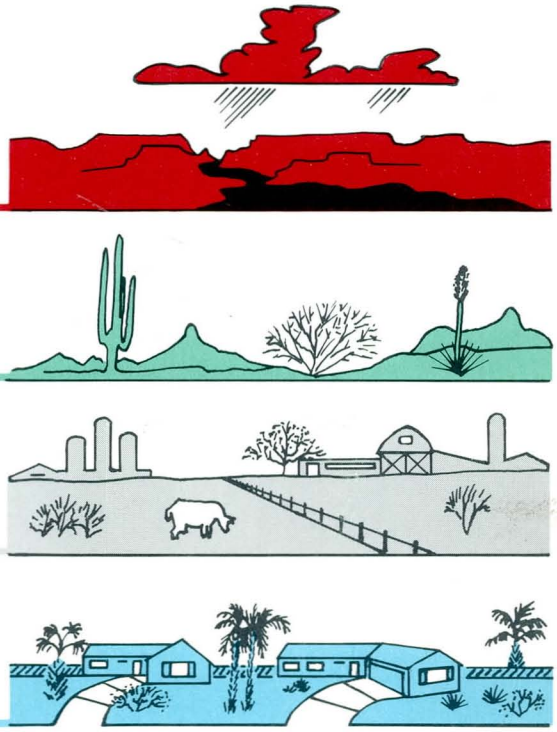
FCD



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HYDROLOGIC ANALYSIS

FOR

ESTRELLA ALLUVIAL FAN

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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HYDROLOGIC ANALYSIS

FOR

ESTRELLA ALLUVIAL FAN

HYDROLOGIC ANALYSIS FOR ESTRELLA ALLUVIAL FAN APRIL, 1991

METHODOLOGY: Methodologies used are from the Hydrologic Design Manual for Maricopa County (HDM), September, 1990, and the HEC-1 flood hydrograph package, Version 4.0, September, 1990.

RAINFALL: Three design storms and one historic storm were used in the analysis. These included the SCS Type II 24-hour storm, the 6-hour Queen Creek storm from the HDM, the 2-hour FCD retention design storm, and the recorded August 15, 1990 storm at the telemetered South Mountain raingauge, which is considered applicable to the Estrella Mountains. The 24-hour storm precipitation depths were not aerially reduced, the 6-hour depths were reduced using the Queen Creek curve from the HDM, and the 2-hour depths were reduced using the 2-hour Osborn curves from experimental watershed data at Walnut Gulch near Tombstone, Arizona.

LOSSES: Green and Ampt loss parameters were estimated from soil texture data compiled from the SCS Soil Survey of Americana County, Arizona - Central Part. Connected imperviousness (RTIMP) was estimated as 75% of the given rock outcrop percentages. Vegetation adjustment values for XKSAT were estimated from Figure 4.3 in the HDM.

HYDROGRAPHS: The Clark Unit Hydrograph Method was used for rainfall excess routing within the subbasins. Times of concentration and storage coefficients (R) were estimated using the 2/21/91 version of MCUHP1 for the design storms and Appendix E worksheet in the HDM for the recorded storm. Tc's were calculated for actual measured (non-adjusted) slopes, and for slopes adjusted using Figure 5.4 in the HDM.

ROUTING: Muskingum-Cunge routing was used with an approximate 8-point cross section. Lengths and slopes were estimated from USGS topographic maps, and "n" values are from Chow. Transmission losses were estimated at 2 inches per hour. Routing losses, due to both storage and percolation, were minimal because of very short travel times through the reach.

RESULTS: Design discharges at the apex ranged from 182 cfs for the 2-hour, 2-year run with adjusted slopes to 3,289 cfs for the 2-hour, 100-year run with actual measured slopes. The recorded storm (3 hours) produced a discharges of 456 and 573 cfs for adjusted and actual slopes respectively, which corresponds approximately to the 5 year runoff return period. From the plots of the 100-year design discharges shown on Figure 1, one might conclude that the 2-hour discharge with actual slopes is a bit high. The other discharges seem to be within reason, and no conclusions about the applicability of the slope adjustment can be made, with the possible exception of the 6-hour, actual slope discharge.

ESTRELLA ALLUVIAL FAN
SUBBASIN MAP
T25, R1W-sec 12
N
DRAINAGE DIVIDE
WATERCOURSE
2 CONCENTRATION POINT
#2 ROUTING SECTION LOCATION
A AVERAGE ROUTING SECTION
SUB 1
SUB 2
SUB 3
#1
#2
A
2
1
6
7
11
12
30
31
BM 1325
BM 1306
GILA AND SALT RIVER MERIDIAN
FAULK BOUN
VABM Spur 2968
1515
1789
1440
2582
3655
1825
1339
1386
1320
1360
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3600
1990
2355
2907
2812
3567
3482
3650
2964

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL RAINFALL COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____

DEPTHS

RETURN PERIOD (YEARS)	24-HOUR	6-HOUR	2-HOUR
2	1.77	1.30	.91
5	2.41	1.83	1.50
10	2.90	2.23	1.83
25	3.59	2.80	2.20
50	4.05	3.18	2.61
100	4.53	3.58	2.95

2-HOUR CALCS.

$$P_2^1 = .011 + .942\left[(1.3)^2/1.77\right] = .910 \text{ in}$$

$$P_{100}^1 = .494 + .755\left[(3.58)^2/4.53\right] = 2.630 \text{ in}$$

$$P_2^2 = .341\,(1.30) + .659\,(.91) = 1.04 \text{ in}$$

$$P_{100}^2 = .341\,(3.58) + .659\,(2.63) = 2.95 \text{ in}$$

AERIAL REDUCTION & DISTRIBUTIONS

24-HOUR → SCS TYPE II (NO REDUCTION)
6-HOUR → FCD QUEEN CREEK (QUEEN CREEK)
2-HOUR → FCD DETENTION STORM (WALNUT GULCH)

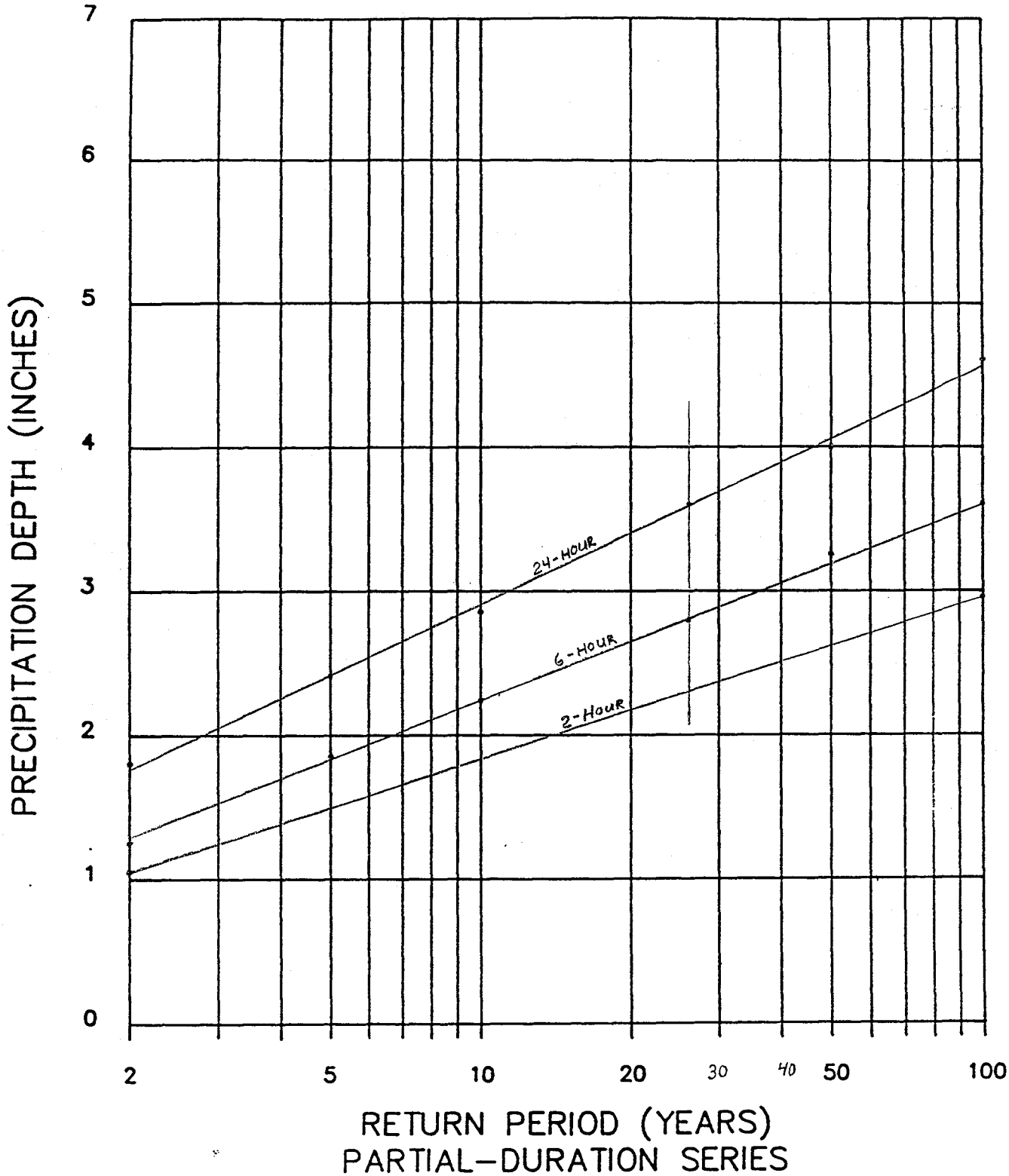


Figure 2.14
Precipitation Depth versus Return Period for Partial-Duration Series

ESTRELLA ALLUVIAL FAN
T2S - R1W - SEC 12

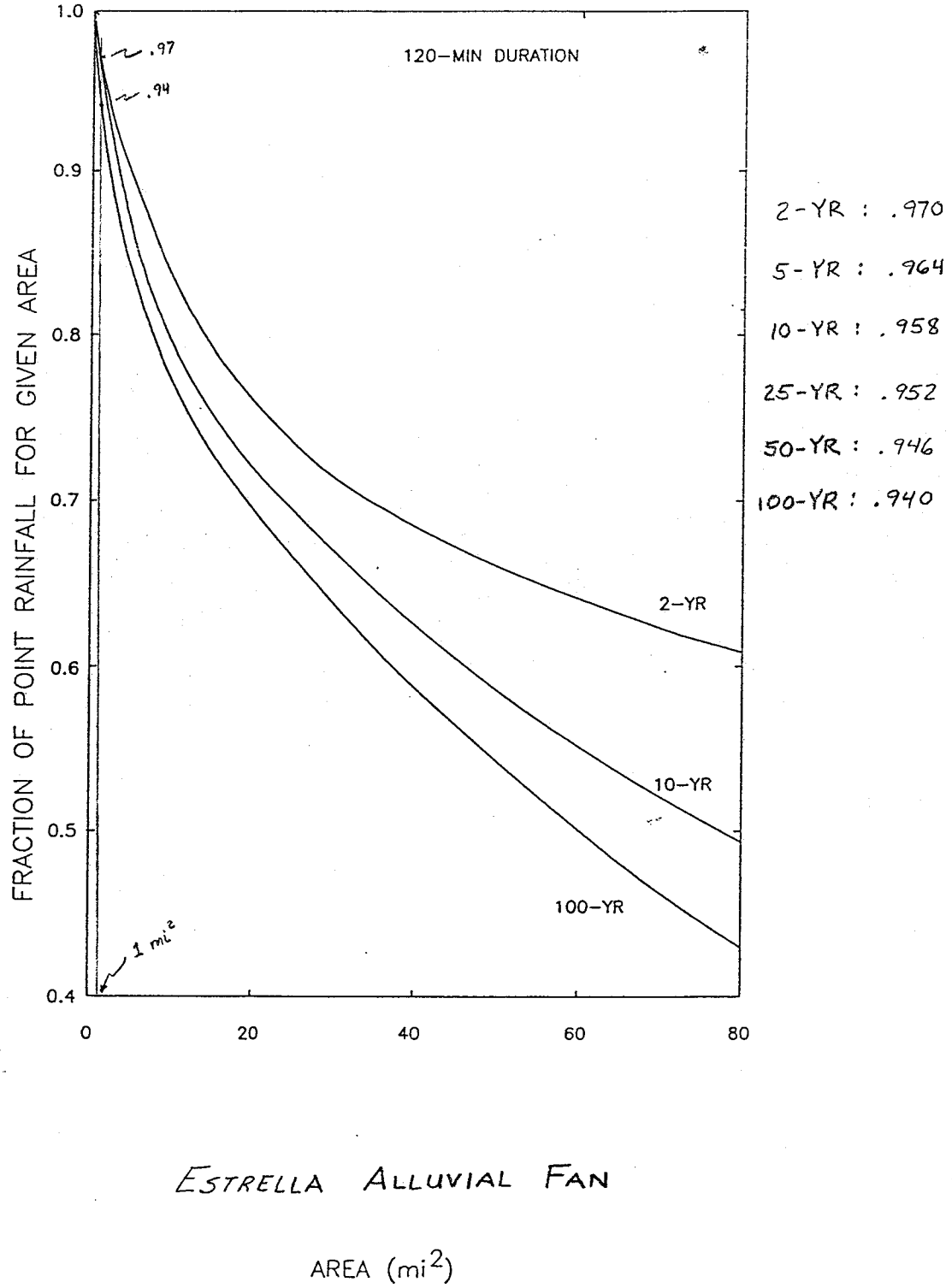
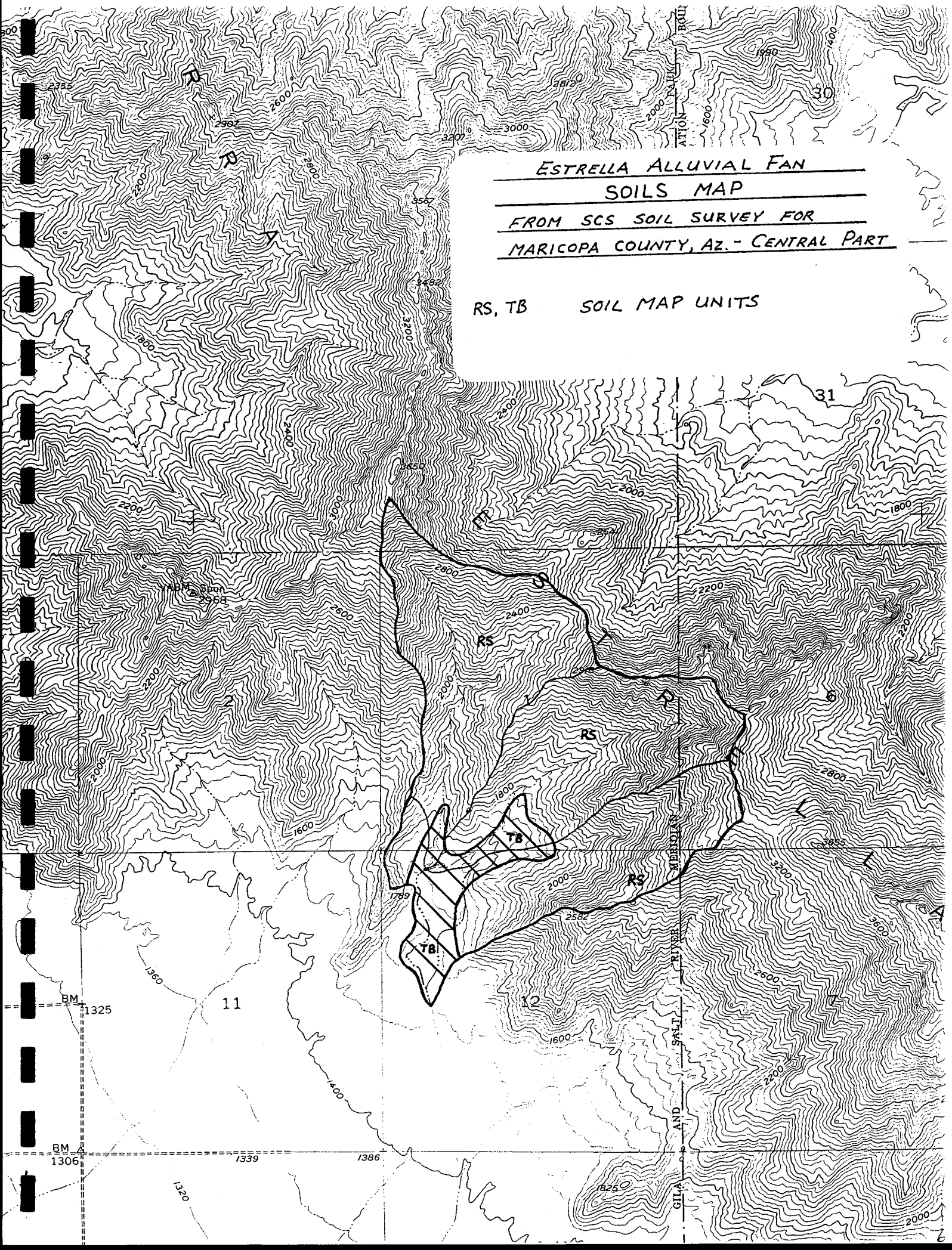


FIGURE 3. Point–to–area conversion ratios for 2–hr duration rainfalls for selected frequencies.


ESTRELLA ALLUVIAL FAN
SOILS MAP
FROM SCS SOIL SURVEY FOR
MARICOPA COUNTY, AZ. - CENTRAL PART
RS, TB SOIL MAP UNITS
RS
TB
RS
TB
RS
ESTRELLA
GILA AND SALT RIVER MERIDIAN
BM 1325
BM 1306
YABM Spon 2968
30
31
2
6
11
12
7

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL LOSS COMPUTATIONS COMPUTED ____ DATE ____

____ CHECKED BY ____ DATE ____

SOILS [MARICOPA COUNTY - CENTRAL PART]

RS 65% ROCK OUTCROP
20% CHERIONI VERY GRAVELLY LOAM (SANDY LOAM)
15% GACHADO VERY GRAVELLY SANDY CLAY LOAM (SANDY CLAY LOAM)

NORMALIZE SOIL PORTION WHEN RTIMP > 10%
CHERIONI : 20/35 = 57.1 %
GACHADO : 15/35 = 42.9 %

XKSAT : .571 (.40) + .429 (.06) = 0.25 in/hr
PSIF = 3.5 in
DTHETA = 0.35 in (DRY)
RTIMP = 50% (ASSUME 75% CONNECTED IMPERVIOUSNESS)

TB TORRIFLUVENTS

35 - 80% GRAVEL, COBBLES, AND STONES

ASSUME LOSS CHARACTERISTICS OF SANDY LOAM
XKSAT = 0.40 in/hr
PSIF = 4.3 in
DTHETA = 0.35 in (DRY)

SUBBASIN PARAMETERS :

SUB1 → RS = 96% TB = 4%
XKSAT = .96 (.25) + .04 (.40) = .26 in/hr
PSIF = .96 (3.5) + .04 (4.3) = 3.53 in
DTHETA = .35 in
RTIMP = .96 (50) = 48%

SUB2 → RS = 92% TB = 8%
XKSAT = .92 (.25) + .08 (.40) = .26 in/hr
PSIF = .92 (3.5) + .08 (4.3) = 3.56 in
DTHETA = .35 in
RTIMP = .92 (50) = 46%

SUB3 → RS = 77% TB = 23%
XKSAT = .77 (.25) + .23 (.40) = .28 in/hr
PSIF = .77 (3.5) + .23 (4.3) = 3.68 in
DTHETA = .35 in
RTIMP = .77 (50) = 38.5 %

VEGETATION ADJUSTMENT

ASSUME:
RS SOILS - MOUNTAIN
TB SOILS - HILLSLOPES

ASSUME VEG. COVER :
MOUNTAIN : 20% (1.11)
HILLSLOPES : 30% (1.22)

SUB1 :
ADJ = .96 (1.11) + .04 (1.22) = 1.114
XKSAT = .26 (1.114) = .290 in/hr

SUB2 :
ADJ = .92 (1.11) + .08 (1.22) = 1.119
XKSAT = .26 (1.119) = .291 in/hr

SUB3 :
ADJ = .77 (1.11) + .23 (1.22) = 1.135
XKSAT = .28 (1.135) = .318 in/hr

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL BASIN CHARACTERISTICS COMPUTED ____ DATE ____

CHECKED BY ____ DATE ____

AREAS: 1" = 2000', 1 in² = (2000 ft)² = 4,000,000 ft² = .1435 mi²

SUB1 → 2.573 in² × .1435 mi²/in² = 0.369 mi² = 236 ac

SUB2 → 2.4335 in² × .1435 mi²/in² = 0.349 mi² = 223 ac

SUB3 → 2.472 in² × .1435 mi²/in² = 0.355 mi² = 227 ac

1.073 mi²

TOTAL → 7.4565 × .1435 = 1.070 mi², Δ = 0.3%

SUBBASIN LENGTHS:

SUB 1: 2.9375 in × 2000 ft/in = 5875 ft = 1.113 mi

SUB 2: 3.0938 in × 2000 ft/in = 6188 ft = 1.172 mi

SUB 3: 3.719 in × 2000 ft/in = 7438 ft = 1.409 mi

SLOPES:

SUB 1: 3000' - 1515'/1.113 mi = 1,334 ft/mi ADJ. = 315 ft/mi

SUB 2: 3120' - 1515'/1.172 mi = 1,369 ft/mi ADJ = 315 ft/mi

SUB 3: 3220 - 1440/1.409 mi = 1,263 ft/mi ADJ = 315 ft/mi

BASIN ROUGHNESS:

ASSUME RS SOILS - MOUNTAIN, TB SOILS - HILLSLOPES / ALLUVIAL FAN

SUB1 → Kb = .96 [-.03 (log 236) + .2] + .04 [-.025 (log 236) + .15] = .127

SUB2 → Kb = .92 [-.03 (log 223) + .2] + .08 [-.025 (log 223) + .15] = .127

SUB3 → Kb = .77 [-.03 (log 227) + .2] + .08 [-.025 (log 227) + .15] = .107

INITIAL ABSTRACTION

ASSUME RS SOILS - MOUNTAIN, TB SOILS - HILLSLOPES

SUB1 → IA = .96 (.25) + .04 (.15) = .246 in

SUB2 → IA = .92 (.25) + .08 (.15) = .242 in

SUB3 → IA = .77 (.25) + .23 (.15) = .227 in

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL Tc & R COMPUTED ____ DATE ____

ADJUSTED SLOPES CHECKED BY ____ DATE ____

Tc / R (HOURS)

24-HOUR

	TR 2	5	10	25	50	100
SUB 1	1.067/.764	.783/.543	.650/.441	.533/.354	.483/.317	.450/.293
SUB 2	1.100/.851	.817/.611	.683/.502	.567/.407	.517/.368	.467/.328
SUB 3	1.133/1.009	.850/.733	.700/.591	.583/.483	.517/.422	.467/.377

6-HOUR

	2	5	10	25	50	100
SUB1	.967/.685	.783/.543	.667/.454	.533/.354	.483/.317	.433/.281
SUB2	1.000/.765	.800/.598	.683/.502	.550/.394	.500/.355	.450/.315
SUB3	1.033/.911	.817/.702	.700/.591	.567/.468	.500/.407	.467/.377

2-HOUR

	2	5	10	25	50	100
SUB1	1.117/.804	.600/.404	.500/.330	.433/.281	.383/.245	.350/.222
SUB2	1.133/.880	.617/.448	.517/.368	.450/.315	.383/.264	.367/.251
SUB3	1.167/1.042	.633/.529	.533/.437	.450/.362	.400/.318	.367/.288

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL Tc & R COMPUTED ____ DATE ____

NON-ADJUSTED SLOPES CHECKED BY ____ DATE ____

Tc / R (HOURS)

24-HOUR	Tr 2	5	10	25	50	100
SUB1	.650/.441	.433/.281	.383/.245	.333/.210	.317/.199	.300/.187
SUB2	.650/.475	.433/.303	.383/.264	.333/.226	.317/.214	.300/.201
SUB3	.700/.591	.467/.377	.400/.318	.350/.274	.333/.259	.317/.245

6-HOUR	2	5	10	25	50	100
SUB1	.567/.379	.417/.269	.350/.222	.300/.187	.267/.164	.250/.153
SUB2	.583/.421	.433/.303	.350/.239	.300/.201	.283/.189	.267/.177
SUB3	.617/.514	.450/.362	.383/.303	.317/.245	.283/.217	.267/.203

2-HOUR	2	5	10	25	50	100
SUB1	.683/.466	.300/.187	.267/.164	.217/.130	.200/.119	.183/.108
SUB2	.700/.515	.317/.214	.267/.177	.233/.152	.200/.128	.183/.116
SUB3	.733/.623	.333/.259	.283/.217	.233/.175	.217/.161	.200/.147

CALCULATION OF Tc & R

Calculated by: SDW Date: 4/16/91
Checked by: Project: 90-22

Watershed: Estrella Subbasin #1, ADJUSTED SLOPES
Rainfall Frequency: — - yr Duration: 3 - hr. Pattern #: — Recorded Storm

Rainfall Loss Method:
[X] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.
0320	.07
0330	.12
0340	.12
0350	.17
0400	.21
0410	.10
0420	.10
0430	.10

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.21	.21	1.26
20	.17	.38	1.14
30	.12	.50	1.00
40	.12	.62	.93
50	.10	.72	.864
60	.10	.82	.82

A = .369 sq.mi.
L = 1.113 mi.
S = 315 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .127

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

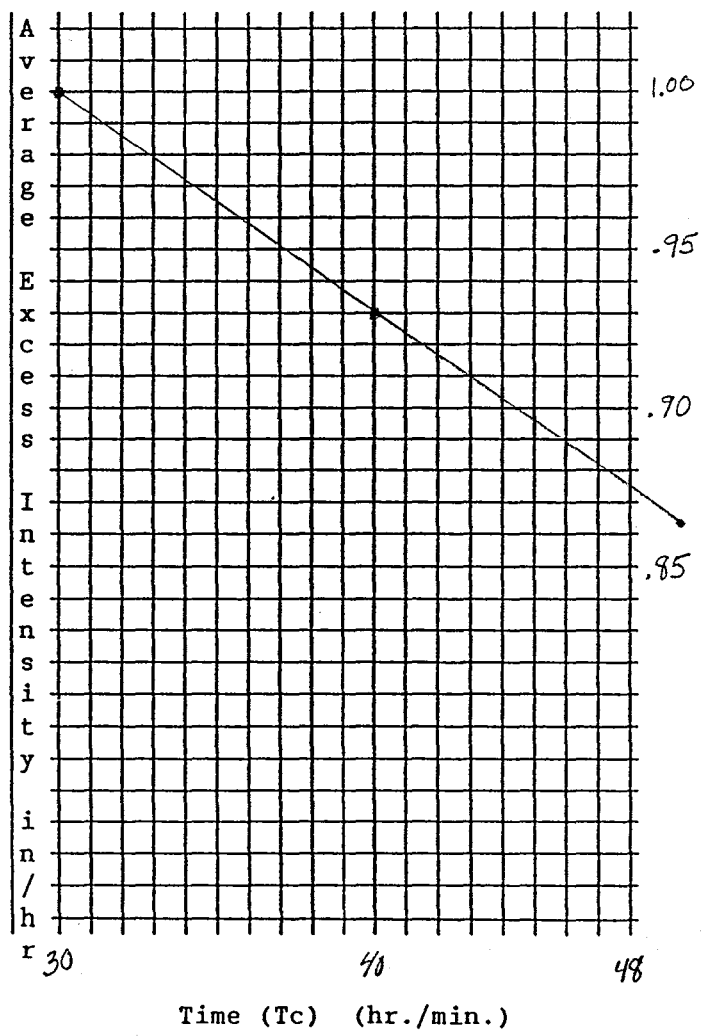
$Tc = (.691)\ i^{-.38}$

Trial Tc	i	Calc. Tc
30	1.00	41.5
40	.93	42.6
43	.91	43.0

Tc = .717 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .492 hr.



CALCULATION OF Tc & R

Calculated by: _____ Date: _____
Checked by: _____ Project: _____

Watershed: SUB 2 Adjusted Slopes
Rainfall Frequency: _____ - yr Duration: _____ - hr. Pattern #: _____

Rainfall Loss Method:
[x] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.21	.21	1.26
20	.17	.38	1.14
30	.11	.49	.98
40	.12	.61	.915
50	.09	.70	.84
60	.10	.80	.80

A = .349 sq.mi.
L = 1.172 mi.
S = 315 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .127

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

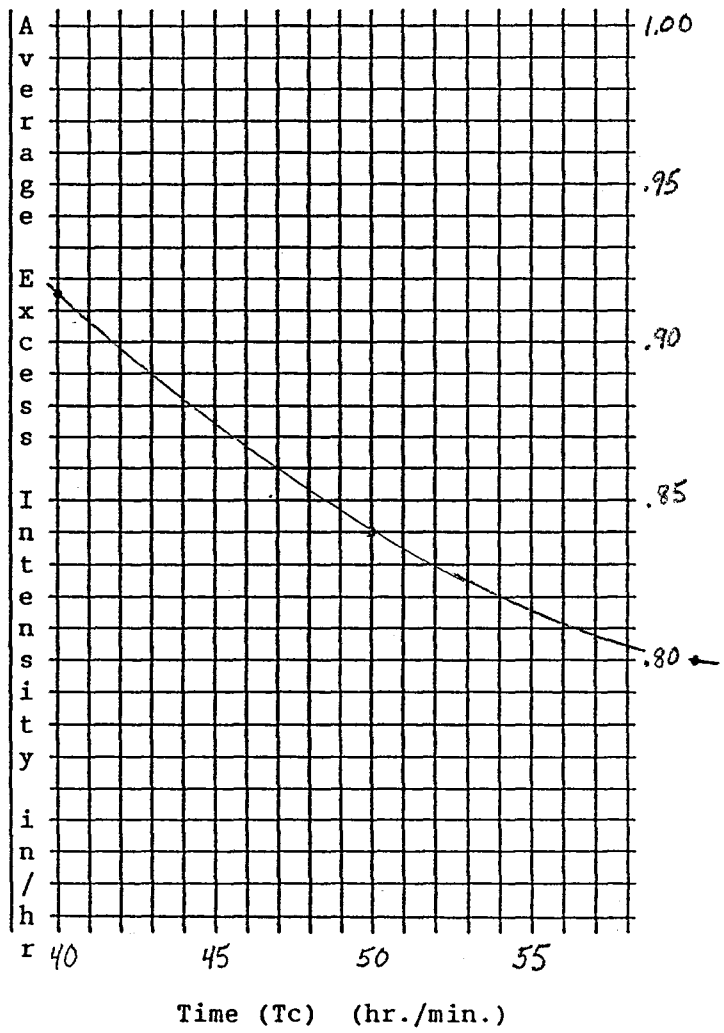
$Tc = (.709)\ i^{-.38}$

Trial Tc	i	Calc. Tc
40	.915	44.0
45	.875	44.8

Tc = .750 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .556 hr.



CALCULATION OF Tc & R

Calculated by: SDW Date:
Checked by: Project:

Watershed: ESTRELLA SUB3 ADJUSTED Slopes
Rainfall Frequency: _____ - yr Duration: _____ - hr. Pattern #: _____

Rainfall Loss Method:
[X] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.19	.19	1.14
20	.15	.34	1.02
30	.09	.43	.86
40	.10	.53	.795
50	.08	.61	.732
60	.08	.69	.690
70	.09	.78	.669

A = .355 sq.mi.
L = 1.409 mi.
S = 315 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .107

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

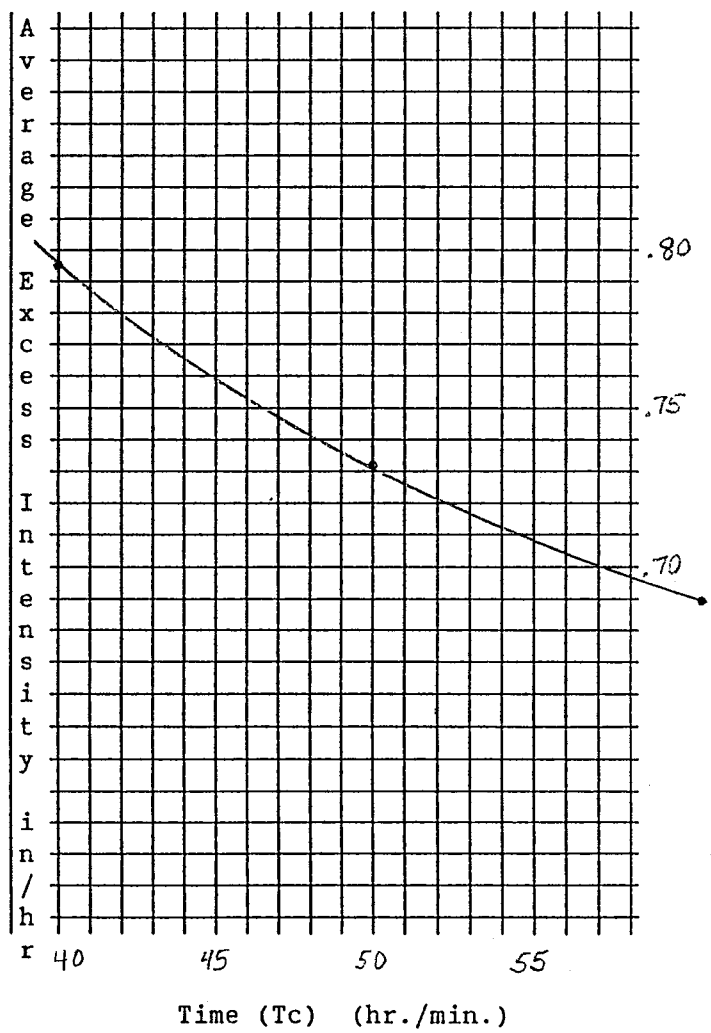
Tc = (.711) $i^{-.38}$

Trial Tc	i	Calc. Tc
40	.795	46.6
47	.748	47.7
48	.742	47.8

Tc = .800 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .686 hr.



CALCULATION OF Tc & R

Calculated by: _____ Date: _____
Checked by: _____ Project: _____

Watershed: ESTRELLA SUBI NON-ADJUSTED SLOPES
Rainfall Frequency: _____ - yr Duration: 3 - hr. Pattern #: _____

Rainfall Loss Method:
[ ] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.21	.21	1.26
20	.17	.38	1.14
30	.12	.50	1.00
40	.12	.62	.93
50	.10	.72	.864

A = .369 sq.mi.
L = 1.113 mi.
S = 1334 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .127

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

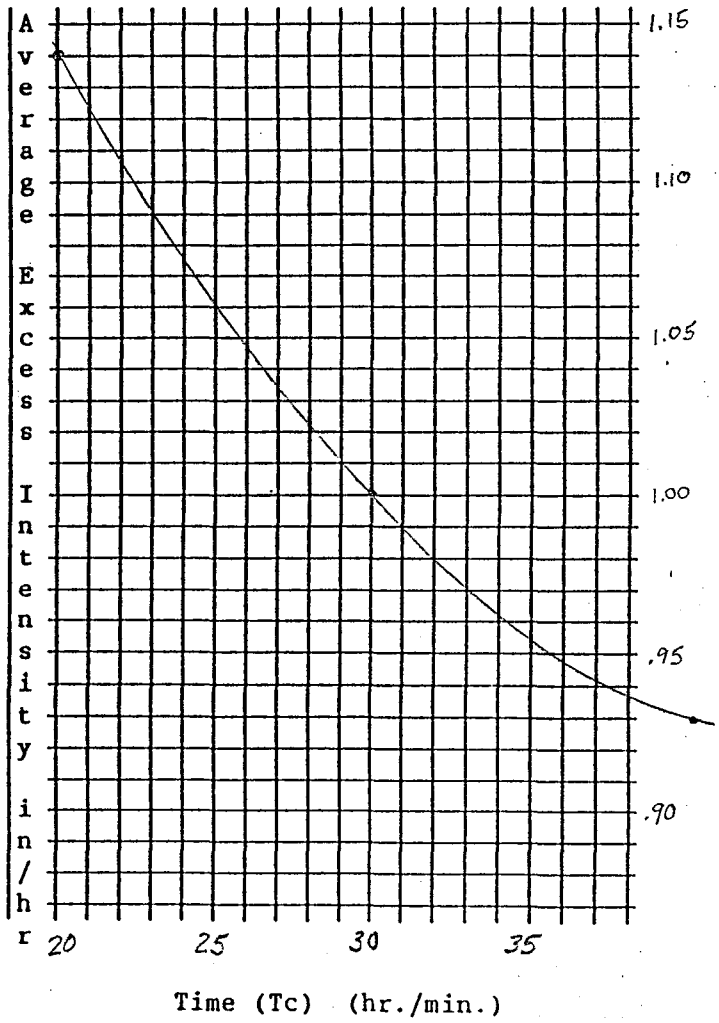
Tc = (.442) $i^{-.38}$

Trial Tc	i	Calc. Tc
30	1.00	26.5
25	1.06	25.9
26	1.047	26.1

Tc = .433 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .281 hr.



CALCULATION OF Tc & R

Calculated by: _____ Date: _____
Checked by: _____ Project: _____

Watershed: SUB 2 NON-ADJUSTED SLOPES
Rainfall Frequency: _____ - yr Duration: _____ - hr. Pattern #: _____

Rainfall Loss Method:
[X] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.21	.21	1.26
20	.17	.38	1.14
30	.11	.49	.98
40	.12	.61	.915
50	.09	.70	.84
60	.10	.80	.80

A = .349 sq.mi.
L = 1.172 mi.
S = 1369 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .127

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

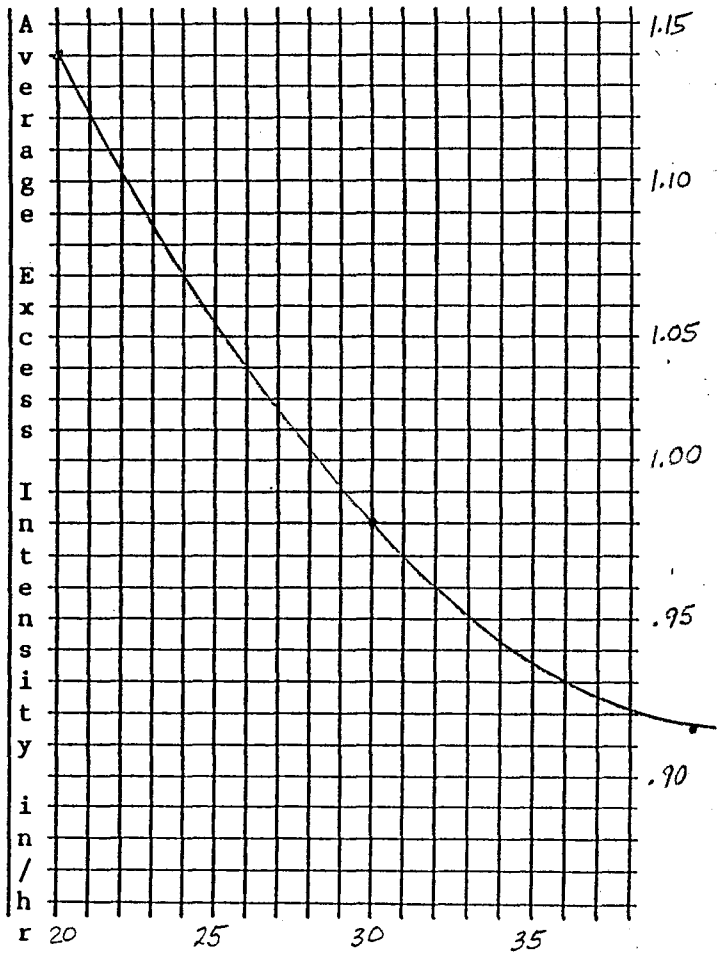
Tc = (.450) $i^{-.38}$

Trial Tc	i	Calc. Tc
30	.98	27.2
25	1.054	26.5
27	1.017	26.8

Tc = .450 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .315 hr.



CALCULATION OF Tc & R

Calculated by: _____ Date: _____
Checked by: _____ Project: _____

Watershed: ESTRELLA SUB 3 NON-ADJUSTED SLOPES
Rainfall Frequency: — - yr Duration: 3 - hr. Pattern #: —

Rainfall Loss Method:
[X] Green & Ampt Method
[ ] IL + ULR by soil texture
[ ] IL + ULR by hydrologic soil group

Tabulate Period of Peak Rainfall Excess

Clock Time @ end of Increm.	Increm. Excess in.

Rearrange Incremental Excesses in Order of Decreasing Average Intensity

Accum. Time hr./min.	Increm. Excess in.	Accum. Excess in.	Avg. Excess Intensity in./hr.
10	.19	.19	1.14
20	.15	.34	1.02
30	.09	.43	.86
40	.10	.53	.795
50	.08	.61	.732
60	.08	.69	.690

A = .355 sq.mi.
L = 1.409 mi.
S = 1263 ft/mi.

Kb = m [log(A * 640)]+ b
Kb = ( ) log (*640) + ( )
Kb = .107

$Tc = 11.4\ L^{.50}\ Kb^{.52}\ S^{-.31}\ i^{-.38}$

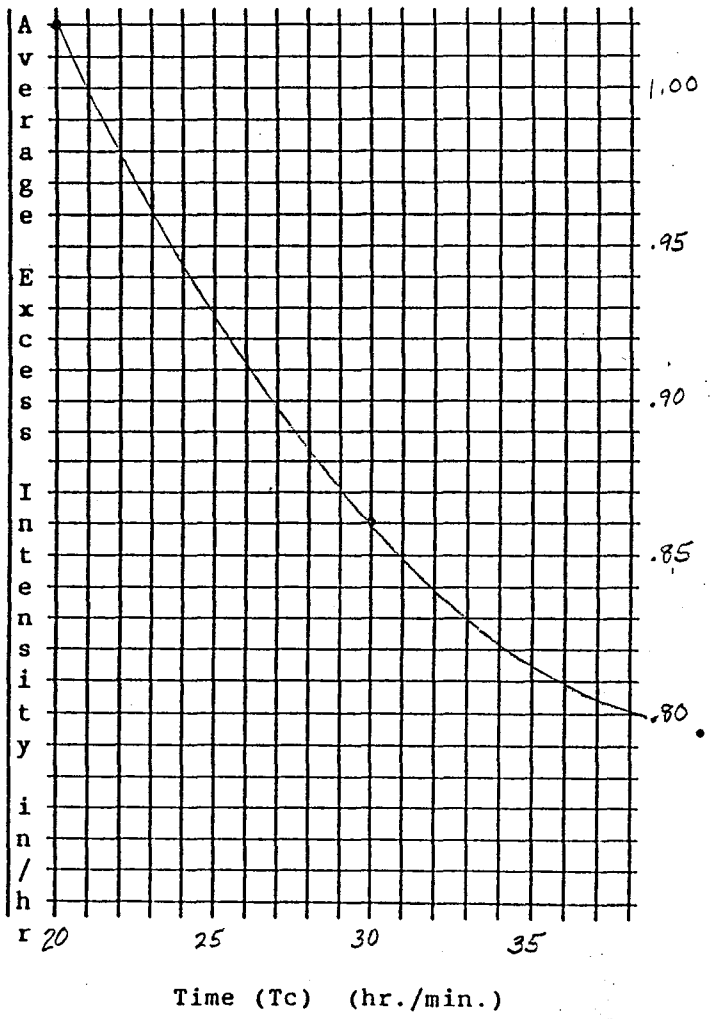
$Tc = (.463)\ i^{-.38}$

Trial Tc	i	Calc. Tc
30	.86	29.4
29	.871	29.3

Tc = .483 hr.

$R = .37\ Tc^{1.11}\ A^{-.57}\ L^{.80}$

R = .392 hr.



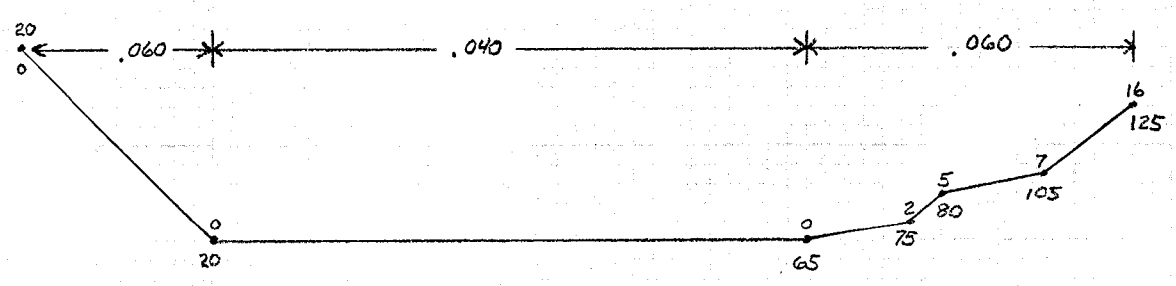
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT *ESTRELLA ALLUVIAL FAN* PAGE ____ OF ____

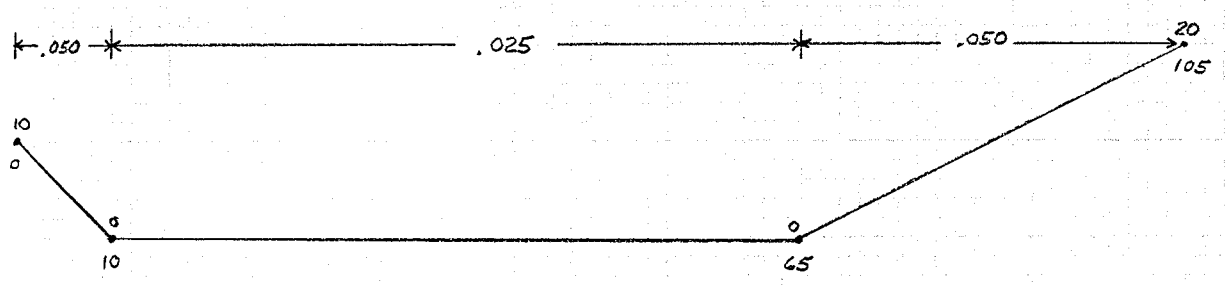
DETAIL ____ COMPUTED ____ DATE ____

____ CHECKED BY ____ DATE ____

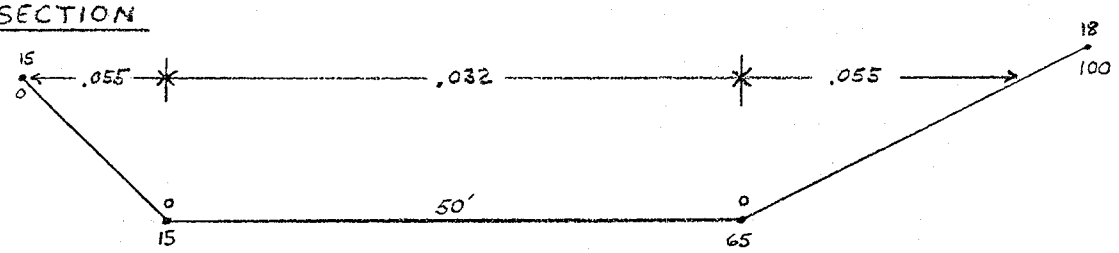
SECTION # 1



SECTION #2



COMPOSITE SECTION

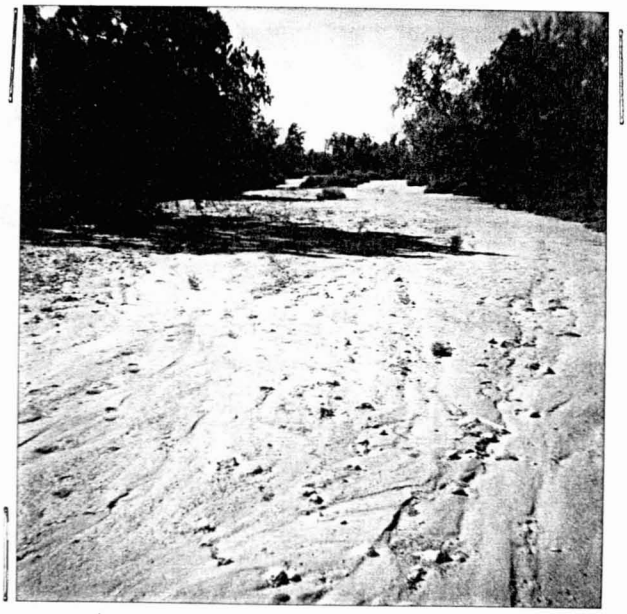


.041

REACH LENGTH: 1.344 in x 2000' = 2690 ft

SLOPE: 1515 - 1440 / 2690 ft = .0279 ft/ft

4/12/91 SDW
ESTRELLA FAN, FACING SOUTH
Routing Section at end of
shade, Section # 1



4/12/91 SDW
ESTRELLA FAN, Facing South
Routing Section # 2

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
*  RUN DATE  04/18/1991  TIME  11:25:22 *
*                                      *
****************************************
```

```
* ************************************
*   U.S. ARMY CORPS OF ENGINEERS     *
*   HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET          *
*      DAVIS, CALIFORNIA 95616       *
*          (916) 756-1104            *
* ************************************
```

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

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

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

  1           ID    ALLUVIAL FAN DATA COLLECTION AND MONITORING PROJECT
  2           ID    ESTRELLA FAN HYDROLOGY
  3           ID    AUGUST 15, 1991
  4           ID    SOUTH MOUNTAIN STORM OF AUGUST 15, 1990, 3-HOUR DURATION, 2.05 INCHES
  5           ID    SLOPES ADJUSTED USING THE MARICOPA COUNTY METHOD
              * ******************************
  6           IT       5 15AUG90    0300     150
  7           IO       5
              * ************************************

  8           KK    SUB1
  9           KM   RUNOFF FROM SUBBASIN 1
 10           BA    .369
 11           IN      15 15AUG90    0300
 12           PI     .04     .39     .35     .43     .24     .24     .16     .04     .04     .04
 13           PI     .04     .04
 14           LG    .246    .350   3.530    .290  48.000
 15           UC    .433    .281
 16           UA       0       3       5       8      12      20      43      75      90      96
 17           UA     100
              * ************************************

 18           KK    SUB2
 19           KM    RUNOFF FROM SUBBASIN 2
 20           BA    .349
 21           LG    .242    .350   3.560    .291  46.000
 22           UC    .450    .315
 23           UA       0       3       5       8      12      20      43      75      90      96
 24           UA     100
```

```
                    * ************************************

          25        KK     CP1
          26        KM     COMBINE SUB1 AND SUB2 AT CP1
          27        HC       2
                    * ************************************

          28        KK     CP2
          29        KM     ROUTE (SUB1 & SUB2) FROM CP1 TO CP2 WITH TRANSMISSION LOSSES
          30        RD
          31        RC    .055    .032    .055    2690   .0279     15.
          32        RX       0     7.5      15      35      45      65    82.5     100
          33        RY      15     7.5       0       0       0       0       9      18
          34        RL                      2.
                    * ************************************

          35        KK    SUB3
          36        KM    RUNOFF FROM SUBBASIN 3
          37        BA    .355
          38        LG    .227    .350   3.680    .318  38.500
          39        UC    .483    .392
          40        UA       0       3       5       8      12      20      43      75      90      96
          41        UA     100
                    * ************************************
1                                          HEC-1 INPUT                                                  PAGE  2

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


          42        KK    APEX
          43        KM    COMBINE (SUB1 & SUB2) + SUB3 AT THE APEX
          44        HC       2
                    * ************************************
          45        ZZ
*****************************************************************************************************************************
*

                        ALLUVIAL FAN DATA COLLECTION AND MONITORING PROJECT
                        ESTRELLA FAN HYDROLOGY
                        AUGUST 15, 1991
                        SOUTH MOUNTAIN STORM OF AUGUST 15, 1990, 3-HOUR DURATION, 2.05 INCHES
                        SLOPES ADJUSTED USING THE MARICOPA COUNTY METHOD

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

    IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE     15AUG90  STARTING DATE
                     ITIME       0300  STARTING TIME
                        NQ        150  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     15AUG90  ENDING DATE
                    NDTIME       1525  ENDING TIME
                    ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   12.42 HOURS
```

ENGLISH UNITS

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

1

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	SUB1	221.	1.25	47.	23.	23.	.37		
+	HYDROGRAPH AT	SUB2	195.	1.25	43.	21.	21.	.35		
+	2 COMBINED AT	CP1	416.	1.25	90.	43.	43.	.72		
+	ROUTED TO	CP2	410.	1.42	90.	43.	43.	.72		
+	HYDROGRAPH AT	SUB3	163.	1.33	37.	18.	18.	.35		
+	2 COMBINED AT	APEX	573.	1.33	127.	62.	62.	1.07		

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
CP2	MANE	3.75	417.06	82.50	1.16	5.00	410.17	85.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4456E+02 EXCESS= .0000E+00 OUTFLOW= .4456E+02 BASIN STORAGE= .1280E-03 PERCENT ERROR= .0

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

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL ____ COMPUTED ____ DATE ____

____ CHECKED BY ____ DATE ____

24-HOUR DISCHARGES (cfs)

TR	ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX	NON-ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX
2	88	76	60	222	124	110	85	317
5	180	157	132	467	254	231	198	674
10	262	230	201	692	348	318	281	946
25	385	341	305	1018	482	445	409	1321
50	474	412	381	1266	560	519	487	1560
100	558	503	468	1496	653	602	566	1814

6-HOUR DISCHARGES (cfs)

TR	ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX	NON-ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX
2	109	94	75	278	159	140	112	408
5	207	182	154	541	317	278	240	825
10	307	271	235	809	455	414	356	1222
25	478	425	377	1279	648	594	539	1779
50	594	528	485	1607	789	712	670	2141
100	724	646	586	1953	920	834	794	2536

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ESTRELLA ALLUVIAL FAN PAGE ____ OF ____

DETAIL ____ COMPUTED ____ DATE ____

____ CHECKED BY ____ DATE ____

2-HOUR DISCHARGES

TR	ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX	NON-ADJUSTED SLOPES SUB1	SUB2	SUB3	APEX
2	73	62	47	182	107	93	70	268
5	261	229	194	681	407	357	308	1069
10	387	339	294	1018	564	512	447	1525
25	536	473	425	1429	791	693	639	2117
50	708	643	572	1921	1002	915	818	2743
100	857	759	701	2311	1197	1098	988	3289

RECORDED STORM DISCHARGES

SOUTH MOUNTAIN STORM OF AUG. 15, 1990

3-HOURS
2.05 INCHES

ADJUSTED SLOPES:

	Tc (hr)	Q (cfs)
SUB1	.717	177
SUB2	.750	155
SUB3	.800	124
APEX		456

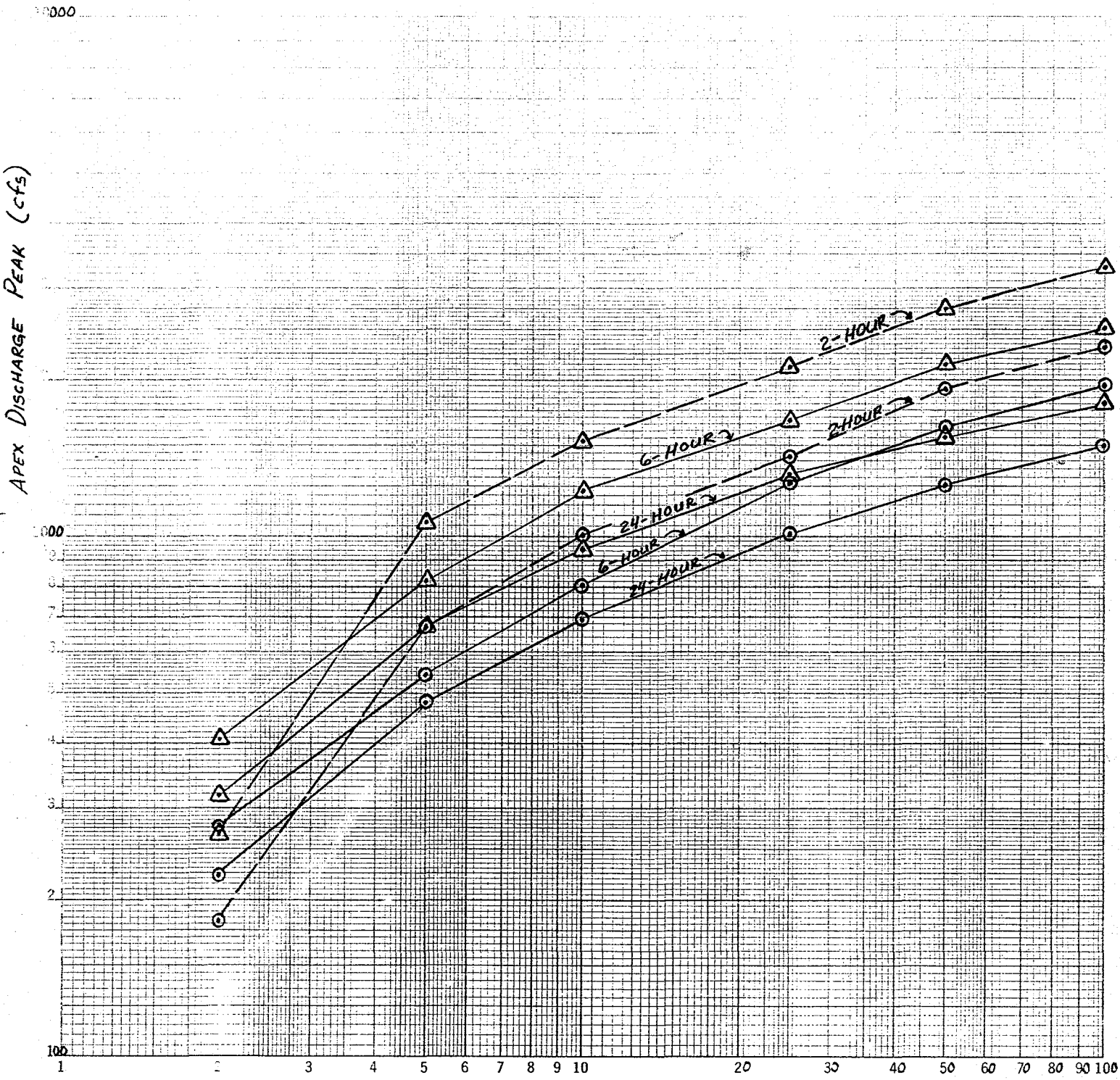
NON-ADJUSTED SLOPES:

	Tc (hr)	Q (cfs)
SUB1	.433	221
SUB2	.450	195
SUB3	.483	163
APEX		573

NATIONAL 12-185

ESTRELLA ALLUVIAL FAN

GRAPH OF DISCHARGE vs. FREQUENCY
RESULTS OF HEC-1 MODELING



⊙ ADJUSTED SLOPES

△ NON-ADJUSTED SLOPES

RAINFALL RETURN PERIOD (Years)

Logarithmic, 2 x 2 Cycles

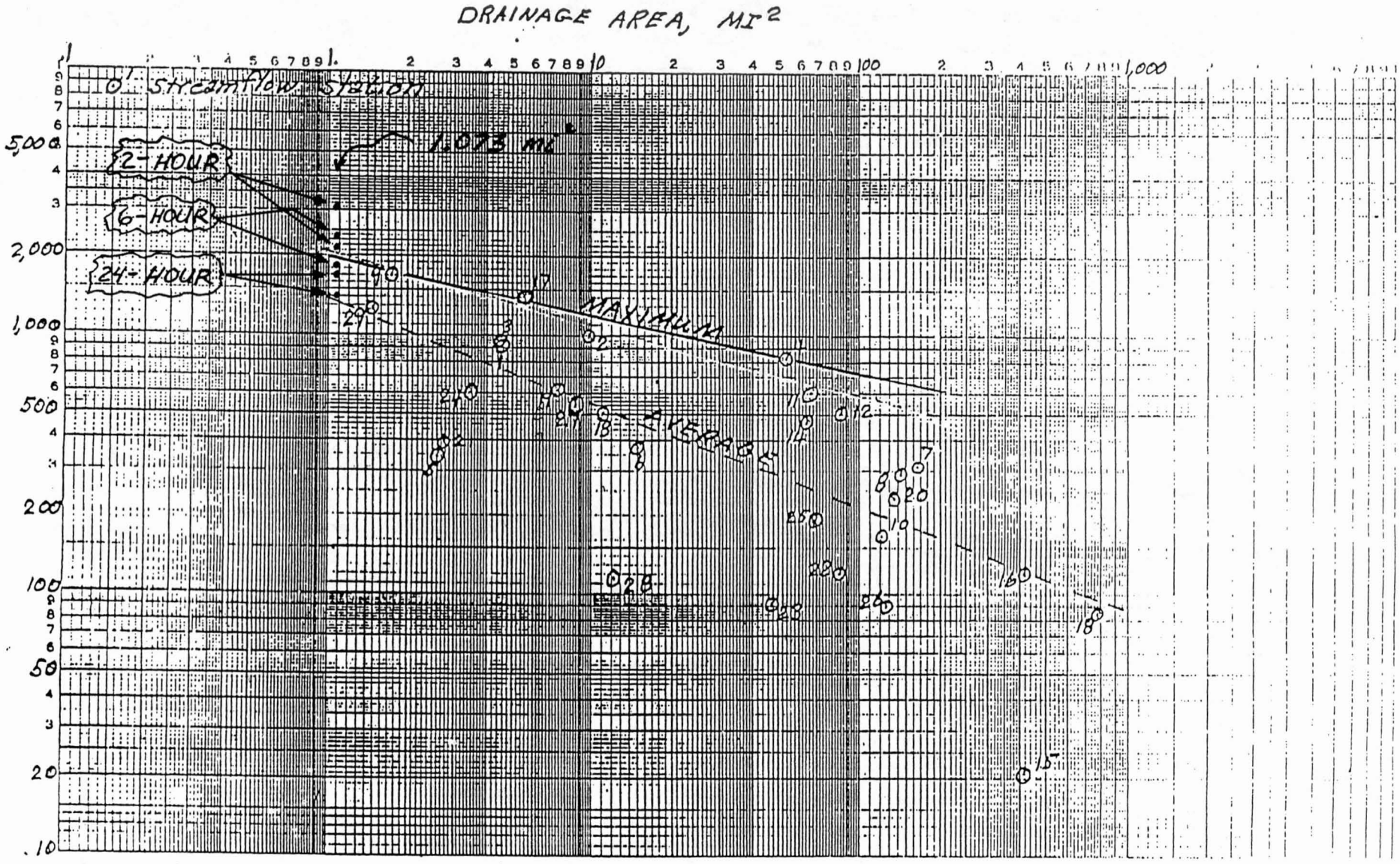


Figure 1.- Plot of 100-year discharge, from Log Pearson III Analysis, for streamflow stations in Maricopa County. For a given duration, the lower discharge value (in cfs/mi²) represents adjusted slopes.