V x T x r = _____ compare to line 13		1213	2766		
21.	$T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.41	+ 0.22	=	0.63
22.	Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr				1.02

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.61$

Time of concentration (T_c) or travel time (T_t)

G-5

Project **FCD-Floodplain Delineation** By DRO Date 26 Oct 89

Location **Morgan City Wash** Checked BRG Date 10-27-89

T_c for Subarea M-5

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SF		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P2	in		1.8		
5. Land slope, s	ft/ft		0.300		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	+	0.16	=	0.16

Shallow concentrated flow	Segment ID				
			CS		
7. Manning's roughness coeff., n			0.080		
8. Hydraulic radius r (appx - avg. depth) Est.			0.25		
9. Flow Length, L	ft		1700		
10. Watercourse slope, s	ft/ft		0.047		
11. Average velocity, V (Figure CHT 8)	ft/s		1.85		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	+	0.26	=	0.26

Channel flow	Segment ID				
		CH-1	CH-2		
13. Approximate flow rate, Q	ft³/sec	600	1200		
14. Top width, T	ft	20	50		
15. Hydraulic radius, r = d = A/T	Estimate ft	4.2	3.6		
16. Channel slope, s	ft/ft	0.0342	0.022		
17. Manning's roughness coeff., n		0.080	0.070		
18. Average velocity, V (Figure ____)	ft/s	7.1	6.7		
19 Flow length, L	ft	7600	4100		
20. Check r estimate: Q = V x T x r = _____ compare to line 13		596	1206		
21. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.29	+ 0.17	=	0.46
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr				0.88

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.53$

7

Time of concentration (T_c) or travel time (T_t)

G-6

Project **FCD-Floodplain Delineation** By DRO Date 20 Oct 89

Location **Morgan City Wash** Checked BMG Date 10-27-89

T_c for Subarea M-6

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SP		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P2	in		1.8		
5. Land slope, s	ft/ft		0.1333		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr		0.22	=	0.22

Shallow concentrated flow	Segment ID				
		CS-1	CS-2		
7. Manning's roughness coeff., n ..... BMG 12-7-89 ..... 0.10		~~0.010~~	0.080		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25	0.50		
9. Flow Length, L	ft	550	5100		
10. Watercourse slope, s	ft/ft	0.3636	0.0549		
11. Average velocity, V (Figure CHT 10)	ft/s	3.6	2.8	CHT 8	
12. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.04	0.51	=	0.55

Channel flow	Segment ID				
		CH-1	CH-2		
13. Approximate flow rate, Q	ft^3/sec	1100	9000		
14. Top width, T	ft	140	250		
15. Hydraulic radius, r = d = A/T	Estimate ft	1.6	4.5		
16. Channel slope, s	ft/ft	0.0267	0.0150		
17. Manning's roughness coeff., n		0.070	0.060		
18. Average velocity, V (Figure ____)	ft/s	4.8	8.0		
19 Flow length, L	ft	7500	8000		
20. Check r estimate: Q = V x T x r = _____ compare to line 13		1075	9000		
21. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.43	0.28	=	0.71
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr				1.48

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.89$ hr

Time of concentration (T_c) or travel time (T_t)

G-7

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked BMG Date 10-27-89

T_c for Subarea M-7 Assumed Watershed Conditions

T_t for Routing Reach

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SF		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P2	in		1.8		
5. Land slope, s	ft/ft		0.3833		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	+	0.14	=	0.14

Shallow concentrated flow	Segment ID				
			CS		
7. Manning's roughness coeff., n			0.08		
8. Hydraulic radius r (appx - avg. depth) Est.			0.25		
9. Flow Length, L	ft		1250		
10. Watercourse slope, s	ft/ft		0.1440		
11. Average velocity, V (Figure CHT 8)	ft/s		2.8		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	+	0.12	=	0.12

Channel flow	Segment ID	CH-1	CH-2		
13. Approximate flow rate, Q	ft^3/sec	400	1200		
14. Top width, T	ft	60	80		
15. Hydraulic radius, r = d = A/T	Estimate ft	1.4	2.7		
16. Channel slope, s	ft/ft	0.0323	0.0153		
17. Manning's roughness coeff., n		0.070	0.060		
18. Average velocity, V (Figure ____)	ft/s	4.7	5.6		
19 Flow length, L	ft	6500	5900		
20. Check r estimate: Q = V x T x r = _____ compare to line 13		395	1210		
21. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.38	+ 0.29	=	0.67
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr				0.93

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.56$ hr

Time of concentration (T_c) or travel time (T_t)

G-8

Project **FCD-Floodplain Delineation** By DRD Date 23 Oct 89

Location **Morgan City Wash** Checked PMG Date 10-27-89

T_c for Subarea M-8

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SF		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft) ft			300		
4. Two-yr 24-hr rainfall, P2 in			1.8		
5. Land slope, s ft/ft			0.1666		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+	0.20	=	0.20

Shallow concentrated flow	Segment ID				
	CS-1	CS-2			
7. Manning's roughness coeff., n	0.10	0.10			
8. Hydraulic radius r (appx - avg. depth) Est.	0.25	0.50			
9. Flow Length, L ft	1300	2600			
10. Watercourse slope, s ft/ft	0.0923	0.0423			
11. Average velocity, V (Figure CHT 10) ft/s	1.8	1.9	CHT 10		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.20	+ 0.38	=	0.58	

Channel flow	Segment ID				
	CH-1	CH-2			
13. Approximate flow rate, Q ft³/sec	1800	3100			
14. Top width, T ft	110	150			
15. Hydraulic radius, r = d = A/T Estimate ft	2.3	2.7			
16. Channel slope, s ft/ft	0.0254	0.0185			
17. Manning's roughness coeff., n	0.055	0.050			
18. Average velocity, V (Figure ____) ft/s	7.2	7.7			
19 Flow length, L ft	11,800	2700			
20. Check r estimate: Q = V x T x r = _____ compare to line 13	1822	3119			
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.46	+ 0.10	=	0.56	
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				1.34	

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_p = 0.80$ hr

Time of concentration (T_c) or travel time (T_t)

G-9

Project **FCD-Floodplain Delineation** By DEO Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10-27-89

T_c for Subarea M-9

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SP		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P2	in		1.8		
5. Land slope, s	ft/ft		0.3667		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	+	0.15	=	0.15

Shallow concentrated flow	Segment ID				
			CS		
7. Manning's roughness coeff., n			0.10		
8. Hydraulic radius r (appx - avg. depth) Est.			0.25		
9. Flow Length, L	ft		900		
10. Watercourse slope, s	ft/ft		0.100		
11. Average velocity, V (Figure CH 10)	ft/s		1.9		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	+	0.13	=	0.13

Channel flow	Segment ID	CH-1	CH-2
13. Approximate flow rate, Q	ft^3/sec	500	9000
14. Top width, T	ft	100	250
15. Hydraulic radius, r = d = A/T	Estimate ft	1.1	4.5
16. Channel slope, s	ft/ft	0.0289	0.0148
17. Manning's roughness coeff., n		0.060	0.060
18. Average velocity, V (Figure ____)	ft/s	4.5	8.0
19 Flow length, L	ft	8300	10,500
20. Check r estimate: Q = V x T x r = _____ compare to line 13		495	9000
21. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.51 +	0.36 = 0.87
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr		1.15

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.69$ hr.

Time of concentration (T_c) or travel time (T_t)

G-10

Project **FCD-Floodplain Delineation** By DRD Date 23 Oct 89

Location **Morgan City Wash** Checked PRG Date 10-27-89

T_c for Subarea M-10

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SF		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P2	in		1.8		
5. Land slope, s	ft/ft		0.2667		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr	+	0.17	=	0.17

Shallow concentrated flow	Segment ID				
			CS		
7. Manning's roughness coeff., n			0.10		
8. Hydraulic radius r (appx - avg. depth) Est.			0.25		
9. Flow Length, L	ft		1600		
10. Watercourse slope, s	ft/ft		0.050		
11. Average velocity, V (Figure CHT 10)	ft/s		1.3		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	+	0.34	=	0.34

Channel flow	Segment ID	CH-1	CH-2		
13. Approximate flow rate, Q	ft^3/sec	700	1700		
14. Top width, T	ft	70	90		
15. Hydraulic radius, r = d = A/T	Estimate ft	1.99	2.7		
16. Channel slope, s	ft/ft	0.0240	0.0228		
17. Manning's roughness coeff., n		0.07	0.06		
18. Average velocity, V (Figure ____)	ft/s	5.0	7.0		
19 Flow length, L	ft	7500	10,300		
20. Check r estimate: Q = V x T x r = _____ compare to line 13		697	1656		
21. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.42 +	0.41	=	0.83
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21)	hr				1.34

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.80$

Time of concentration (T_c) or travel time (T_t)

G-11

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked ____ Date ____

T_c for Subarea M-11 Assumed Watershed Conditions

T_t for Routing Reach

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
			SF		
1. Surface description (table 3-1, TR-55)			OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)			0.13		
3. Flow length, L (total L ≤ 300 ft) ft			300		
4. Two-yr 24-hr rainfall, P2 in			1.8		
5. Land slope, s ft/ft			0.3333		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+	0.15	=	0.15

Shallow concentrated flow	Segment ID				
	CS-1		CS-2		
7. Manning's roughness coeff., n	0.10		0.10		
8. Hydraulic radius r (appx - avg. depth) Est.	0.25		0.50		
9. Flow Length, L ft	600		1700		
10. Watercourse slope, s ft/ft	0.400		0.0824		
11. Average velocity, V (Figure CHT 10) ft/s	3.7		2.7 CHT 10		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.05	+	0.17	=	0.22

Channel flow	Segment ID				
	CH-1		CH-2		
13. Approximate flow rate, Q ft^3/sec	900		9000		
14. Top width, T ft	100		140		
15. Hydraulic radius, r = d = A/T Estimate ft	1.8		5.6		
16. Channel slope, s ft/ft	0.0225		0.0167		
17. Manning's roughness coeff., n	0.065		0.05		
18. Average velocity, V (Figure ____) ft/s	5.0		11.5		
19 Flow length, L ft	7100		3600		
20. Check r estimate: Q = V x T x r = ____ compare to line 13	900		9016		
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.39	+	0.09	=	0.48
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr					0.85

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_c = 0.51$

16

Time of concentration (T_c) or travel time (T_t)

G-12

Project **FCD-Floodplain Delineation** By DRD Date 23 Oct 89

Location **Morgan City Wash** Checked ____ Date ____

T_c for Subarea M-12 Assumed Watershed Conditions

T_t for Routing Reach

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID			
		SF		
1. Surface description (table 3-1, TR-55)		OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)		0.13		
3. Flow length, L (total L ≤ 300 ft) ft		300		
4. Two-yr 24-hr rainfall, P2 in		1.8		
5. Land slope, s ft/ft		0.667		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+ 0.11	=	0.11

Shallow concentrated flow	Segment ID			
		CS		
7. Manning's roughness coeff., n		0.10		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25		
9. Flow Length, L ft		4700		
10. Watercourse slope, s ft/ft		0.132		
11. Average velocity, V (Figure CHT 10) ft/s		2.1		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+ 0.62	=	0.62

Channel flow	Segment ID			
		CH-1	CH-2	
13. Approximate flow rate, Q ft^3/sec		700	1400	
14. Top width, T ft		20	100	
15. Hydraulic radius, r = d = A/T Estimate ft		6.0	2.4	
16. Channel slope, s ft/ft		0.0167	0.0314	
17. Manning's roughness coeff., n		0.080	0.080	
18. Average velocity, V (Figure ____) ft/s		5.8	5.8	
19 Flow length, L ft		4200	8600	
20. Check r estimate: Q = V x T x r = ____ compare to line 13		696	1392	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		0.20 +	0.41 =	0.61
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				1.34

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.80$

Time of concentration (T_c) or travel time (T_t)

G-13

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10-27-89

T_c for Subarea M-13

T_t for Routing Reach

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID			
		SF		
1. Surface description (table 3-1, TR-55)		OPEN RANGE		
2. Manning's roughness coeff., n (table 3-1, TR-55)		0.13		
3. Flow length, L (total L ≤ 300 ft) ft		300		
4. Two-yr 24-hr rainfall, P2 in		1.8		
5. Land slope, s ft/ft		0.100		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	0.25	=	0.25

Shallow concentrated flow	Segment ID			
		CS		
7. Manning's roughness coeff., n		0.030		
8. Hydraulic radius r (appx - avg. depth) Est.		0.25		
9. Flow Length, L ft		2200		
10. Watercourse slope, s ft/ft		0.0227		
11. Average velocity, V (Figure CHT 8) ft/s		1.1		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	0.56	=	0.56

Channel flow	Segment ID			
		CH-1	CH-2	
13. Approximate flow rate, Q ft^3/sec		500	9000	
14. Top width, T ft		40	150	
15. Hydraulic radius, r = d = A/T Estimate ft		2.0	8.9	
16. Channel slope, s ft/ft		0.0315	0.0130	
17. Manning's roughness coeff., n		0.065	0.100	
18. Average velocity, V (Figure ____) ft/s		6.1	6.7	
19 Flow length, L ft		6200	8100	
20. Check r estimate: Q = V x T x r = _____ compare to line 13		488	8944	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		0.28 +	0.34 =	0.62
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr				143

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

$T_L = 0.86$

Average Velocities for Upland Channels & Shallow Concentrated Flow

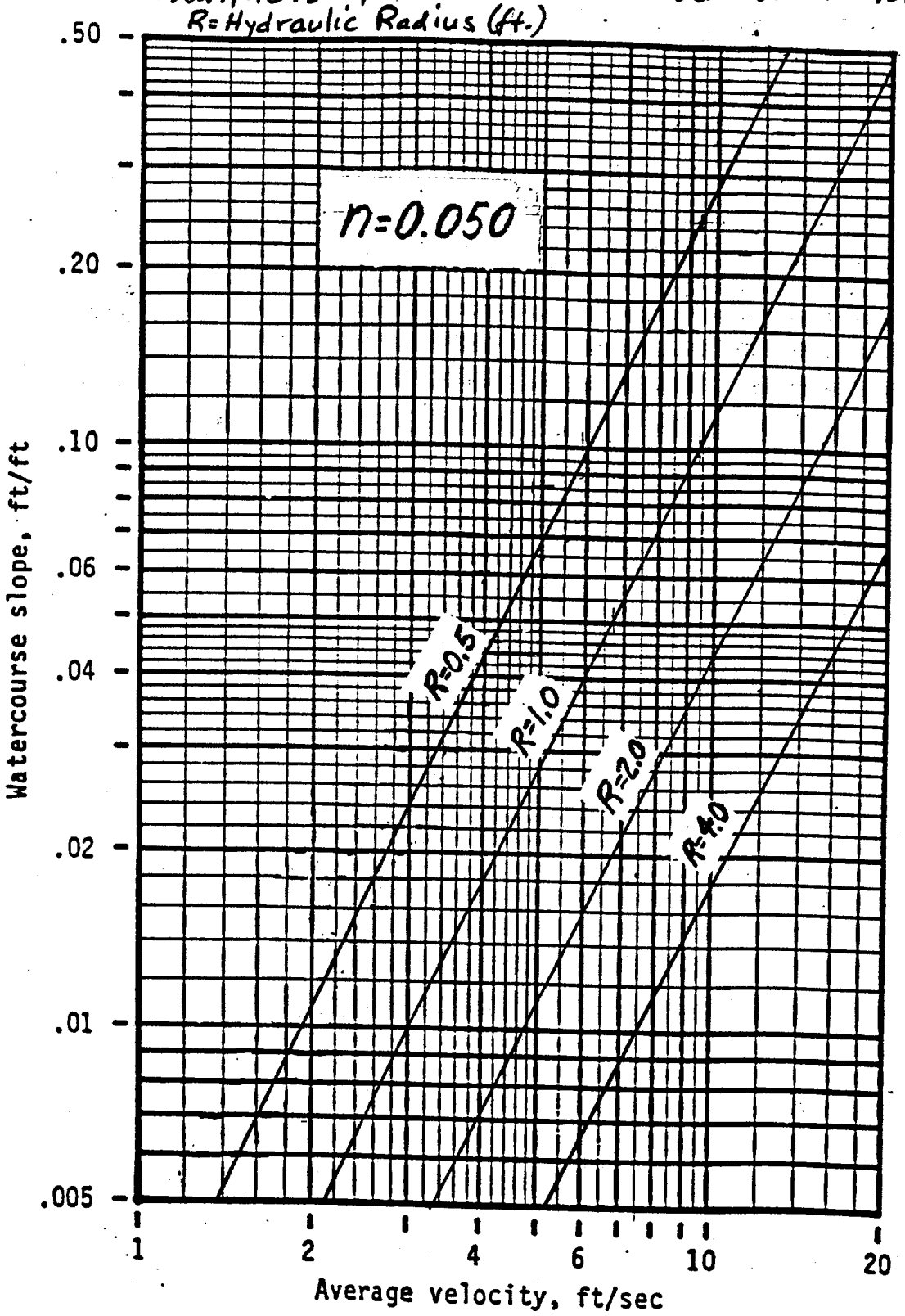


CHART 5

Average Velocities for Upland Channels & Shallow Concentrated Flow

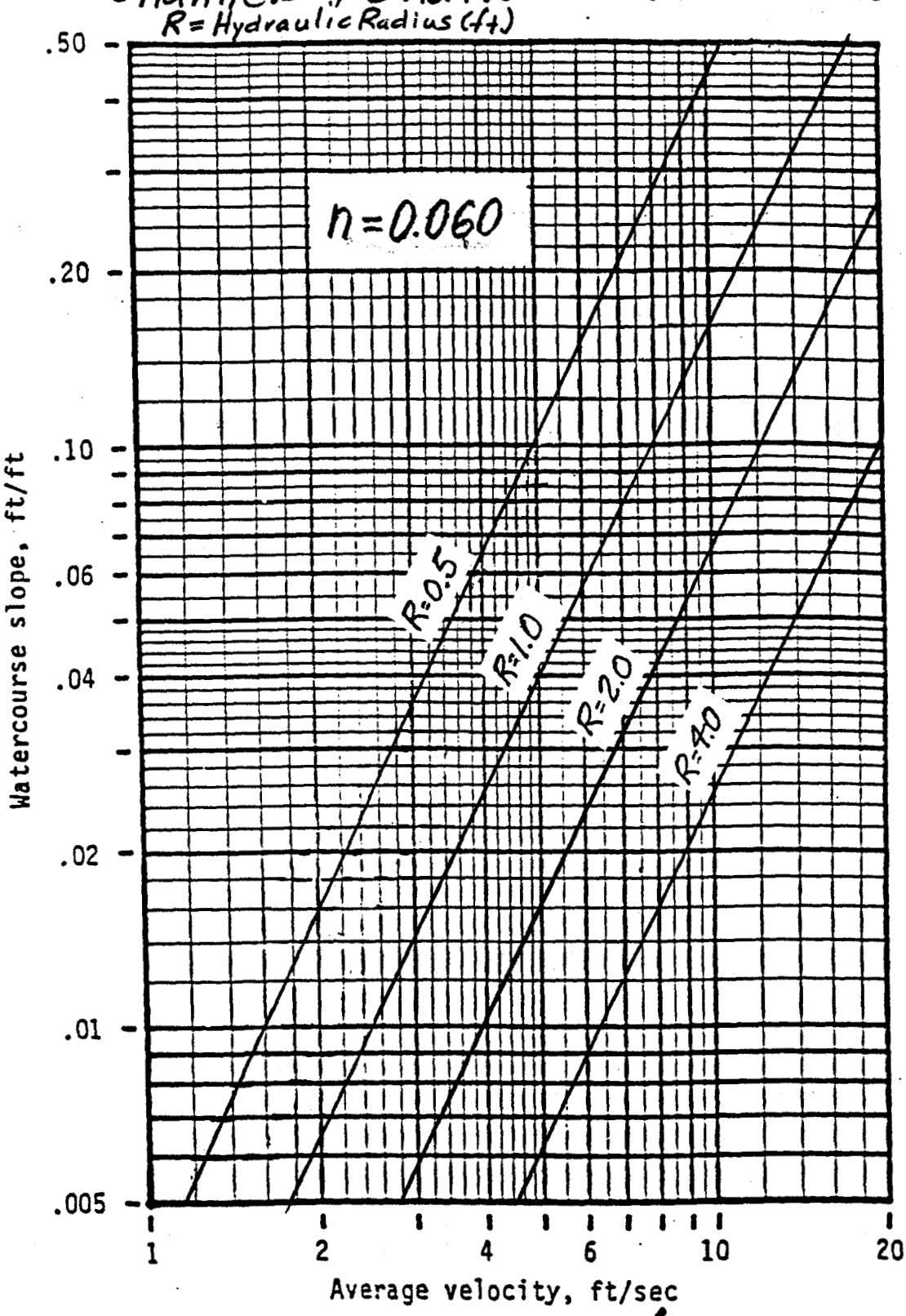


CHART 6

Average Velocities for Upland Channels & Shallow Concentrated Flow

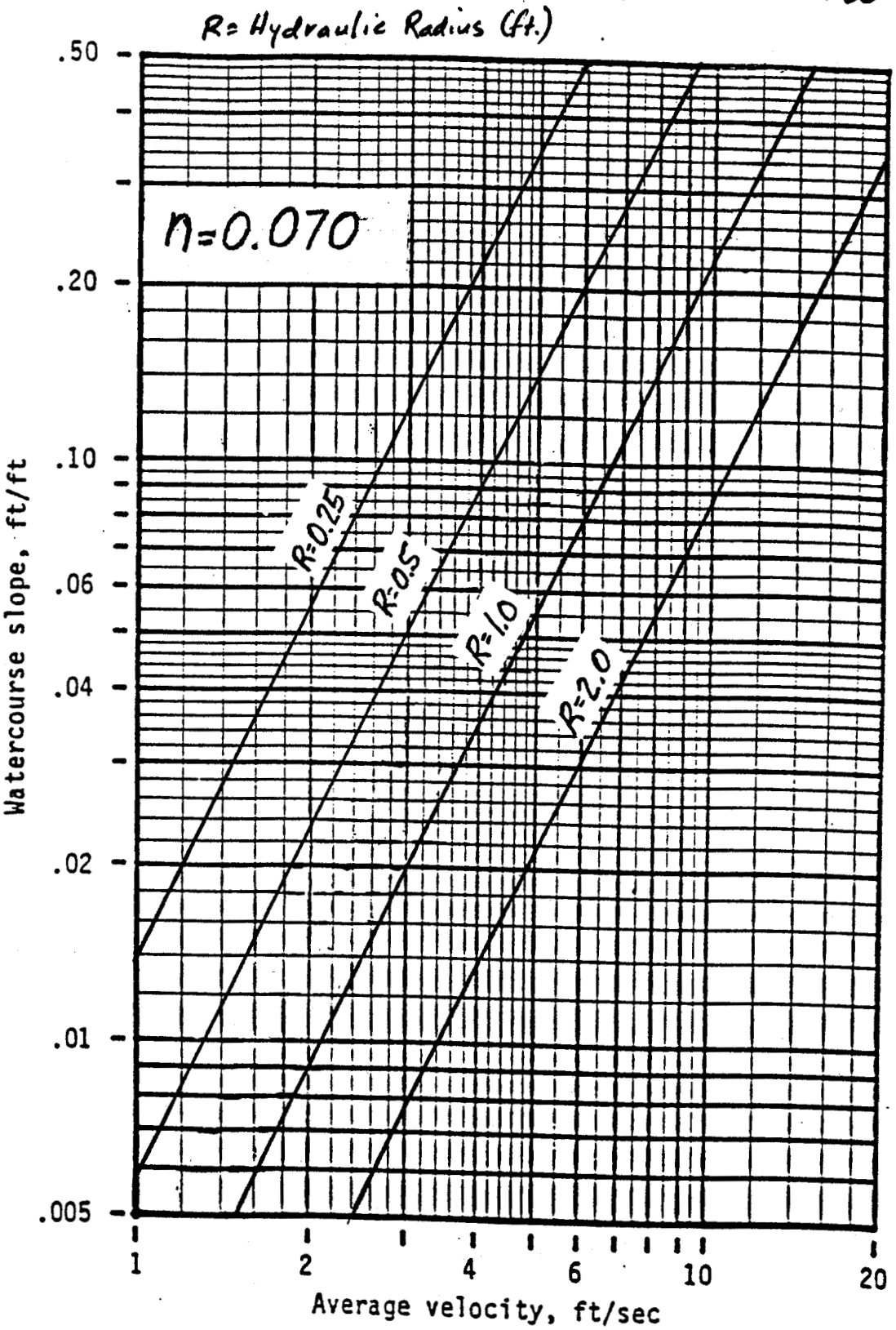


CHART 7

Average Velocities for Upland Channels & Shallow Concentrated Flow

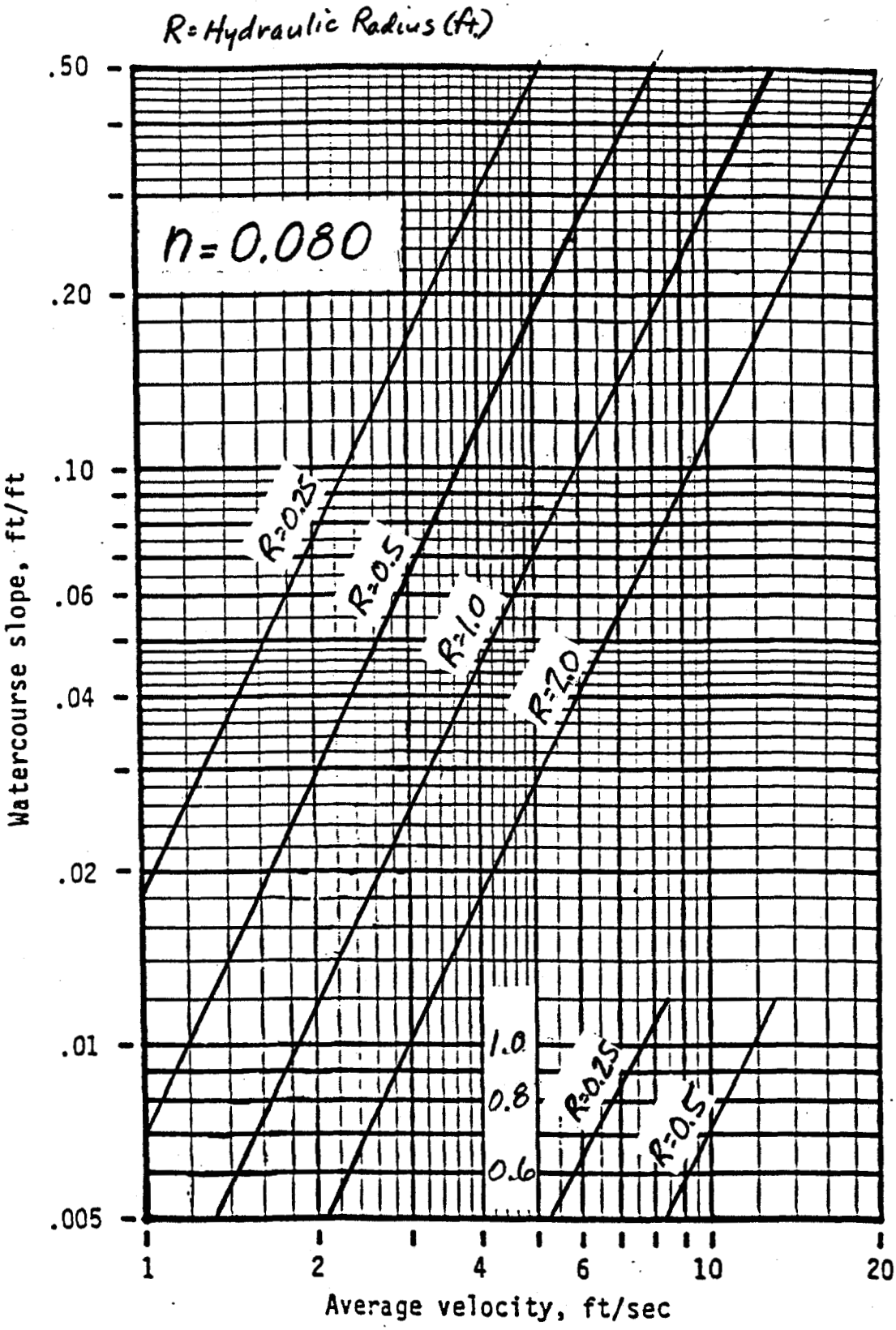


CHART 8

Average Velocities for Upland Channels & Shallow Concentrated Flow

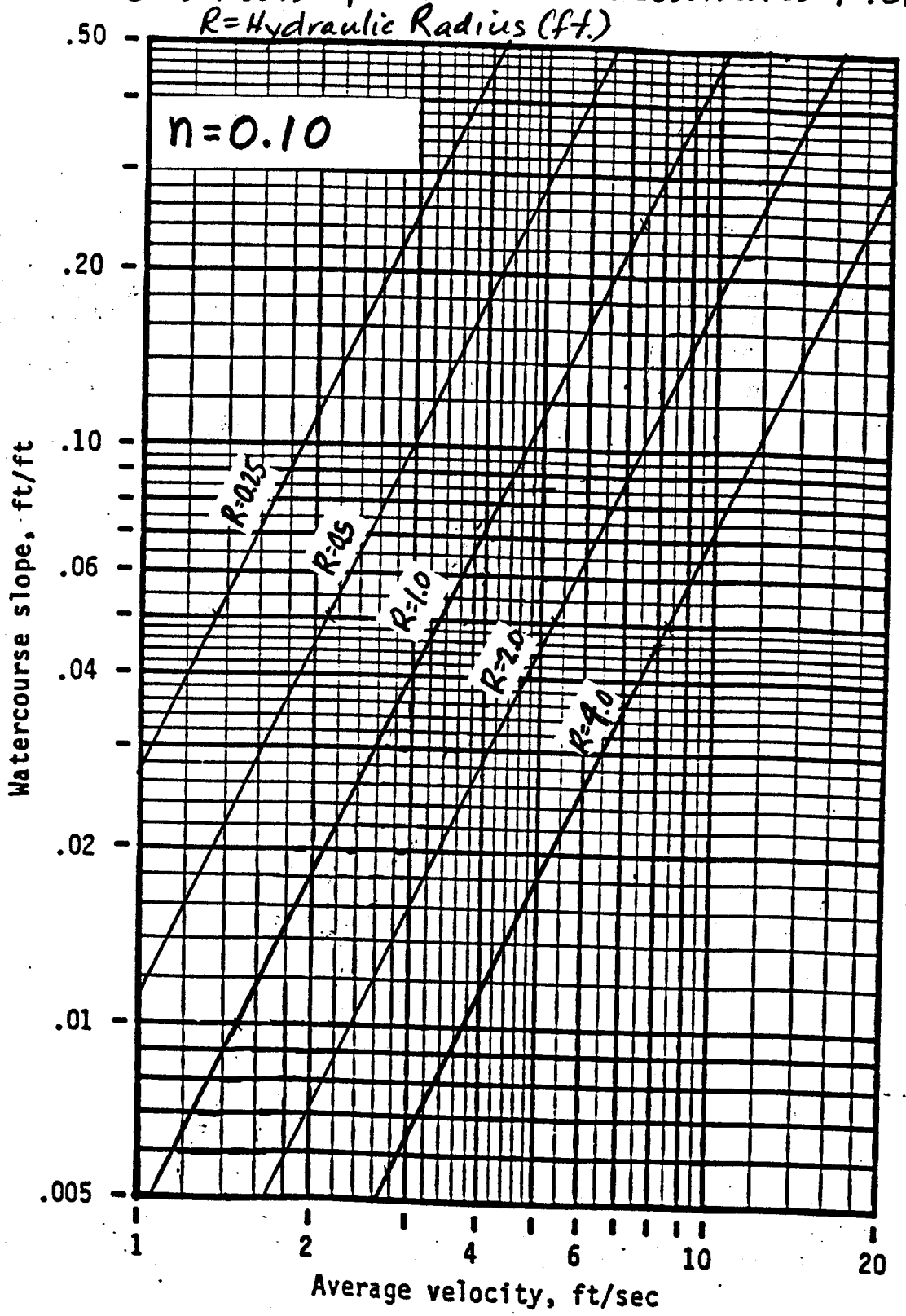


CHART 10

Manning's Normal Depth

```
x32$ vidit f
ksh: vidit:  not found
1100

N        =    0.0700
Slope    =    0.0500 ft/ft
B        =   20.0000 ft
Z        =    0.0000
Flow     =  1100.0000 cfs
Velocity =    10.7157 ft/s
Depth    =     5.1327 ft
Area     =   102.6536 sq ft
Spread   =   20.0000 ft
Do you wish to perform another analysis? [y,N]

2800

N        =    0.0600
Slope    =    0.0273 ft/ft
B        =   30.0000 ft
Z        =    0.0000
Flow     =  2800.0000 cfs
Velocity =    12.1091 ft/s
Depth    =     7.7077 ft
Area     =   231.2317 sq ft
Spread   =   30.0000 ft
you wish to perform another analysis? [y,N]
```

M-1
CH-1

M-1
CH-2

1800

N = 0.0800

Slope = 0.0476 ft/ft

B = 100.0000 ft

Z = 0.0000

M-2

Flow = 1800.0000 cfs

Velocity = 7.2164 ft/s

CH.1

Depth = 2.4943 ft

Area = 249.4317 sq ft

Spread = 100.0000 ft

Do you wish to perform another analysis? [y,N]

N = 0.0550

Slope = 0.0226 ft/ft

M-2

B = 150.0000 ft

CH-2

Z = 0.0000

Flow = 4100.0000 cfs

Velocity = 8.5637 ft/s

Depth = 3.1918 ft

Area = 478.7648 sq ft

Spread = 150.0000 ft

Do you wish to perform another analysis? [y,N]

1100

N = 0.0700

Slope = 0.0603 ft/ft

B = 70.0000 ft

Z = 0.0000

Flow = 1100.0000 cfs

Velocity = 7.9287 ft/s

Depth = 1.9820 ft

Area = 138.7373 sq ft

Spread = 70.0000 ft

M-3

CH-1

Do you wish to perform another analysis? [y,N]

N = 0.0500

Slope = 0.0255 ft/ft

B = 150.0000 ft

Z = 0.0000

Flow = 2100.0000 cfs

Velocity = 7.2419 ft/s

Depth = 1.9332 ft

Area = 289.9783 sq ft

Spread = 150.0000 ft

M-3

CH-2

Do you wish to perform another analysis? [y,N]

1200

N = 0.0800

Slope = 0.0394 ft/ft

B = 30.0000 ft

Z = 0.0000

Flow = 1200.0000 cfs

Velocity = 8.5870 ft/s

Depth = 4.6582 ft

Area = 139.7464 sq ft

Spread = 30.0000 ft

Do you wish to perform another analysis? [y,N]

M.4
CH-1

2750

N = 0.0700

Slope = 0.0229 ft/ft

B = 60.0000 ft

Z = 0.0000

Flow = 2750.0000 cfs

Velocity = 8.7191 ft/s

Depth = 5.2567 ft

Area = 315.4013 sq ft

Spread = 60.0000 ft

Do you wish to perform another analysis? [y,N]

M.4
CH-2

600

N = 0.0800

Slope = 0.0342 ft/ft

B = 20.0000 ft

Z = 0.0000

Flow = 600.0000 cfs

Velocity = 7.0987 ft/s

Depth = 4.2261 ft

Area = 84.5227 sq ft

Spread = 20.0000 ft

M-5

CH-1

Do you wish to perform another analysis? [y,N]

N = 0.0700

Slope = 0.0220 ft/ft

B = 50.0000 ft

Z = 0.0000

Flow = 1200.0000 cfs

Velocity = 6.7264 ft/s

Depth = 3.5680 ft

Area = 178.4006 sq ft

Spread = 50.0000 ft

M-5

CH-2

Do you wish to perform another analysis? [y,N]

1100

N = 0.0700

Slope = 0.0267 ft/ft

B = 140.0000 ft

Z = 0.0000

Flow = 1100.0000 cfs

Velocity = 4.7661 ft/s

Depth = 1.6486 ft

Area = 230.7980 sq ft

Spread = 140.0000 ft

M-6
CH-1

Do you wish to perform another analysis? [y,N]

N = 0.0600

Slope = 0.0150 ft/ft

B = 250.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.0444 ft/s

Depth = 4.4752 ft

Area = 1118.7946 sq ft

Spread = 250.0000 ft

M-6
CH-2

Do you wish to perform another analysis? [y,N]

400

N = 0.0700

Slope = 0.0323 ft/ft

B = 60.0000 ft

Z = 0.0000

Flow = 400.0000 cfs

Velocity = 4.6817 ft/s

Depth = 1.4240 ft

Area = 85.4393 sq ft

Spread = 60.0000 ft

M-7
CH-1

Do you wish to perform another analysis? [y,N]

1200

N = 0.0600

Slope = 0.0153 ft/ft

B = 80.0000 ft

Z = 0.0000

Flow = 1200.0000 cfs

Velocity = 5.6369 ft/s

Depth = 2.6610 ft

Area = 212.8833 sq ft

Spread = 80.0000 ft

M-7
CH-2

Do you wish to perform another analysis? [y,N]

1800

```
N        =    0.0550

Slope    =    0.0254 ft/ft

B        =  110.0000 ft

Z        =    0.0000

Flow     = 1800.0000 cfs

Velocity =    7.2276 ft/s

Depth    =    2.2641 ft

Area     =  249.0459 sq ft

Spread   =  110.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-8
CH-1

```
N        =    0.0500

Slope    =    0.0185 ft/ft

B        =  150.0000 ft

Z        =    0.0000

Flow     = 3100.0000 cfs

Velocity =    7.6566 ft/s

Depth    =    2.6992 ft

Area     =  404.8789 sq ft

Spread   =  150.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-8
CH 2

500

N = 0.0600

Slope = 0.0289 ft/ft

B = 100.0000 ft

Z = 0.0000

Flow = 500.0000 cfs

Velocity = 4.4702 ft/s

Depth = 1.1185 ft

Area = 111.8528 sq ft

Spread = 100.0000 ft

M-9
CH-1

Do you wish to perform another analysis? [y,N]

9000

N = 0.0600

Slope = 0.0148 ft/ft

B = 250.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.0116 ft/s

Depth = 4.4935 ft

Area = 1123.3775 sq ft

Spread = 250.0000 ft

M-9
CH-2

Do you wish to perform another analysis? [y,N]

700

G-28

N = 0.0700

Slope = 0.0240 ft/ft

B = 70.0000 ft

Z = 0.0000

Flow = 700.0000 cfs

Velocity = 5.0188 ft/s

Depth = 1.9925 ft

Area = 139.4760 sq ft

Spread = 70.0000 ft

M-10

CH·1

Do you wish to perform another analysis? [y,N]

1700

N = 0.0600

Slope = 0.0228 ft/ft

B = 90.0000 ft

Z = 0.0000

Flow = 1700.0000 cfs

Velocity = 6.9843 ft/s

Depth = 2.7045 ft

Area = 243.4019 sq ft

Spread = 90.0000 ft

M·10

CH·2

Do you wish to perform another analysis? [y,N]

N = 0.0650

Slope = 0.0225 ft/ft

B = 100.0000 ft

Z = 0.0000

Flow = 900.0000 cfs

Velocity = 4.9760 ft/s

Depth = 1.8087 ft

Area = 180.8665 sq ft

Spread = 100.0000 ft

M-11

CH-1

Do you wish to perform another analysis? [y,N]

N = 0.0500

Slope = 0.0167 ft/ft

B = 140.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 11.4835 ft/s

Depth = 5.5981 ft

Area = 783.7355 sq ft

Spread = 140.0000 ft

M-11

CH-2

Do you wish to perform another analysis? [y,N]

700

```
N        =    0.0800

Slope    =    0.0167 ft/ft

B        =   20.0000 ft

Z        =    0.0000

Flow     =  700.0000 cfs

Velocity =    5.8054 ft/s

Depth    =    6.0289 ft

Area     =  120.5774 sq ft

Spread   =   20.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-12
CH-1

```
N        =    0.0800

Slope    =    0.0314 ft/ft

B        =  100.0000 ft

Z        =    0.0000

Flow     = 1400.0000 cfs

Velocity =    5.7632 ft/s

Depth    =    2.4292 ft

Area     =  242.9195 sq ft

Spread   =  100.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-12
CH-2

500

```
N        =    0.0650

Slope    =    0.0315 ft/ft

B        =   40.0000 ft

Z        =    0.0000

Flow     =  500.0000 cfs

Velocity =    6.1213 ft/s

Depth    =    2.0421 ft

Area     =   81.6823 sq ft

Spread   =   40.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-13
CH-1

```
N        =    0.1000

Slope    =    0.0130 ft/ft

B        =  150.0000 ft

Z        =    0.0000

Flow     = 9000.0000 cfs

Velocity =    6.7485 ft/s

Depth    =    8.8909 ft

Area     = 1333.6295 sq ft

Spread   =  150.0000 ft
Do you wish to perform another analysis? [y,N]
```

M-13
CH-2

Time of concentration (T_c) or travel time (T_t)

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10-26-89

T_c for Subarea RO-1

T_t for Routing Reach ~~R-1~~

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID		
1. Surface description (table 3-1, TR-55)			
2. Manning's roughness coeff., n (table 3-1, TR-55)			
3. Flow length, L (total L ≤ 300 ft) ft			
4. Two-yr 24-hr rainfall, P2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	=	

Shallow concentrated flow	Segment ID		
7. Manning's roughness coeff., n			
8. Hydraulic radius r (appx - avg. depth) Est.			
9. Flow Length, L ft			
10. Watercourse slope, s ft/ft			
11. Average velocity, V (Figure _____) ft/s			
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	=	

Channel flow	Segment ID		
	CH-A	CH-B	
13. Approximate flow rate, Q ft³/sec	2600	4100	
14. Top width, T ft	70	150	
15. Hydraulic radius, r = d = A/T Estimate ft	3.3	3.2	
16. Channel slope, s ft/ft	0.0394	0.0220	
17. Manning's roughness coeff., n	0.055	0.055	
18. Average velocity, V (Figure _____) ft/s	11.2	8.6	
19 Flow length, L ft	3300	6200	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	2587	4128	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.08 +	0.20 =	0.28
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr			0.28

Velocities by Manning Equation, Rectangular Channel

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

B = T, line 14 y = d line 15 All Sheets

Time of concentration (T_c) or travel time (T_t)

G-33

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked ____ Date ____

T_c for Subarea RO-2

T_t for Routing Reach ~~R-2~~

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID		
1. Surface description (table 3-1, TR-55)			
2. Manning's roughness coeff., n (table 3-1, TR-55)			
3. Flow length, L (total L ≤ 300 ft) ft			
4. Two-yr 24-hr rainfall, P2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+	=

Shallow concentrated flow	Segment ID		
7. Manning's roughness coeff., n			
8. Hydraulic radius r (appx - avg. depth) Est.			
9. Flow Length, L ft			
10. Watercourse slope, s ft/ft			
11. Average velocity, V (Figure ____) ft/s			
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+	=

Channel flow	Segment ID		
	CH-C	CH-D	
13. Approximate flow rate, Q ft^3/sec	5800	6800	
14. Top width, T ft	180	220	
15. Hydraulic radius, r = d = A/T Estimate ft	3.8	3.4	
16. Channel slope, s ft/ft	0.0147	0.0195	
17. Manning's roughness coeff., n	0.050	0.050	
18. Average velocity, V (Figure ____) ft/s	8.5	9.20	
19 Flow length, L ft	3400	4600	
20. Check r estimate: Q = V x T x r = ____ compare to line 13	5814	6882	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.11 +	0.14 =	0.25
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr			0.25

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

Time of concentration (T_c) or travel time (T_t)

G-34

Project **FCD-Floodplain Delineation** By DRD Date 20 Oct 89

Location **Morgan City Wash** Checked ____ Date _____

T_c for Subarea RO-3

T_t for Routing Reach ~~R-3~~

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID		
1. Surface description (table 3-1, TR-55)			
2. Manning's roughness coeff., n (table 3-1, TR-55)			
3. Flow length, L (total L ≤ 300 ft) ft			
4. Two-yr 24-hr rainfall, P2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+	=

Shallow concentrated flow	Segment ID		
7. Manning's roughness coeff., n			
8. Hydraulic radius r (appx - avg. depth) Est.			
9. Flow Length, L ft			
10. Watercourse slope, s ft/ft			
11. Average velocity, V (Figure _____) ft/s			
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr		+	=

Channel flow	Segment ID		
	CH-E	CH-F	
13. Approximate flow rate, Q ft^3/sec	8000	9000	
14. Top width, T ft	200	220	
15. Hydraulic radius, r = d = A/T Estimate ft	4.4	4.6	
16. Channel slope, s ft/ft	0.0189	0.0175	
17. Manning's roughness coeff., n	0.060	0.060	
18. Average velocity, V (Figure ____) ft/s	19.0	8.8	
19 Flow length, L ft	7400	8000	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	7920	8900	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.23	+ 0.25	= 0.48
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr			0.48

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

Time of concentration (T_c) or travel time (T_t)

G-35

Project **FCD-Floodplain Delineation** By DRD Date 23 Oct 89

Location **Morgan City Wash** Checked PMG Date 10-27-89

T_c for Subarea RO-4

T_t for Routing Reach R-4

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID		
1. Surface description (table 3-1, TR-55)			
2. Manning's roughness coeff., n (table 3-1, TR-55)			
3. Flow length, L (total L ≤ 300 ft) ft			
4. Two-yr 24-hr rainfall, P2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	=	

Shallow concentrated flow	Segment ID		
7. Manning's roughness coeff., n			
8. Hydraulic radius r (appx - avg. depth) Est.			
9. Flow Length, L ft			
10. Watercourse slope, s ft/ft			
11. Average velocity, V (Figure _____) ft/s			
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	=	

Channel flow	Segment ID		
	CH-G	CH-H	
13. Approximate flow rate, Q ft^3/sec	9000	9000	
14. Top width, T ft	200	230	
15. Hydraulic radius, r = d = A/T Estimate ft	4.9	4.4	
16. Channel slope, s ft/ft	0.0182	0.0129	
17. Manning's roughness coeff., n	0.060	0.050	
18. Average velocity, V (Figure ____) ft/s	9.3	8.9	
19 Flow length, L ft	1100	3100	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	9114	9007	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.03 +	0.10 =	0.13
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr			SEE SH# 13

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

Time of concentration (T_c) or travel time (T_t)

G-36

Project **FCD-Floodplain Delineation** By DRP Date 23 Oct 89

Location **Morgan City Wash** Checked RCG Date 10-27-89

T_c for Subarea RO-4

T_t for Routing Reach ~~R-4~~ CON'T

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	
1. Surface description (table 3-1, TR-55)		
2. Manning's roughness coeff., n (table 3-1, TR-55)		
3. Flow length, L (total L ≤ 300 ft) ft		
4. Two-yr 24-hr rainfall, P2 in		
5. Land slope, s ft/ft		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	=

Shallow concentrated flow	Segment ID	
7. Manning's roughness coeff., n		
8. Hydraulic radius r (appx - avg. depth) Est.		
9. Flow Length, L ft		
10. Watercourse slope, s ft/ft		
11. Average velocity, V (Figure _____) ft/s		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	=

Channel flow	Segment ID	
	CH-1	
13. Approximate flow rate, Q ft^3/sec	9000	
14. Top width, T ft	250	
15. Hydraulic radius, r = d = A/T Estimate ft	4.5	
16. Channel slope, s ft/ft	0.0148	
17. Manning's roughness coeff., n	0.060	
18. Average velocity, V (Figure _____) ft/s	8.0	
19 Flow length, L ft	10,500	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	9000	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.36 + 0.13	= 0.49
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr		0.49

From Sh # 12

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

Time of concentration (T_c) or travel time (T_t)

G-37

Project **FCD-Floodplain Delineation** By DRD Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10-27-89

T_c for Subarea R1-5

T_t for Routing Reach R-5

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	
1. Surface description (table 3-1, TR-55)		
2. Manning's roughness coeff., n (table 3-1, TR-55)		
3. Flow length, L (total L ≤ 300 ft) ft		
4. Two-yr 24-hr rainfall, P2 in		
5. Land slope, s ft/ft		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	=

Shallow concentrated flow	Segment ID	
7. Manning's roughness coeff., n		
8. Hydraulic radius r (appx - avg. depth) Est.		
9. Flow Length, L ft		
10. Watercourse slope, s ft/ft		
11. Average velocity, V (Figure _____) ft/s		
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	=

Channel flow	Segment ID	
	CH-J+K	
13. Approximate flow rate, Q ft^3/sec	9000	
14. Top width, T ft	140	
15. Hydraulic radius, r = d = A/T Estimate ft	5.5	
16. Channel slope, s ft/ft	0.0177	
17. Manning's roughness coeff., n	0.050	
18. Average velocity, V (Figure _____) ft/s	11.7	
19 Flow length, L ft	4800	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	9009	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+ 0.11	= 0.11
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr		0.11

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

Time of concentration (T_c) or travel time (T_t)

G-38

Project **FCD-Floodplain Delineation** By DRO Date 23 Oct 89

Location **Morgan City Wash** Checked [illegible] Date 10/27/89

T_c for Subarea RO-4

T_t for Routing Reach R-6

Assumed Watershed Conditions

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID		
1. Surface description (table 3-1, TR-55)			
2. Manning's roughness coeff., n (table 3-1, TR-55)			
3. Flow length, L (total L ≤ 300 ft) ft			
4. Two-yr 24-hr rainfall, P2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr	+	=	

Shallow concentrated flow	Segment ID		
7. Manning's roughness coeff., n			
8. Hydraulic radius r (appx - avg. depth) Est.			
9. Flow Length, L ft			
10. Watercourse slope, s ft/ft			
11. Average velocity, V (Figure _____) ft/s			
12. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	+	=	

Channel flow	Segment ID		
	CH-L	CH-M	
13. Approximate flow rate, Q ft^3/sec	9000	9000	
14. Top width, T ft	120	150	
15. Hydraulic radius, r = d = A/T Estimate ft	7.4	8.9	
16. Channel slope, s ft/ft	0.0094	0.0130	
17. Manning's roughness coeff., n	0.050	0.10	
18. Average velocity, V (Figure ____) ft/s	10.1	6.7	
19 Flow length, L ft	6900	8100	
20. Check r estimate: Q = V x T x r = _____ compare to line 13	8968	8945	
21. $T_t = \frac{L}{3600\,V}$ Compute T_t hr	0.19 +	0.34 =	0.53
22. Watershed or subarea T_c or T_t (add T_t in steps 6, 12 and 21) hr			0.53

(Adapted from Worksheet 3, SCS TR-55, Urban Hydrology for Small Watersheds)

2600

N = 0.0550

Slope = 0.0394 ft/ft

B = 70.0000 ft

Z = 0.0000

Flow = 2600.0000 cfs

Velocity = 11.2173 ft/s

Depth = 3.3112 ft

Area = 231.7850 sq ft

Spread = 70.0000 ft

R-1

CH-A

Do you wish to perform another analysis? [y,N]

N = 0.0550

Slope = 0.0226 ft/ft

B = 150.0000 ft

Z = 0.0000

Flow = 4100.0000 cfs

Velocity = 8.5637 ft/s

Depth = 3.1918 ft

Area = 478.7648 sq ft

Spread = 150.0000 ft

R-1

CH-B

Do you wish to perform another analysis? [y,N]

5800

N = 0.0500

Slope = 0.0147 ft/ft

B = 180.0000 ft

Z = 0.0000

Flow = 5800.0000 cfs

Velocity = 8.5136 ft/s

Depth = 3.7848 ft

Area = 681.2593 sq ft

Spread = 180.0000 ft

R-2

CH-C

Do you wish to perform another analysis? [y,N]

6800

N = 0.0500

Slope = 0.0195 ft/ft

B = 220.0000 ft

Z = 0.0000

Flow = 6800.0000 cfs

Velocity = 9.1541 ft/s

Depth = 3.3765 ft

Area = 742.8338 sq ft

Spread = 220.0000 ft

R-2

CH. D

Do you wish to perform another analysis? [y,N]

G-41

N = 0.0600

Slope = 0.0175 ft/ft

B = 220.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.8456 ft/s

Depth = 4.6248 ft

Area = 1017.4570 sq ft

Spread = 220.0000 ft

Do you wish to perform another analysis? [y,N]

R-3
CH-E

N = 0.0600

Slope = 0.0175 ft/ft

B = 220.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.8456 ft/s

Depth = 4.6248 ft

Area = 1017.4570 sq ft

Spread = 220.0000 ft

Do you wish to perform another analysis? [y,N]

R-3
CH-F

1100

N = .0700

Slope = 0.0267 ft/ft

9000

N = 0.0600

Slope = 0.0182 ft/ft

B = 200.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 9.2746 ft/s

Depth = 4.8520 ft

Area = 970.3970 sq ft

Spread = 200.0000 ft

R-4
CH. G

you wish to perform another analysis? [y,N]

00

N = 0.0500

Slope = 0.0129 ft/ft

B = 230.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.8594 ft/s

Depth = 4.4168 ft

Area = 1015.8652 sq ft

Spread = 230.0000 ft

R-4
CH-H

Do you wish to perform another analysis? [y,N]

9000

N = 0.0600

Slope = 0.0148 ft/ft

B = 250.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 8.0116 ft/s

Depth = 4.4935 ft

Area = 1123.3775 sq ft

Spread = 250.0000 ft

R-4
CH-I

Do you wish to perform another analysis? [y,N]

9000

N = 0.0500

Slope = 0.0177 ft/ft

B = 140.0000 ft

Z = 0.0000

Flow = 9000.0000 cfs

Velocity = 11.6996 ft/s

Depth = 5.4947 ft

Area = 769.2592 sq ft

Spread = 140.0000 ft

Do you wish to perform another analysis? [y,N]

R-5
CH.-J+K

9000

```
N        =    0.0500

Slope    =    0.0094 ft/ft

B        =  120.0000 ft

Z        =    0.0000

Flow     =  9000.0000 cfs

Velocity =   10.1294 ft/s

Depth    =    7.4042 ft

Area     =  888.5040 sq ft

Spread   =  120.0000 ft
Do you wish to perform another analysis? [y,N]
```

R-6
CH-L

```
N        =    0.1000

Slope    =    0.0130 ft/ft

B        =  150.0000 ft

Z        =    0.0000

Flow     =  9000.0000 cfs

Velocity =    6.7485 ft/s

Depth    =    8.8909 ft

Area     =  1333.6295 sq ft

Spread   =  150.0000 ft
Do you wish to perform another analysis? [y,N]
```

R-6
CH-M

Chapter 3: Time of concentration and travel time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600\ V} \qquad \text{[Eq. 3-1]}$$

where

T_t = travel time (hr),
L = flow length (ft),
V = average velocity (ft/s), and
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[Eq. 3-2]}$$

where

T_c = time of concentration (hr) and
m = number of flow segments.

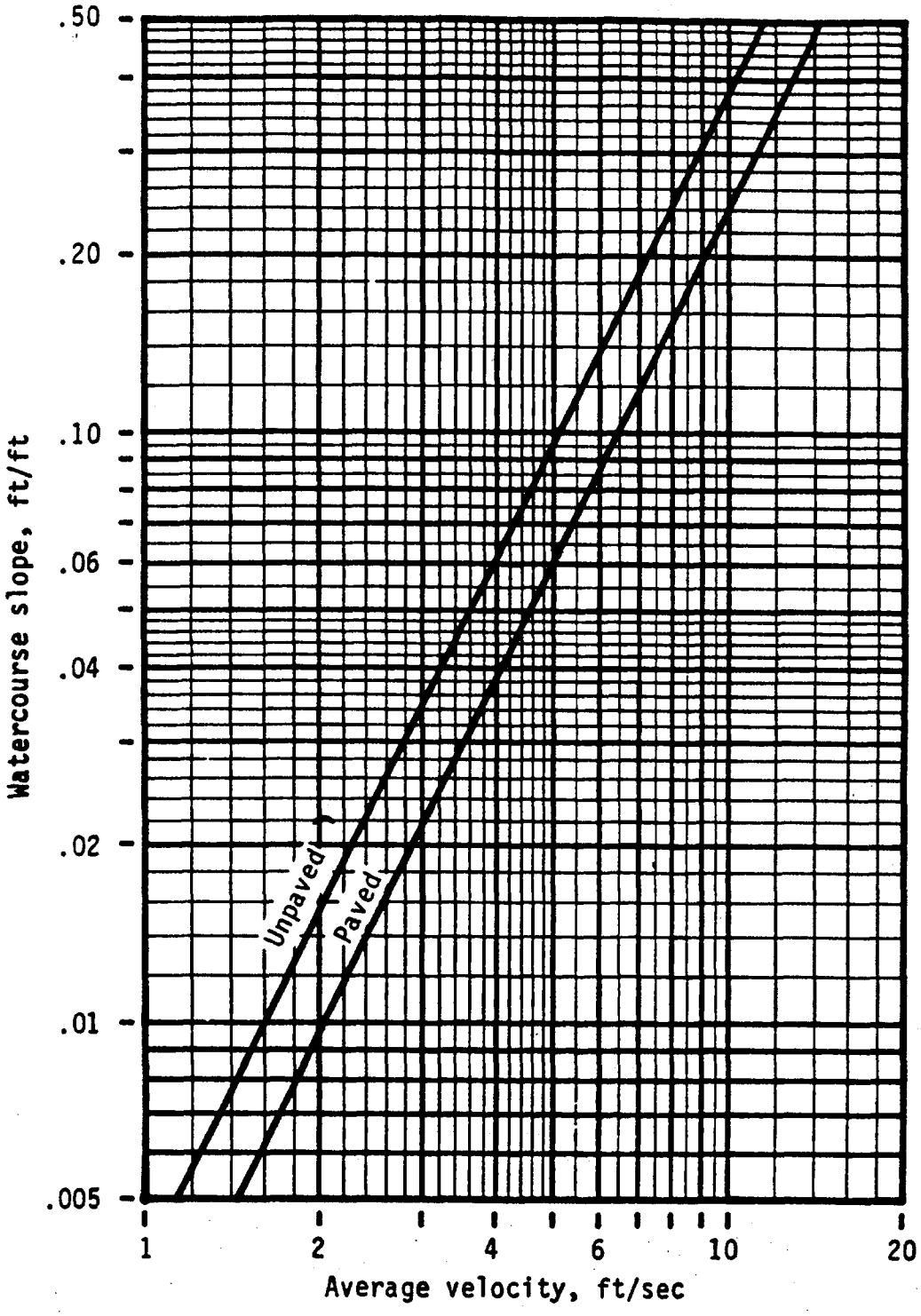


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
P_2 = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Manning's equation is

$$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n} \qquad \text{[Eq. 3-4]}$$

where

- V = average velocity (ft/s),
- r = hydraulic radius (ft) and is equal to a/p_w,
- a = cross sectional flow area (ft^2),
- p_w = wetted perimeter (ft),
- s = slope of the hydraulic grade line (channel slope, ft/ft), and
- n = Manning's roughness coefficient for open channel flow.

Manning's n values for open channel flow can be obtained from standard textbooks such as Chow (1959) or Linsley et al. (1982). After average velocity is computed using equation 3-4, T_t for the channel segment can be estimated using equation 3-1.

Reservoirs or lakes

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.

Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.

- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate T_c. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.

- The minimum T_c used in TR-55 is 0.1 hour.

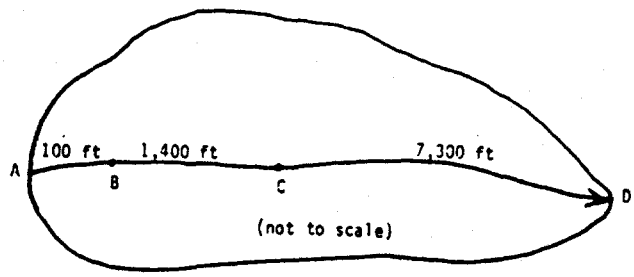
- A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

Example 3-1

The sketch below shows a watershed in Dyer County, northwestern Tennessee. The problem is to compute T_c at the outlet of the watershed (point D). The 2-year 24-hour rainfall depth is 3.6 inches. All three types of flow occur from the hydraulically most distant point (A) to the point of interest (D). To compute T_c, first determine T_t for each segment from the following information:

Segment AB:	Sheet flow; dense grass; slope (s) = 0.01 ft/ft; and length (L) = 100 ft.
Segment BC:	Shallow concentrated flow; unpaved; s = 0.01 ft/ft; and L = 1400 ft.
Segment CD:	Channel flow; Manning's n = .05; flow area (a) = 27 ft^2; wetted perimeter (p_w) = 28.2 ft; s = 0.005 ft/ft; and L = 7300 ft.

See figure 3-2 for the computations made on worksheet 3.



Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Heavenly Acres By DW Date 10/6/85

Location Dyer County, Tennessee Checked XY Date 10/8/85

Circle one: Present (Developed)

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)					
Segment ID		AB			
1. Surface description (table 3-1)		DENSE GRASS			
2. Manning's roughness coeff., n (table 3-1) ..		0.24			
3. Flow length, L (total L ≤ 300 ft)	ft	100			
4. Two-yr 24-hr rainfall, P_2	in	3.6			
5. Land slope, s	ft/ft	0.01			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.30	+		= 0.30

Shallow concentrated flow					
Segment ID		BC			
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	1400			
9. Watercourse slope, s	ft/ft	0.01			
10. Average velocity, V (figure 3-1)	ft/s	1.6			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.24	+		= 0.24

Channel flow					
Segment ID		CD			
12. Cross sectional flow area, a	ft^2	27			
13. Wetted perimeter, p_w	ft	28.2			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft	0.957			
15. Channel slope, s	ft/ft	0.005			
16. Manning's roughness coeff., n		0.05			
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	2.05			
18. Flow length, L	ft	7300			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.99	+		= 0.99
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.53

Figure 3-2.—Worksheet 3 for example 3-1.

APPENDIX H

CALCULATIONS:

MUSKINGUM ROUTING

PARAMETERS

Baker Engineers

S.O. No. 16923-HPH

Subject: FCDMC Floodplain Delineation.
Morgan City Wash
Muskingum Routing Parameters

Sheet No. ____ of ____
Drawing No. ____

Computed by BRG 11/2/89 Checked By TJR Date 11/5/89

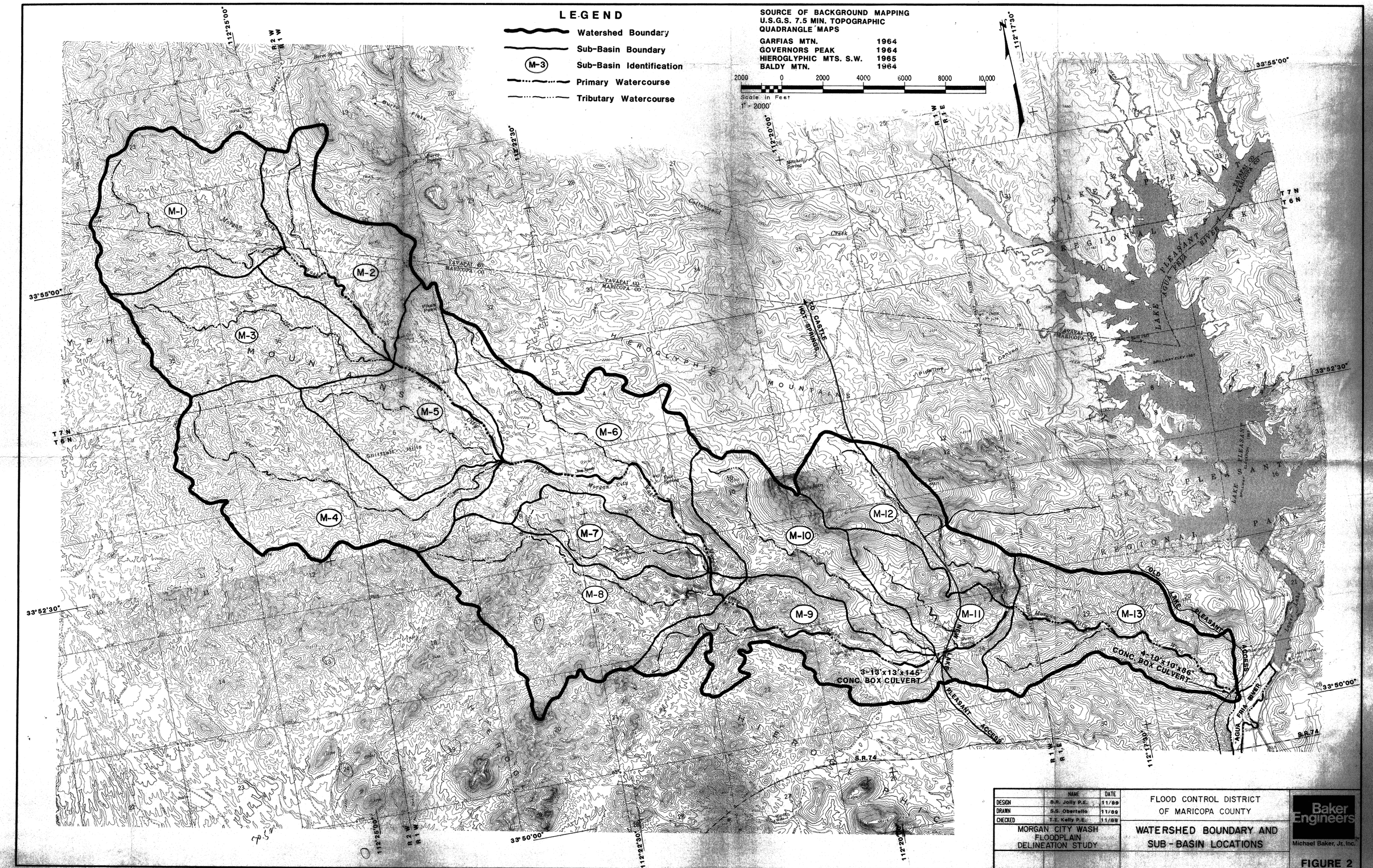
AMSKK = K = reach travel time (hrs.)
NMIN = Δt = computation interval (min.)
X = Muskingum weighting factor
NSTPS = n = number of sub-reach calculations (integer)

$\Delta t = 6$ minutes (selected interval)

$X = 0.3$ (estimated)

K from travel time computation sheets

Reach ID.	K (hrs)	$\frac{1}{2(1-x)} \leq \frac{K*60}{n*\Delta t} \leq \frac{1}{2X}$ $0.714 \leq \left(\frac{VALUE}{n}\right) \leq 1.667$	Range of Acceptable n values (integer)	Selected Value n	ROUTING INPUT ID	NSTPS	AMSKK	X
R-1	0.28	$\frac{2.80}{n}$	$2 \leq n \leq 3$	3	RM	3	0.28	0.3
R-2	0.25	$\frac{2.50}{n}$	$2 \leq n \leq 3$	3	RM	3	0.25	0.3
R-3	0.48	$\frac{4.80}{n}$	$3 \leq n \leq 6$	5	RM	5	0.48	0.3
R-4	0.49	$\frac{4.90}{n}$	$3 \leq n \leq 6$	5	RM	5	0.49	0.3
R-5	0.11	$\frac{1.10}{n}$	$1 \leq n \leq 1$	1	RM	1	0.11	0.3
R-6	0.53	$\frac{5.30}{n}$	$4 \leq n \leq 7$	6	RM	6	0.53	0.6



	NAME	DATE
DESIGN	S.R. Jolly P.E.	11/89
DRAWN	S.S. Obertello	11/89
CHECKED	T.E. Kelly P.E.	11/89

MORGAN CITY WASH
FLOODPLAIN
DELINEATION STUDY

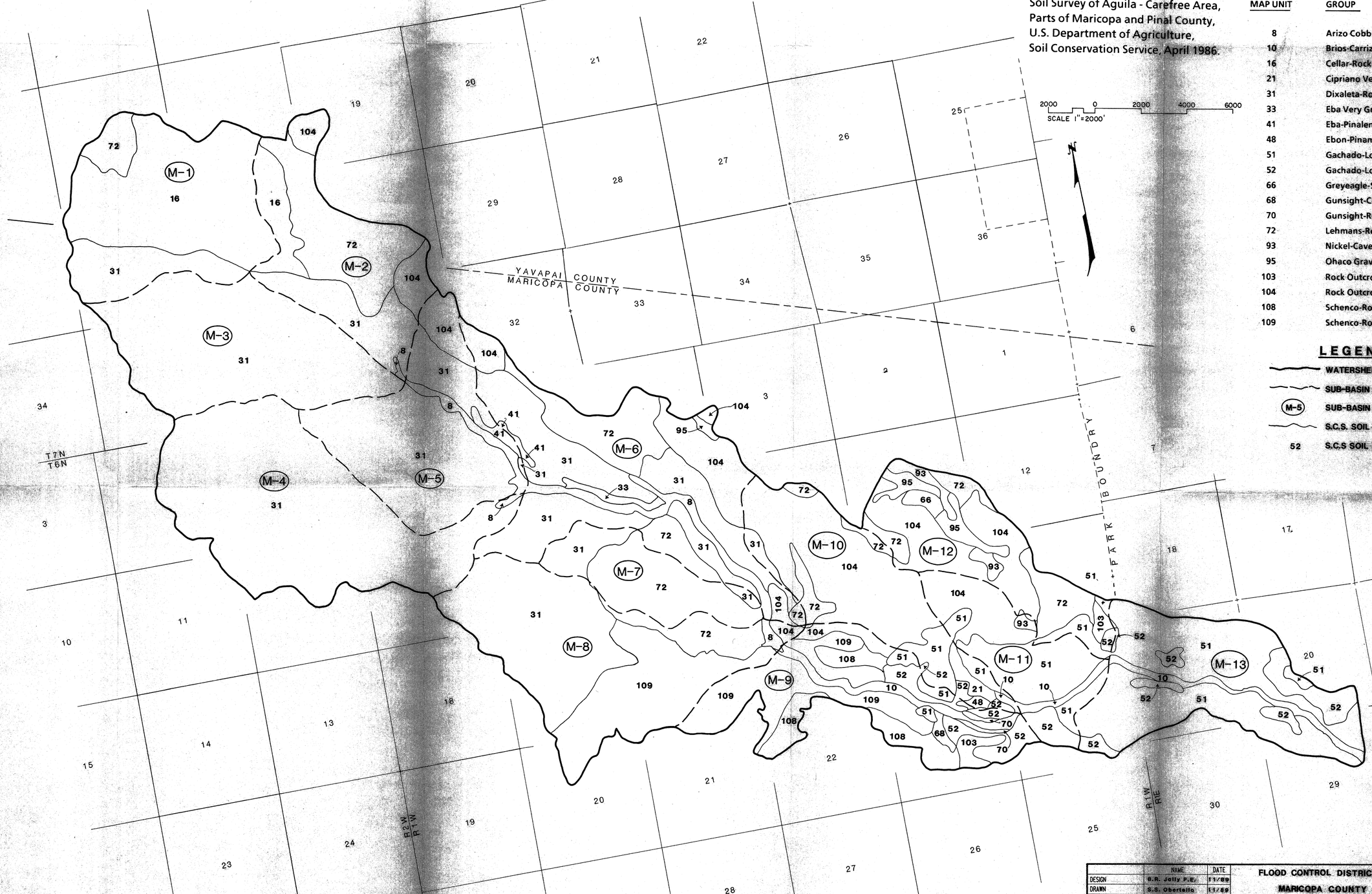
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

WATERSHED BOUNDARY AND
SUB - BASIN LOCATIONS

Baker Engineers
Michael Baker, Jr., Inc.

FIGURE 2

BASIS OF SOIL CLASSIFICATION:
Soil Survey of Aguila - Carefree Area, Parts of Maricopa and Pinal County, U.S. Department of Agriculture, Soil Conservation Service, April 1986.



SCS SOIL MAP UNIT	SCS SOIL GROUP
8	Arizo Cobbly Sandy Loam
10	Brios-Carrizo Complex
16	Cellar-Rock Outcrop
21	Cipriano Very Gravelly Loam
31	Dixaleta-Rock Outcrop Complex
33	Eba Very Gravelly Loam
41	Eba-Pinaleno Complex
48	Ebon-Pinamt Complex
51	Gachado-Lomitas Complex
52	Gachado-Lomitas-Rock Outcrop Complex
66	Greyeagle-Suncity Variant Complex
68	Gunsight-Cipriano Complex
70	Gunsight-Rillito Complex
72	Lehmans-Rock Outcrop Complex
93	Nickel-Cave Complex
95	Ohaco Gravelly Loam
103	Rock Outcrop-Gachado Complex
104	Rock Outcrop-Lehmans Complex
108	Schenco-Rock Outcrop Complex
109	Schenco-Rock Outcrop Complex

LEGEND

- WATERSHED BOUNDARY
- SUB-BASIN BOUNDARY
- (M-5) SUB-BASIN IDENTIFICATION
- S.C.S. SOIL GROUP BOUNDARY
- 52 S.C.S SOIL MAP UNIT

NO	DESCRIPTION OF REVISIONS	MADE BY	DATE
1			
2			
3			
4			

	NAME	DATE
DESIGN	B.R. Jolly P.E.	11/89
DRAWN	S.S. Obertello	11/89
CHECKED	T.E. Kelly P.E.	11/89

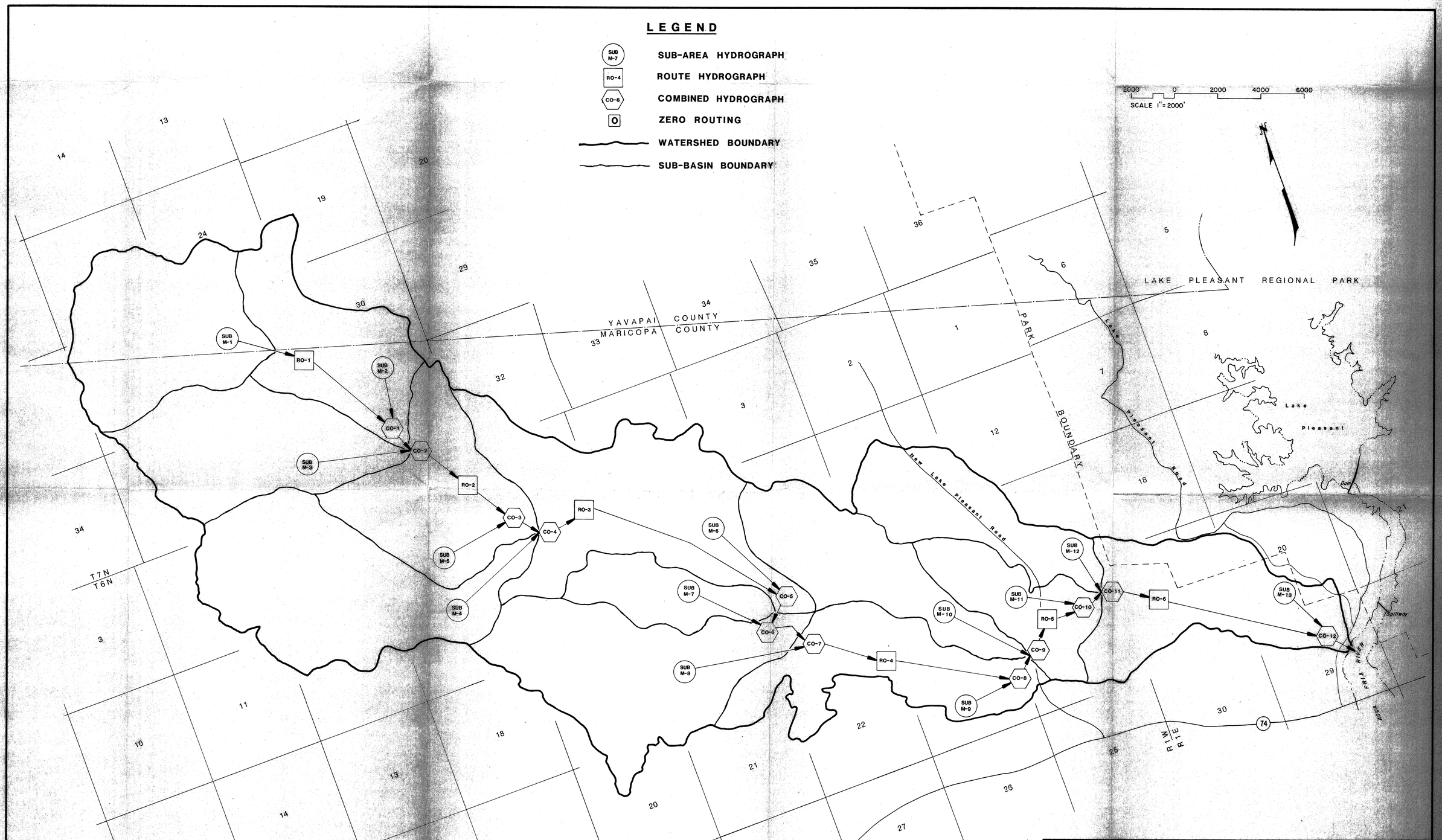
MORGAN CITY WASH FLOODPLAIN DELINEATION STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WATERSHED SOILS MAP

Baker Engineers
Michael Baker, Jr., Inc.

FIGURE-4



NO.	DESCRIPTION OF REVISIONS	MADE BY	DATE
1			
2			
3			
4			

	NAME	DATE
DESIGN	B.R. Jolly P.E.	11/89
DRAWN	S.S. Obertello	11/89
CHECKED	T.E. Kelly P.E.	11/89

MORGAN CITY WASH FLOODPLAIN DELINEATION STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HEC-1 MODEL SCHEMATIC

Baker Engineers

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FIGURE-5