HYDROLOGY REPORT

ENLARGEMENT OF OLD DILLON RESERVOIR
DAM ID 360117

WATER DIVISION NO. 5
WATER DISTRICT NO. 36

Prepared for:

Colorado River Water Conservation District
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October 2008

TETRA TECH

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1.0 INTRODUCTION

This report summarizes the hydrology evaluation of the Old Dillon Reservoir (ODR) enlargement project and presents the inflow design flood (IDF) for the determination of the require spillway capacity. The report also includes calculations and supporting data. The components of the project include the following:

- Replacing Dillon Ditch with a pipe and modifying its headgate on Salt Lick Gulch to serve the enlarged reservoir
- Increasing the size of the existing reservoir to 286 acre-feet
- Restoring the outlet from the existing reservoir to the south to the Blue River (now Dillon Reservoir)
- Rehabilitating the outlet to Salt Lick Gulch

Subsequent sections of this report present the design criteria established for storm flow criteria for the proposed improvements.

The purpose of the ODR improvements is to:

- Increase the capacity of the ODR
- Increase storage for the Towns of Dillon, Silverthorne and Summit County
- Provide more flexibility in management of water from Salt Lick Gulch

The dam is located in Water Division No. 5, Water District No. 36. It is also located in Section 13, Township 5 South, Range 78 West. The State DAM ID is 360117. The dam is currently classified as a Small, Low Hazard Dam. The proposed enlargement will change the Hazard Classification to a Small, High Hazard Dam.

The Colorado River Water Conservation District is the lead agency for design and implementation of the ODR improvements. A vicinity map is presented in Figure 1.

2.0 HISTORY AND EXISTING CONDITIONS

The ODR is located near the center of Summit County, approximately 70 miles west of Denver, Colorado (Figure 1). The reservoir was originally built in 1939 to supply water for the historic Town of Dillon. After the Town of Dillon was relocated for the construction of Denver Water's Dillon Reservoir, the Town no longer used the Old Dillon Reservoir for water supply and the reservoir no longer actively serviced Dillon.

The existing reservoir has a surface area of approximately 9 acres, and is impounded by two embankments approximately 5 to 7 feet high in a saddle on an east-west trending ridge providing storage of about 46 acre-feet. Under proposed conditions the embankments will be raised so the surface area of the reservoir will be increased to approximately 16 acres, providing storage for about 286 acre-feet. Water is supplied to the reservoir from Salt Lick Gulch. The Salt Lick Gulch drainage basin extends to the peak of Buffalo Mountain in the Gore Range. Salt Lick Gulch is tributary to the Blue River. Water from Salt Lick Gulch is diverted via a headgate into the Dillon Ditch. Dillon Ditch continues east and passes under Interstate 70 through an inverted siphon and then continues east discharging into the Old Dillon Reservoir. The siphon was built in the 1970's with the construction of Interstate I-70. The siphon is a 24" diameter, reinforced concrete pipe. Flow then returns to Salt Lick Gulch approximately 0.9 miles downstream of the diversion via an outlet channel and culvert under Interstate 70. Drainage area tributary to the headgate on Salt Lick Gulch is 2.73 sq.mi. The drainage area directly tributary to the reservoir is relatively small at 0.051 sq.mi. (33 acres).

3.0 HYDROLOGY

This section presents the development of the inflow design flood and provides the hydrologic and hydraulic calculations for the proposed enlargement of Old Dillon Reservoir. Analyses of storm precipitation and runoff were performed to evaluate the capacity of proposed conveyance facilities for the Old Dillon Reservoir. The Probable Maximum Precipitation (PMP) Storms, used to determine the IDF, are discussed in this section. Both USBR and NRCS methods were used for hydrologic calculations.

3.1 Hydrologic Parameters

3.1.1 Basin Geometry and Topographic Parameters

The drainage basins that directly contribute to the Old Dillon Reservoir encompass a total of 0.051 square miles. The total watershed area and individual contributing hydrologic basins and centroid locations are presented in Figure 2. A summary of the physical parameters including area, elevations, and flow lengths are presented in Tables 1 and 2.

The hydraulic characteristics of each subbasin were represented by a K_n roughness value. The United States Bureau of Reclamation (USBR) publication, "Design of Small Dams", recommends K_n values that range from 0.050 to 0.339 for the Rocky Mountains. A K_n value was applied as a representative roughness for the study drainage basin based on previously accepted basin studies in comparable hydrologic and topographic settings. Separate K_n values for the frequency storms, the local PMP, and the general PMP were estimated. K_n values for each basin are summarized in Table 1.

For the NRCS method, soil maps were reviewed and it was determined that 'Type B' soils are present in the drainage areas directly tributary to ODR. A CN value of 86 was selected for the analysis. This value was selected because it represents bare soil which is the conservative condition. The TR-55 method was used to calculate time of concentration and lag times. Curve Number values and times of concentration used in the SCS method are summarized in Table 2.

3.1.2 Unit Hydrographs

The synthetic unit hydrographs for the contributing basins were determined using a Microsoft Excel spreadsheet developed by the Division One Office of the State Engineer. The hydrographs were calculated for each basin using the USBR Rocky Mountains data and are provided in

Appendix A. For the NRCS method unit hydrographs were created using a Type 2 storm distribution.

3.1.3 Reservoir Hydrograph

The peak runoff for rain falling directly on to the ODR reservoir was calculated using the following formula:

$$Q_p = 645.33\left(\frac{A}{t}\right)$$

Where A = basin area in square miles
t = duration in hours, also the calculation interval from HEC-1

3.1.4 Inflow Design Flood

The Inflow Design Flood (IDF) requirements for determining the spillway capacity was developed using Hydrometeorological Report (HMR) 49.

3.1.5 Probable Maximum Precipitation (PMP)

The Inflow Design Flood requirement for a small, high hazard dam is 90% of the PMP per Rule 5.9.1.4, Table 5.2 of the Dam Safety Rules and Regulations (2007).

3.1.5.1 PMP Adjustments

Based on rule 5.9.1.5, Table 5.3, the PMP was not adjusted for elevation.

3.1.5.2 PMP General Storm

A general storm is a long-duration event associated with a frontal storm system. Determination of the 1-, 6-, 24-, and 72-hour general storm index PMP values were made using the HMR-49 10-mi^2 PMP index maps. Duration values for the general storm PMP were estimated for durations of 5-minutes, 15-minutes, 1-hour, 2-hours, 3-hours, 6-hours, 12-hours, 24-hours, 48-hours, and 72-hours. The recommended procedure by the Colorado Dam Safety Branch Hydrology Committee was used for depth duration values that were not determined by HMR-49. Calculations for PMP storms are presented in Appendix A.

3.1.5.3 PMP Local Storm

A local storm is short duration, high intensity event. Determination of the one-hour index PMP estimate was made using the 1-mi^2 PMP at elevation 5,000 feet index map in HMR-49. Calculations for PMP storms are presented in Appendix A.

Local storm precipitation data for the HEC-1 program requires depth duration values at 5-minute, 15-minute, 1-hour, 2-hour, 3-hour, and 6-hour durations. Depth duration values that were not readily available from HMR-49 were based upon the recommended procedure by the

Colorado Dam Safety Branch Hydrology Committee. Calculations for the PMP Local Storm are presented in Appendix A.

3.1.6 Snowmelt Runoff

Due to the very small size of the tributary drainage basin snowmelt runoff was not calculated in this study. A base flow of 10 cfs was assumed for the flow entering reservoir from the Salt Lick Gulch headgate based upon the in priority water rights.

3.2 Reservoir Elevation-Capacity Curve

The ODR Reservoir elevation-capacity curve used in the HEC-1 modeling was based on 1-foot contours based upon the proposed dam embankments. The elevation-area data was entered directly in to HEC-1 model which then computes, using the conic method, the reservoir volume.

The total storage within the reservoir at the proposed normal high water surface elevation (el. 9190.5) is approximately 286 ac-ft. The total storage at the maximum high water surface elevation (el. 9192.4) is approximately 314 ac-ft. A summary of elevation-capacity data and a chart of the curve is presented in Appendix A.

3.3 Hydrologic Modeling – Reservoir Inflow

The HEC-1 computer program (US Army Corps of Engineers, 1990) is used for the hydrologic modeling. The USBR and NRCS models were run using both the Local and General PMP events.

All models were produced using the parameters described in preceding sections. All of the basins modeled are directly tributary to the reservoir so channel routing was not necessary. Detailed input and output of the modeling effort is presented in Appendix B in the form of HEC-1 reports.

Table 3. Summary of HEC-1 Model Output Inflow to Reservoir

Model	Peak Discharge (cfs)
USBR – LOCAL PMP	258
USBR – GENERAL PMP	169
NRCS – LOCAL PMP	254
NRCS – GENERAL PMP	195

3.4 Proposed Old Dillon Dam Spillway

The proposed ODR spillway is a concrete structure located on the north end of the dam. It is a concrete box with rectangular weirs cut into the sides. One slot, on the front of the box, is 8' wide with a crest elevation set at 9190.5. Two additional slots, one on each side, are 6' wide with crest elevations set at 9191.5. A 40% obstruction due to screening was assumed for these openings so the widths were adjusted in the HEC-1 model in order to account for this factor.

The top elevation of the dam is approximately at elevation 9194. The spillway discharges into the existing channel that will return flows to Salt Lick Gulch.

A weir coefficient of 2.65 was used in the hydrologic model. This value was selected because it is a conservative value for the spillway. A sketch of the proposed spillway, and associated spillway rating curve and calculations are presented in Appendix A.

3.5 Hydrologic Modeling Results - Spillway

A table summarizing the results of the hydrologic models is presented below. Detailed HEC-1 reports, including input and output, are presented in Appendix A.

Table 4. Summary of HEC-1 Model Output, Outflow to Salt Lick Gulch

Model	Spillway Peak Discharge (cfs)	Maximum Elevation (ft. AMSL)
USBR – LOCAL PMP	37	9192.2
USBR – GENERAL PMP	37	9192.2
NRCS – LOCAL PMP	31	9192.0
NRCS – GENERAL PMP	37	9192.2

Three of the models summarized in the above table show that the peak discharge from the reservoir is not dependent on the type of storm analyzed. The peak discharge is approximately 37 cfs over the spillway with a maximum elevation of 9192.2. The proposed spillway is shown to be effective for this storm. The ODR system is able to store and release the IDF.

A summary of proposed reservoir area capacity data and curve is presented in Appendix A.

4.0 CONCLUSION

It is proposed to expand the size of the Old Dillon Reservoir to increase its storage capacity. The project includes construction of new dam embankments and a new spillway structure. The new spillway will discharge to Salt Lick Gulch, located on the north end of the project site.

The new dams will be classified as a small high hazard dams. The Inflow Design Flood for the new dam is 90% of the PMP.

Four HEC-1 models of the ODR and its tributary basins were prepared to model the local and general PMP storms using USBR and NRCS hydrographs. The results of the models show that the local PMP model with USBR hydrographs has the greatest peak discharge.

A spillway was encoded into each model to evaluate the storage capacity of the ODR. Results of the hydrologic modeling show that the proposed spillway has the same peak outflow rate independent of the inflow. This is due to the ratio of the reservoir volume to the tributary watershed area including the base inflow of 10 cfs from Dillon Ditch. The peak outflow for the proposed ODR is approximately 37 cfs. The proposed system is capable of storing and discharging the Inflow Design Flood.

5.0 REFERENCES

Hydrologic Engineering Center, U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1, Version 4.1, June 1998.

Resource Engineering Inc., *Hydrology Specialist's Report Old Dillon Reservoir Enlargement Environmental Assessment,* August 2008.

State of Colorado, Department of Natural Resources, Division of Water Resources, Office of the State Engineer, *Rules and Regulations for Dam Safety and Dam Construction* January 1, 2007.

United States Department of Commerce, National Oceanic and Atmospheric Administration Hydrometeorological Reports (HMR No. 49, Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages).

United State Department of the Interior, Bureau of Reclamation, *Design of Small Dam* Third Edition, United States Government Printing Office Denver, CO, 1987.

TABLES

TABLE 1

PROPOSED RESERVOIR BASIN CHARACTERISTICS - USBR Methodology

Basin ID	Area (ft^2)	Area (acres)	(sq. miles)			Elevation Change (feet)	Flow Length, L (feet)	Flow Length, L (mile)	Centroidal Flow Length, Lca (feet)	Centroidal Flow Length, Lca (mile)	Basin Slope (ft/ft)	Basin Slope (ft/mile)	Kn1 100/500 YR	Local PMP	Gen. PMP	Basin Factor	Lag Time (hours)
	sf			top	bot												
SW	388960	8.93	0.014	9337	9190.5	146.5	1383	0.262	260	0.049	0.106	559.314	0.050	0.080	0.130	0.001	0.106
NE	334868	7.69	0.012	9349	9190.5	158.5	854	0.162	229	0.043	0.186	979.488	0.050	0.080	0.130	0.000	0.079
Lake	699116	16.05	0.025			0											
Total		32.67	0.051														

Notes: 1. An average drainage area Kn was applied to each sub-basin.

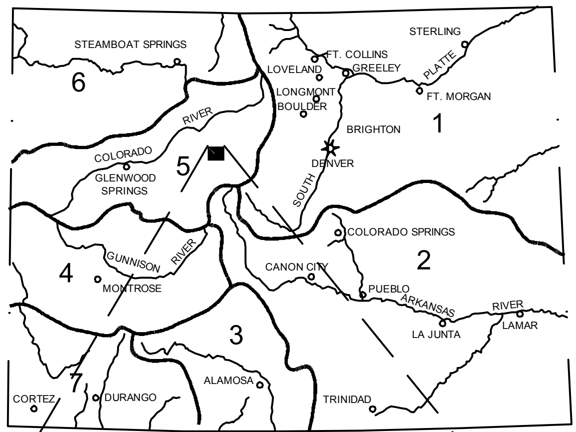
TABLE 2

PROPOSED RESERVOIR BASIN CHARACTERISTICS - NRCS Methodology

Basin ID	Area (ft^2)	Area (acres)	(sq. miles)			Elevation Change (feet)	Flow Length, L (feet)	Flow Length, L (mile)	Basin Slope (ft/ft)	Basin Slope (ft/mile)	Curve Number	Rainfall in inches Local	General	Lag Time (hours)
	sf			top	bot									
SW	388960	8.93	0.014	9337	9190.5	146.5	1383	0.262	0.106	559.314	86	10.920	21.500	0.117
NE	334868	7.69	0.012	9349	9190.5	158.5	854	0.162	0.186	979.488	86	10.920	21.500	0.104
Lake	699116	16.05	0.025			0					98	10.920	21.500	
Total		32.67	0.051											

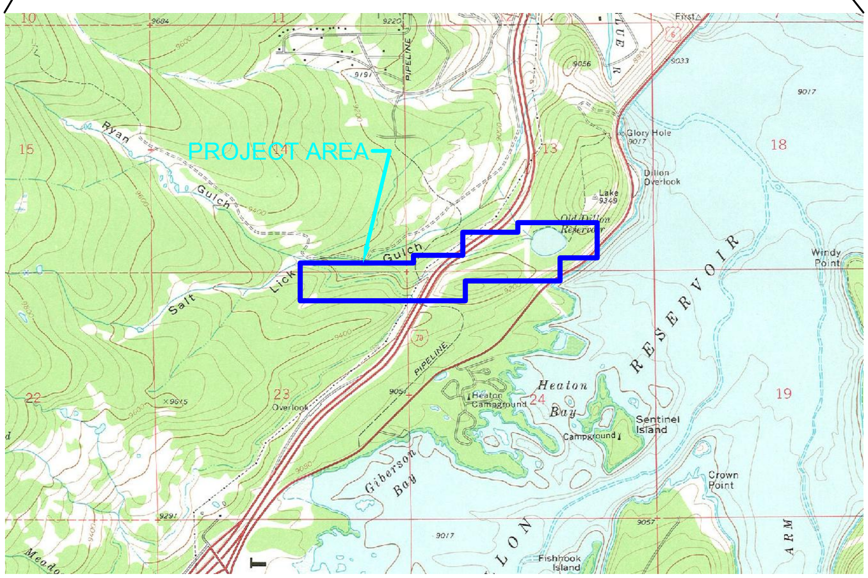
Notes: 1. General Storm Rainfall totals were much higher than county averages due to the small size of the drainage area.

FIGURES



STATE OF COLORADO
PROJECT LOCATION MAP

NOT TO SCALE



0 2000' 4000' 8000'

TETRA TECH

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LONGMONT, COLORADO 80501
PHONE: 303-772-5282 FAX: 303-772-7039

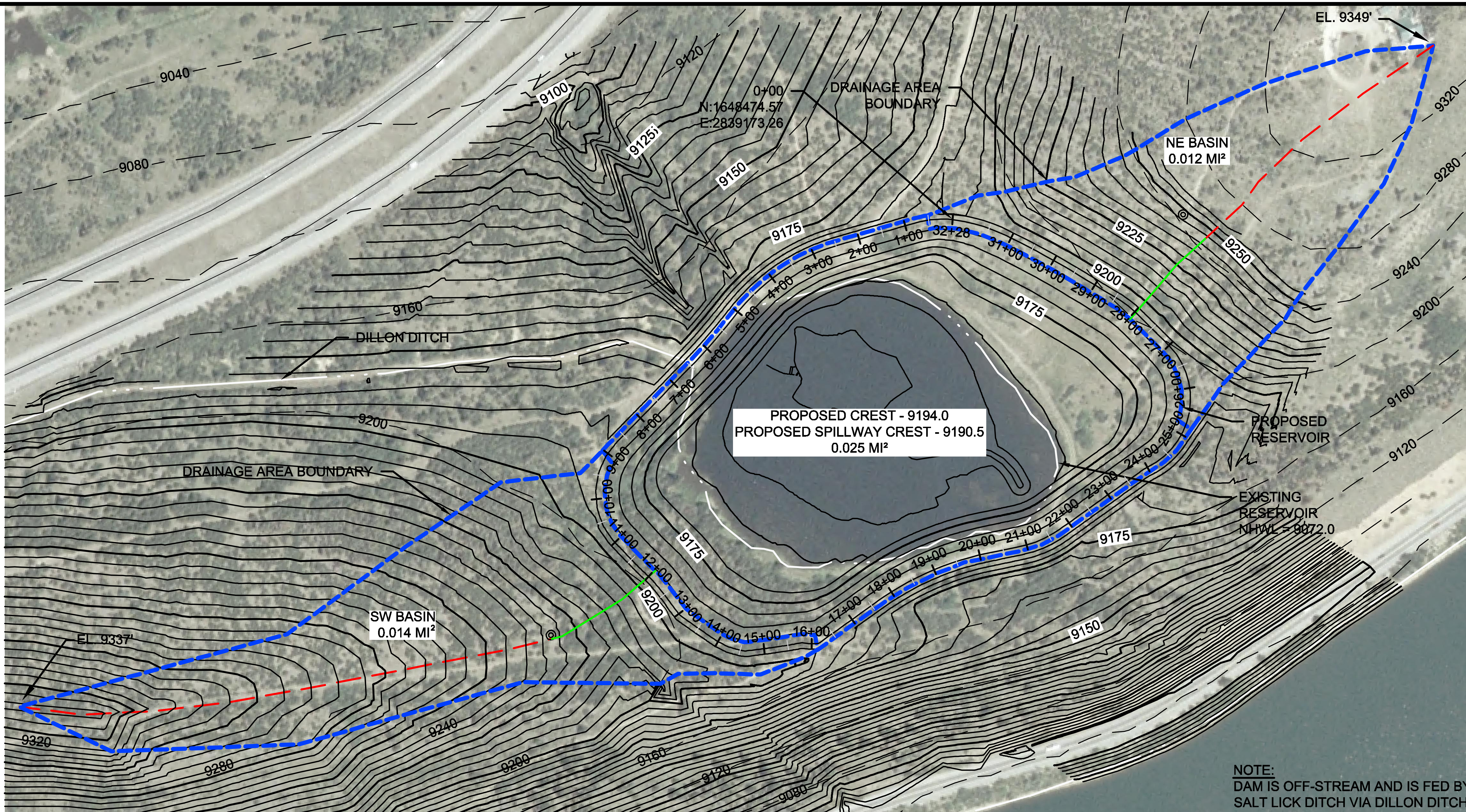
Drawing Description

PROJECT LOCATION
AND VICINITY MAP

Project No.:	133-1187-004-03
Date:	10-24-08
Designed By:	SCG

Figure No.

1



LEGEND

5' C.I. TETRA TECH (EXISTING/PROPOSED)
40' C.I. USGS CONTOURS
DRAINAGE BOUNDARY
L
LC
CENTROID

N

0 100' 200' 400'

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PHONE: 303-772-5282 FAX: 303-772-7039

Drawing Description

OLD DILLON RESERVOIR
WATERSHED MAP

Project No.:	133-1187-004-03
Date:	10-24-08
Designed By:	AT
Figure No.	2

Monday, January 18, 2010 11:36:21 AM DRAWING: P:\133_1187_004_03_Old_Dillon_Res\CAD\RefFiles\ModelFiles\ReportFigures\Figures1-2 .DWG LAYOUT: FIG-2 USER NAME: MORISON, MIKE

APPENDIX A

CALCULATIONS

USBR UNIT HYDROGRAPHS

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: USBR HYDROGRAPH FOR RAINFALLING DIRECTLY ON A RESERVOIR

Total Number of Pages (including cover sheet): 1

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: Date:

Description and Purpose:

UNIT HYDROGRAPH FOR RAINFALL DIRECTLY ON A RESERVOIR

$Q_p = 645.33\left(\frac{A}{t}\right)$ A = basin area in square miles
t = duration in hours
Q_p = ft³/s

Design Basis/References/Assumptions:

A = 16.05 ACRES
= 0.025 mi²

t = 1 minute = 0.0167
3 minute = 0.05

1 minute interval Q_p = 968 cfs

3 minute interval Q_p = 323 cfs

Remarks/Conclusions/Results:

FOR INPUT IN HEC-1

Calculation Approved by: [signature] Project Manager 10/24/08 Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

P:\133_1187_004_03_Old_Dillon_Res\SupportDocs\Calcs\Calculation Cover Sheet_Tt.doc

Unit Hydrograph for Rainfall Directly on a Reservoir

$Q_p = 645.33*(A/t)$ for: A = Basin Area in square miles
t = Duration in hours

A = 0.3 Square Miles
t = 0.083 Hours
5.0 Minutes (Time step from HEC-1)

Q_p = 2323 cfs

$\frac{.013}{1}$

1 min = .0167

Q_p = 503 cfs

A = .025 mi²

t = 1 min

Q_p = 968.

t = 5 min

Q_p = 194

$Area_{res}$ = .025

t = 3 min

Q_{peak} = 322.7
= 323.0

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: USBR LOCAL STORM HYDROGRAPH

Total Number of Pages (including cover sheet): 5

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: ______ Date: ______

Description and Purpose:

USBR LOCAL STORM (PMP) HYDROGRAPH

Design Basis/References/Assumptions:

SPREAD SHEET FROM SEO

Remarks/Conclusions/Results:

FOR INPUT INTO HEC-1

Calculation Approved by: ______

Project Manager Date

Revision No.:	Description of Revision:	Approved by:
		Project Manager/Date

ROCKY MOUNTAIN (THUNDERSTORM) UNIT HYDROGRAPH **LOCAL** 18-Jan-10

Old Dillon Reservoir - NE basin

Drainage Area =	0.012	sq. miles	Lg+D/2 =	0.17	Hours
Basin Slope =	979.488	ft./mile	Basin Factor =	0.06	
L =	0.162	mi., Length of Watercourse	V' =	0.32	cfs/Day
Lca =	0.043	mi., Distance to Centroid	Qs =	1.9	* q, cfs
Kn =	0.08	-, Ave. Weighted Manning's n			

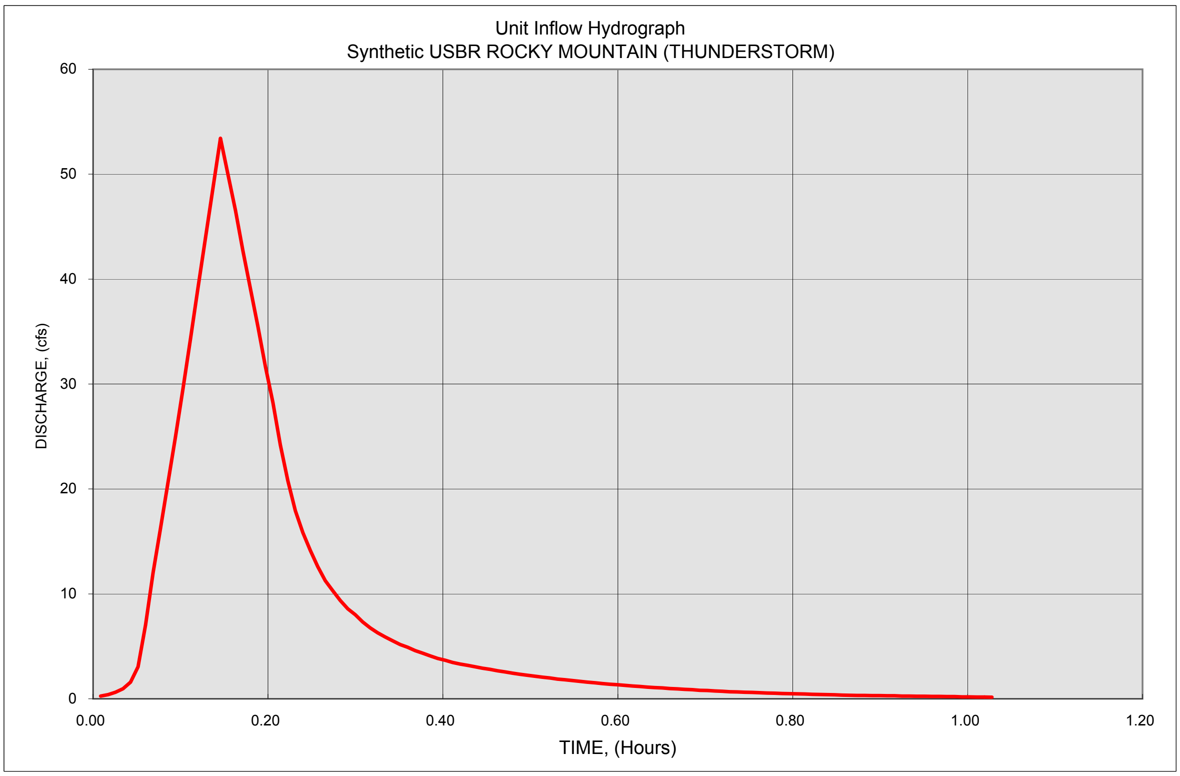
PARAMETERS:

Calculated: Lag Time, Lg = 0.13 Hours Unit Duration, D = 1.41 minutes

Calculated Timestep = 0.51 minutes

Data to be used in Analysis Unit Duration, D = 5 minutes, round down to nearest of 5, 10, 15, 30, 60, 120, 180, or 360

Selected Timestep = 1 minutes, integer value evenly divisible into 60



UI Record - Unit Graph 1 **minute interval**

UI	0	1	3	11	19	28	37	47	52	45
UI	38	30	23	17	14	11	9	8	7	6
UI	5	5	4	4	3	3	3	3	2	2
UI	2	2	2	2	1	1	1	1	1	1
UI	1	1	1	1	1	1	1	0	0	0
UI	0	0	0	0	0	0	0	0	0	0
UI	0	0								
UI										
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USBR calculated unitgraph peak = 53 Interpolated Peak = 52

Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs	Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs
5.0	0.01	0.5	0.14	0	305.0	0.52	31.3	1.05	2
10.0	0.02	1.0	0.21	0	310.0	0.53	31.9	1.00	2
15.0	0.03	1.5	0.33	1	315.0	0.54	32.4	0.96	2
20.0	0.03	2.1	0.51	1	320.0	0.55	32.9	0.92	2
25.0	0.04	2.6	0.84	2	325.0	0.56	33.4	0.88	2
30.0	0.05	3.1	1.62	3	330.0	0.57	33.9	0.84	2
35.0	0.06	3.6	3.74	7	335.0	0.57	34.4	0.81	2
40.0	0.07	4.1	6.38	12	340.0	0.58	34.9	0.77	1
45.0	0.08	4.6	8.61	16	345.0	0.59	35.5	0.74	1
50.0	0.09	5.1	10.94	21	350.0	0.60	36.0	0.71	1
55.0	0.09	5.7	13.26	25	355.0	0.61	36.5	0.68	1
60.0	0.10	6.2	15.70	30	360.0	0.62	37.0	0.65	1
65.0	0.11	6.7	18.23	34	365.0	0.63	37.5	0.62	1
70.0	0.12	7.2	20.76	39	370.0	0.63	38.0	0.59	1
75.0	0.13	7.7	23.30	44	375.0	0.64	38.5	0.57	1
80.0	0.14	8.2	25.83	49	380.0	0.65	39.1	0.55	1
85.0	0.15	8.7	28.36	53	385.0	0.66	39.6	0.52	1
90.0	0.15	9.3	26.53	50	390.0	0.67	40.1	0.50	1
95.0	0.16	9.8	24.71	47	395.0	0.68	40.6	0.48	1
100.0	0.17	10.3	22.68	43	400.0	0.69	41.1	0.46	1
105.0	0.18	10.8	20.76	39	405.0	0.69	41.6	0.43	1
110.0	0.19	11.3	18.84	35	410.0	0.70	42.1	0.42	1
115.0	0.20	11.8	16.81	32	415.0	0.71	42.7	0.40	1
120.0	0.21	12.3	14.99	28	420.0	0.72	43.2	0.38	1
125.0	0.21	12.8	12.86	24	425.0	0.73	43.7	0.36	1
130.0	0.22	13.4	11.04	21	430.0	0.74	44.2	0.35	1
135.0	0.23	13.9	9.52	18	435.0	0.75	44.7	0.33	1
140.0	0.24	14.4	8.41	16	440.0	0.75	45.2	0.32	1
145.0	0.25	14.9	7.50	14	445.0	0.76	45.7	0.31	1
150.0	0.26	15.4	6.69	13	450.0	0.77	46.3	0.29	1
155.0	0.27	15.9	5.98	11	455.0	0.78	46.8	0.28	1
160.0	0.27	16.4	5.47	10	460.0	0.79	47.3	0.27	1
165.0	0.28	17.0	4.97	9	465.0	0.80	47.8	0.26	0
170.0	0.29	17.5	4.55	9	470.0	0.81	48.3	0.25	0
175.0	0.30	18.0	4.25	8	475.0	0.81	48.8	0.24	0
180.0	0.31	18.5	3.89	7	480.0	0.82	49.3	0.23	0
185.0	0.32	19.0	3.59	7	485.0	0.83	49.8	0.22	0
190.0	0.33	19.5	3.34	6	490.0	0.84	50.4	0.21	0
195.0	0.33	20.0	3.13	6	495.0	0.85	50.9	0.20	0
200.0	0.34	20.6	2.93	6	500.0	0.86	51.4	0.19	0
205.0	0.35	21.1	2.75	5	505.0	0.87	51.9	0.18	0
210.0	0.36	21.6	2.61	5	510.0	0.87	52.4	0.17	0
215.0	0.37	22.1	2.44	5	515.0	0.88	52.9	0.17	0
220.0	0.38	22.6	2.31	4	520.0	0.89	53.4	0.16	0
225.0	0.39	23.1	2.17	4	525.0	0.90	54.0	0.16	0
230.0	0.39	23.6	2.04	4	530.0	0.91	54.5	0.15	0
235.0	0.40	24.2	1.95	4	535.0	0.92	55.0	0.15	0
240.0	0.41	24.7	1.84	3	540.0	0.93	55.5	0.14	0
245.0	0.42	25.2	1.76	3	545.0	0.93	56.0	0.14	0
250.0	0.43	25.7	1.69	3	550.0	0.94	56.5	0.13	0
255.0	0.44	26.2	1.62	3	555.0	0.95	57.0	0.13	0
260.0	0.45	26.7	1.55	3	560.0	0.96	57.6	0.12	0
265.0	0.45	27.2	1.49	3	565.0	0.97	58.1	0.12	0
270.0	0.46	27.8	1.42	3	570.0	0.98	58.6	0.11	0
275.0	0.47	28.3	1.36	3	575.0	0.99	59.1	0.11	0
280.0	0.48	28.8	1.30	2	580.0	0.99	59.6	0.10	0
285.0	0.49	29.3	1.24	2	585.0	1.00	60.1	0.10	0
290.0	0.50	29.8	1.19	2	590.0	1.01	60.6	0.09	0
295.0	0.51	30.3	1.14	2	595.0	1.02	61.2	0.09	0
300.0	0.51	30.8	1.09	2	600.0	1.03	61.7	0.08	0

NOTES :
1. Methodology used Dimensionless Unit Hydrograph.
2. For values of q use Table 4-11 from Flood Hydrology Manual

ROCKY MOUNTAIN (THUNDERSTORM) UNIT HYDROGRAPH

18-Jan-10

Old Dillon Reservoir - SW basin

LOCAL

Drainage Area =	0.014 sq. miles	Lg+D/2 =	0.22 Hours
Basin Slope =	559.3 ft./mile	Basin Factor =	0.08
L =	0.262 mi., Length of Watercourse	V' =	0.38 cfs/Day
Lca =	0.049 mi., Distance to Centroid	Qs =	1.7 * q, cfs
Kn =	0.08 -, Ave. Weighted Manning's n		

PARAMETERS:

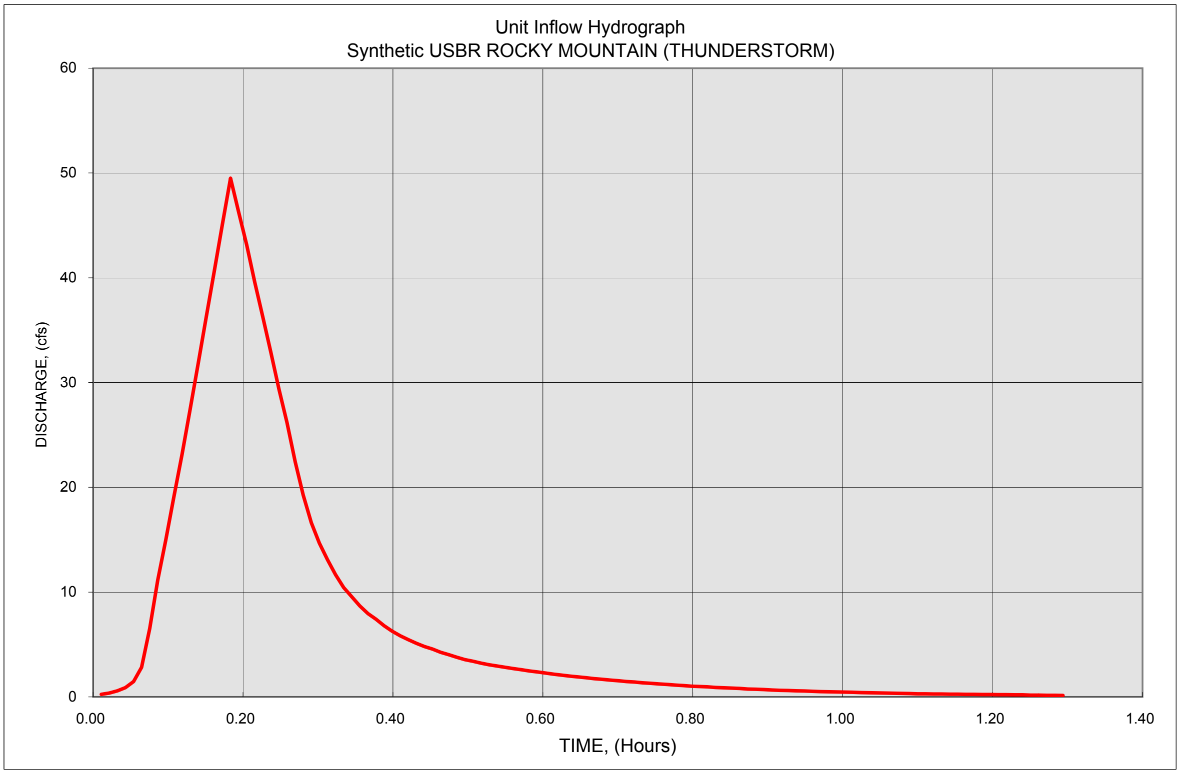
Calculated: Lag Time, Lg = 0.17 Hours — Unit Duration, D = 1.90 minutes

Calculated Timestep = 0.65 minutes

Data to be used in Analysis

Unit Duration, D = 5 minutes, round down to nearest of 5, 10, 15, 30, 60, 120, 180, or 360

Selected Timestep = 1 minutes, integer value evenly divisible into 60



UI Record - Unit Graph — **1 minute interval**

UI	0	1	1	4	10	16	22	29	36	43
UI	49	45	39	34	29	23	19	15	13	11
UI	9	8	7	6	6	5	5	4	4	4
UI	3	3	3	3	2	2	2	2	2	2
UI	2	2	1	1	1	1	1	1	1	1
UI	1	1	1	1	1	1	1	1	0	0
UI	0	0	0	0	0	0	0	0	0	0
UI	0	0	0	0	0	0	0	0		
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USBR calculated unitgraph peak = 50 Interpolated Peak = 49

Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs	Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs
5.0	0.01	0.6	0.14	0	305.0	0.66	39.5	1.05	2
10.0	0.02	1.3	0.21	0	310.0	0.67	40.1	1.00	2
15.0	0.03	1.9	0.33	1	315.0	0.68	40.8	0.96	2
20.0	0.04	2.6	0.51	1	320.0	0.69	41.4	0.92	2
25.0	0.05	3.2	0.84	1	325.0	0.70	42.1	0.88	2
30.0	0.06	3.9	1.62	3	330.0	0.71	42.7	0.84	1
35.0	0.08	4.5	3.74	7	335.0	0.72	43.3	0.81	1
40.0	0.09	5.2	6.38	11	340.0	0.73	44.0	0.77	1
45.0	0.10	5.8	8.61	15	345.0	0.74	44.6	0.74	1
50.0	0.11	6.5	10.94	19	350.0	0.75	45.3	0.71	1
55.0	0.12	7.1	13.26	23	355.0	0.77	45.9	0.68	1
60.0	0.13	7.8	15.70	27	360.0	0.78	46.6	0.65	1
65.0	0.14	8.4	18.23	32	365.0	0.79	47.2	0.62	1
70.0	0.15	9.1	20.76	36	370.0	0.80	47.9	0.59	1
75.0	0.16	9.7	23.30	41	375.0	0.81	48.5	0.57	1
80.0	0.17	10.4	25.83	45	380.0	0.82	49.2	0.55	1
85.0	0.18	11.0	28.36	50	385.0	0.83	49.8	0.52	1
90.0	0.19	11.6	26.53	46	390.0	0.84	50.5	0.50	1
95.0	0.20	12.3	24.71	43	395.0	0.85	51.1	0.48	1
100.0	0.22	12.9	22.68	40	400.0	0.86	51.8	0.46	1
105.0	0.23	13.6	20.76	36	405.0	0.87	52.4	0.43	1
110.0	0.24	14.2	18.84	33	410.0	0.88	53.0	0.42	1
115.0	0.25	14.9	16.81	29	415.0	0.89	53.7	0.40	1
120.0	0.26	15.5	14.99	26	420.0	0.91	54.3	0.38	1
125.0	0.27	16.2	12.86	22	425.0	0.92	55.0	0.36	1
130.0	0.28	16.8	11.04	19	430.0	0.93	55.6	0.35	1
135.0	0.29	17.5	9.52	17	435.0	0.94	56.3	0.33	1
140.0	0.30	18.1	8.41	15	440.0	0.95	56.9	0.32	1
145.0	0.31	18.8	7.50	13	445.0	0.96	57.6	0.31	1
150.0	0.32	19.4	6.69	12	450.0	0.97	58.2	0.29	1
155.0	0.33	20.1	5.98	10	455.0	0.98	58.9	0.28	0
160.0	0.35	20.7	5.47	10	460.0	0.99	59.5	0.27	0
165.0	0.36	21.3	4.97	9	465.0	1.00	60.2	0.26	0
170.0	0.37	22.0	4.55	8	470.0	1.01	60.8	0.25	0
175.0	0.38	22.6	4.25	7	475.0	1.02	61.5	0.24	0
180.0	0.39	23.3	3.89	7	480.0	1.04	62.1	0.23	0
185.0	0.40	23.9	3.59	6	485.0	1.05	62.8	0.22	0
190.0	0.41	24.6	3.34	6	490.0	1.06	63.4	0.21	0
195.0	0.42	25.2	3.13	5	495.0	1.07	64.0	0.20	0
200.0	0.43	25.9	2.93	5	500.0	1.08	64.7	0.19	0
205.0	0.44	26.5	2.75	5	505.0	1.09	65.3	0.18	0
210.0	0.45	27.2	2.61	5	510.0	1.10	66.0	0.17	0
215.0	0.46	27.8	2.44	4	515.0	1.11	66.6	0.17	0
220.0	0.47	28.5	2.31	4	520.0	1.12	67.3	0.16	0
225.0	0.49	29.1	2.17	4	525.0	1.13	67.9	0.16	0
230.0	0.50	29.8	2.04	4	530.0	1.14	68.6	0.15	0
235.0	0.51	30.4	1.95	3	535.0	1.15	69.2	0.15	0
240.0	0.52	31.1	1.84	3	540.0	1.16	69.9	0.14	0
245.0	0.53	31.7	1.76	3	545.0	1.18	70.5	0.14	0
250.0	0.54	32.3	1.69	3	550.0	1.19	71.2	0.13	0
255.0	0.55	33.0	1.62	3	555.0	1.20	71.8	0.13	0
260.0	0.56	33.6	1.55	3	560.0	1.21	72.5	0.12	0
265.0	0.57	34.3	1.49	3	565.0	1.22	73.1	0.12	0
270.0	0.58	34.9	1.42	2	570.0	1.23	73.8	0.11	0
275.0	0.59	35.6	1.36	2	575.0	1.24	74.4	0.11	0
280.0	0.60	36.2	1.30	2	580.0	1.25	75.0	0.10	0
285.0	0.61	36.9	1.24	2	585.0	1.26	75.7	0.10	0
290.0	0.63	37.5	1.19	2	590.0	1.27	76.3	0.09	0
295.0	0.64	38.2	1.14	2	595.0	1.28	77.0	0.09	0
300.0	0.65	38.8	1.09	2	600.0	1.29	77.6	0.08	0

NOTES :
1. Methodology used Dimensionless Unit Hydrograph.
2. For values of q use Table 4-11 from Flood Hydrology Manual

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: USBR GENERAL STORM HYDROGRAPH

Total Number of Pages (including cover sheet): 5

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: Date:

Description and Purpose:

USBR GENERAL STORM (PMP) HYDROGRAPH

Design Basis/References/Assumptions:

SPREAD SHEET FROM SEO

Remarks/Conclusions/Results:

FOR INPUT INTO HEC-1

Calculation Approved by: ______________________

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

P:\133_1187_004_03_Old_Dillon_Res\SupportDocs\Calcs\Calculation Cover Sheet_Tt.doc

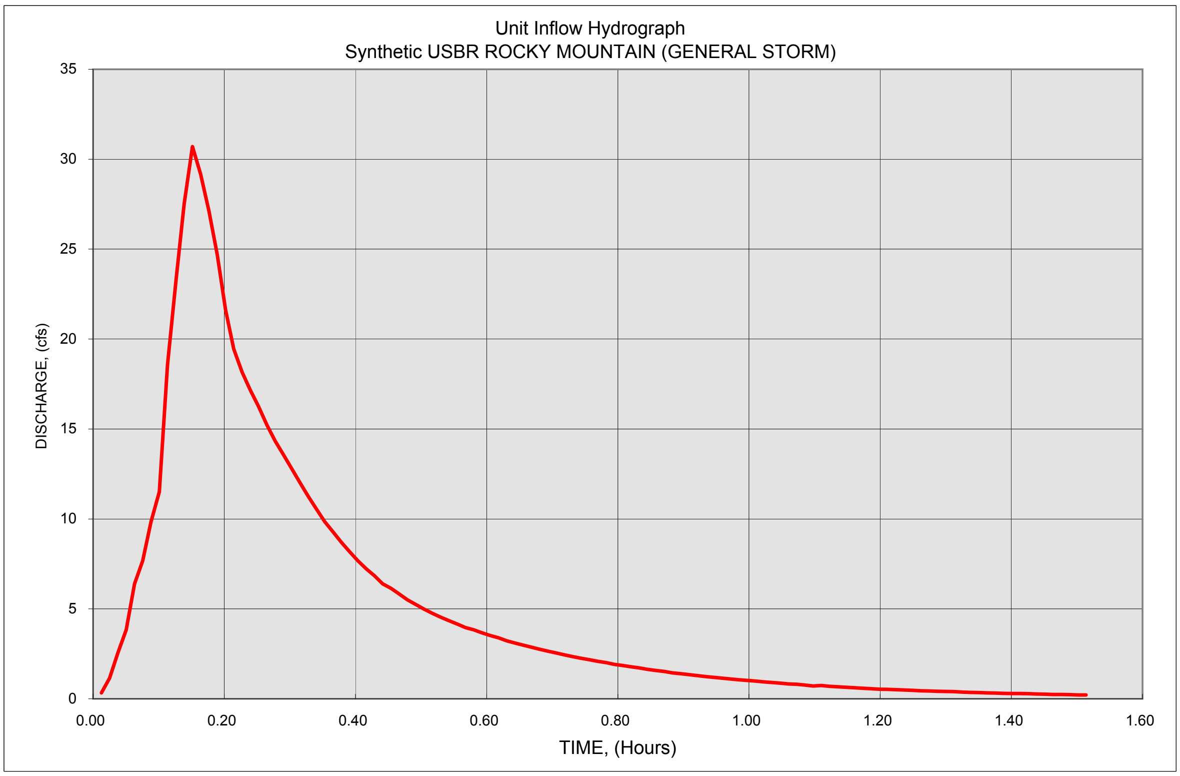
ROCKY MOUNTAIN (GENERAL STORM) UNIT HYDROGRAPH **GENERAL** 18-Jan-10

Old Dillon Reservoir - NE basin

Drainage Area =	0.012	sq. miles	Lg+D/2 =	0.25	Hours
Basin Slope =	979.488	ft./mile	Basin Factor =	0.06	
L =	0.162	mi., Length of Watercourse	V' =	0.32	cfs/Day
Lca =	0.043	mi., Distance to Centroid	Qs =	1.3	* q, cfs
Kn =	0.13	-, Ave. Weighted Manning's n			

PARAMETERS:
Calculated: Lag Time, Lg = 0.21 Hours Unit Duration, D = 2.30 minutes
Calculated Timestep = 0.76 minutes

Data to be used in Analysis Unit Duration, D = 5 minutes, round down to nearest of 5, 10, 15, 30, 60, 120, 180, or 360
Selected Timestep = 3 minutes, integer value evenly divisible into 60



UI Record - Unit Graph 3 **minute interval**

UI	4	11	30	22	16	13	10	8	6	5
UI	4	4	3	3	2	2	2	1	1	1
UI	1	1	1	1	0	0	0	0	0	0
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USBR calculated unitgraph peak = 31 Interpolated Peak = 30

Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs	Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs
5.0	0.01	0.8	0.26	0	305.0	0.77	46.2	1.63	2
10.0	0.03	1.5	0.90	1	310.0	0.78	46.9	1.57	2
15.0	0.04	2.3	2.00	3	315.0	0.79	47.7	1.50	2
20.0	0.05	3.0	3.00	4	320.0	0.81	48.4	1.45	2
25.0	0.06	3.8	5.00	6	325.0	0.82	49.2	1.39	2
30.0	0.08	4.5	6.00	8	330.0	0.83	50.0	1.34	2
35.0	0.09	5.3	7.70	10	335.0	0.85	50.7	1.28	2
40.0	0.10	6.1	9.00	12	340.0	0.86	51.5	1.23	2
45.0	0.11	6.8	14.51	19	345.0	0.87	52.2	1.19	2
50.0	0.13	7.6	18.11	23	350.0	0.88	53.0	1.13	1
55.0	0.14	8.3	21.51	28	355.0	0.90	53.7	1.09	1
60.0	0.15	9.1	24.01	31	360.0	0.91	54.5	1.05	1
65.0	0.16	9.8	22.81	29	365.0	0.92	55.3	1.01	1
70.0	0.18	10.6	21.21	27	370.0	0.93	56.0	0.97	1
75.0	0.19	11.4	19.31	25	375.0	0.95	56.8	0.93	1
80.0	0.20	12.1	16.91	22	380.0	0.96	57.5	0.90	1
85.0	0.21	12.9	15.21	19	385.0	0.97	58.3	0.86	1
90.0	0.23	13.6	14.21	18	390.0	0.98	59.0	0.83	1
95.0	0.24	14.4	13.41	17	395.0	1.00	59.8	0.80	1
100.0	0.25	15.1	12.71	16	400.0	1.01	60.6	0.77	1
105.0	0.26	15.9	11.91	15	405.0	1.02	61.3	0.74	1
110.0	0.28	16.7	11.21	14	410.0	1.03	62.1	0.71	1
115.0	0.29	17.4	10.61	14	415.0	1.05	62.8	0.68	1
120.0	0.30	18.2	10.01	13	420.0	1.06	63.6	0.65	1
125.0	0.32	18.9	9.40	12	425.0	1.07	64.3	0.63	1
130.0	0.33	19.7	8.80	11	430.0	1.09	65.1	0.60	1
135.0	0.34	20.4	8.25	11	435.0	1.10	65.9	0.56	1
140.0	0.35	21.2	7.70	10	440.0	1.11	66.6	0.58	1
145.0	0.37	22.0	7.25	9	445.0	1.12	67.4	0.54	1
150.0	0.38	22.7	6.80	9	450.0	1.14	68.1	0.52	1
155.0	0.39	23.5	6.40	8	455.0	1.15	68.9	0.50	1
160.0	0.40	24.2	6.00	8	460.0	1.16	69.6	0.48	1
165.0	0.42	25.0	5.65	7	465.0	1.17	70.4	0.46	1
170.0	0.43	25.7	5.35	7	470.0	1.19	71.2	0.44	1
175.0	0.44	26.5	5.00	6	475.0	1.20	71.9	0.42	1
180.0	0.45	27.3	4.80	6	480.0	1.21	72.7	0.41	1
185.0	0.47	28.0	4.55	6	485.0	1.22	73.4	0.40	1
190.0	0.48	28.8	4.30	5	490.0	1.24	74.2	0.38	0
195.0	0.49	29.5	4.10	5	495.0	1.25	74.9	0.37	0
200.0	0.50	30.3	3.90	5	500.0	1.26	75.7	0.35	0
205.0	0.52	31.0	3.72	5	505.0	1.27	76.5	0.34	0
210.0	0.53	31.8	3.55	5	510.0	1.29	77.2	0.33	0
215.0	0.54	32.6	3.40	4	515.0	1.30	78.0	0.32	0
220.0	0.56	33.3	3.25	4	520.0	1.31	78.7	0.31	0
225.0	0.57	34.1	3.10	4	525.0	1.32	79.5	0.29	0
230.0	0.58	34.8	3.00	4	530.0	1.34	80.2	0.28	0
235.0	0.59	35.6	2.87	4	535.0	1.35	81.0	0.27	0
240.0	0.61	36.3	2.75	4	540.0	1.36	81.8	0.26	0
245.0	0.62	37.1	2.65	3	545.0	1.38	82.5	0.25	0
250.0	0.63	37.8	2.52	3	550.0	1.39	83.3	0.24	0
255.0	0.64	38.6	2.42	3	555.0	1.40	84.0	0.23	0
260.0	0.66	39.4	2.33	3	560.0	1.41	84.8	0.23	0
265.0	0.67	40.1	2.24	3	565.0	1.43	85.5	0.22	0
270.0	0.68	40.9	2.15	3	570.0	1.44	86.3	0.21	0
275.0	0.69	41.6	2.07	3	575.0	1.45	87.1	0.20	0
280.0	0.71	42.4	1.99	3	580.0	1.46	87.8	0.19	0
285.0	0.72	43.1	1.91	2	585.0	1.48	88.6	0.19	0
290.0	0.73	43.9	1.83	2	590.0	1.49	89.3	0.18	0
295.0	0.74	44.7	1.76	2	595.0	1.50	90.1	0.17	0
300.0	0.76	45.4	1.70	2	600.0	1.51	90.8	0.17	0

NOTES :
1. Methodology used Dimensionless Unit Hydrograph.
2. For values of q use Table 4-9 from Flood Hydrology Manual

ROCKY MOUNTAIN (GENERAL STORM) UNIT HYDROGRAPH **GENERAL** 18-Jan-10

Old Dillon Reservoir - SW basin

Drainage Area =	0.014	sq. miles	Lg+D/2 =	0.32	Hours
Basin Slope =	559.3	ft./mile	Basin Factor =	0.08	
L =	0.262	mi., Length of Watercourse	V' =	0.38	cfs/Day
Lca =	0.049	mi., Distance to Centroid	Qs =	1.2	* q, cfs
Kn =	0.13	-, Ave. Weighted Manning's n			

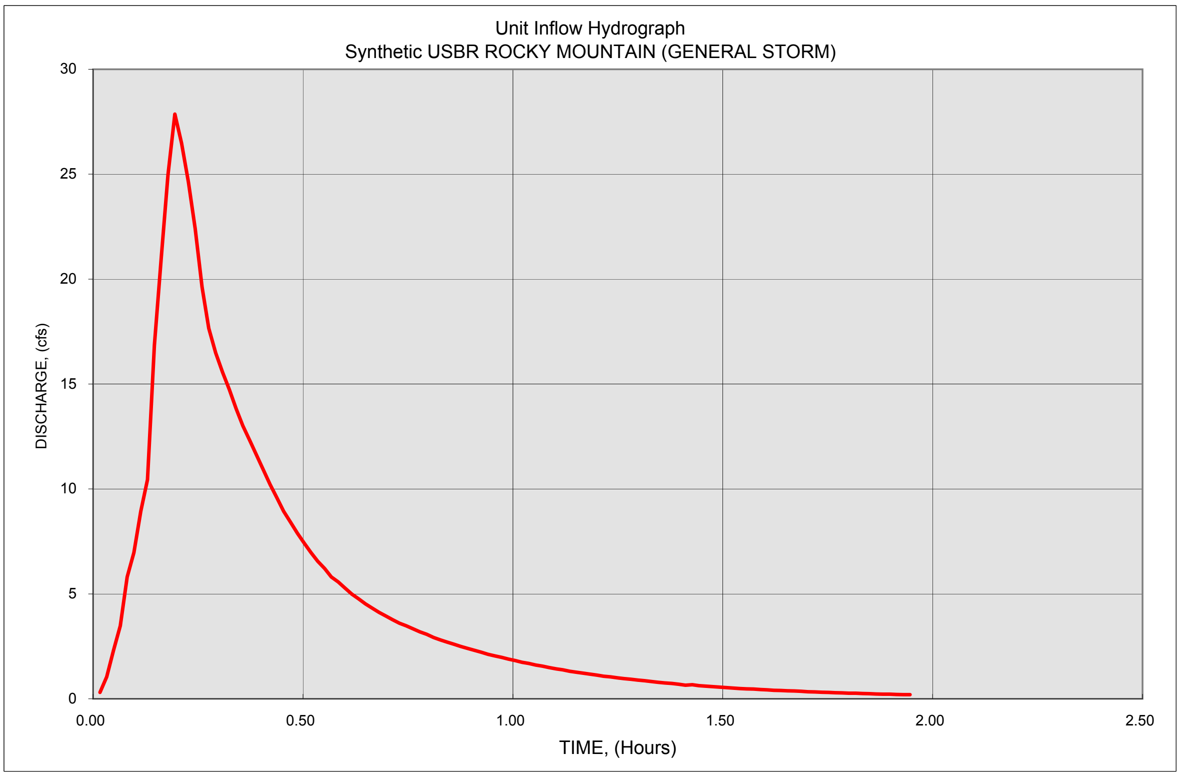
PARAMETERS:

Calculated: Lag Time, Lg = 0.28 Hours Unit Duration, D = 3.08 minutes

Calculated Timestep = 0.97 minutes

Data to be used in Analysis Unit Duration, D = 5 minutes, round down to nearest of 5, 10, 15, 30, 60, 120, 180, or 360

Selected Timestep = 3 minutes, integer value evenly divisible into 60



UI Record - Unit Graph 3 **minute interval**

UI	2	7	18	27	21	16	13	11	9	8
UI	6	5	5	4	3	3	3	2	2	2
UI	2	1	1	1	1	1	1	1	1	1
UI	0	0	0	0	0	0	0	0	0	
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USBR calculated unitgraph peak = 28 Interpolated Peak = 27

Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs	Time t, % of Lg+D/2	Hours	Min.	q	Qs cfs
5.0	0.02	1.0	0.26	0	305.0	0.99	59.4	1.63	2
10.0	0.03	1.9	0.90	1	310.0	1.01	60.3	1.57	2
15.0	0.05	2.9	2.00	2	315.0	1.02	61.3	1.50	2
20.0	0.06	3.9	3.00	3	320.0	1.04	62.3	1.45	2
25.0	0.08	4.9	5.00	6	325.0	1.05	63.3	1.39	2
30.0	0.10	5.8	6.00	7	330.0	1.07	64.2	1.34	2
35.0	0.11	6.8	7.70	9	335.0	1.09	65.2	1.28	1
40.0	0.13	7.8	9.00	10	340.0	1.10	66.2	1.23	1
45.0	0.15	8.8	14.51	17	345.0	1.12	67.1	1.19	1
50.0	0.16	9.7	18.11	21	350.0	1.14	68.1	1.13	1
55.0	0.18	10.7	21.51	25	355.0	1.15	69.1	1.09	1
60.0	0.19	11.7	24.01	28	360.0	1.17	70.1	1.05	1
65.0	0.21	12.7	22.81	26	365.0	1.18	71.0	1.01	1
70.0	0.23	13.6	21.21	25	370.0	1.20	72.0	0.97	1
75.0	0.24	14.6	19.31	22	375.0	1.22	73.0	0.93	1
80.0	0.26	15.6	16.91	20	380.0	1.23	74.0	0.90	1
85.0	0.28	16.5	15.21	18	385.0	1.25	74.9	0.86	1
90.0	0.29	17.5	14.21	16	390.0	1.27	75.9	0.83	1
95.0	0.31	18.5	13.41	16	395.0	1.28	76.9	0.80	1
100.0	0.32	19.5	12.71	15	400.0	1.30	77.9	0.77	1
105.0	0.34	20.4	11.91	14	405.0	1.31	78.8	0.74	1
110.0	0.36	21.4	11.21	13	410.0	1.33	79.8	0.71	1
115.0	0.37	22.4	10.61	12	415.0	1.35	80.8	0.68	1
120.0	0.39	23.4	10.01	12	420.0	1.36	81.7	0.65	1
125.0	0.41	24.3	9.40	11	425.0	1.38	82.7	0.63	1
130.0	0.42	25.3	8.80	10	430.0	1.39	83.7	0.60	1
135.0	0.44	26.3	8.25	10	435.0	1.41	84.7	0.56	1
140.0	0.45	27.2	7.70	9	440.0	1.43	85.6	0.58	1
145.0	0.47	28.2	7.25	8	445.0	1.44	86.6	0.54	1
150.0	0.49	29.2	6.80	8	450.0	1.46	87.6	0.52	1
155.0	0.50	30.2	6.40	7	455.0	1.48	88.6	0.50	1
160.0	0.52	31.1	6.00	7	460.0	1.49	89.5	0.48	1
165.0	0.54	32.1	5.65	7	465.0	1.51	90.5	0.46	1
170.0	0.55	33.1	5.35	6	470.0	1.52	91.5	0.44	1
175.0	0.57	34.1	5.00	6	475.0	1.54	92.5	0.42	0
180.0	0.58	35.0	4.80	6	480.0	1.56	93.4	0.41	0
185.0	0.60	36.0	4.55	5	485.0	1.57	94.4	0.40	0
190.0	0.62	37.0	4.30	5	490.0	1.59	95.4	0.38	0
195.0	0.63	38.0	4.10	5	495.0	1.61	96.3	0.37	0
200.0	0.65	38.9	3.90	5	500.0	1.62	97.3	0.35	0
205.0	0.66	39.9	3.72	4	505.0	1.64	98.3	0.34	0
210.0	0.68	40.9	3.55	4	510.0	1.65	99.3	0.33	0
215.0	0.70	41.8	3.40	4	515.0	1.67	100.2	0.32	0
220.0	0.71	42.8	3.25	4	520.0	1.69	101.2	0.31	0
225.0	0.73	43.8	3.10	4	525.0	1.70	102.2	0.29	0
230.0	0.75	44.8	3.00	3	530.0	1.72	103.2	0.28	0
235.0	0.76	45.7	2.87	3	535.0	1.74	104.1	0.27	0
240.0	0.78	46.7	2.75	3	540.0	1.75	105.1	0.26	0
245.0	0.79	47.7	2.65	3	545.0	1.77	106.1	0.25	0
250.0	0.81	48.7	2.52	3	550.0	1.78	107.0	0.24	0
255.0	0.83	49.6	2.42	3	555.0	1.80	108.0	0.23	0
260.0	0.84	50.6	2.33	3	560.0	1.82	109.0	0.23	0
265.0	0.86	51.6	2.24	3	565.0	1.83	110.0	0.22	0
270.0	0.88	52.6	2.15	2	570.0	1.85	110.9	0.21	0
275.0	0.89	53.5	2.07	2	575.0	1.87	111.9	0.20	0
280.0	0.91	54.5	1.99	2	580.0	1.88	112.9	0.19	0
285.0	0.92	55.5	1.91	2	585.0	1.90	113.9	0.19	0
290.0	0.94	56.4	1.83	2	590.0	1.91	114.8	0.18	0
295.0	0.96	57.4	1.76	2	595.0	1.93	115.8	0.17	0
300.0	0.97	58.4	1.70	2	600.0	1.95	116.8	0.17	0

NOTES : 1. Methodology used Dimensionless Unit Hydrograph.
2. For values of q use Table 4-9 from Flood Hydrology Manual

NRCS DOCUMENTATION

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: NRCS SOIL GROUP FOR OD.R. WATERSHED

Total Number of Pages (including cover sheet): 5

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: Date:

Description and Purpose:

DETERMINE SOIL GROUP FOR O.D.R. WATERSHED

Design Basis/References/Assumptions:

USING website: http://websurvey.nrcs.usda.gov/app/

Remarks/Conclusions/Results:

SOIL GROUP FOR ENTIRE WATERSHED

= TYPE B

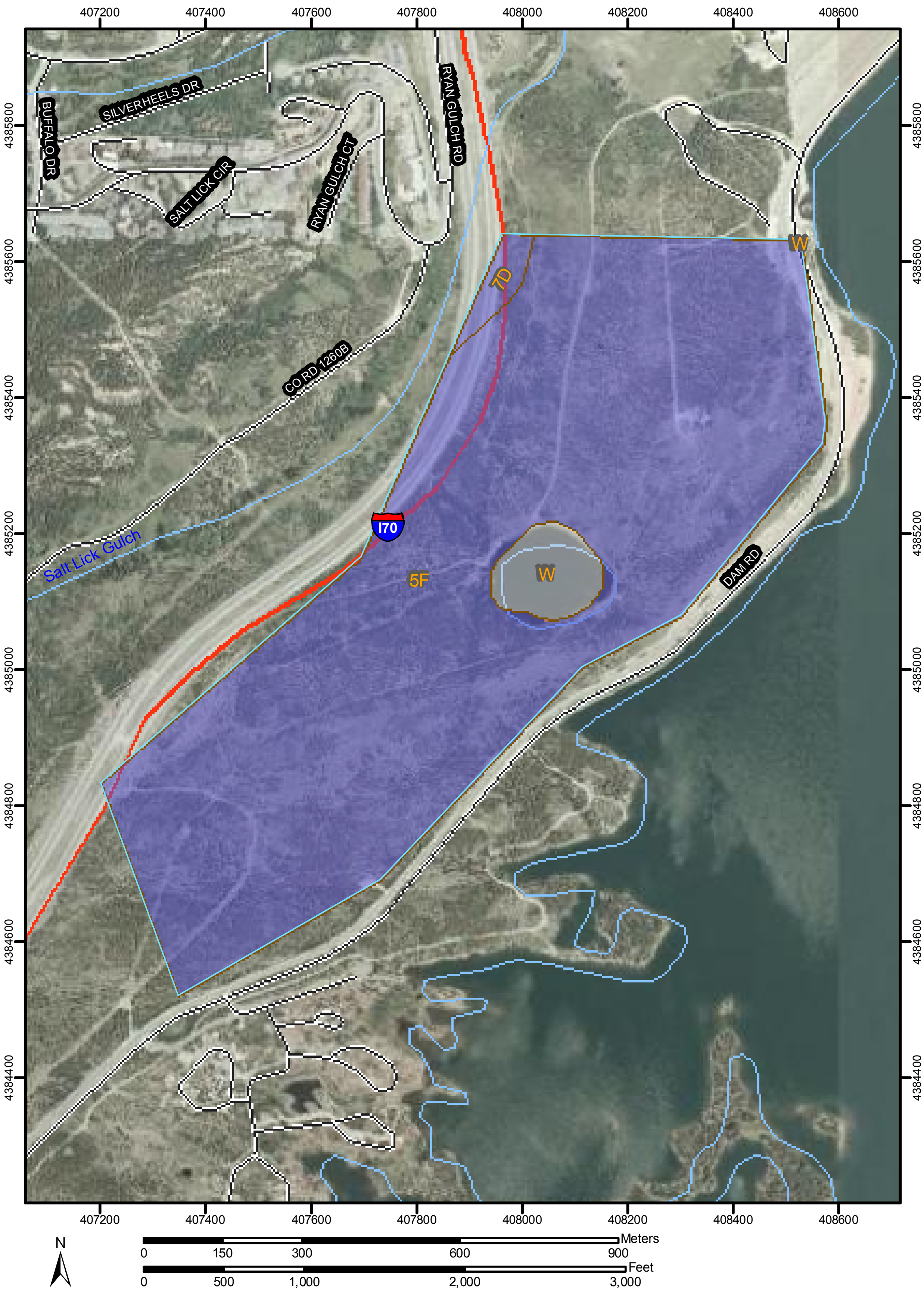
Calculation Approved by: [signature] 10/24/08

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

Hydrologic Soil Group–Summit County Area, Colorado
(Old Dillon Dam)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Municipalities

Cities

Urban Areas

Water Features

Oceans

Streams and Canals

Transportation

Rails

Roads

Interstate Highways

US Routes

State Highways

Local Roads

Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County Area, Colorado
Survey Area Data: Version 4, Jan 30, 2008

Date(s) aerial images were photographed: 1999

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Summit County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5F	Frisco-Peeler complex, 25 to 65 percent slopes	B	207.9	95.3%
7D	Grenadier gravelly loam, 6 to 15 percent slopes	B	3.0	1.4%
W	Water		7.3	3.3%
Totals for Area of Interest (AOI)			218.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: NRCS CURVE NUMBER

Total Number of Pages (including cover sheet): 2

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: Date:

Description and Purpose:

CURVE NUMBER EQUIVALENT FOR ODR WATERSHED

Design Basis/References/Assumptions:

- TYPE B SOIL GROUP
- ASSUME ALL TREE'S IN WATERSHED REMOVED
  - DUE TO PINE BEETLE OR FIRE
- CHOOSE HIGHEST CN FOR TYPE B SOILS

Remarks/Conclusions/Results:

- USE CN OF 86 FOR MOST CONSERVATIVE CASE

Calculation Approved by: ______________________

Project Manager Date

Revision No.:	Description of Revision:	Approved by:
		Project Manager/Date

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and I_a=0.2s
2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: NRCS TIME OF CONCENTRATION

Total Number of Pages (including cover sheet): 3

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 16, 2008

Checked by: Date:

Description and Purpose:

DETERMINE TIME OF CONCENTRATION (Tc) FOR THE TWO ODR SUBBASINS

Design Basis/References/Assumptions:

Remarks/Conclusions/Results:

- ASSUME Tc = 5 minutes for Reservoir

Calculation Approved by:

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

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BASIN NE	
Sheet Flow (Applicable to Tc only) Segment ID	
1. Surface description (Table 3-1)	Fallow (no residue)
2. Manning's roughness coeff., n (Table 3-1)	0.05
3. Flow length, L (total L < 100 ft) .... ft	300
4. Two-year 24-hour rainfall, P2.. in	1.16
5. Land slope, s .... ft/ft	0.08
top elevation	9,349
bottom elevation	9,324
6. Compute Tt .... hr	0.15
Shallow Concentrated Flow	
7. Surface description (paved or unpaved)	unpaved
8. Flow length, L .... ft	554
9. Watercourse slope, s .... ft/ft	0.24
top elevation	9,324
bottom elevation	9,191
10. Average velocity, V (Figure 3-1) .... ft/s	7.92
11. Compute Tt .... hr	0.019
Tc	0.173
No channelized flow	
SCS lag time (tc x 0.6)	0.104

BASIN SW	
Sheet Flow (Applicable to Tc only) Segment ID	
1. Surface description (Table 3-1)	Fallow (no residue)
2. Manning's roughness coeff., n (Table 3-1)	0.05
3. Flow length, L (total L < 100 ft) .... ft	300
4. Two-year 24-hour rainfall, P2.. in	1.16
5. Land slope, s .... ft/ft	0.12
top elevation	9,337
bottom elevation	9,300
6. Compute Tt .... hr	0.13
Shallow Concentrated Flow	
7. Surface description (paved or unpaved)	unpaved
8. Flow length, L .... ft	1148
9. Watercourse slope, s .... ft/ft	0.10
top elevation	9,300
bottom elevation	9,191
10. Average velocity, V (Figure 3-1) .... ft/s	4.98
11. Compute Tt .... hr	0.064
Tc	0.195
No channelized flow	
SCS lag time (tc x 0.6)	0.117

HMR-49
PMP Storm Determination

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: LOCAL STORM PMP COMPUTATION

Total Number of Pages (including cover sheet): 7

Total Number of Computer Runs: N/A

Prepared by: AJT Date: OCT 6, 2008

Checked by: Date:

Description and Purpose:

DETERMINE LOCAL PMP

Design Basis/References/Assumptions:

HMR-49, PMP ESTIMATES, COLORADO RIVER

Remarks/Conclusions/Results:

ONE HOUR INCREMENTS

0.25 0.58 8.4 ~~1.48~~ 1.18 0.34 0.17

(FOR INPUT INTO ~~HEC~~-1 / HEC-HMS)

Calculation Approved by: [signature] 10/24/08

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

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Table 6.3A.--Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage OLD DILLON RESERVOIR Area 0.05 mi^2 (km^2)
Latitude 39° 36' 40.19" Longitude 106° 04' 17.53" Minimum Elevation 9200 ft (m)
39.611235° 106.071270°

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 10.5 in. (~~mm~~)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 80 %

   b. Multiply step 1 by step 2a. 8.4 in. (~~mm~~)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.27

	Duration (hr)									
	1/4	1/2	3/4	1	2	3	4	5	6	
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	74	89	95	100	114	121	125	128	130	%
5. 1-mi^2 (2.6-km^2) PMP for indicated durations [step 2b X step 4].	6.22	7.48	7.98	8.4	9.58	10.16	10.5	10.75	10.92	in. (mm)
6. Areal reduction [fig. 4.9].	100%									%
7. Areal reduced PMP [steps 5 X 6].	6.22	7.48	7.98	8.40	9.58	10.16	10.50	10.75	10.92	in. (mm)
8. Incremental PMP [successive subtraction in step 7].				8.4	1.18	0.58	0.34	0.25	0.17	in. (mm)
	6.22	1.26	0.5	0.42	} 15-min. increments					

9. Time sequence of incremental PMP according to:

   Hourly increments [table 4.7]. 0.25 0.58 8.4 1.18 0.34 0.17 in. (mm)

   Four largest 15-min. increments [table 4.8]. 6.22 1.26 0.5 0.42 in. (mm)

10.92" total

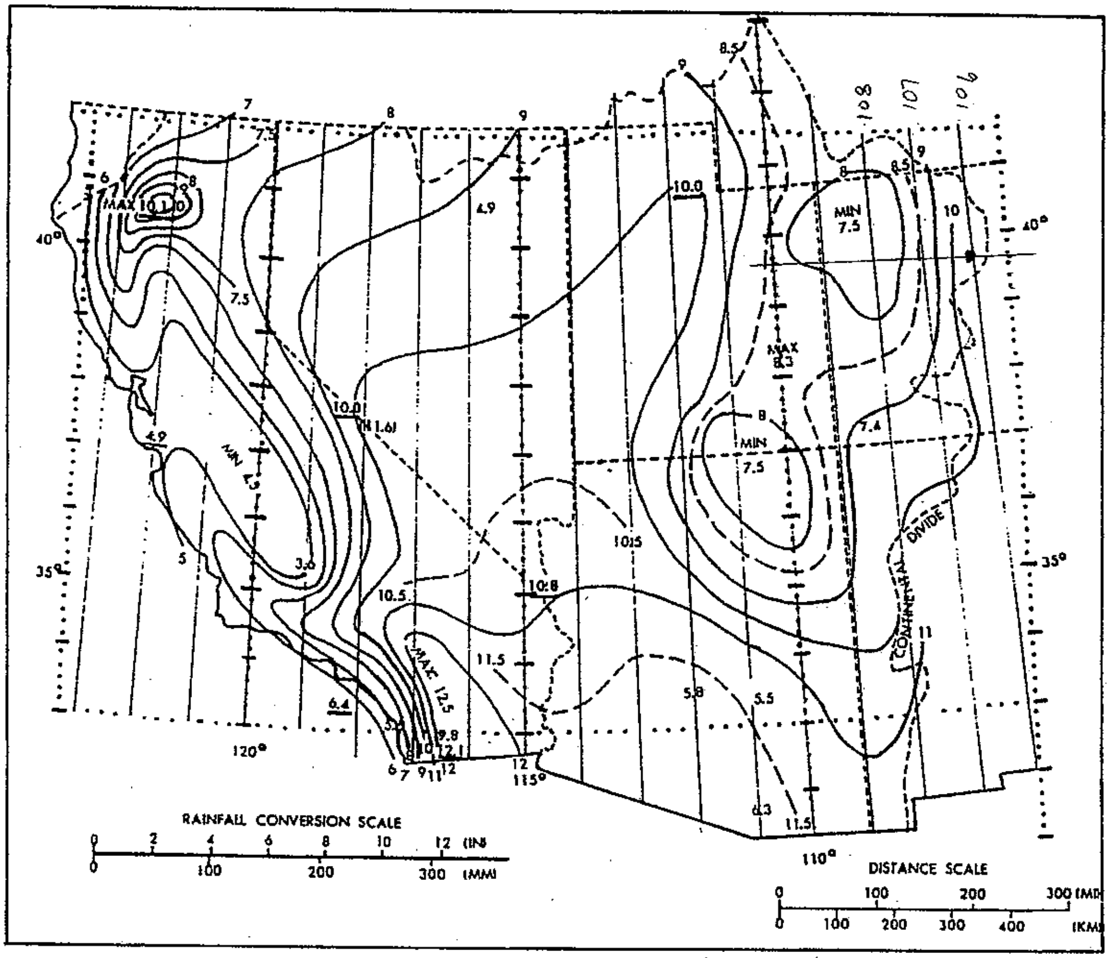


Figure 4.5--Local-storm PMP for 1 mi^2 (2.6 km^2) 1 hr. Directly applicable for locations between sea level and 5000 ft (1524 m). Elevation adjustment must be applied for locations above 5000 ft.

events. In contrast to figure 4.4, figure 4.5 maintains a maximum between these two locations. There is no known meteorological basis for a different solution. The analysis suggests that in the northern portion of the region maximum PMP occurs between the Sierra Nevada on the west and the Wasatch range on the east.

A discrete maximum (> 10 inches, 254 mm) occurs at the north end of the Sacramento Valley in northern California because the northward-flowing moist air is increasingly channeled and forced upslope. Support for this PMP center comes from the Newton, Kennett, and Red Bluff storms (fig. 4.1). Although the analysis in this region appears to be an extension of the broad maximum through the center of the Southwestern Region, it does not indicate the direction of moist inflow. The pattern has evolved primarily as a result of attempts to tie plotted maxima into a reasonable picture while considering inflow directions, terrain effects, and moisture potential.

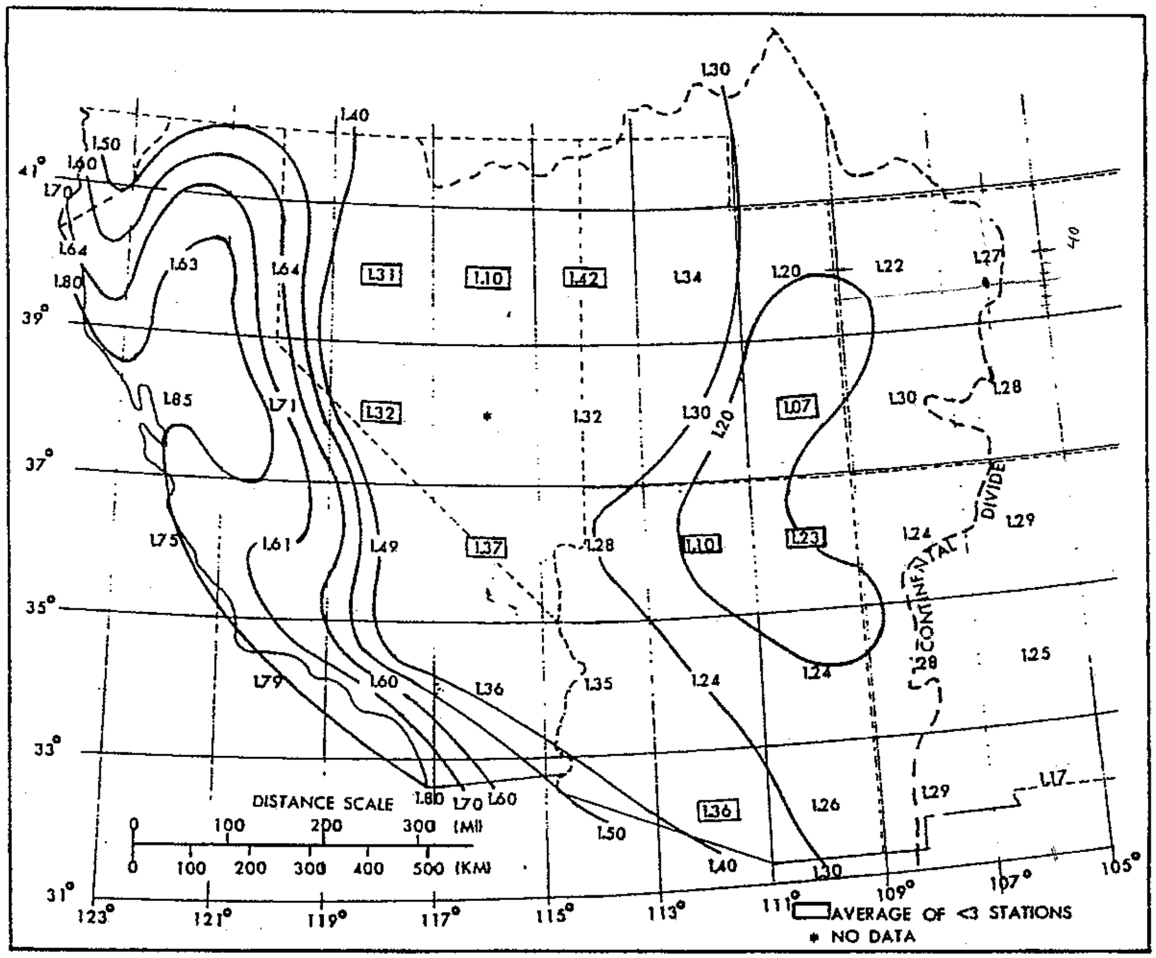


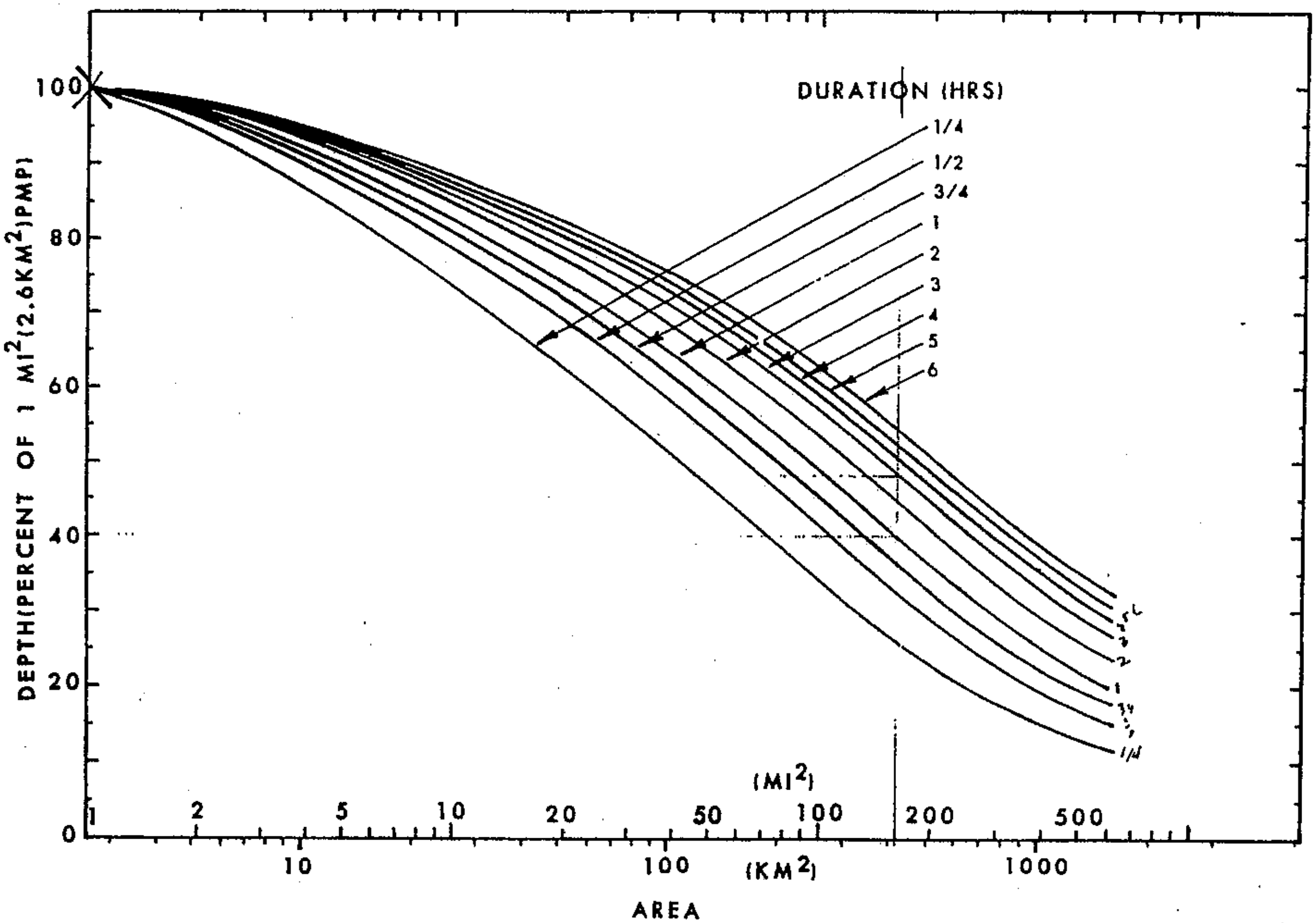
Figure 4.7.--Analysis of 6/1-hr ratios of averaged maximum station data (plotted at midpoints of a 2° latitude-longitude grid).

establish the basic depth-duration curve, then structure a variable set of depth-duration curves to cover the range of 6/1-hr ratios that are needed.

Three sets of data were considered for obtaining a base relation (see table 4.3 for depth-duration data).

a. An average of depth-duration relations from each of 17 greatest 3-hr rains from summer storms (1940-49) in Utah (U. S. Weather Bureau 1951b) and in unpublished tabulations for Nevada and Arizona (1940-63). The 3-hr amounts ranged from 1 to 3 inches (25 to 76 mm) in these events.

b. An average depth-duration relation from 14 of the most extreme short-duration storms listed in Storm Rainfall (U. S. Army, Corps of Engineers 1945-). These storms come from Eastern and Central States and have 3-hr amounts of 5 to 22 inches (127 to 559 mm).



AREA = 0.05 mi^2

Figure 4.9.--Adopted depth-area relations for local-storm PMP.

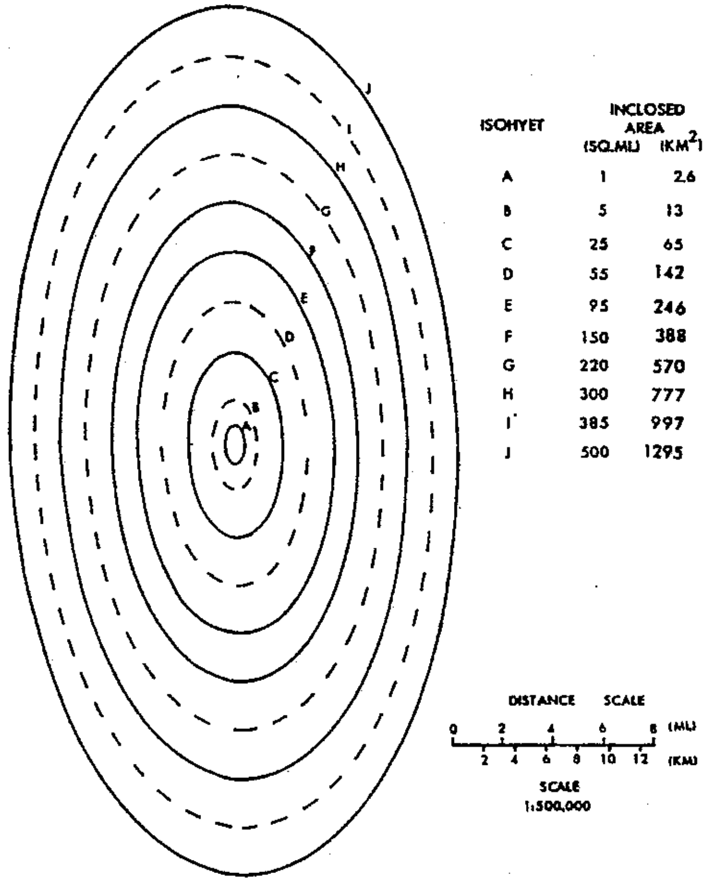


Figure 4.10.--Idealized local-storm isohyetal pattern.

storm period. The sequence of hourly incremental PMP for the Southwest 6-hr thunderstorm in accord with this study is presented in column 2 of table 4.7. A small variation from this sequence is given in Engineering Manual 1110-2-1411 (U. S. Army, Corps of Engineers 1965). The latter, listed in column 3 of table 4.7, places greater incremental amounts somewhat more toward the end of the 6-hr storm period. In application, the choice of either of these distributions is left to the user since one may prove to be more critical in a specific case than the other.

Table 4.7.--Time sequence for hourly incremental PMP in 6-hr storm

Increment	HMR No. 5[1] Sequence Position	EM1110-2-1411[2] Sequence Position
Largest hourly amount	Third	Fourth
2nd largest	Fourth	Third
3rd largest	Second	Fifth
4th largest	Fifth	Second
5th largest	First	Last
least	Last	First

[1]U. S. Weather Bureau 1947.
[2]U. S. Corps of Engineers 1952.

Also of importance is the sequence of the four 15-min incremental PMP values. We recommend a time distribution, table 4.8, giving the greatest intensity in the first 15-min interval (U.S. Weather Bureau 1947). This is based on data from a broad geographical region. Additional support for this time distribution is found in the reports of specific storms by Keppell (1963) and Osborn and Renard (1969).

Table 4.8--Time sequence for 15-min incremental PMP within 1 hr.

Increment	Sequence Position
Largest 15-min amount	First
2nd largest	Second
3rd largest	Third
least	Last

4.8 Seasonal Distribution

The time of the year when local-storm PMP is most likely is of interest. Guidance was obtained from analysis of the distribution of maximum 1-hr thunderstorm events through the warm season at the recording stations in Utah, Arizona, and in southern California (south of 37°N and east of the Sierra Nevada ridgeline). The period of record used was for 1940-72 with an average record length for the stations considered of 27 years. The month with the one greatest thunderstorm rainfall for the period of record at each station was noted. The totals of these events for each month, by States, are shown in table 4.9.

Table 4.9.--Seasonal distribution of thunderstorm rainfalls.

(The maximum event at each of 108 stations, period of record 1940-72.)

	Month						
	M	J	J	A	S	O	No. of Cases
Utah	1	5	9	14	5		34
Arizona		4	16	19	4		43
S. Calif.*		14	10	7			31
No. of cases/mo.	1	23	35	40	9	0	

*South of 37°N and east of Sierra Nevada ridgeline.

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: GENERAL STORM PMP CALCULATION

Total Number of Pages (including cover sheet): ______

Total Number of Computer Runs: ______

Prepared by: AJT Date: OCT 6, 2008

Checked by: ______ Date: ______

Description and Purpose:

DETERMINE GENERAL STORM PMP FOR

JULY, AUGUST, SEPTEMBER; OCTOBER

Design Basis/References/Assumptions:

HMR-49

Remarks/Conclusions/Results:

DETERMINED 6, 12, 18, 24, 48, 72 hr RAINFALL AMOUNTS

- USED CURVE FIT TO DETERMINE 5min 30min, 1hr, 2hr, 3hr

- FOR INPUT INTO HEC-1/HEC-HMS

Calculation Approved by: ______ 10/24/08

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

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Table 6.1.--General-storm PMP computations for the Colorado River and Great basin

Drainage OLD DILLON RES Area 0.05 mi^2 (km^2)

Latitude 39°36", Longitude ___ of basin center 106°04'

Month JULY

Step		Duration (hrs) 6	12	18	24	48	72	
A. Convergence PMP								
1. Drainage average value from one of figures 2.5 to 2.16	15 in. (mm)							
2. Reduction for barrier-elevation [fig. 2.18]	30 %							
3. Barrier-elevation reduced PMP [step 1 X step 2]	4.5 in. (mm)							
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].		69	86	94	100	115	121	%
5. Convergence PMP for indicated durations [steps 3 X 4]		3.1	3.9	4.2	4.5	5.2	5.4	in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]		3.1	0.8	0.3	0.3	0.7	0.2	in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]		100	100	100	100	100	100	%
8. Areally reduced PMP [step 6 X step 7]		3.1	0.8	0.3	0.3	0.7	0.2	in. (mm)
9. Drainage average PMP [accumulated values of step 8]		3.1	3.9	4.2	4.5	5.2	5.4	in. (mm)
B. Orographic PMP								
1. Drainage average orographic index from figure 3.11a to d.	8.5 in. (mm)							
2. Areal reduction [figure 3.20]	100 %							
3. Adjustment for month [one of figs. 3.12 to 3.17]	102 %							
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	8.67 in. (mm)							
		6	12	18	24	48	72	
5. Durational variation [table ~~3.6]~~ 3.9		30	57	80	100	158	186	%
6. Orographic PMP for given durations [steps 4 X 5]		2.6	4.9	6.9	8.7	13.7	16.1	in. (mm)
C. Total PMP								
1. Add steps A9 and B6		5.7	8.8	11.1	13.2	18.9	21.5	in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.								
3. Comparison with local-storm PMP (see sec. 6.3).								

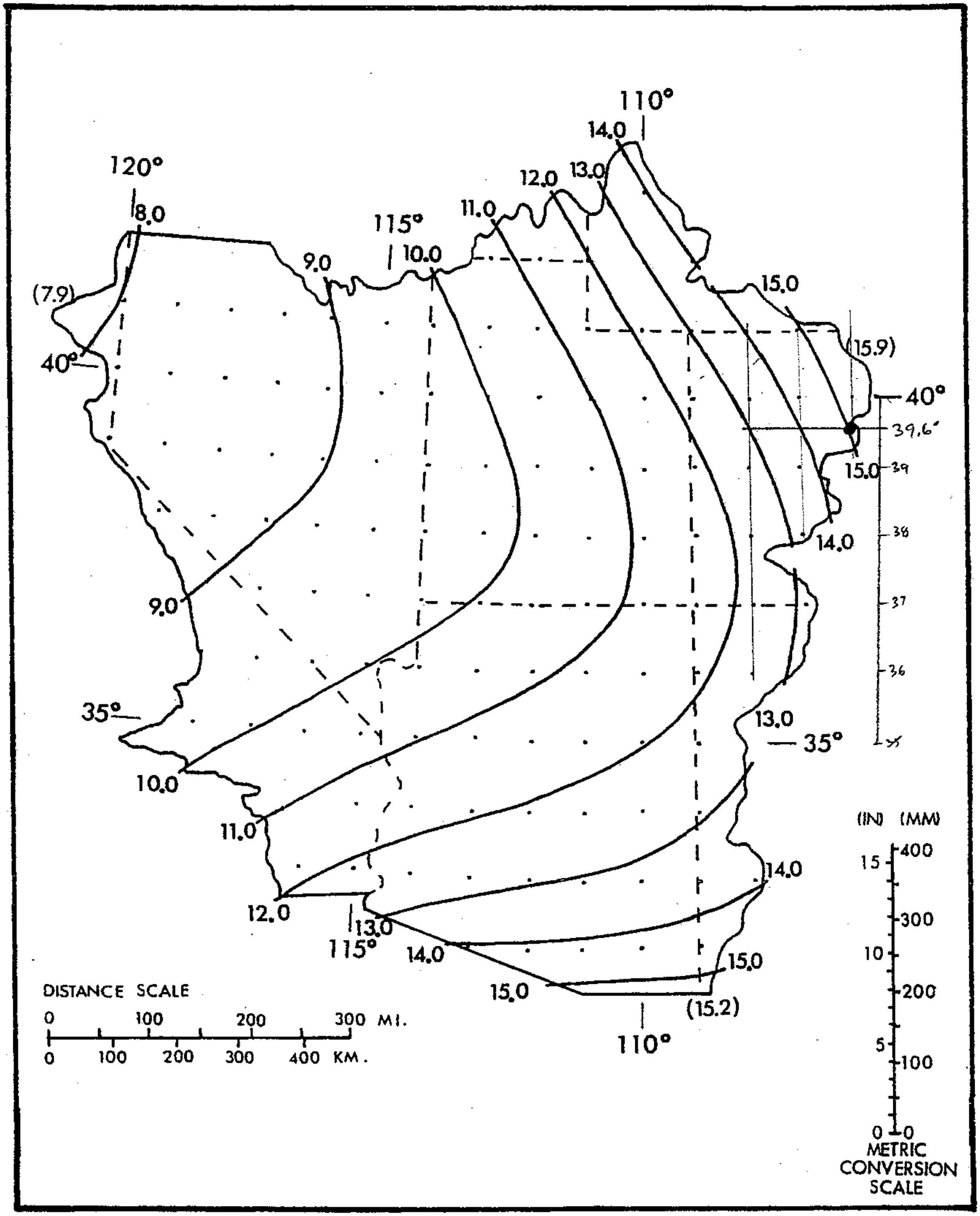


Figure 2.11.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi2 (26 km2) for July. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

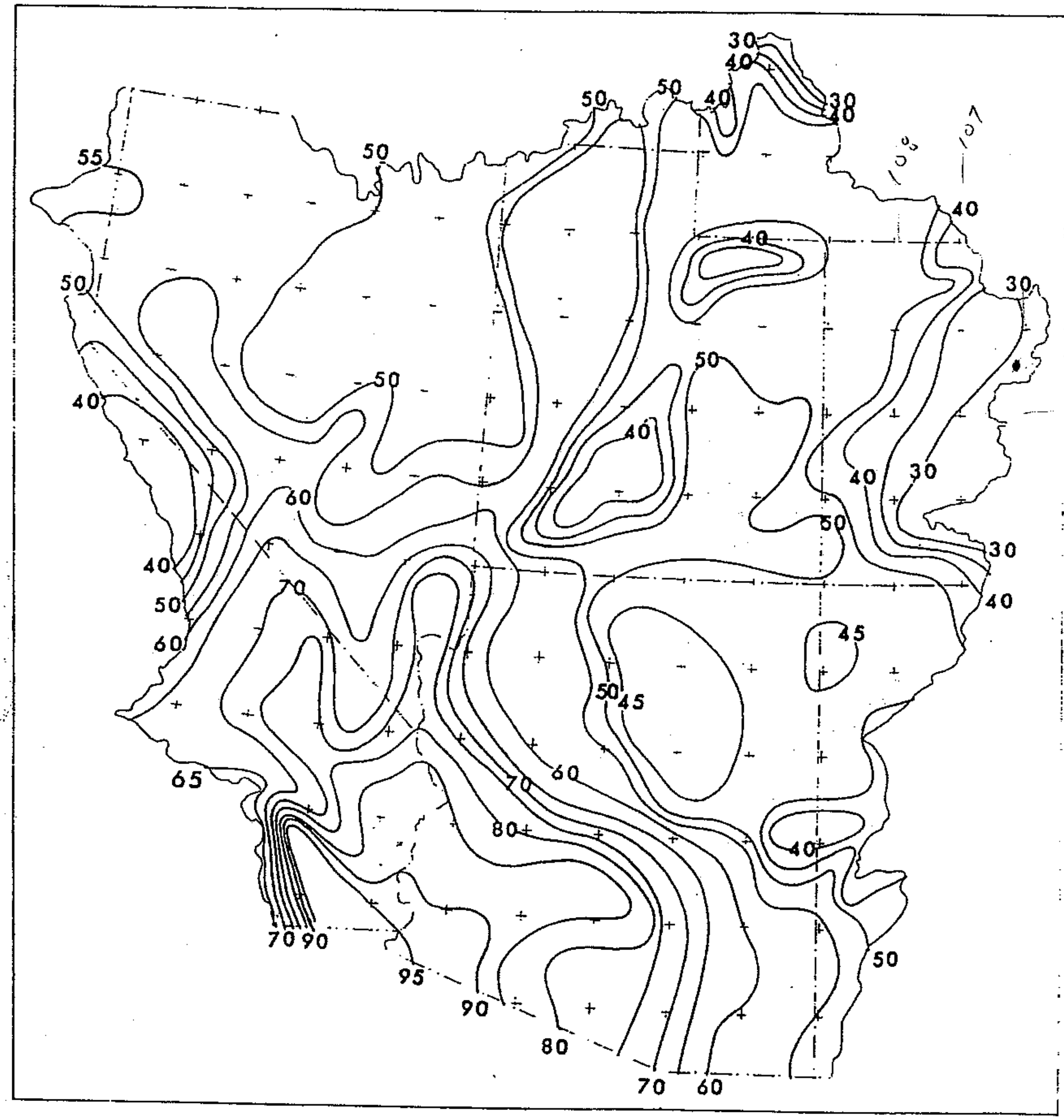
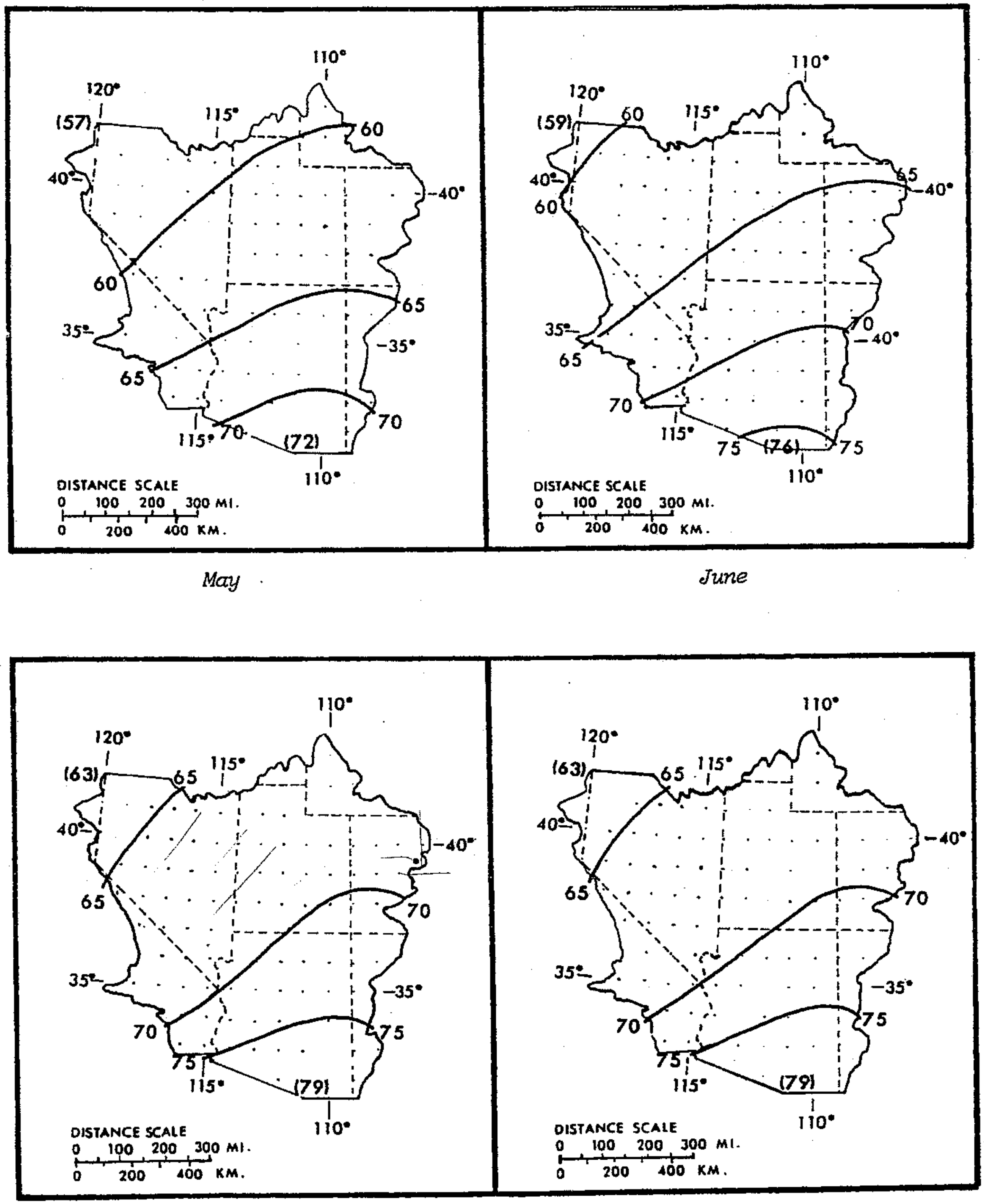


Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.



May *June*

July *August*

Figure 2.26.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 2.1.

Table 2.7.—Durational variation of convergence PMP (in percent of 24-hr amount).

Duration (Hrs)						Duration (Hrs)					
6	12	18	24	48	72	6	12	18	24	48	72
50	76	90	100	129	150	66	84	93	100	116	124
51	77	90	100	128	148	67	85	94	100	116	123
52	77	90	100	127	146	68	85	94	100	115	122
53	77	91	100	127	144	69	86	94	100	115	121
54	78	91	100	126	142						
55	78	91	100	125	140	70	87	94	100	114	120
56	79	91	100	124	138	71	87	95	100	114	119
57	79	92	100	123	137	72	88	95	100	113	118
58	80	92	100	122	135	73	88	95	100	113	118
59	80	92	100	121	134	74	89	95	100	112	117
						75	89	96	100	112	116
60	81	92	100	120	132	76	90	96	100	111	115
61	81	92	100	120	131	77	90	96	100	110	114
62	82	93	100	119	129	78	91	96	100	110	114
63	82	93	100	118	128	79	92	97	100	109	113
64	83	93	100	117	126						
65	84	93	100	117	125	80	92	97	100	109	113

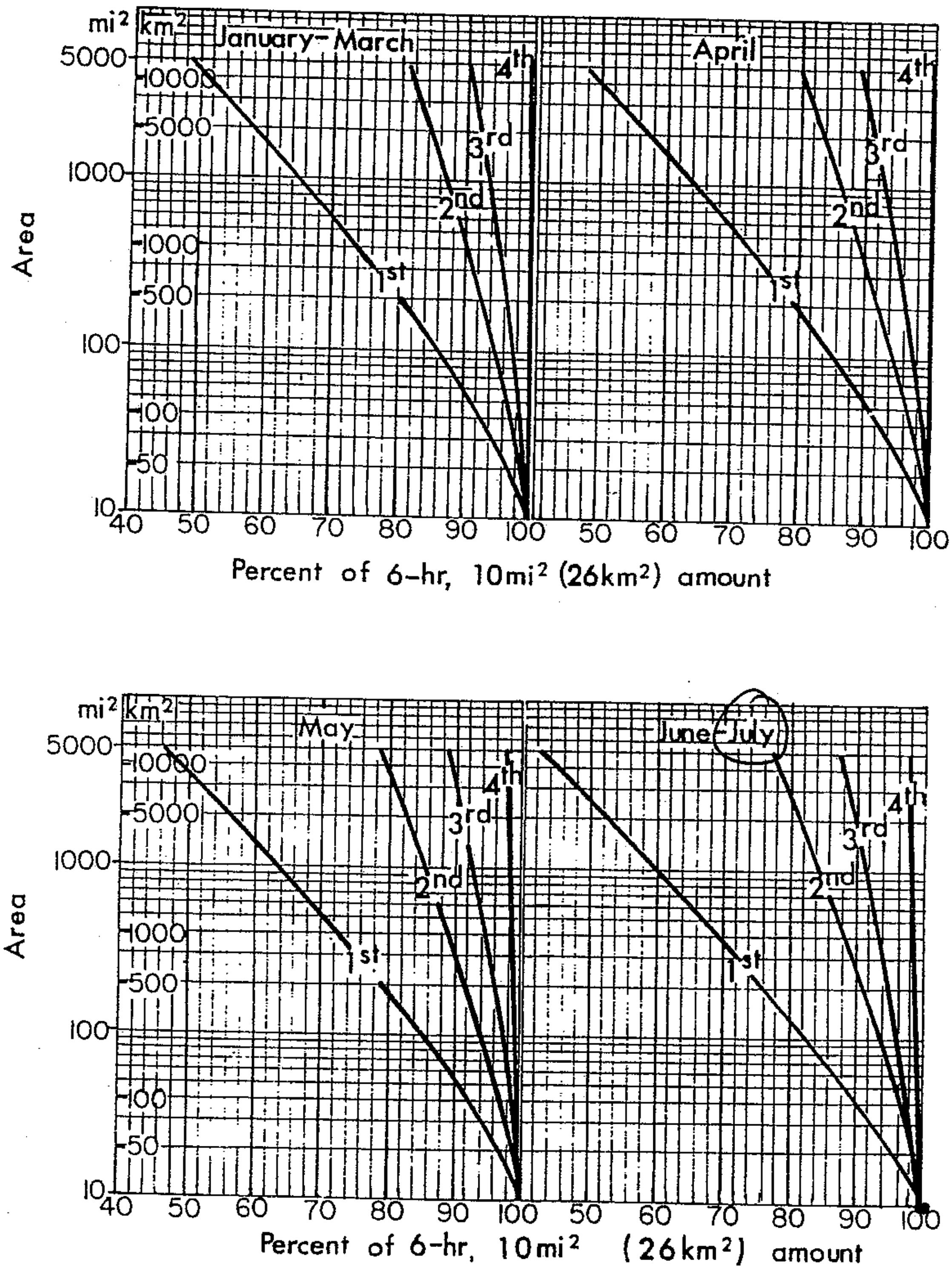
Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

2.5 Areal Reduction for Basin Size

For operational use, basin average values of convergence PMP are needed rather than 10-mi^2 (26-km^2) values. Preferably, the method for reducing 10-mi^2 (26-km^2) values to basin average rainfalls should be derived from depth-area relations of storms in the region. However, all general storms in the region include large proportions ot orographic precipitation.

Our solution was to use generalized depth-area relations developed for PMP estimates within bordering zones in the Central and Eastern United States (Riedel et al. 1956). The smoothed areal variations adopted for the Southwestern States are shown in figures 2.28 and 2.29 for each month or a combination of months where differences are insignificant.

Figures 2.28 and 2.29 give depth-area relations that reduce 10-mi^2 (26-km^2) convergence PMP for basin sizes up to 5,000 mi^2 (12,950 km^2) for each month. Areal variations are given for the 4 greatest (1st to 4th) 6-hr PMP increments. After the 4th increment no reduction for basin size is required. Application of these figures will become clear through consideration of an example of PMP computation in chapter 6.



BASIN AREA = 0.05 mi²

Figure 2.23 --Depth-area variation for convergence PMP for first to fourth 6-hr increments.

109 108 107 106

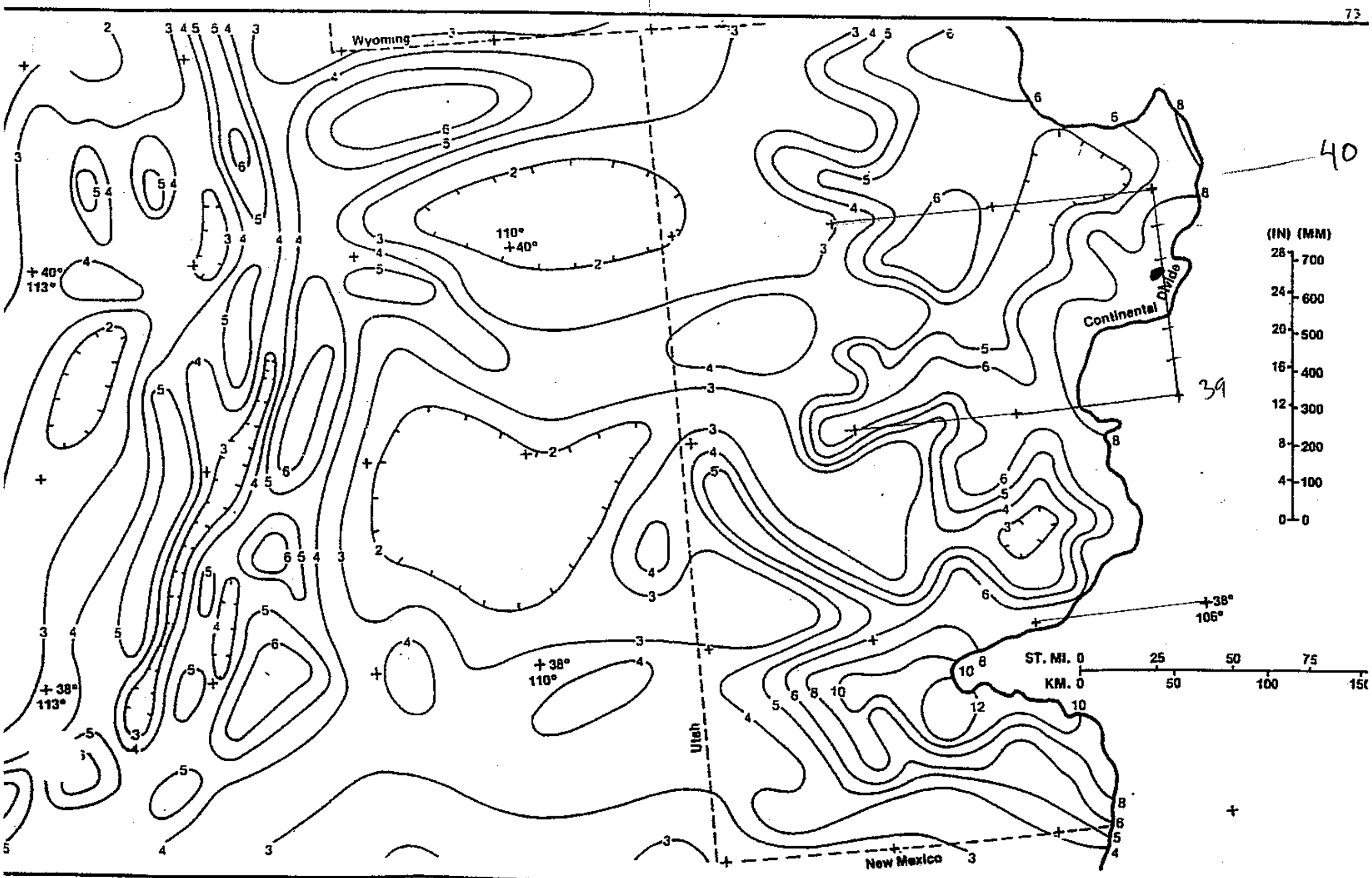


FIGURE 3.11b (Revised) — 10-mi² (26-km²) 24-hr orographic PMP index map (inches), north-central section.

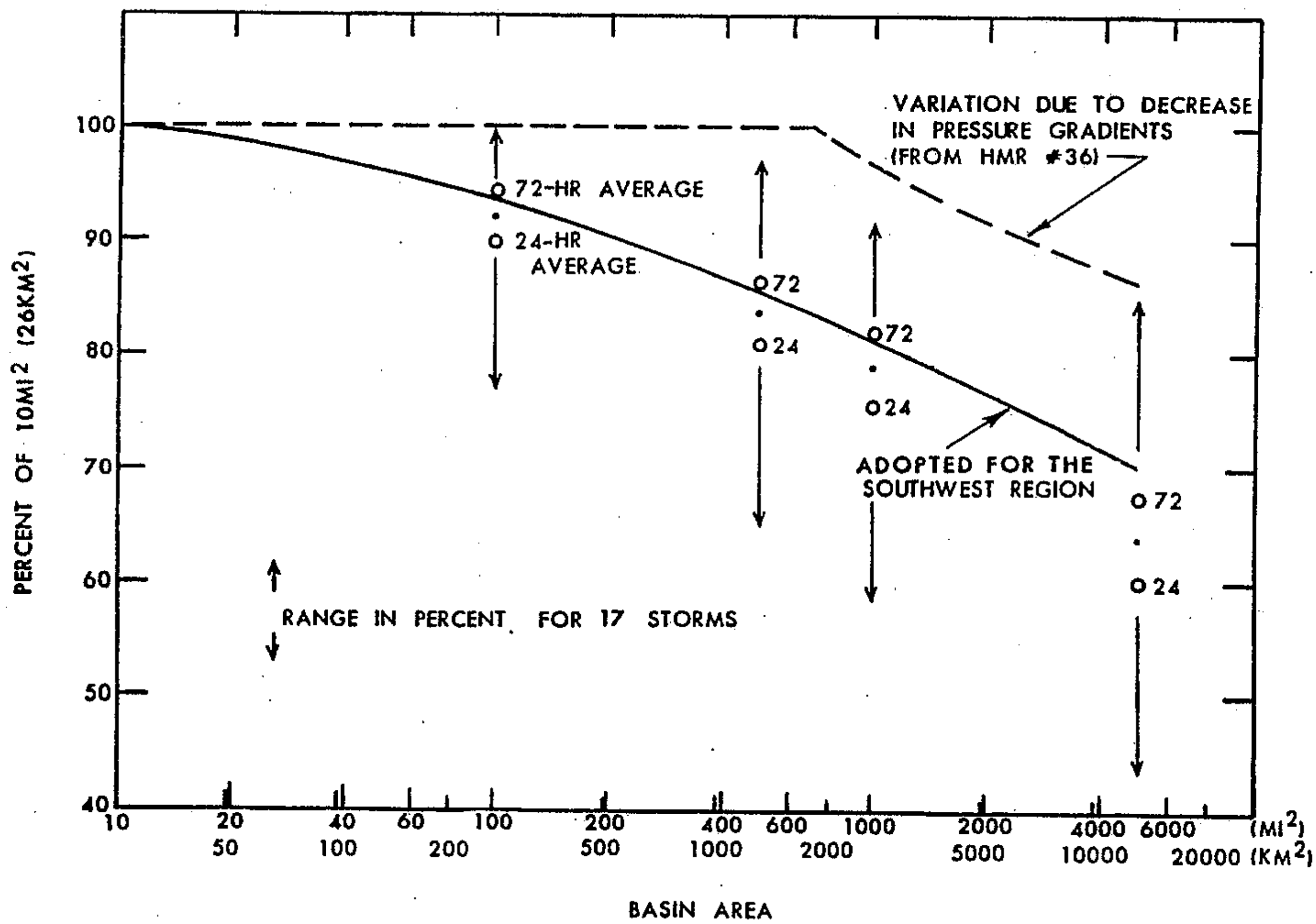
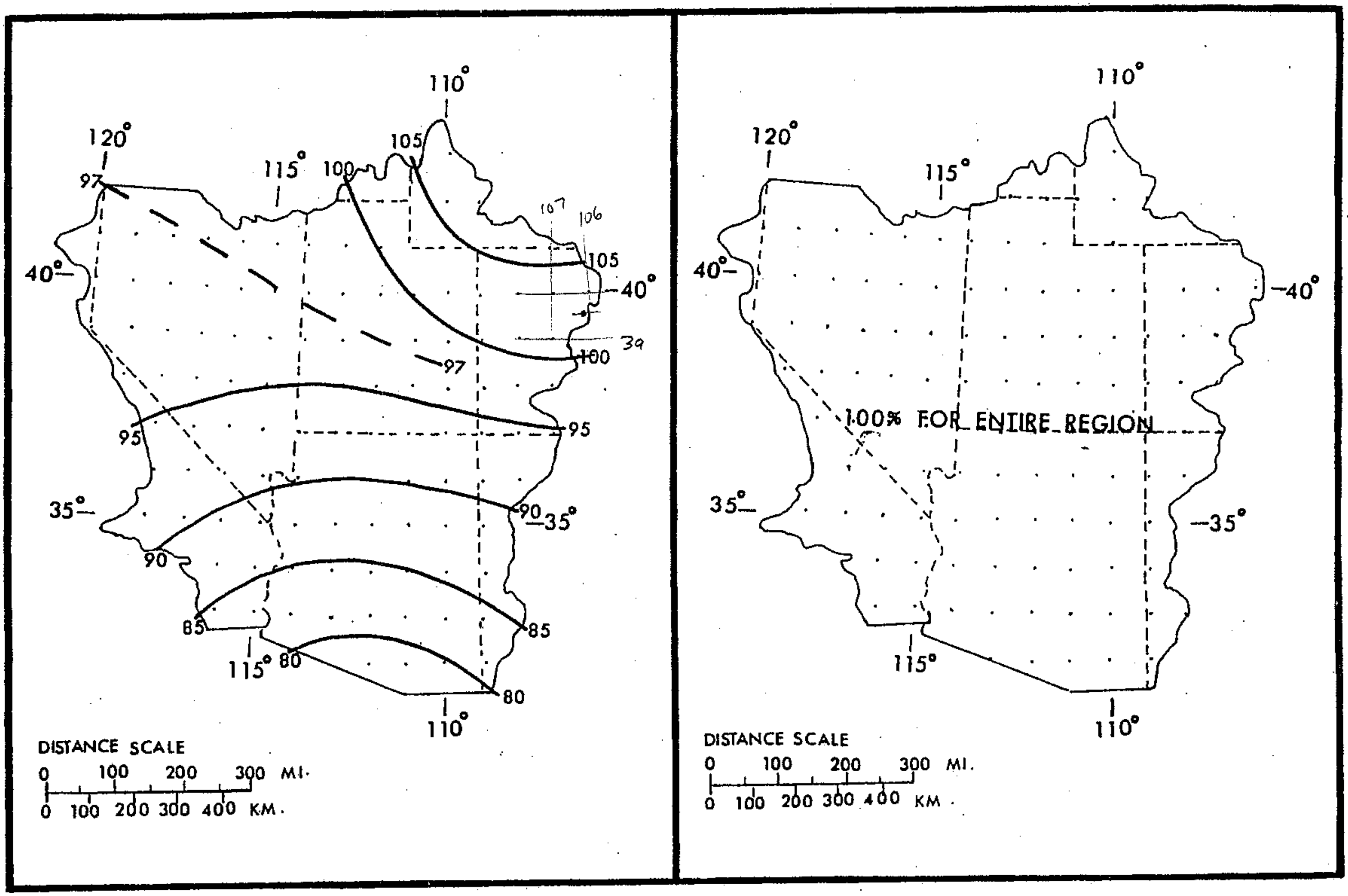


Figure 3.20.--Variation of orographic PMP with basin size.



July

August

Figure 3.15.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

Table 3.9.--Durational variation of orographic PMP

39.6°

Latitude °N	Percent of 24-hr value					
	6 hr	12	18	24	48	72
42	28	55	79	100	161	190
41	29	56	79	100	160	189
40	30	57	80	100	159	187
39	30	57	80	100	157	185
38	31	58	81	100	155	182
37	32	59	81	100	152	177
36	33	60	82	100	149	172
35	34	61	82	100	146	167
34	35	62	83	100	143	162
33	36	63	84	100	139	157
32	37	64	84	100	135	152
31	39	66	85	100	132	146

4. LOCAL-STORM PMP FOR THE SOUTHWESTERN REGION AND CALIFORNIA

4.1 Introduction

This chapter provides generalized estimates of local or thunderstorm probable maximum precipitation. By "generalized" is meant that mapped values are given from which estimates of PMP may be determined for any selected drainage.

4.1.1 Region of Interest

Local-storm PMP was not included in the "Interim Report, Probable Maximum Precipitation in California" (HMR No. 36). During the formulation of the present study, we decided that the local-storm part of the study should include California west of the Sierra Nevada. It was also noted that PMP for summer thunderstorms was not considered west of the Cascade Divide in the Northwestern Region (HMR No. 43). As stated in the latter report, "No summer thunderstorms have been reported there (west of the Divide) of an intensity of those to the east, for which the moisture source is often the Gulf of Mexico or Gulf of California. The Cascade Divide offers an additional barrier to such moisture inflows to coastal areas where, in addition, the Pacific Ocean to the west has a stabilizing influence on the air to hinder the occurrence of intense summer local storms." Therefore, it was necessary to establish some continuation of the Cascade Divide into California so that the local-storm PMP definition would have continuity between the two regions.

The stabilizing influence of the Pacific air is at times interrupted by the warm moist tropical air from the south pushing into California, although it is difficult to determine where the limit of southerly flow occurs. General storms having the tropical characteristic of excessive thunderstorm rains are observed as far north as the northern end of the Sacramento Valley. Thus, a northern boundary has been selected for this study, excluding that portion of

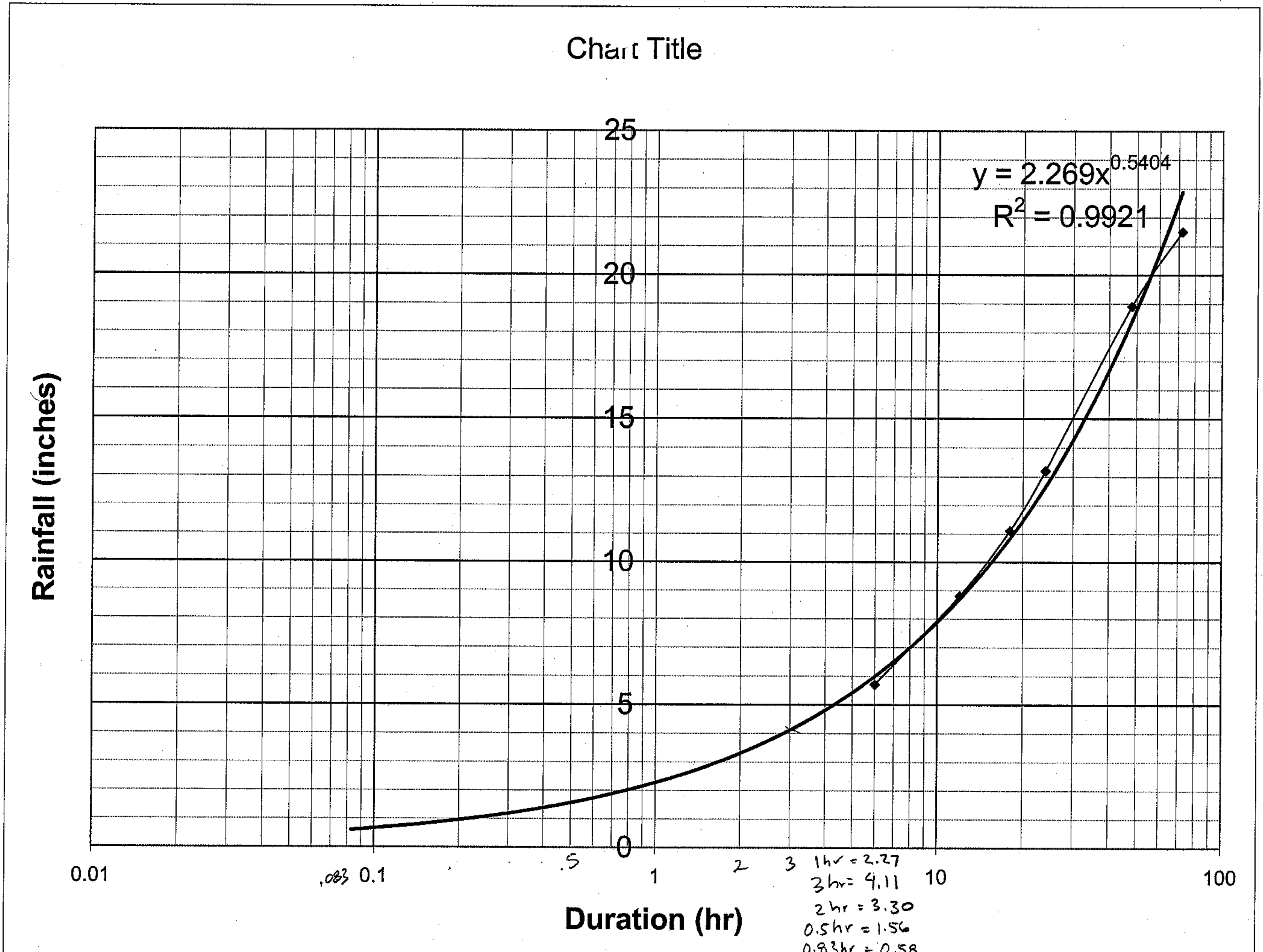


Chart Title
y = 2.269x^0.5404
R^2 = 0.9921
Rainfall (inches)
Duration (hr)
0
5
10
15
20
25
0.01
.083
0.1
.5
1
2
3
10
100
1hr = 2.27
3hr = 4.11
2hr = 3.30
0.5hr = 1.56
0.83hr = 0.58

Table 6.1.--General-storm PMP computations for the Colorado River and Great basin

Drainage OLD DILLON RES   Area 0.05 mi^2 (km^2)

Latitude 39°36", Longitude ___ of basin center 106°04"

Month AUGUST

Step		6	12	18	24	48	72	
		Duration (hrs)						
A. Convergence PMP								
1. Drainage average value from one of figures 2.5 to 2.16	15.3 in. (mm)							
2. Reduction for barrier-elevation [fig. 2.18]	30 %							
3. Barrier-elevation reduced PMP [step 1 X step 2]	4.6 in. (mm)							
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].		69	86	94	100	115	121	%
5. Convergence PMP for indicated durations [steps 3 X 4]		3.2	4.0	4.3	4.6	5.3	5.6	in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]		3.2	0.8	0.3	0.3	0.7	0.3	in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]		100	100	100	100	100	100	%
8. Areally reduced PMP [step 6 X step 7]		3.2	0.8	0.3	0.3	0.7	0.3	in. (mm)
9. Drainage average PMP [accumulated values of step 8]		3.2	4.0	4.3	4.6	5.3	5.6	in. (mm)
B. Orographic PMP								
1. Drainage average orographic index from figure 3.11a to d.	8.5 in. (mm)							
2. Areal reduction [figure 3.20]	100 %							
3. Adjustment for month [one of figs. 3.12 to 3.17]	100 %							
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	8.5 in. (mm)							
5. Durational variation [table ~~3.6~~] 3.9		30	57	80	100	158	186	%
6. Orographic PMP for given durations [steps 4 X 5]		2.6	4.8	6.8	8.5	13.4	15.8	in. (mm)
C. Total PMP								
1. Add steps A9 and B6		5.8	8.8	11.1	13.1	18.7	21.4	in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

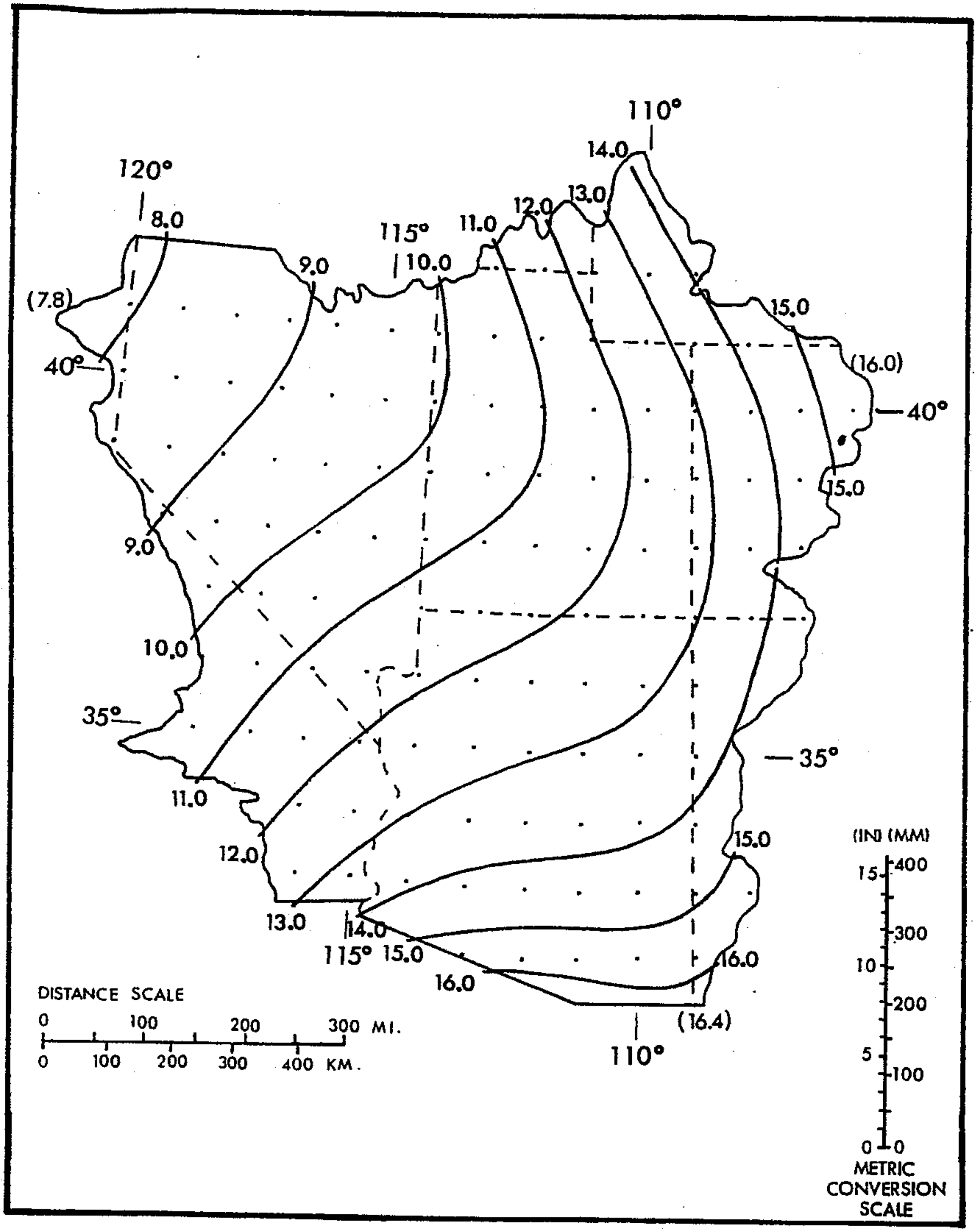


Figure 2.12.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for August. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

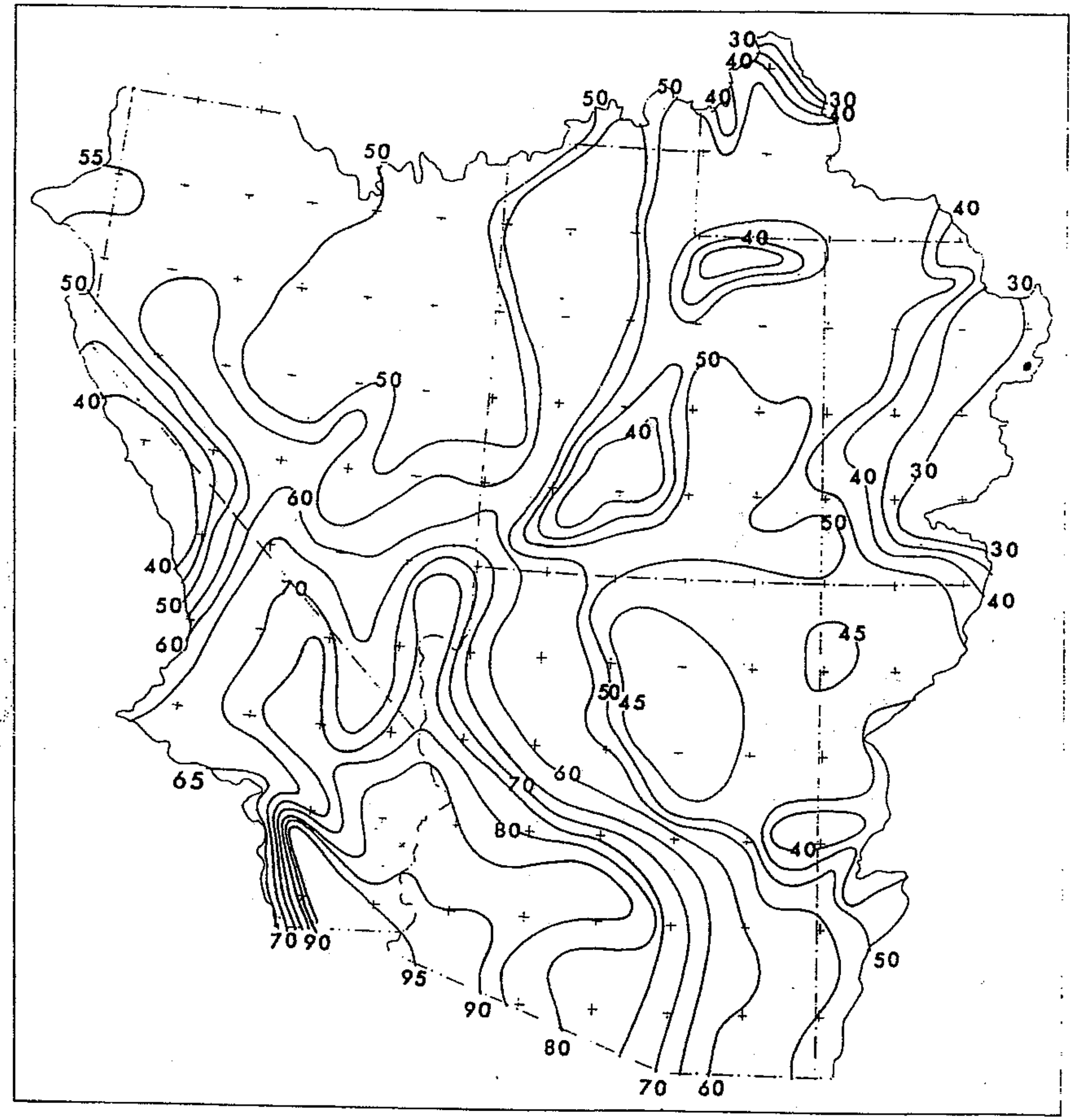


Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.

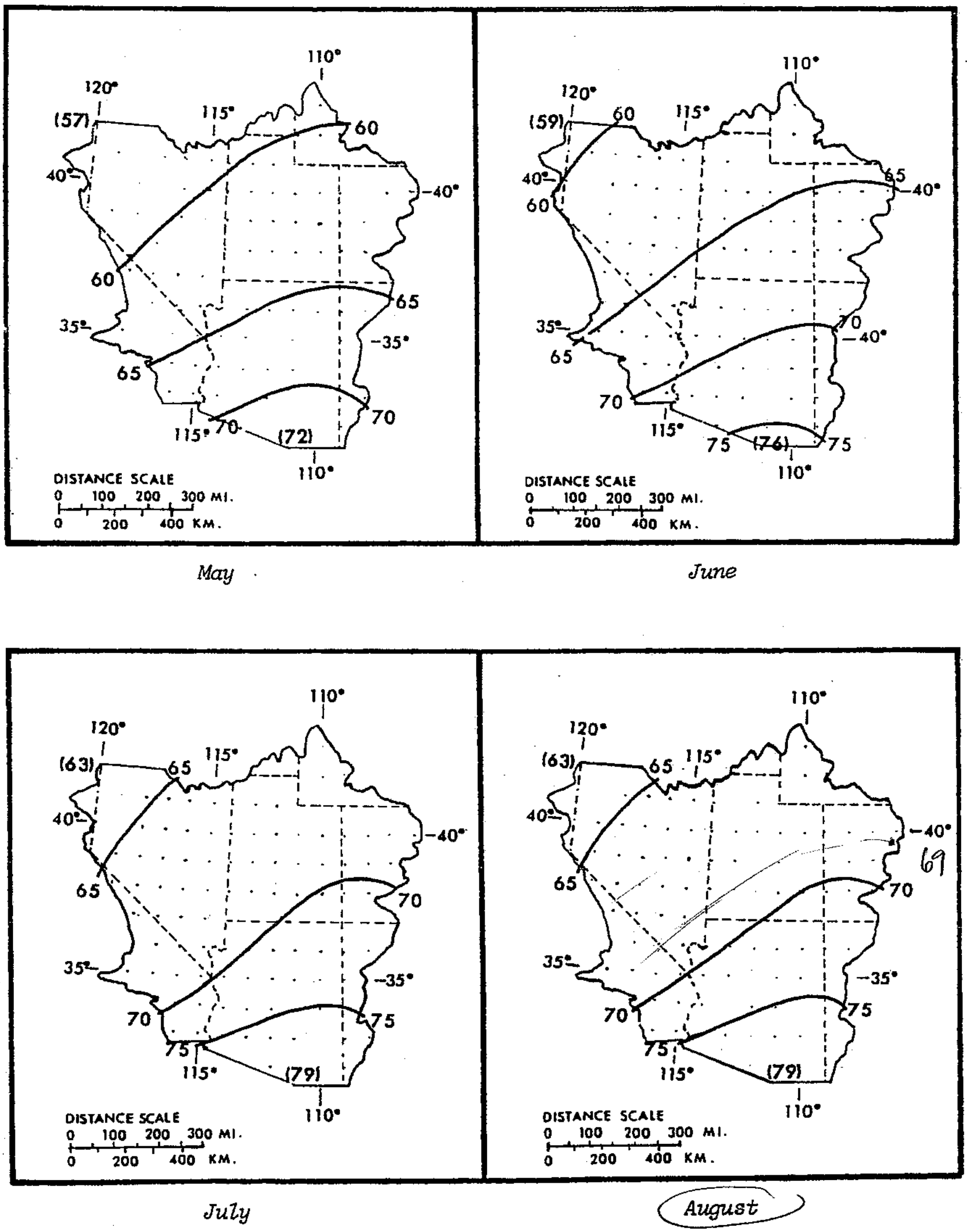


Figure 2.26.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 7.1.

Table 2.7.--Durational variation of convergence PMP (in percent of 24-hr amount).

Duration (Hrs)					
6	12	18	24	48	72
50	76	90	100	129	150
51	77	90	100	128	148
52	77	90	100	127	146
53	77	91	100	127	144
54	78	91	100	126	142
55	78	91	100	125	140
56	79	91	100	124	138
57	79	92	100	123	137
58	80	92	100	122	135
59	80	92	100	121	134
60	81	92	100	120	132
61	81	92	100	120	131
62	82	93	100	119	129
63	82	93	100	118	128
64	83	93	100	117	126
65	84	93	100	117	125
66	84	93	100	116	124
67	85	94	100	116	123
68	85	~~94~~	~~100~~	~~115~~	~~122~~
69	86	94	100	115	121
70	87	94	100	114	120
71	87	95	100	114	119
72	88	95	100	113	118
73	88	95	100	113	118
74	89	95	100	112	117
75	89	96	100	112	116
76	90	96	100	111	115
77	90	96	100	110	114
78	91	96	100	110	114
79	92	97	100	109	113
80	92	97	100	109	113

Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

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For operational use, basin average values of convergence PMP are needed rather than 10-mi^2 (26-km^2) values. Preferably, the method for reducing 10-mi^2 (26-km^2) values to basin average rainfalls should be derived from depth-area relations of storms in the region. However, all general storms in the region include large proportions or orographic precipitation.

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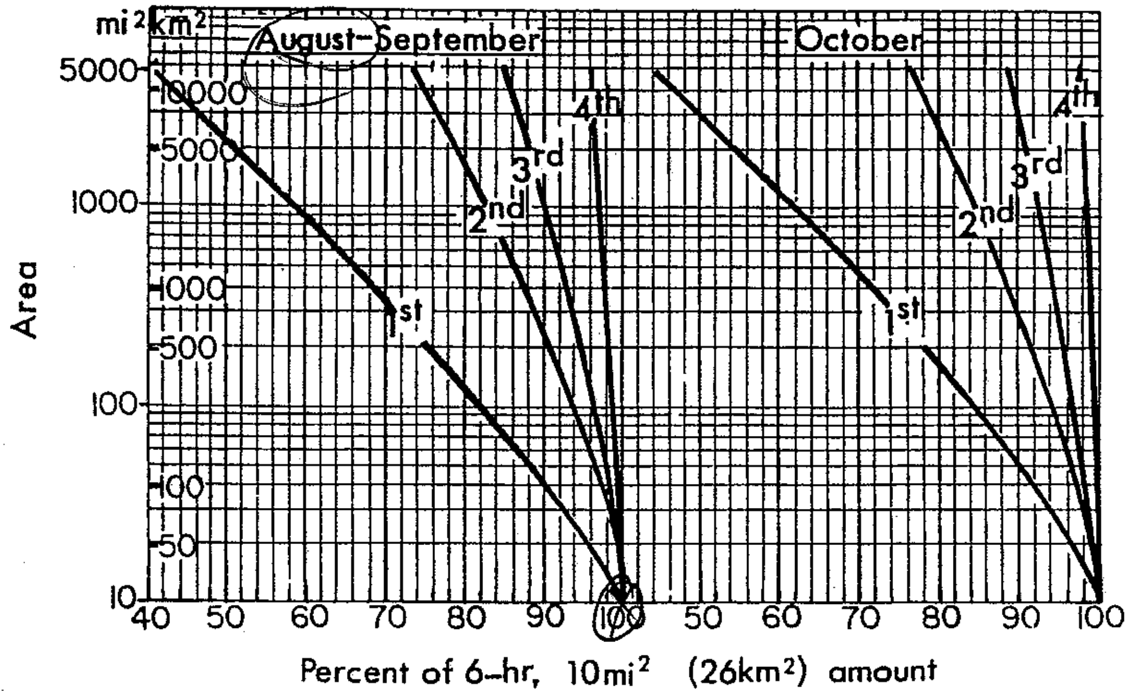


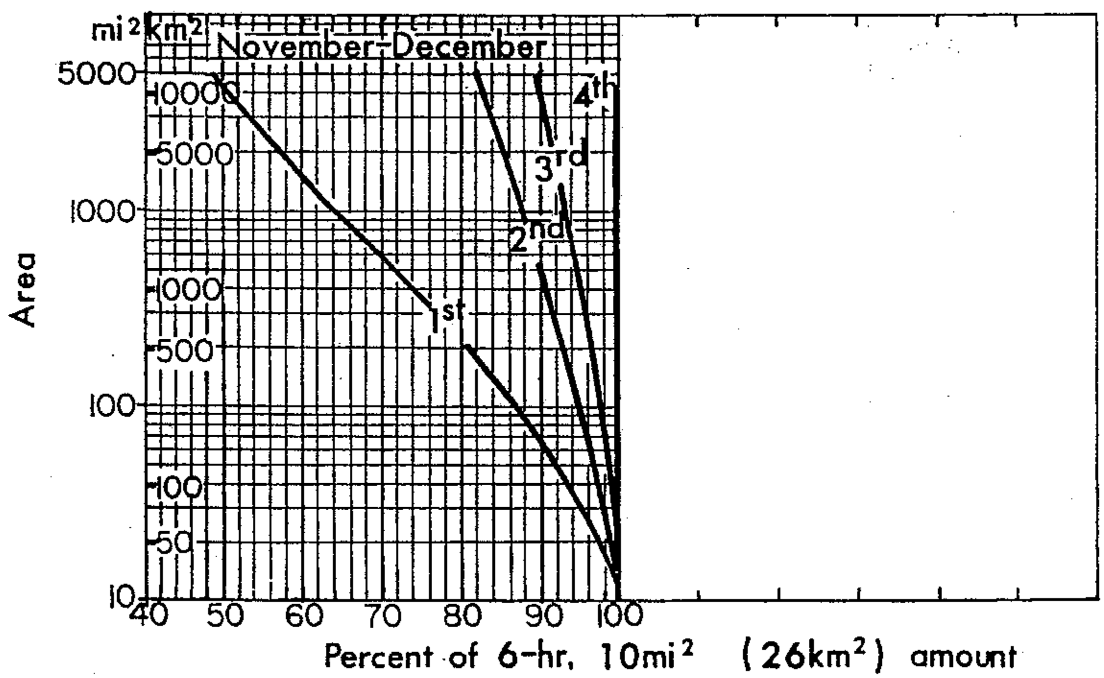


Figure 2.29.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.

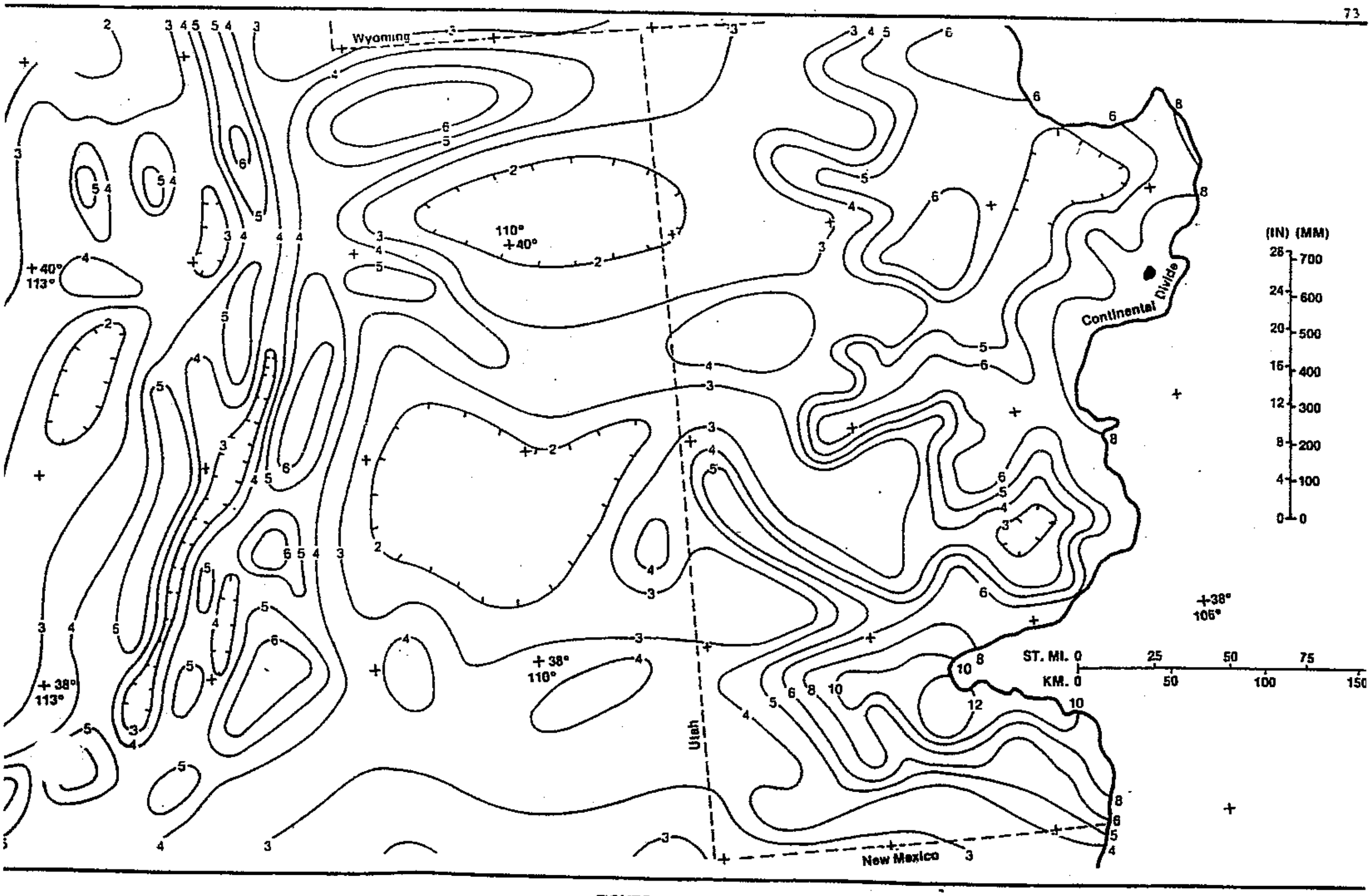


FIGURE 3.11b (Revised) — 10-mi² (26-km²) 24-hr orographic PMP index map (inches), north-central section.

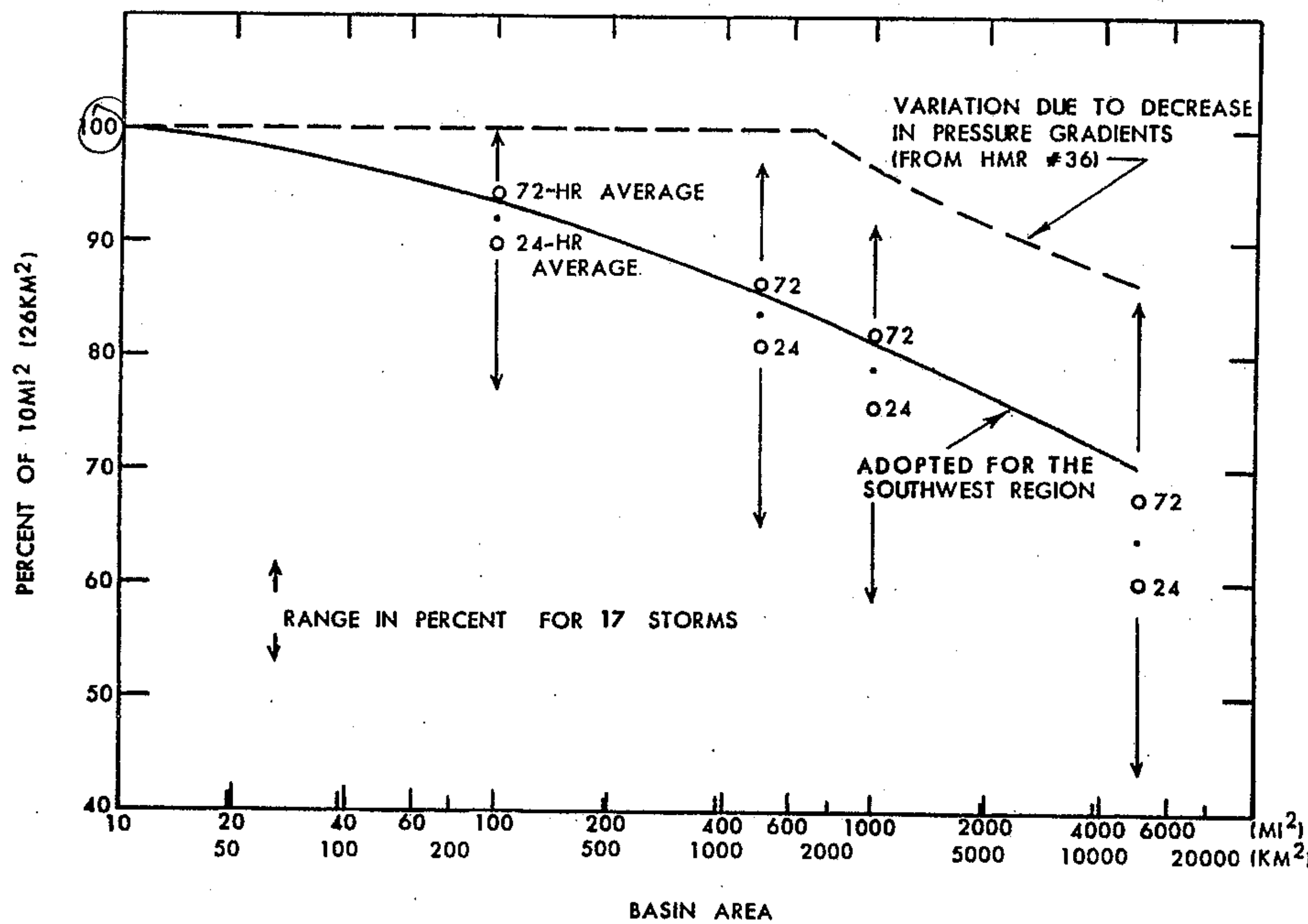
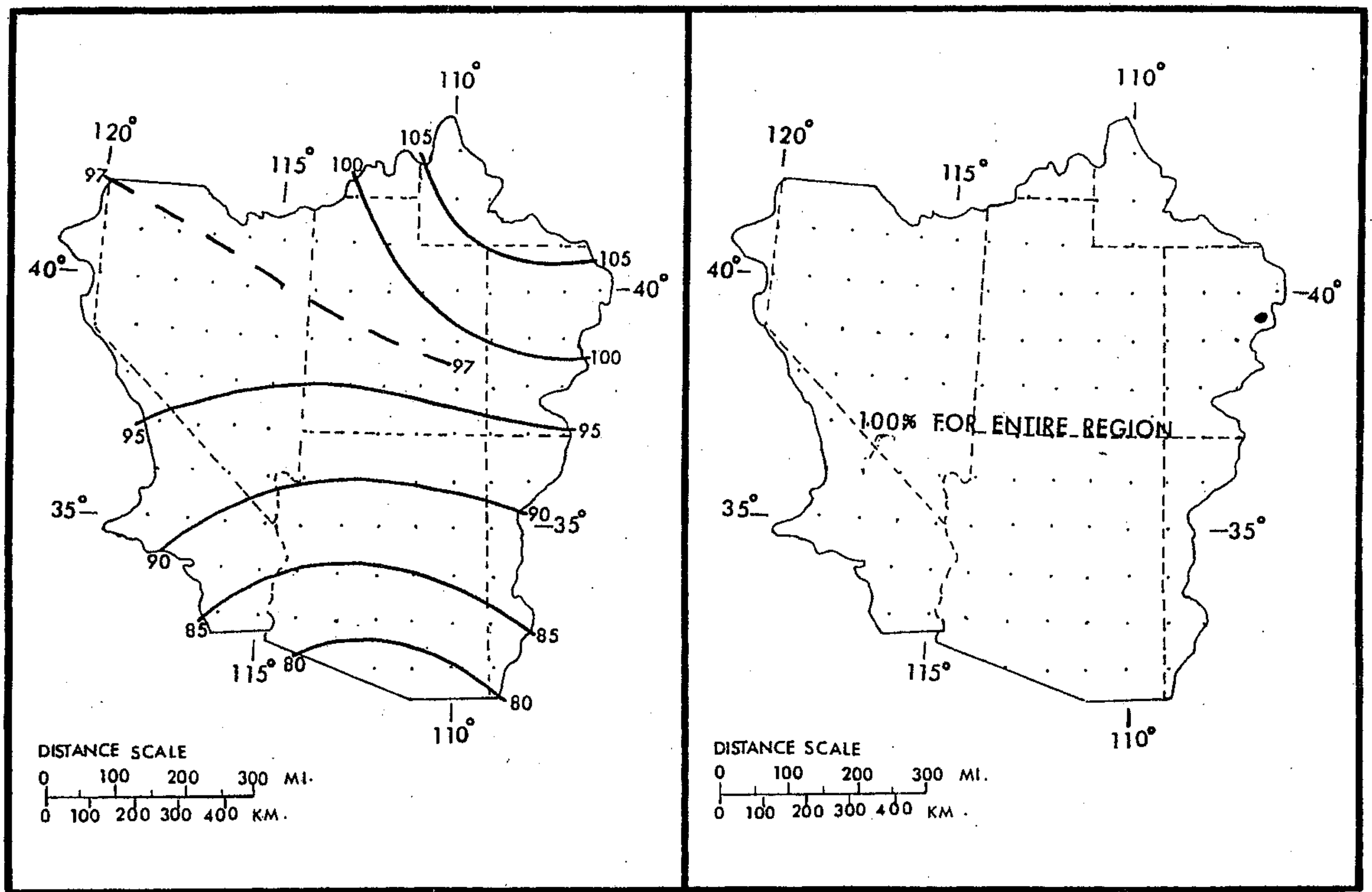


Figure 3.20.--Variation of orographic PMP with basin size.



July *August*

Figure 3.15.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

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Latitude °N	Percent of 24-hr value					
	6 hr	12	18	24	48	72
42	28	55	79	100	161	190
41	29	56	79	100	160	189
40	30	57	80	100	159	187
39	30	57	80	100	157	185
38	31	58	81	100	155	182
37	32	59	81	100	152	177
36	33	60	82	100	149	172
35	34	61	82	100	146	167
34	35	62	83	100	143	162
33	36	63	84	100	139	157
32	37	64	84	100	135	152
31	39	66	85	100	132	146

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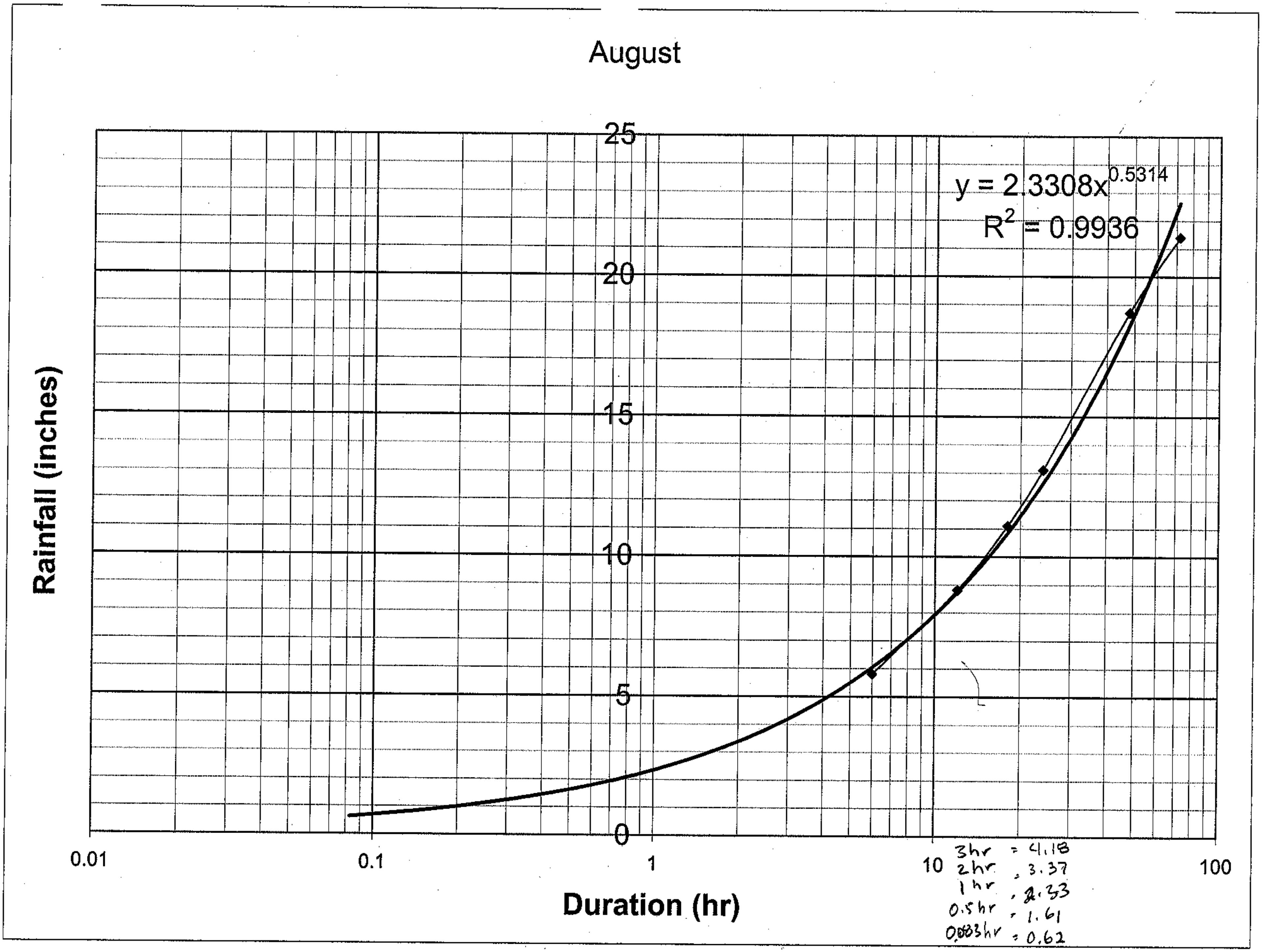

August
$y = 2.3308x^{0.5314}$
$R^2 = 0.9936$
Rainfall (inches)
0
5
10
15
20
25
Duration (hr)
0.01
0.1
1
10
100
3hr = 4.18
2hr = 3.37
1 hr = 2.33
0.5hr = 1.61
0.083hr = 0.62

5

Table 6.1.--General-storm PMP computations for the Colorado River and Great basin

Drainage OLD DILLON RES Area 0.05 mi^2 (km^2)

Latitude 39°36", Longitude ___ of basin center 106°04'

Month SEPTEMBER

Step	6	12	18	24	48	72	
	Duration (hrs)						
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16 15.7 in. (mm)							
2. Reduction for barrier-elevation [fig. 2.18] 30 %							
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.7 in. (mm)							
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	69	86	94	100	115	121	%
5. Convergence PMP for indicated durations [steps 3 X 4]	3.2	4.0	4.4	4.7	5.4	5.7	in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	3.2	0.8	0.4	0.3	0.7	0.3	in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	100	100	100	100	100	100	%
8. Areally reduced PMP [step 6 X step 7]	3.2	0.8	0.4	0.3	0.7	0.3	in. (mm)
9. Drainage average PMP [accumulated values of step 8]	3.2	4.0	4.4	4.7	5.4	5.7	in. (mm)
B. Orographic PMP							
1. Drainage average orographic index from figure 3.11a to d. 8.5 in. (mm)							
2. Areal reduction [figure 3.20] 100 %							
3. Adjustment for month [one of figs. 3.12 to 3.17] 100 %							
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 8.5 in. (mm)							
5. Durational variation [table 3.6]	30	57	80	100	158	186	%
6. Orographic PMP for given durations [steps 4 X 5]	2.6	4.8	6.8	8.5	13.4	15.8	in. (mm)
C. Total PMP							
1. Add steps A9 and B6	5.8	8.8	11.2	13.2	18.8	21.5	in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.							
3. Comparison with local-storm PMP (see sec. 6.3).							

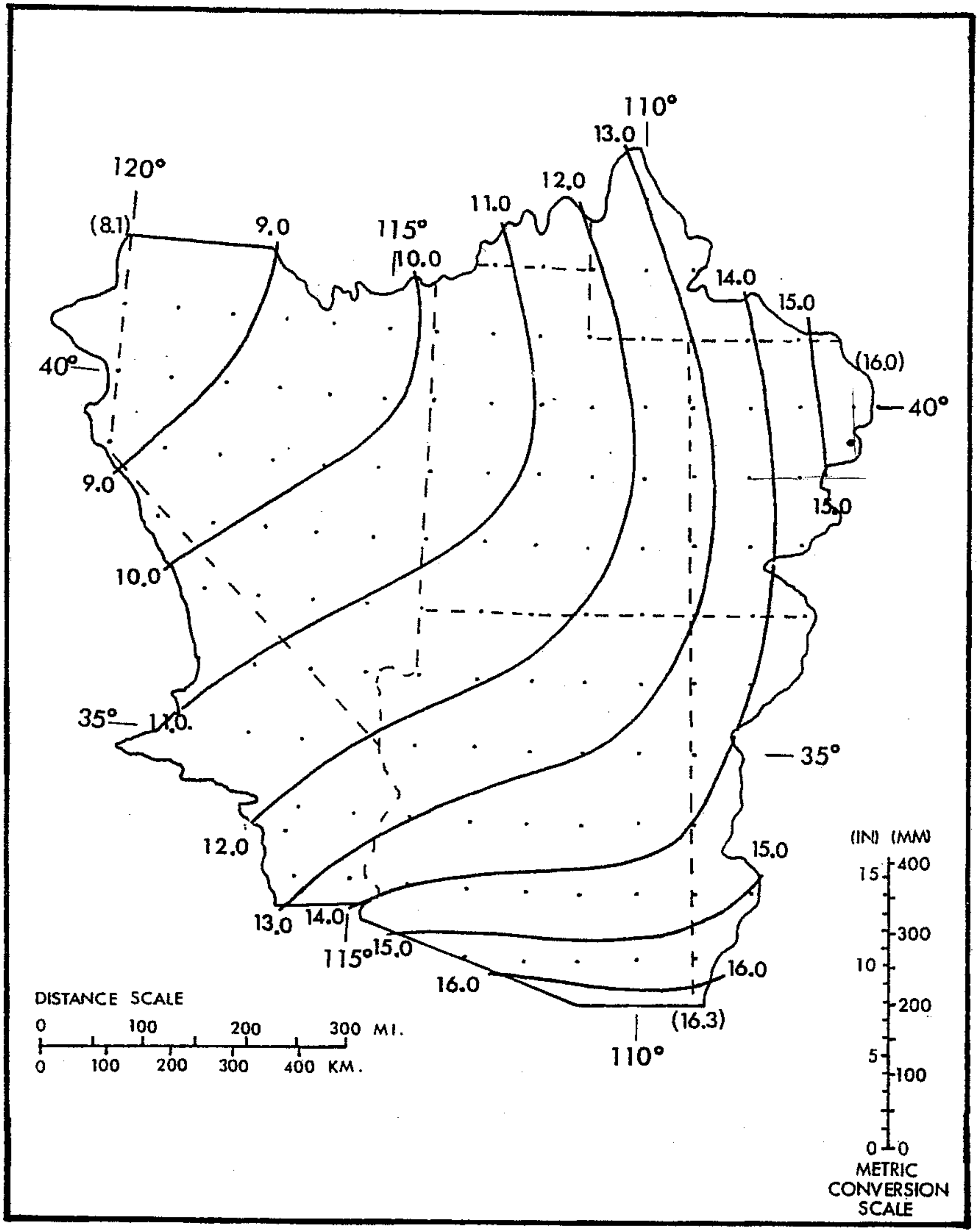

Figure 2.13.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi² (26 km²) for September. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

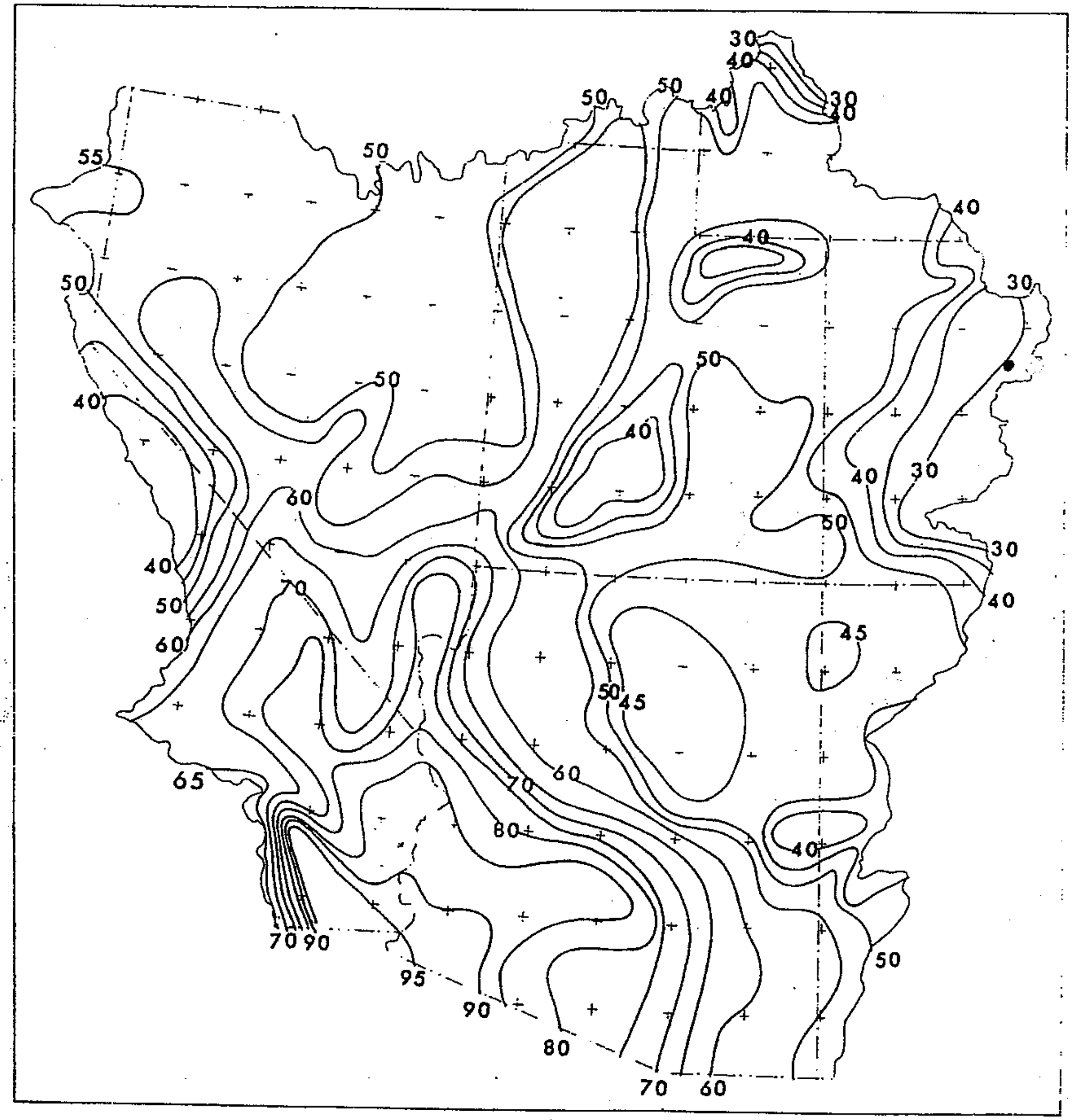

Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.

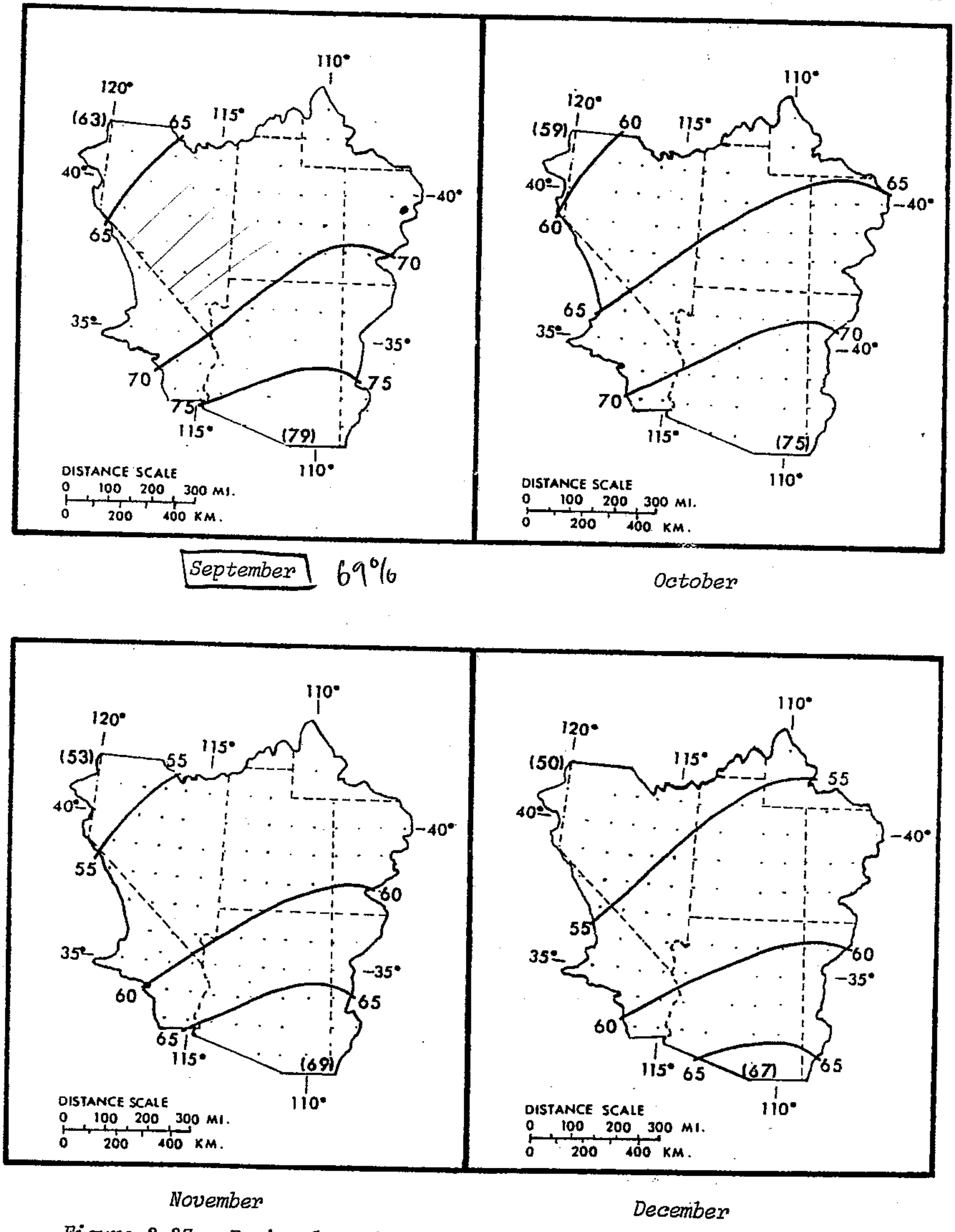

Figure 2.27.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 2.1.

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Duration (Hrs)					
6	12	18	24	48	72
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51	77	90	100	128	148
52	77	90	100	127	146
53	77	91	100	127	144
54	78	91	100	126	142
55	78	91	100	125	140
56	79	91	100	124	138
57	79	92	100	123	137
58	80	92	100	122	135
59	80	92	100	121	134
60	81	92	100	120	132
61	81	92	100	120	131
62	82	93	100	119	129
63	82	93	100	118	128
64	83	93	100	117	126
65	84	93	100	117	125

Duration (Hrs)					
6	12	18	24	48	72
66	84	93	100	116	124
67	85	94	100	116	123
68	85	94	100	115	122
69	86	94	100	115	121
70	87	94	100	114	120
71	87	95	100	114	119
72	88	95	100	113	118
73	88	95	100	113	118
74	89	95	100	112	117
75	89	96	100	112	116
76	90	96	100	111	115
77	90	96	100	110	114
78	91	96	100	110	114
79	92	97	100	109	113
80	92	97	100	109	113

Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

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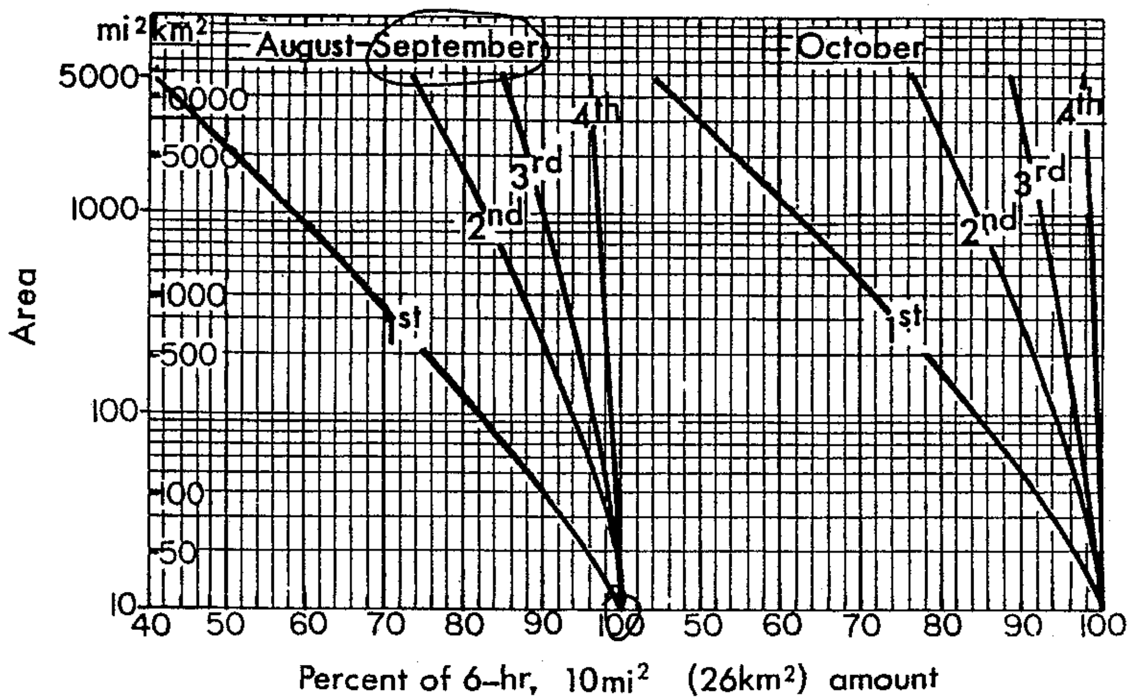


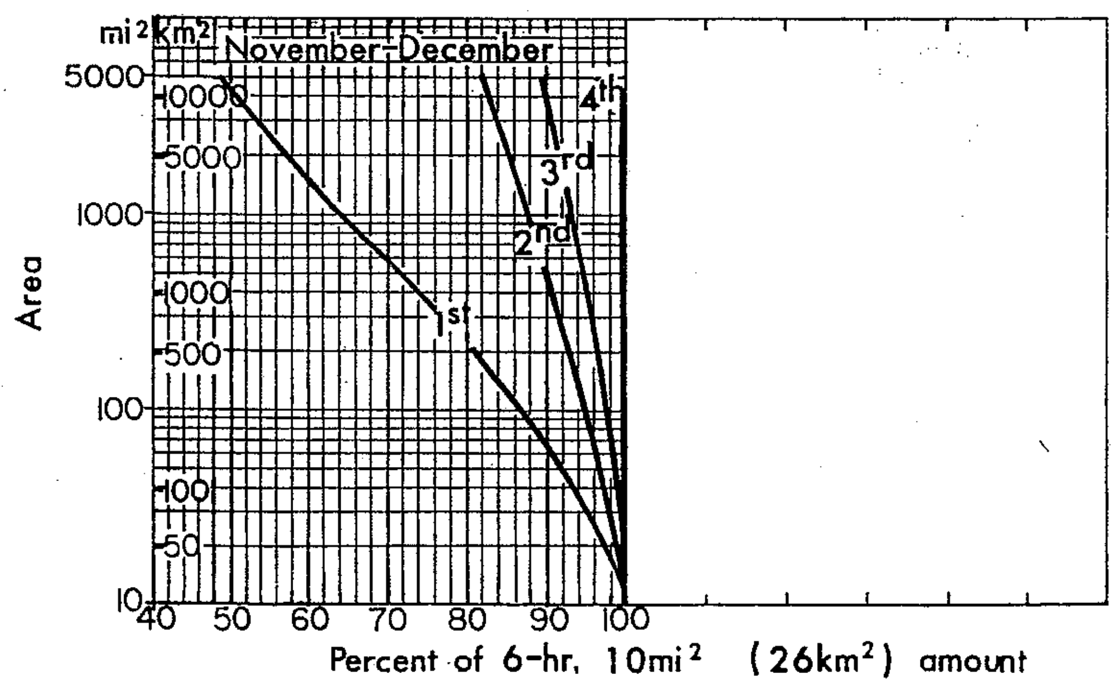


Figure 2.29.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.

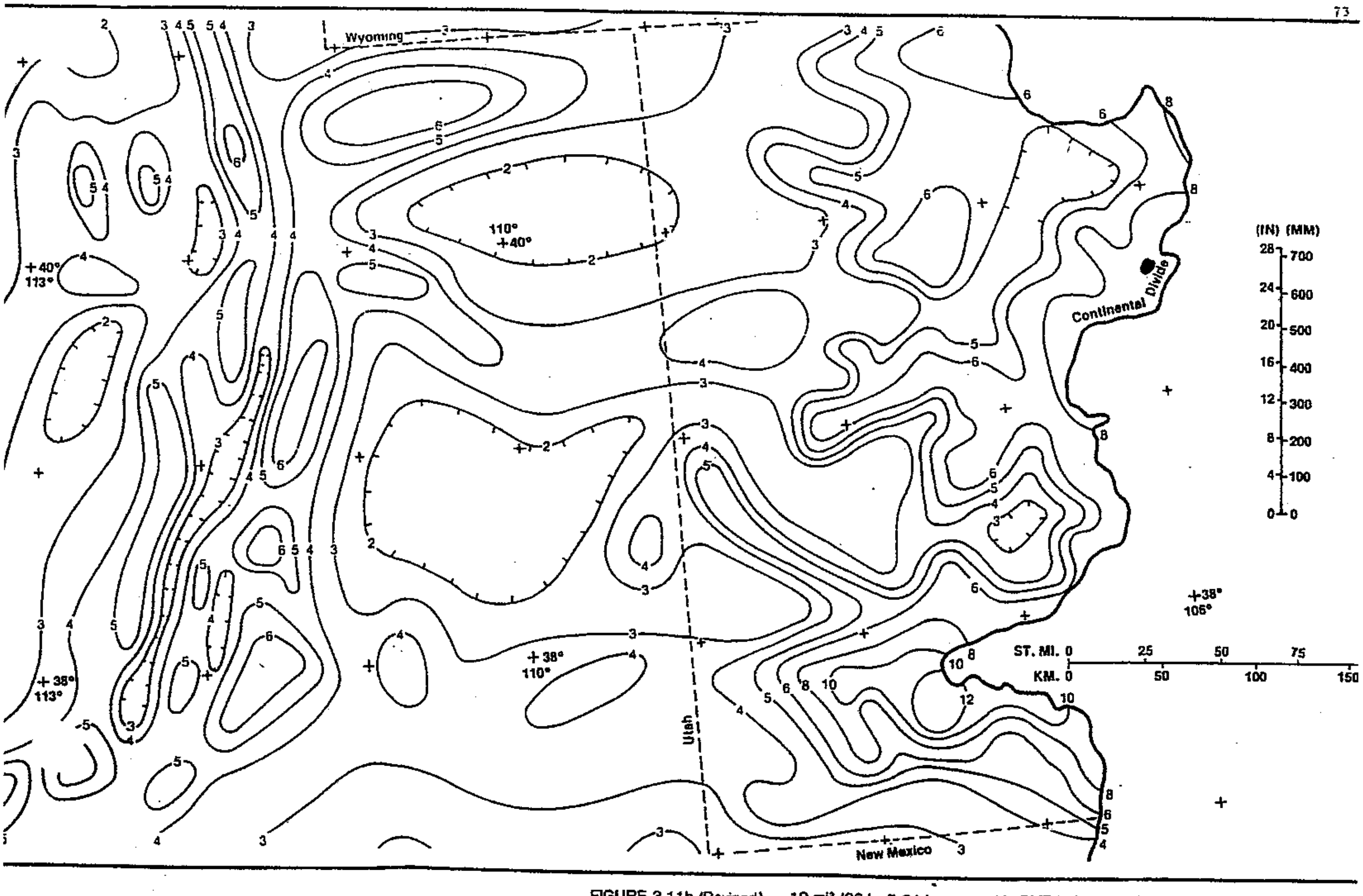


FIGURE 3.11b (Revised) — 10-mi² (26-km²) 24-hr orographic PMP index map (inches), north-central section.

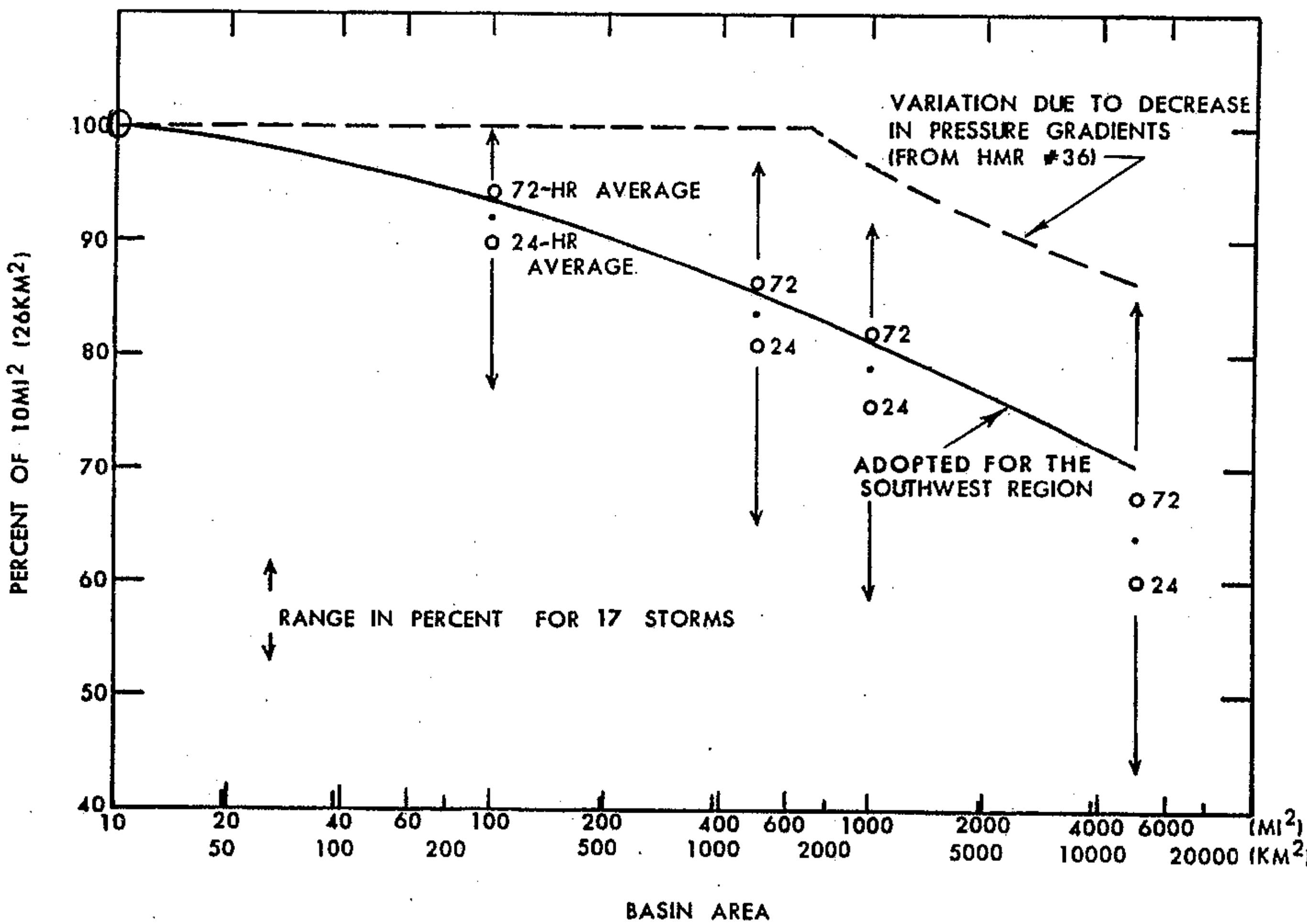


Figure 3.20.--Variation of orographic PMP with basin size.

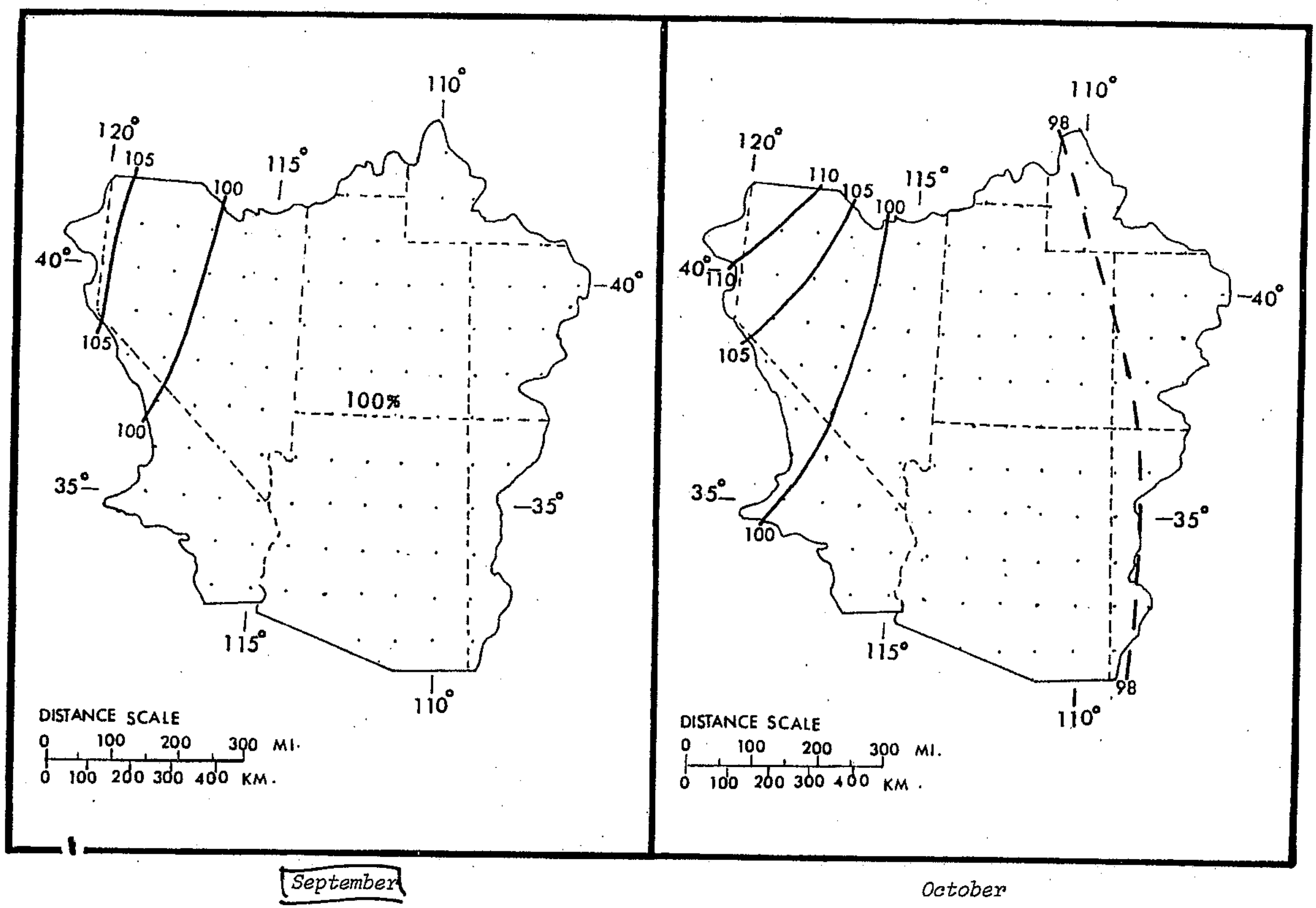


Figure 3.16.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

Table 3.9.--Durational variation of orographic PMP

39.6°

Latitude °N	Percent of 24-hr value					
	6 hr	12	18	24	48	72
42	28	55	79	100	161	190
41	29	56	79	100	160	189
40	30	57	80	100	159	187
39	30	57	80	100	157	185
38	31	58	81	100	155	182
37	32	59	81	100	152	177
36	33	60	82	100	149	172
35	34	61	82	100	146	167
34	35	62	83	100	143	162
33	36	63	84	100	139	157
32	37	64	84	100	135	152
31	39	66	85	100	132	146

4. LOCAL-STORM PMP FOR THE SOUTHWESTERN REGION AND CALIFORNIA

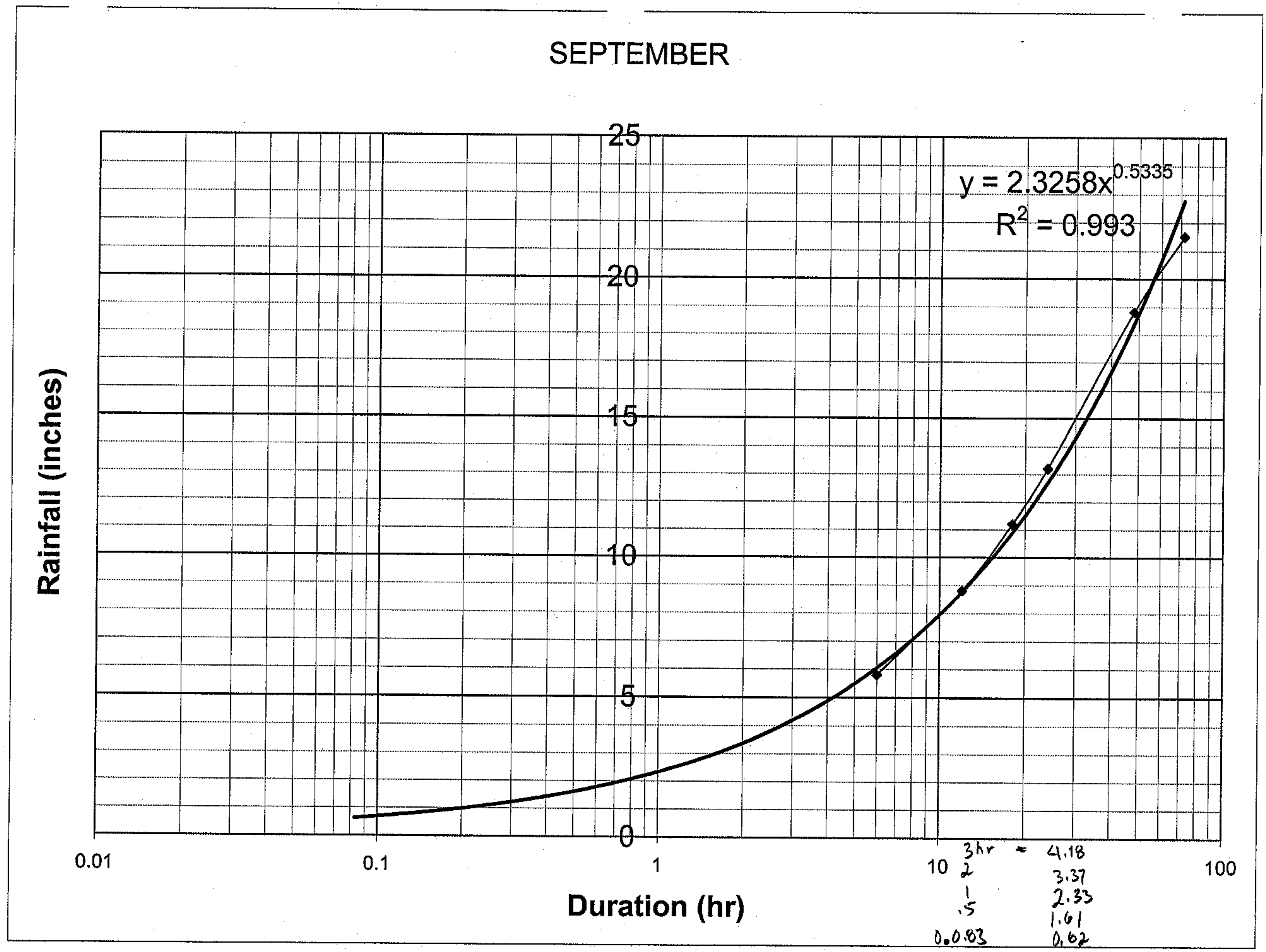
4.1 Introduction

This chapter provides generalized estimates of local or thunderstorm probable maximum precipitation. By "generalized" is meant that mapped values are given from which estimates of PMP may be determined for any selected drainage.

4.1.1 Region of Interest

Local-storm PMP was not included in the "Interim Report, Probable Maximum Precipitation in California" (HMR No. 36). During the formulation of the present study, we decided that the local-storm part of the study should include California west of the Sierra Nevada. It was also noted that PMP for summer thunderstorms was not considered west of the Cascade Divide in the Northwestern Region (HMR No. 43). As stated in the latter report, "No summer thunderstorms have been reported there (west of the Divide) of an intensity of those to the east, for which the moisture source is often the Gulf of Mexico or Gulf of California. The Cascade Divide offers an additional barrier to such moisture inflows to coastal areas where, in addition, the Pacific Ocean to the west has a stabilizing influence on the air to hinder the occurrence of intense summer local storms." Therefore, it was necessary to establish some continuation of the Cascade Divide into California so that the local-storm PMP definition would have continuity between the two regions.

The stabilizing influence of the Pacific air is at times interrupted by the warm moist tropical air from the south pushing into California, although it is difficult to determine where the limit of southerly flow occurs. General storms having the tropical characteristic of excessive thunderstorm rains are observed as far north as the northern end of the Sacramento Valley. Thus, a northern boundary has been selected for this study, excluding that portion of



SEPTEMBER
$y = 2.3258x^{0.5335}$
$R^2 = 0.993$
Rainfall (inches)
Duration (hr)
0
5
10
15
20
25
0.01
0.1
1
10
100
3hr = 4.18
2 3.37
1 2.33
.5 1.61
0.083 0.62

Table 6.1.--General-storm PMP computations for the Colorado River and Great basin

Drainage OLD DILLON RES　　　　Area 0.05 mi^2 (km^2)

Latitude 39°36", Longitude of basin center 106°04"

Month OCTOBER

Step	6	12	18	24	48	72	
	Duration (hrs)						
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16 13.7 in. (mm)							
2. Reduction for barrier-elevation [fig. 2.18] 30 %							
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.1 in. (mm)							
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	66	84	93	100	116	124	%
5. Convergence PMP for indicated durations [steps 3 X 4]	2.7	3.4	3.8	4.1	4.8	5.1	in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	2.7	0.7	0.4	0.3	0.7	0.3	in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	100	100	100	100	100	100	%
8. Areally reduced PMP [step 6 X step 7]	2.7	0.7	0.4	0.3	0.7	0.3	in. (mm)
9. Drainage average PMP [accumulated values of step 8]	2.7	3.4	3.8	4.1	4.8	5.1	in. (mm)
B. Orographic PMP							
1. Drainage average orographic index from figure 3.11a to d. 8.5 in. (mm)							
2. Areal reduction [figure 3.20] 100 %							
3. Adjustment for month [one of figs. 3.12 to 3.17] 98 %							
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 8.3 in. (mm)							
5. Durational variation [table ~~3.6~~ 3.9	30	57	80	100	158	186	%
6. Orographic PMP for given durations [steps 4 X 5]	2.5	4.7	6.6	8.3	13.1	15.4	in. (mm)
C. Total PMP							
1. Add steps A9 and B6	5.2	8.1	10.4	12.4	17.9	20.5	in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

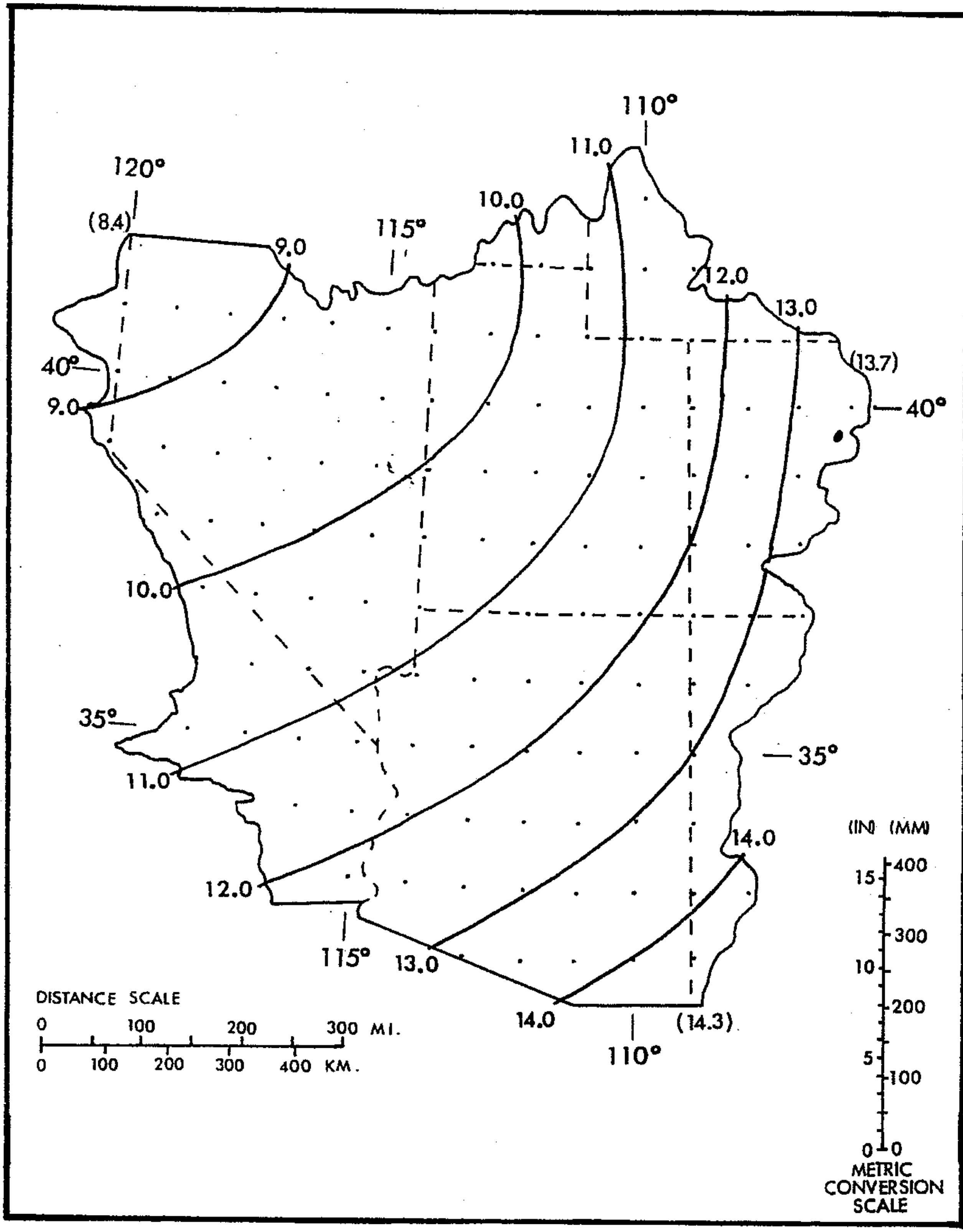


Figure 2.14.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for October. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

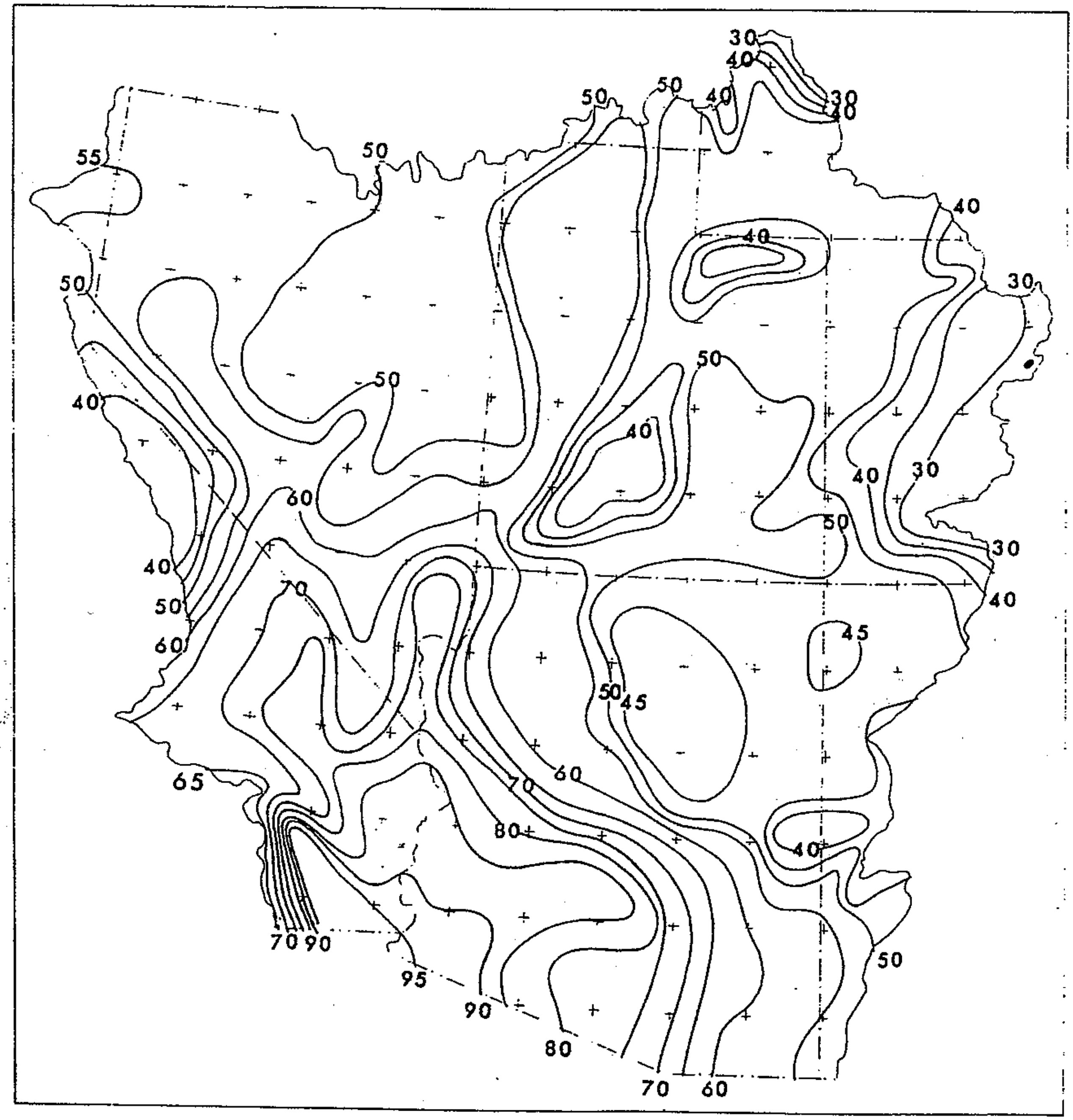
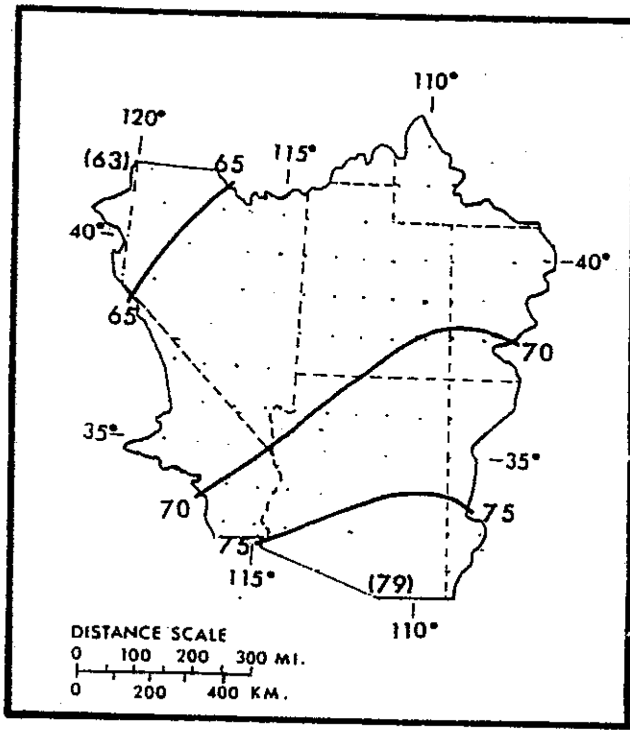
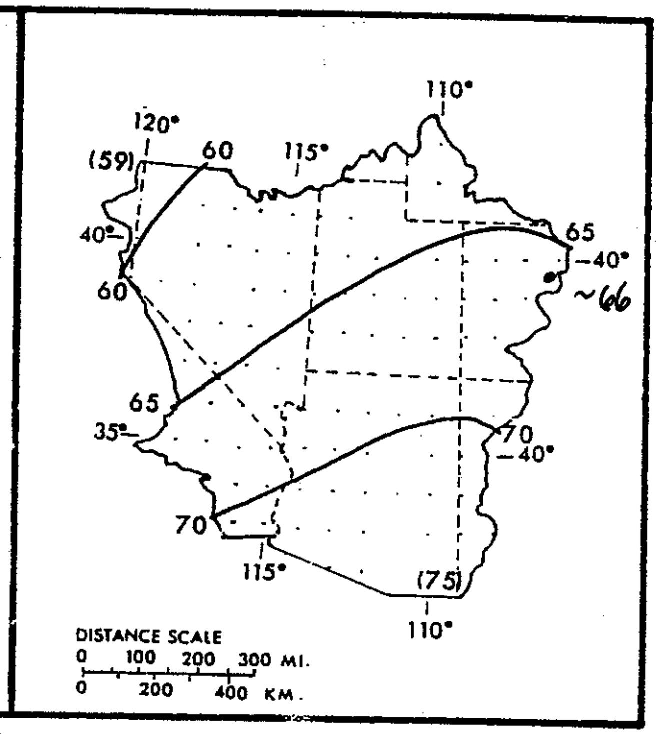


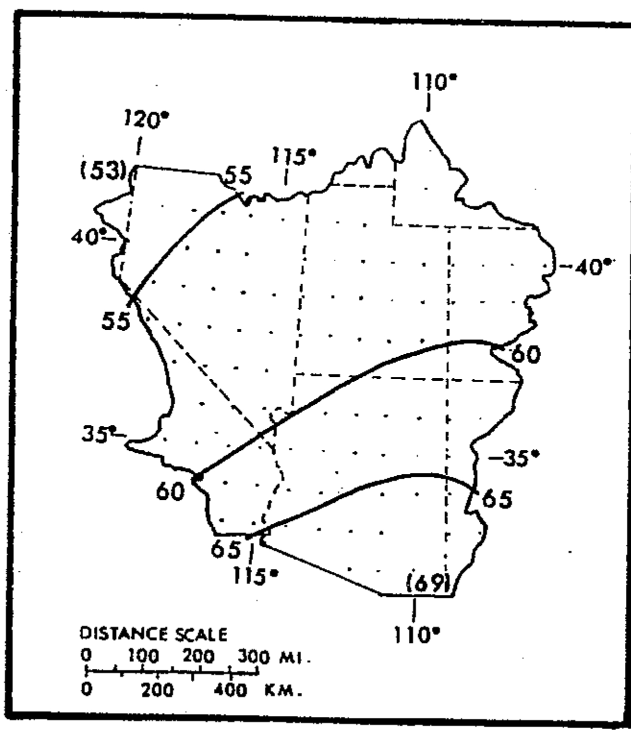
Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.



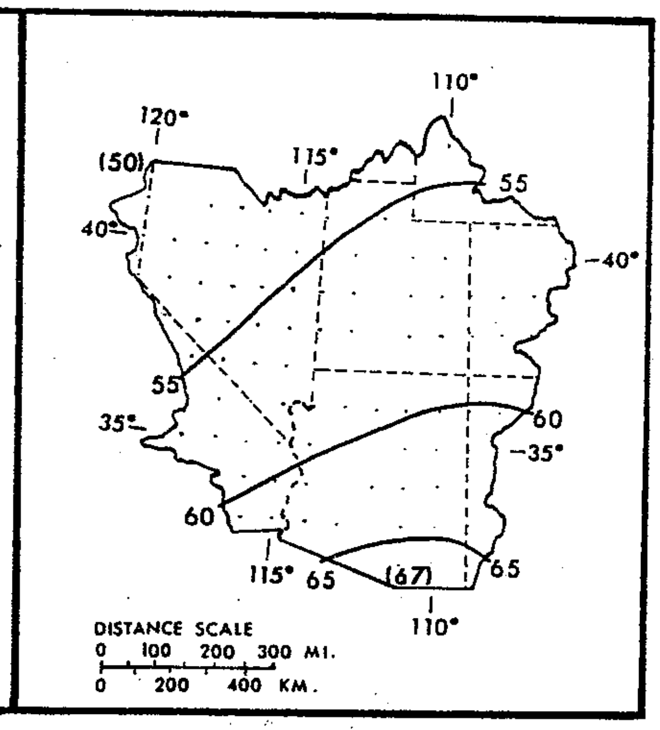
September



October



November



December

Figure 2.27.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 2.1.

Table 2.7.--Durational variation of convergence PMP (in percent of 24-hr amount).

Duration (Hrs) 6	12	18	24	48	72
50	76	90	100	129	150
51	77	90	100	128	148
52	77	90	100	127	146
53	77	91	100	127	144
54	78	91	100	126	142
55	78	91	100	125	140
56	79	91	100	124	138
57	79	92	100	123	137
58	80	92	100	122	135
59	80	92	100	121	134
60	81	92	100	120	132
61	81	92	100	120	131
62	82	93	100	119	129
63	82	93	100	118	128
64	83	93	100	117	126
65	84	93	100	117	125
66	84	93	100	116	124
67	85	94	100	116	123
68	85	94	100	115	122
69	86	94	100	115	121
70	87	94	100	114	120
71	87	95	100	114	119
72	88	95	100	113	118
73	88	95	100	113	118
74	89	95	100	112	117
75	89	96	100	112	116
76	90	96	100	111	115
77	90	96	100	110	114
78	91	96	100	110	114
79	92	97	100	109	113
80	92	97	100	109	113

Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

2.5 Areal Reduction for Basin Size

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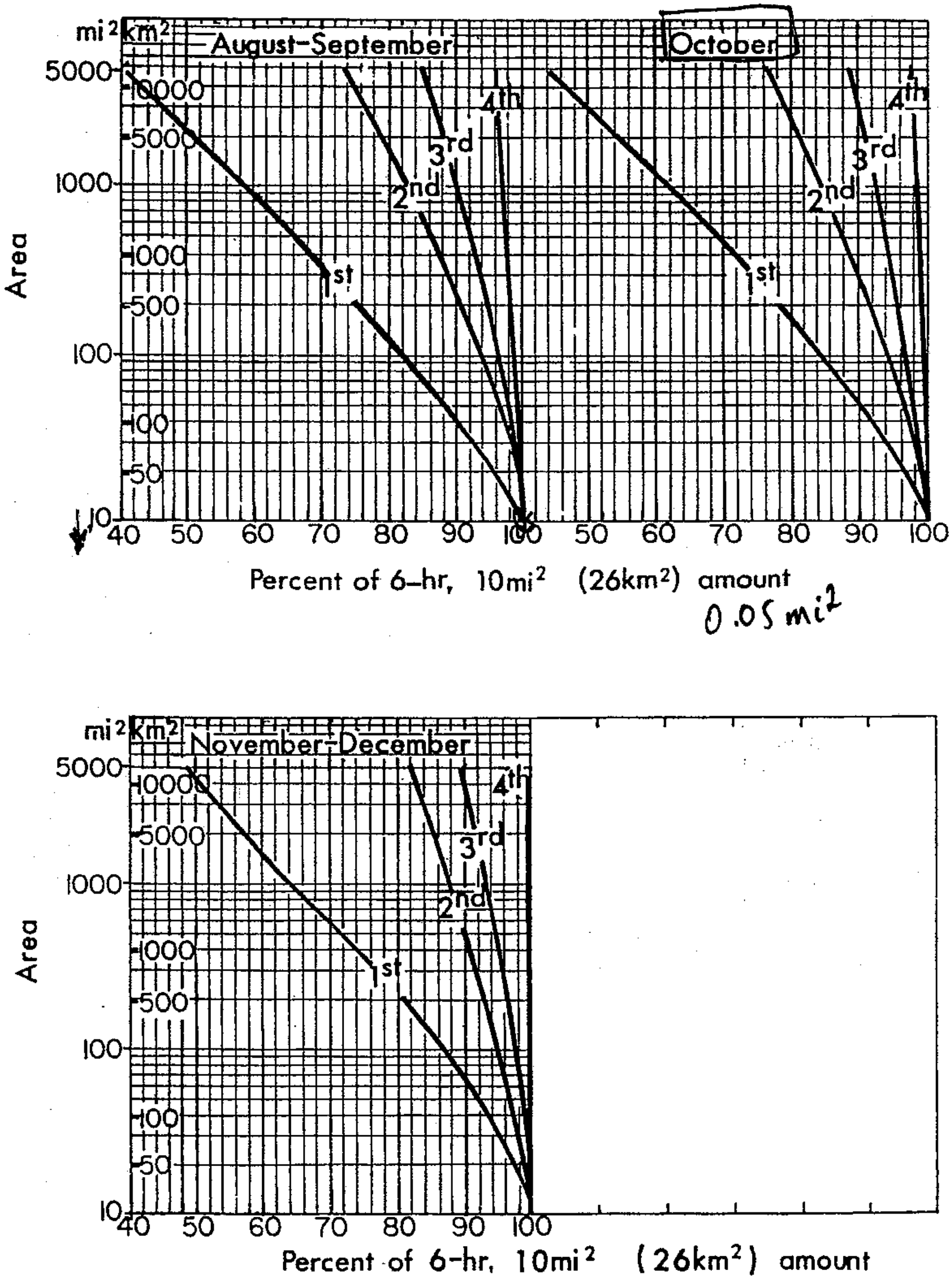

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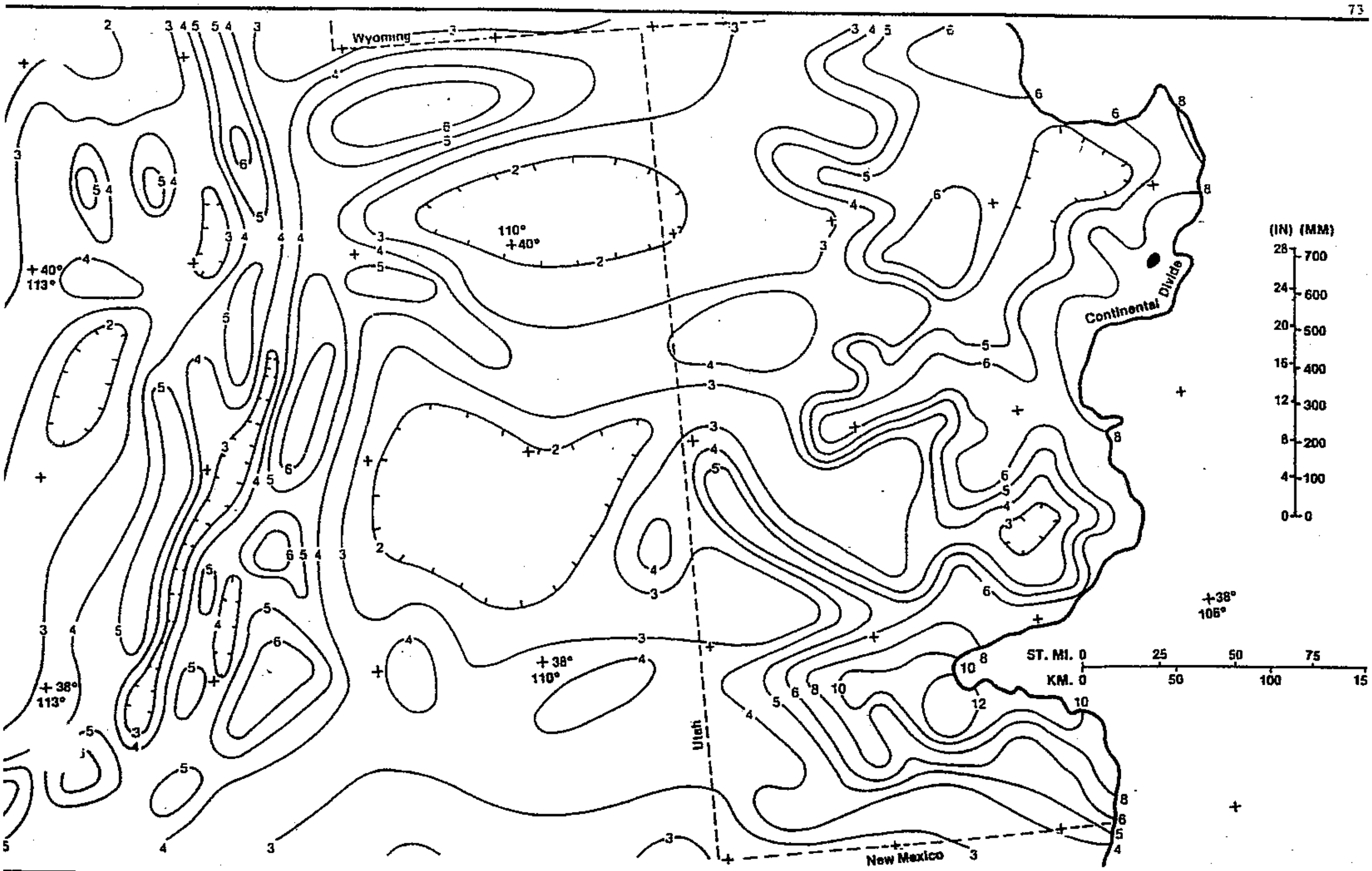


FIGURE 3.11b (Revised) — 10-mi² (26-km²) 24-hr orographic PMP index map (inches), north-central section.

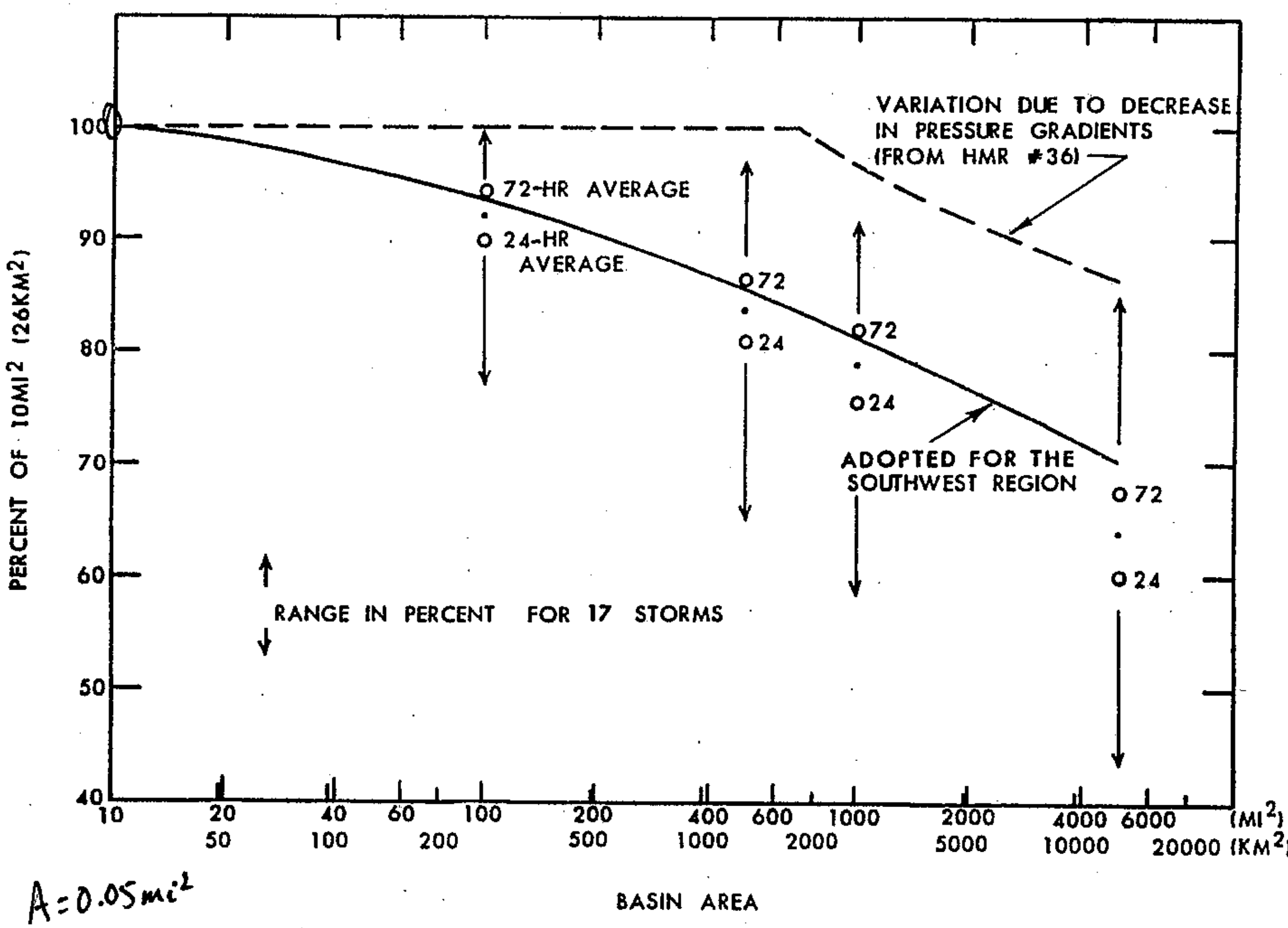
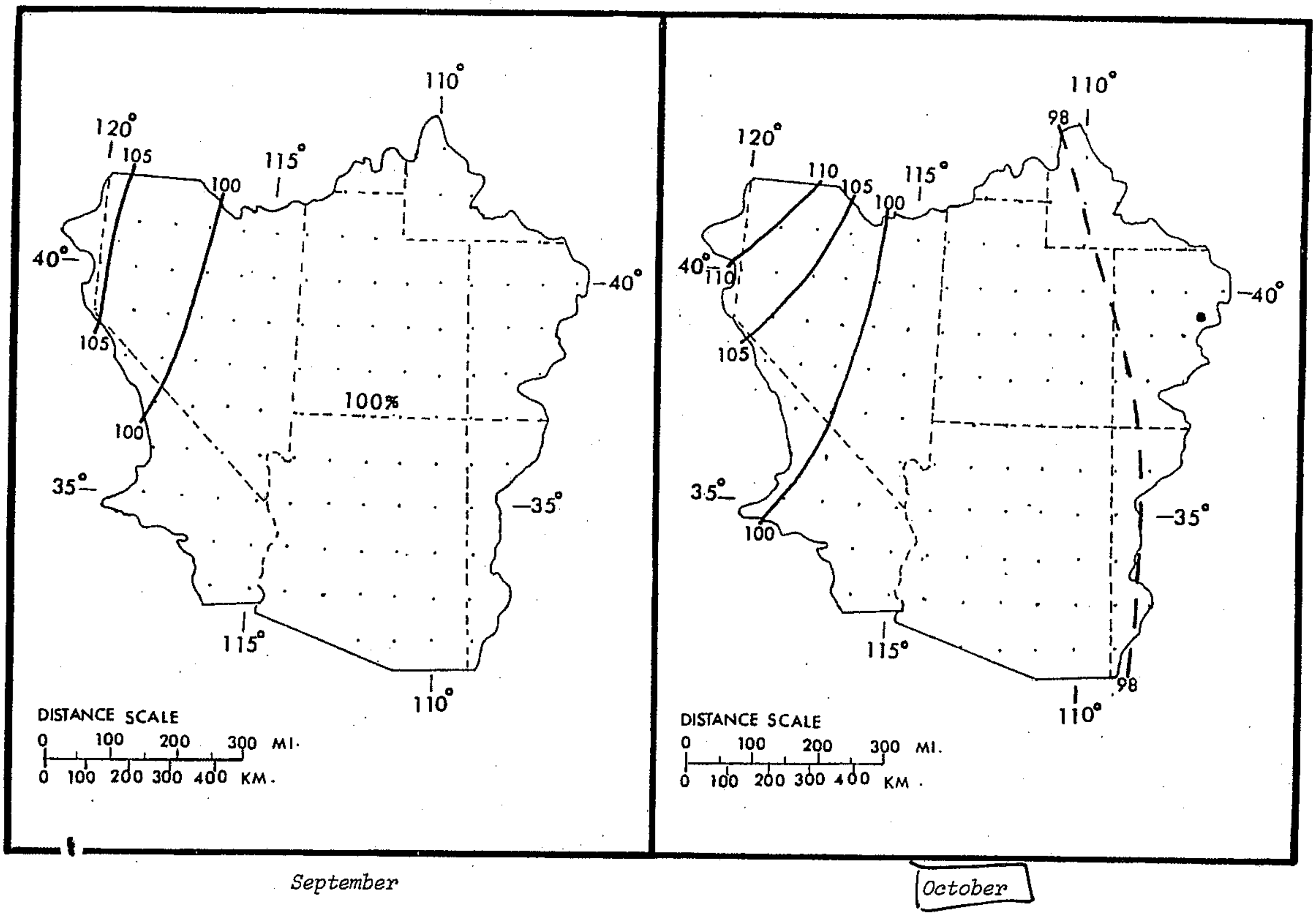


Figure 3.20.--Variation of orographic PMP with basin size.



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AREA CAPACITY CURVE

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: AREA CAPACITY CURVE FOR PROP. ODR

Total Number of Pages (including cover sheet): 3

Total Number of Computer Runs: –

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

DETERMINE THE AREA/CAPACITY RELATIONSHIP FOR THE PROPOSED OLD DILLON RESERVOIR TO BE USED FOR ROUTING FLOWS & CALCULATING DISCHARGES IN HEC-1

Design Basis/References/Assumptions:

- GET PROPOSED ELEVATION - AREA FROM DRAWINGS
- CALCULATE CAPACITY OF PROPOSED RESERVIOR FOR EACH ELEV. STEP IN EXCEL & CREATE RATING CURVE

Remarks/Conclusions/Results:

ATTACHED

Calculation Approved by: ______ Project Manager 10/24/08 Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

Elevation		area		area		average area	Σ volume
		ft^2		acre		acre	acre-ft
9159.99		0		0		0	
9160		29774		0.684		0.3418	0.34
9161		58310		1.339		1.0111	1.35
9162		91631		2.104		1.7211	3.07
9163		122320		2.808		2.4558	5.53
9164		156456		3.592		3.1999	8.73
9165		194829		4.473		4.0322	12.76
9166		235483		5.406		4.9393	17.70
9167		257978		5.922		5.6642	23.37
9168		278391		6.391		6.1567	29.52
9169		291106		6.683		6.5369	36.06
9170		303899		6.977		6.8297	42.89
9171		413151		9.485		8.2306	51.12
9172		423499		9.722		9.6034	60.72
9173		433938		9.962		9.8420	70.56
9174		444548		10.205		10.0836	80.65
9175		455294		10.452		10.3288	90.98
9176		466196		10.702		10.5772	101.55
9177		477228		10.956		10.8290	112.38
9178		488423		11.213		11.0841	123.47
9179		499772		11.473		11.3429	134.81
9180		511305		11.738		11.6056	146.42
9181		522923		12.005		11.8713	158.29
9182		534753		12.276		12.1404	170.43
9183		546715		12.551		12.4135	182.84
9184		558872		12.830		12.6904	195.53
9185		571145		13.112		12.9708	208.50
9186		583634		13.398		13.2550	221.76
9187		596318		13.690		13.5440	235.30
9188		614858		14.115		13.9024	249.20
9189		631594		14.499		14.3073	263.51
9190		640929		14.714		14.6066	278.12
9191		650306		14.929		14.8213	292.94
9192		659721		15.145		15.0370	307.98
9193		669174		15.362		15.2536	323.23
9194		678660		15.580		15.4710	338.70

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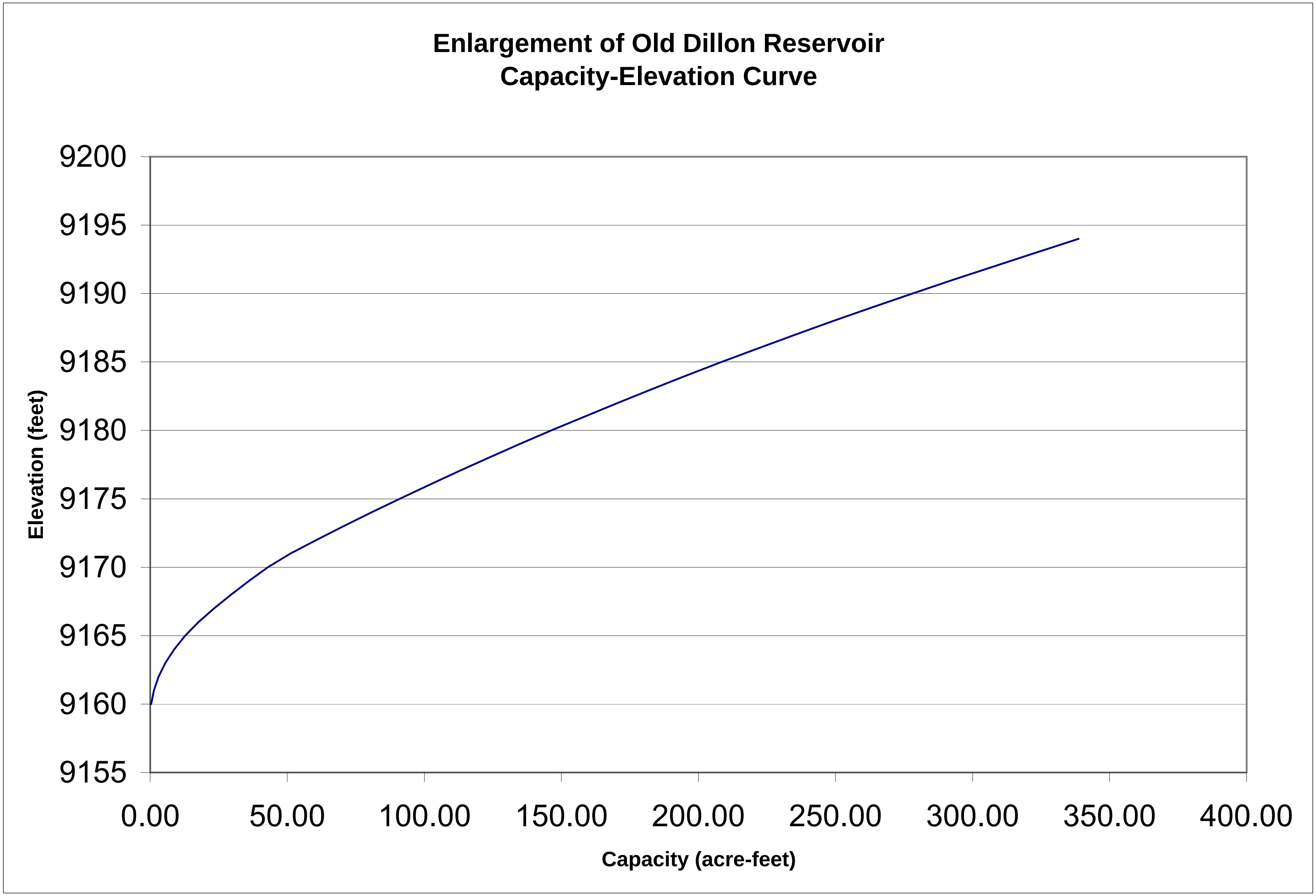
SA	11.213	11.738	12.276	12.830	13.398	14.115	14.714	14.929	15.145	15.580
SE	9159.9	9160	9162	9164	9166	9168	9170	9172	9174	9176
SE	9178	9180	9182	9184	9186	9188	9190	9191	9192	9194


Enlargement of Old Dillon Reservoir
Capacity-Elevation Curve
Elevation (feet)
9200
9195
9190
9185
9180
9175
9170
9165
9160
9155
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
Capacity (acre-feet)

PROPOSED SPILLWAY RATING CURVE

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: SPILLWAY RATING CURVE FOR ODR

Total Number of Pages (including cover sheet): 4

Total Number of Computer Runs: —

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

CREATE A RATING CURVE FOR FLOW OVER THE PROPOSED SPILLWAY AT OLD DILLON RESERVIOR

Design Basis/References/Assumptions:

USE THE SIMPLE WEIR EQUATION IN EXCEL TO DETERMINE THE RELATIONSHIP BETWEEN ELEVATION & DISCHARGE FOR ROUTING CALCULATIONS TO BE PERFORMED IN HEC-1

Remarks/Conclusions/Results:

ATTACHED

Calculation Approved by: Project Manager 10/24/08 Date

Revision No.:	Description of Revision:	Approved by:
		Project Manager/Date

P:\133_1187_004_03_Old_Dillon_Res\SupportDocs\Calcs\Calculation Cover Sheet_Tt.doc

TETRA TECH

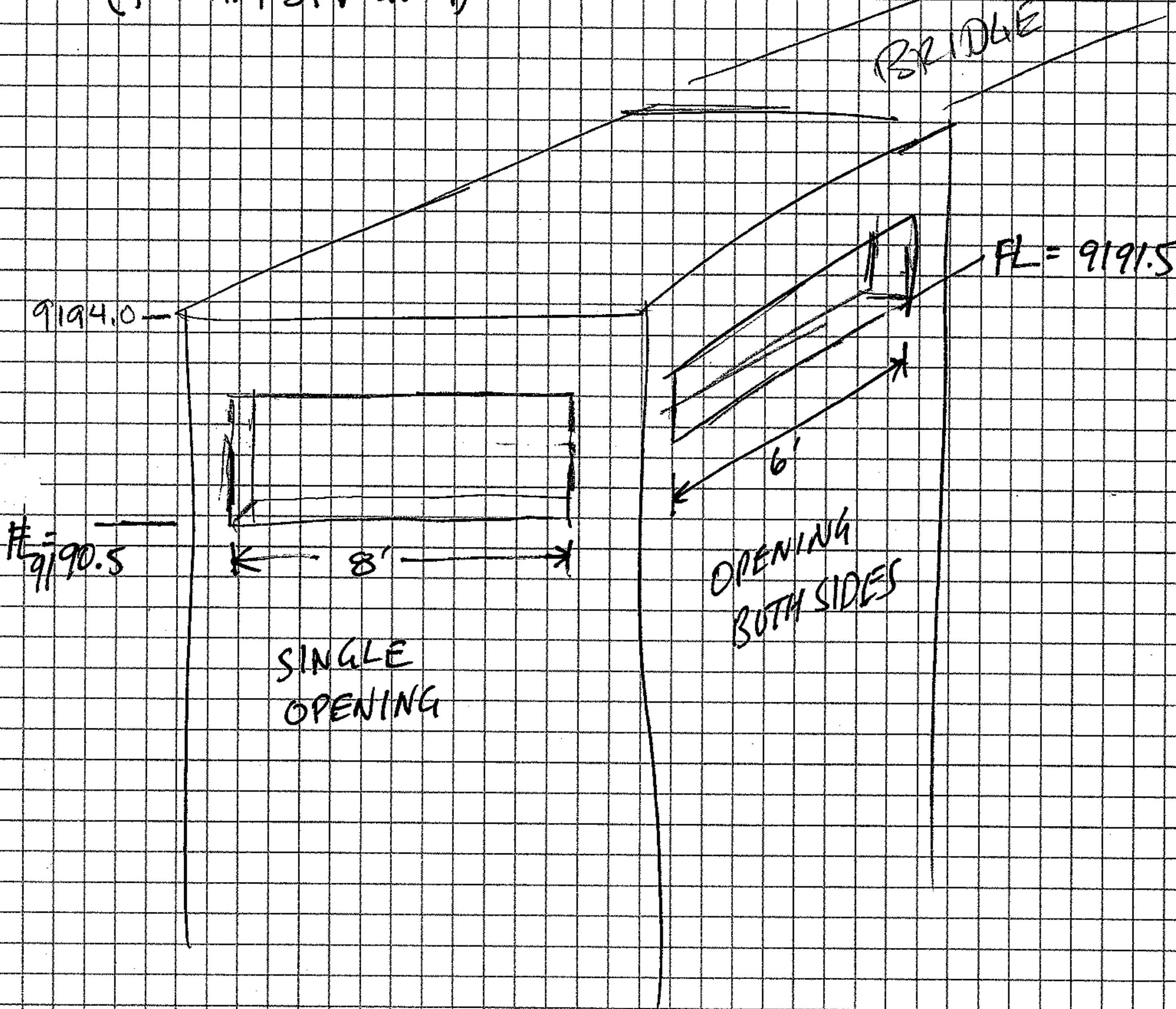
• Professional Engineers •

Client: Job No.: 133-1187.004.03 Sheet of

Description: Designed By: Date:

PROPOSED OLD DILLON DAM Checked By: Date:

INTAKE STRUCTURE - OUTLET TO SALT LICK GULCH
(PRIMARY SPILLWAY)

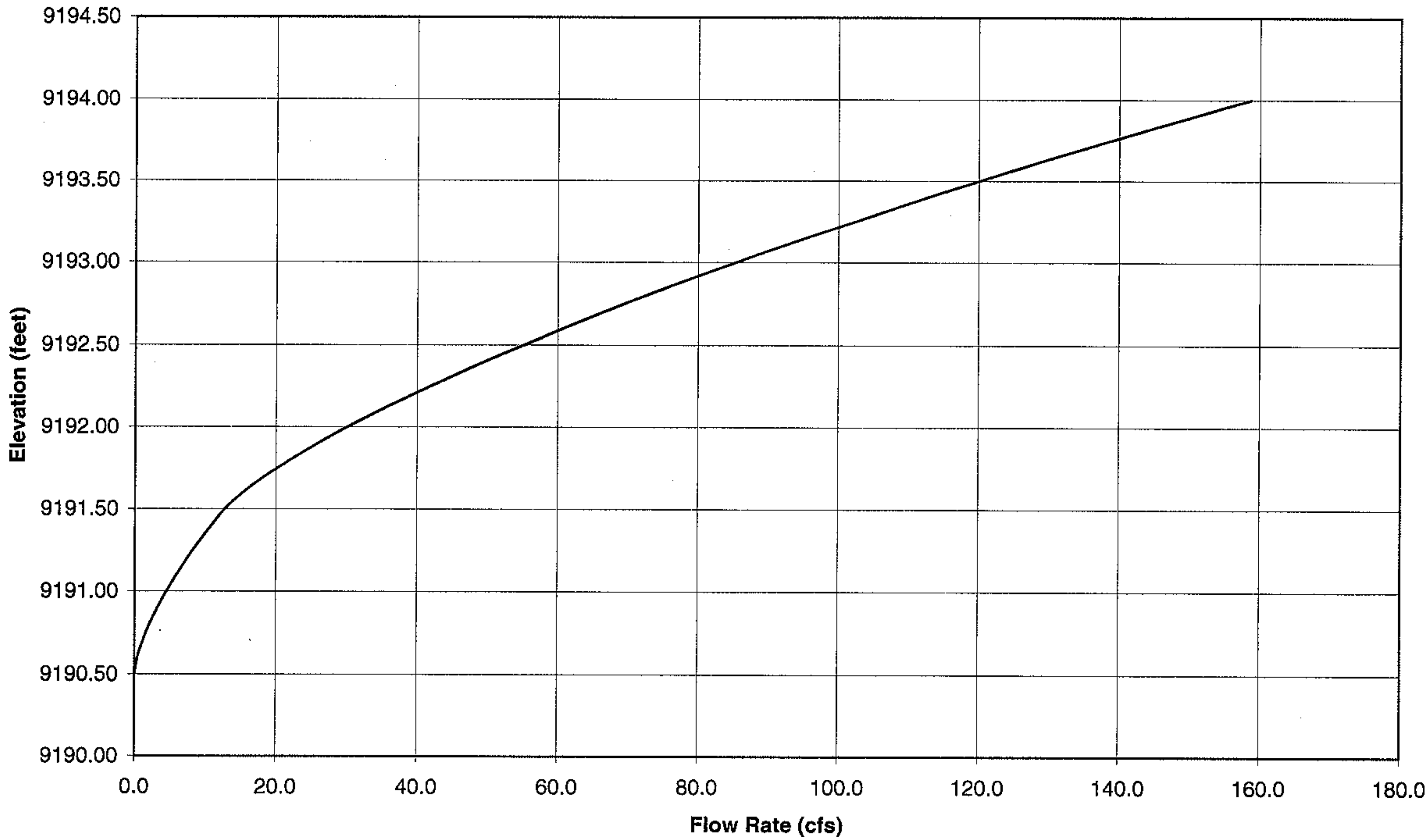


$$Q = CLH^{3/2}$$

$C = 2.65$

Weir Coeff.	2.65												
Lower Opening L=8' - Reduce to 4.8 to account for 40% obstruction due to screening													
'pper Opening L=6' x2 - Reduce from 12' to 7.2' to account for 40% obstruction due to screening													
LOWER OPENING					UPPER OPENINGS					Total			
elev	h	L	q		elev	h	L	q		elev	h	q	
9190.5	0.0	4.8	0.0		9190.50	0.00	7.20	0.0		9190.5	0.0	0.0	Lower Opening Crest
9190.6	0.1	4.8	0.4		9190.60	0.00	7.20	0.0		9190.6	0.0	0.4	
9190.7	0.2	4.8	1.1		9190.70	0.00	7.20	0.0		9190.7	0.0	1.1	
9190.8	0.3	4.8	2.1		9190.80	0.00	7.20	0.0		9190.8	0.0	2.1	
9190.9	0.4	4.8	3.2		9190.90	0.00	7.20	0.0		9190.9	0.0	3.2	
9191.0	0.5	4.8	4.5		9191.00	0.00	7.20	0.0		9191.0	0.0	4.5	
9191.1	0.6	4.8	5.9		9191.10	0.00	7.20	0.0		9191.1	0.0	5.9	
9191.2	0.7	4.8	7.4		9191.20	0.00	7.20	0.0		9191.2	0.0	7.4	
9191.3	0.8	4.8	9.1		9191.30	0.00	7.20	0.0		9191.3	0.0	9.1	
9191.4	0.9	4.8	10.9		9191.40	0.00	7.20	0.0		9191.4	0.0	10.9	
9191.5	1.0	4.8	12.7		9191.50	0.00	7.20	0.0		9191.5	0.0	12.7	Upper Openings Crest
9191.6	1.1	4.8	14.7		9191.60	0.10	7.20	0.6		9191.6	0.1	15.3	
9191.7	1.2	4.8	16.7		9191.70	0.20	7.20	1.7		9191.7	0.2	18.4	
9191.8	1.3	4.8	18.9		9191.80	0.30	7.20	3.1		9191.8	0.3	22.0	
9191.9	1.4	4.8	21.1		9191.90	0.40	7.20	4.8		9191.9	0.4	25.9	
9192.0	1.5	4.8	23.4		9192.00	0.50	7.20	6.7		9192.0	0.5	30.1	
9192.1	1.6	4.8	25.7		9192.10	0.60	7.20	8.9		9192.1	0.6	34.6	
9192.2	1.7	4.8	28.2		9192.20	0.70	7.20	11.2		9192.2	0.7	39.4	
9192.3	1.8	4.8	30.7		9192.30	0.80	7.20	13.7		9192.3	0.8	44.4	
9192.4	1.9	4.8	33.3		9192.40	0.90	7.20	16.3		9192.4	0.9	49.6	
9192.5	2.0	4.8	36.0		9192.50	1.00	7.20	19.1		9192.5	1.0	55.1	
9192.6	2.1	4.8	38.7		9192.60	1.10	7.20	22.0		9192.6	1.1	60.7	
9192.7	2.2	4.8	41.5		9192.70	1.20	7.20	25.1		9192.7	1.2	66.6	
9192.8	2.3	4.8	44.4		9192.80	1.30	7.20	28.3		9192.8	1.3	72.6	
9192.9	2.4	4.8	47.3		9192.90	1.40	7.20	31.6		9192.9	1.4	78.9	
9193.0	2.5	4.8	50.3		9193.00	1.50	7.20	35.1		9193.0	1.5	85.3	
9193.1	2.6	4.8	53.3		9193.10	1.60	7.20	38.6		9193.1	1.6	91.9	
9193.2	2.7	4.8	56.4		9193.20	1.70	7.20	42.3		9193.2	1.7	98.7	
9193.3	2.8	4.8	59.6		9193.30	1.80	7.20	46.1		9193.3	1.8	105.7	
9193.4	2.9	4.8	62.8		9193.40	1.90	7.20	50.0		9193.4	1.9	112.8	
9193.5	3.0	4.8	66.1		9193.50	2.00	7.20	54.0		9193.5	2.0	120.1	
9193.6	3.1	4.8	69.4		9193.60	2.10	7.20	58.1		9193.6	2.1	127.5	
9193.7	3.2	4.8	72.8		9193.70	2.20	7.20	62.3		9193.7	2.2	135.1	
9193.8	3.3	4.8	76.3		9193.80	2.30	7.20	66.6		9193.8	2.3	142.8	
9193.9	3.4	4.8	79.7		9193.90	2.40	7.20	70.9		9193.9	2.4	150.7	
9194.0	3.5	4.8	83.3		9194.00	2.50	7.20	75.4		9194.0	2.5	158.7	Dam Crest

Spillway Rating Curve
Enlargement of Old Dillon Reservoir



Reservoir Elevation – Capacity Curve

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: RESERVOIR ELEVATION CAPACITY CURVE

Total Number of Pages (including cover sheet): 3

Total Number of Computer Runs: —

Prepared by: AJT Date: OCT 24, 2008

Checked by: ______ Date: ______

Description and Purpose:

EXHIBIT RELATING PROPOSED
RESERVOIR - AREA - CAPACITY

Design Basis/References/Assumptions:

SUMMARY OF PREVIOUS CALCS + RESERVOIR
- NHWL
- PMP ELEVATION
- DAM CREST

Remarks/Conclusions/Results:

Calculation Approved by: ______

Project Manager Date

Revision No.: Description of Revision: Approved by:

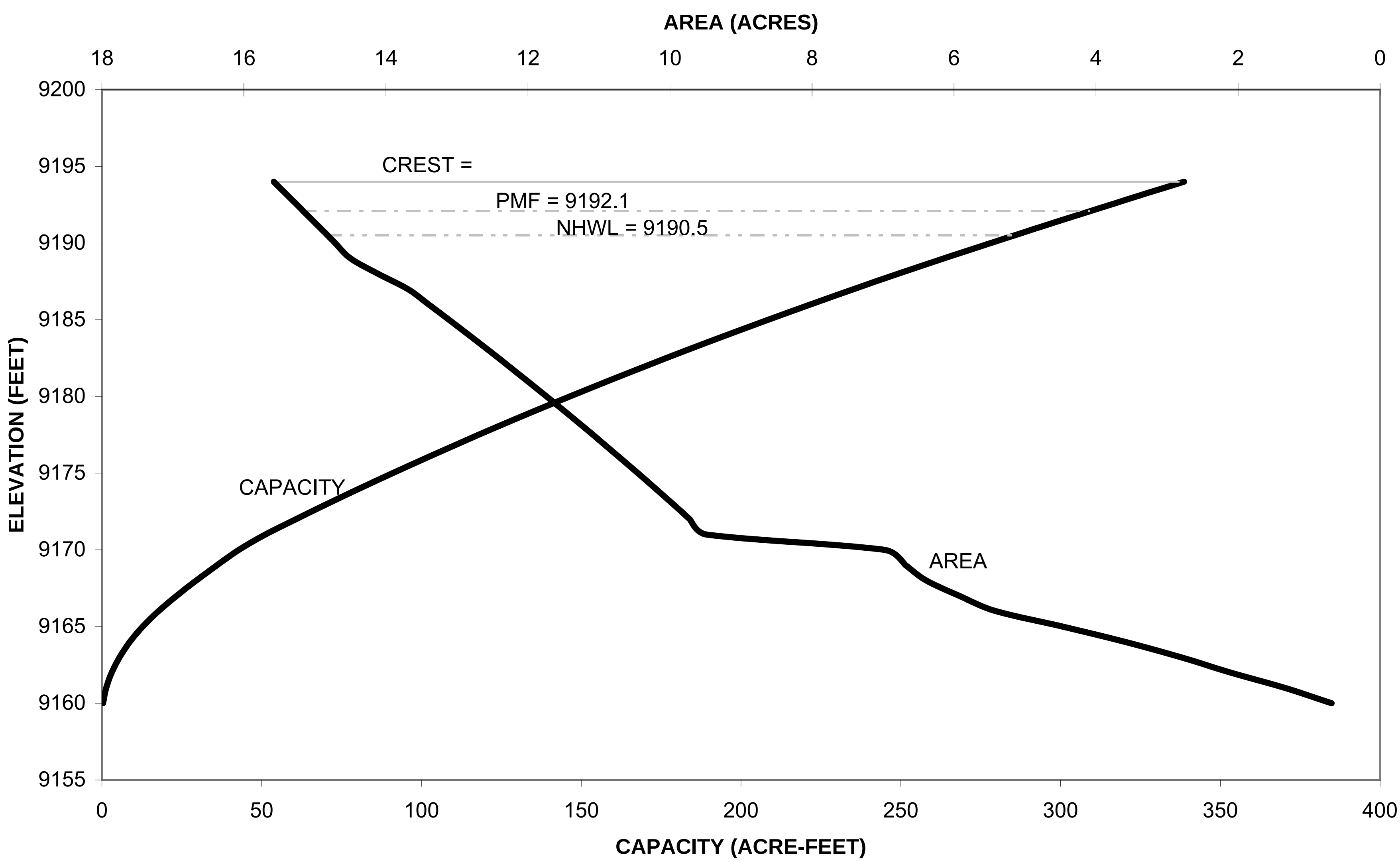
Project Manager/Date

P:\133_1187_004_03_Old_Dillon_Res\SupportDocs\Calcs\Calculation Cover Sheet_Tt.doc

AREA - CAPACITY TABLE

Elevation	Area	Average area	Cum Volume	
	(Acres)		(Acre-Ft)	
9194	15.58	15.5	338.70	Dam Crest
9193	15.36	15.3	323.23	
9192.4	15.23	15.2	314.08	PMF
9192	15.15	15.0	307.98	
9191	14.93	14.8	292.94	
9190.5	14.82	14.7	285.53	Spillway Crest
9190	14.71	14.6	278.12	
9189	14.50	14.3	263.51	
9188	14.12	13.9	249.20	
9187	13.69	13.5	235.30	
9186	13.40	13.3	221.76	
9185	13.11	13.0	208.50	
9184	12.83	12.7	195.53	
9183	12.55	12.4	182.84	
9182	12.28	12.1	170.43	
9181	12.00	11.9	158.29	
9180	11.74	11.6	146.42	
9179	11.47	11.3	134.81	
9178	11.21	11.1	123.47	
9177	10.96	10.8	112.38	
9176	10.70	10.6	101.55	
9175	10.45	10.3	90.98	
9174	10.21	10.1	80.65	
9173	9.96	9.8	70.56	
9172	9.72	9.6	60.72	
9171	9.48	8.2	51.12	
9170	6.98	6.8	42.89	
9169	6.68	6.5	36.06	
9168	6.39	6.2	29.52	
9167	5.92	5.7	23.37	
9166	5.41	4.9	17.70	
9165	4.47	4.0	12.76	
9164	3.59	3.2	8.73	
9163	2.81	2.5	5.53	
9162	2.10	1.7	3.07	
9161	1.34	1.0	1.35	
9160	0.68	0.3	0.34	Outlet Works Invert

AREA CAPACITY CURVE



APPENDIX B

HEC-1 MODELS

USBR

LOCAL

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: HEC-1 Calculations for ODR - Local PMP - USBR hydrographs

Total Number of Pages (including cover sheet): 13

Total Number of Computer Runs:

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

Calculate/Route flows tributary to ODR through reservoir & out the spillway to determine max. discharge & elevation

Design Basis/References/Assumptions:

- Input data from USBR hydrographs & rating curves for stage-storage-discharge into HEC-1 & calculate
- Rule 5.9.1.4 - 'Small Dam, High Hazard' - 0.9 IDF reduction

Remarks/Conclusions/Results:

Q = 51 cfs

Max. Elev. = 9192.43

Calculation Approved by: Project Manager 10/24/08 Date

Revision No.:	Description of Revision:	Approved by:
		Project Manager/Date

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```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   24OCT08  TIME  14:44:59   *
*                                       *
*****************************************
```

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

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

               *DIAGRAM
   1           ID  Old Dillon Reservoir
   2           ID  Proposed Reservoir - LOCAL PMP
   3           ID  USBR hydrographs
   4           ID  Maximum water surface and discharge determination for proposed spillway struct
   5           ID  10/22/2008
   6           ID  file name: PMP_USBR_LOCAL.ih1
               *
   7           IT       1 01JUL09    1200     361
   8           IO       3       0
               * Rule 5.9.1.4 - From Table 5.2 - Small Dam, High Hazard
   9           JR    PREC     0.9
               *

  10           KK   H[NE]
  11           KM  Rainfall runoff for Basin NE
  12           BA   0.012
  13           IN      60
  14           PI    0.25    0.58     8.4    1.18    0.34    0.17
  15           KO                                    22
  16           UI       0       1       3      11      19      27      37      46      52      45
  17           UI      38      31      24      18      14      11       9       8       7       6
  18           UI       5       5       4       4       3       3       3       3       2       2
  19           UI       2       2       2       2       1       1       1       1       1       1
  20           UI       1       1       1       1       1       1       1       0       0       0
               *

  21           KK   H[SW]
  22           KM  Rainfall runoff for Basin SW
  23           BA   0.014
  24           IN      60
  25           PI    0.25    0.58     8.4    1.18    0.34    0.17
  26           KO                                    22
  27           UI       0       1       1       4      10      16      22      29      36      43
  28           UI      49      45      39      34      29      23      19      15      13      11
  29           UI       9       8       7       6       6       5       5       4       4       4
  30           UI       3       3       3       3       2       2       2       2       2       2
  31           UI       2       2       1       1       1       1       1       1       1       1
  32           UI       1       1       1       1       1       1       1       1       0       0
               *

  33           KK   water
  34           KM  Rainfall falling on ODR
  35           KO                                    22
  36           BA   0.025
               * Base flow = 10 cfs from dillon ditch
  37           BF      10
  38           UI       0     968
               *
```

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

  39           KK   combn
  40           KM
  41           KO                                     22
  42           HC       3
               *

  43           KK     ODR
  44           KM  Proposed ODR - enlarged reservoir and proposed spillway; NHWL = 9190.5
  45           KO                                     22
  46           RS       1    ELEV  9190.5
  47           SA       0   0.684   2.104   3.592   5.406   6.391   6.977   9.722  10.205  10.702
  48           SA  11.213  11.738  12.276   12.83  13.398  14.115  14.714  14.929  15.145   15.58
  49           SE  9159.9    9160    9162    9164    9166    9168    9170    9172    9174    9176
  50           SE    9178    9180    9182    9184    9186    9188    9190    9191    9192    9194
               *
               * Outflow structure - lower opening - FL = 90.5; L = 8'; 40% obstruction
               * due to screening
  51           SS  9190.5     4.8    2.65     1.5
               * Outflow structure - upper openings - FL = 91.5; L = 12'; 40% obstruction
               * due to screening
  52           ST  9191.5     7.2    2.65     1.5
               *
  53           ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING            (--->) DIVERSION OR PUMP FLOW

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

  10        H[NE]
                .
                .
  [illegible]              .          H[SW]
                .            .
                .            .
  33            .            .          water
                .            .              .
                .            .              .
  39        combn.......................
                V
                V
  43          ODR

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                                        ***************************************
*                                       *                                        *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                        *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                                        *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                                        *         609 SECOND STREET           *
*                                       *                                        *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE   24OCT08  TIME  14:44:59   *                                        *         (916) 756-1104              *
*                                       *                                        *                                     *
*****************************************                                        ***************************************



                    Old Dillon Reservoir
                    Proposed Reservoir - LOCAL PMP
                    USBR hydrographs
                    Maximum water surface and discharge determination for proposed spillway struct
                    10/22/2008
                    file name: PMP_USBR_LOCAL.ih1

  8 IO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                     NMIN           1  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1JUL 9  STARTING DATE
                    ITIME        1200  STARTING TIME
                       NQ         361  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1JUL 9  ENDING DATE
                   NDTIME        1800  ENDING TIME
                    ICENT          19  CENTURY MARK

               COMPUTATION INTERVAL      .02 HOURS
                    TOTAL TIME BASE     6.00 HOURS

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

   JP          MULTI-PLAN OPTION
                    NPLAN           1  NUMBER OF PLANS

   JR          MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                     .90


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

         **************
         *            *
 10 KK   *    H(NE)   *
         *            *
         **************
                   Rainfall runoff for Basin NE

 13 IN         TIME DATA FOR INPUT TIME SERIES
                   JXMIN          60  TIME INTERVAL IN MINUTES
                  JXDATE      1JUL 9  STARTING DATE
                  JXTIME        1200  STARTING TIME

 15 KO         OUTPUT CONTROL VARIABLES
                   IPRNT           3  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE
                   IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                    IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         361  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .017  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 12 BA         SUBBASIN CHARACTERISTICS
                   TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

 14 PB              STORM       10.92  BASIN TOTAL PRECIPITATION

 14 PI           INCREMENTAL PRECIPITATION PATTERN
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .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
                    .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
                    .01       .01       .01       .01       .01       .01       .01       .01       .01       .01
```

```
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
              .01     .01     .01     .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     .00     .00
              .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
              .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
              .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
              .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
              .00     .00     .00     .00     .00     .00     .00     .00     .00     .00

 16 UI         INPUT UNITGRAPH,  47 ORDINATES,  VOLUME =  .99
               .0     1.0     3.0    11.0    19.0    27.0    37.0    46.0    52.0    45.0
             38.0    31.0    24.0    18.0    14.0    11.0     9.0     8.0     7.0     6.0
              5.0     5.0     4.0     4.0     3.0     3.0     3.0     3.0     2.0     2.0
              2.0     2.0     2.0     2.0     1.0     1.0     1.0     1.0     1.0     1.0
              1.0     1.0     1.0     1.0     1.0     1.0     1.0

                                         ***

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

                HYDROGRAPH AT STATION     H[NE]
                  FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =   10.92, TOTAL LOSS =     .00, TOTAL EXCESS =   10.92

PEAK FLOW      TIME                      MAXIMUM AVERAGE FLOW
  (CFS)        (HR)               6-HR         24-HR        72-HR      6.00-HR
    65.        2.78      (CFS)      14.          14.          14.          14.
                       (INCHES)  10.824       10.824       10.824       10.824
                        (AC-FT)      7.           7.           7.           7.

                 CUMULATIVE AREA =     .01 SQ MI

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

                HYDROGRAPH AT STATION     H[NE]
                  FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =    9.83, TOTAL LOSS =     .00, TOTAL EXCESS =    9.83

PEAK FLOW      TIME                      MAXIMUM AVERAGE FLOW
  (CFS)        (HR)               6-HR         24-HR        72-HR      6.00-HR
    58.        2.78      (CFS)      13.          13.          13.          13.
                       (INCHES)   9.742        9.742        9.742        9.742
                        (AC-FT)      6.           6.           6.           6.

                 CUMULATIVE AREA =     .01 SQ MI


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

          **************
          *            *
 21 KK    *    H[SW]   *
          *            *
          **************
                  Rainfall runoff for Basin SW

 24 IN         TIME DATA FOR INPUT TIME SERIES
                  JXMIN          60  TIME INTERVAL IN MINUTES
                  JXDATE     1JUL 9  STARTING DATE
                  JXTIME       1200  STARTING TIME

 26 KO         OUTPUT CONTROL VARIABLES
                  IPRNT           3  PRINT CONTROL
                  IPLOT           0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE
                  IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                   IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                  ISAV2         361  LAST ORDINATE PUNCHED OR SAVED
                 TIMINT        .017  TIME INTERVAL IN HOURS

            SUBBASIN RUNOFF DATA

 23 BA         SUBBASIN CHARACTERISTICS
                  TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA
```

```
 25 PB          STORM       10.92  BASIN TOTAL PRECIPITATION

 25 PI        INCREMENTAL PRECIPITATION PATTERN
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .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
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .14     .14     .14     .14     .14     .14     .14     .14     .14     .14
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
                .01     .01     .01     .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     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                .00     .00     .00     .00     .00     .00     .00     .00     .00     .00

 27 UI        INPUT UNITGRAPH,  58 ORDINATES,  VOLUME = 1.00
                 .0     1.0     1.0     4.0    10.0    16.0    22.0    29.0    36.0    43.0
               49.0    45.0    39.0    34.0    29.0    23.0    19.0    15.0    13.0    11.0
                9.0     8.0     7.0     6.0     6.0     5.0     5.0     4.0     4.0     4.0
                3.0     3.0     3.0     3.0     2.0     2.0     2.0     2.0     2.0     2.0
                2.0     2.0     1.0     1.0     1.0     1.0     1.0     1.0     1.0     1.0
                1.0     1.0     1.0     1.0     1.0     1.0     1.0     1.0

                                          ***

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

                  HYDROGRAPH AT STATION    H[SW]
                    FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =   10.92, TOTAL LOSS =     .00, TOTAL EXCESS =   10.92

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
   (CFS)       (HR)                6-HR        24-HR       72-HR      6.00-HR
     76.       2.97        (CFS)     16.          16.         16.         16.
                        (INCHES)  10.855       10.855      10.855      10.855
                         (AC-FT)      8.           8.          8.          8.

                  CUMULATIVE AREA =     .01 SQ MI

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

                  HYDROGRAPH AT STATION    H[SW]
                    FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =    9.83, TOTAL LOSS =     .00, TOTAL EXCESS =    9.83

 PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
   (CFS)       (HR)                6-HR        24-HR       72-HR      6.00-HR
     68.       2.97        (CFS)     15.          15.         15.         15.
                        (INCHES)   9.770        9.770       9.770       9.770
                         (AC-FT)      7.           7.          7.          7.

                  CUMULATIVE AREA =     .01 SQ MI


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


          **************
          *            *
 33 KK    *    water   *
          *            *
          **************
                  Rainfall falling on ODR

 35 KO        OUTPUT CONTROL VARIABLES
                  IPRNT          3  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE
                  IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                   IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                  ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
```

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                  ISAV2          361  LAST ORDINATE PUNCHED OR SAVED
                 TIMINT         .017  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 36 BA         SUBBASIN CHARACTERISTICS
                  TAREA          .03  SUBBASIN AREA

 37 BF         BASE FLOW CHARACTERISTICS
                  STRTQ        10.00  INITIAL FLOW
                  QRCSN          .00  BEGIN BASE FLOW RECESSION
                  RTIOR      1.00000  RECESSION CONSTANT

               PRECIPITATION DATA

 25 PB            STORM        10.92  BASIN TOTAL PRECIPITATION

 25 PI           INCREMENTAL PRECIPITATION PATTERN
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .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
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .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      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00

 36 UI         INPUT UNITGRAPH,   2 ORDINATES,  VOLUME = 1.00
                     .0     968.0

                                                       ***

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

                    HYDROGRAPH AT STATION    water
                      FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =   10.92, TOTAL LOSS =      .00, TOTAL EXCESS =   10.92

 PEAK FLOW    TIME                         MAXIMUM AVERAGE FLOW
   (CFS)      (HR)                 6-HR       24-HR       72-HR       6.00-HR
    146.      2.03       (CFS)      39.         39.         39.           39.
                       (INCHES)  14.635      14.635      14.635        14.635
                        (AC-FT)     20.         20.         20.           20.

                    CUMULATIVE AREA =      .03 SQ MI

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

                    HYDROGRAPH AT STATION    water
                      FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =    9.83, TOTAL LOSS =      .00, TOTAL EXCESS =    9.83

 PEAK FLOW    TIME                         MAXIMUM AVERAGE FLOW
   (CFS)      (HR)                 6-HR       24-HR       72-HR       6.00-HR
    132.      2.03       (CFS)      36.         36.         36.           36.
                       (INCHES)  13.543      13.543      13.543        13.543
                        (AC-FT)     18.         18.         18.           18.

                    CUMULATIVE AREA =      .03 SQ MI


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

          **************
          *            *
 39 KK    *    combn   *
          *            *
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     **************

41 KO          OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                      IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          361  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .017  TIME INTERVAL IN HOURS

42 HC          HYDROGRAPH COMBINATION
                     ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                             ***

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

                       HYDROGRAPH AT STATION    combn
                         FOR PLAN 1, RATIO =  .90

PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                   6-HR        24-HR       72-HR       6.00-HR
   258.        2.97          (CFS)      64.          64.         64.           64.
                          (INCHES)   11.613       11.613      11.613        11.613
                           (AC-FT)      32.          32.         32.           32.

                      CUMULATIVE AREA =      .05 SQ MI


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

     **************
     *            *
43 KK     *     ODR    *
     *            *
     **************
                        Proposed ODR - enlarged reservoir and proposed spillway; NHWL = 9190.5

45 KO          OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                      IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2          361  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .017  TIME INTERVAL IN HOURS

             HYDROGRAPH ROUTING DATA

46 RS          STORAGE ROUTING
                     NSTPS            1  NUMBER OF SUBREACHES
                      ITYP         ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC      9190.50  INITIAL CONDITION
                         X          .00 WORKING R AND D COEFFICIENT

47 SA              AREA          .0         .7        2.1        3.6        5.4        6.4        7.0        9.7       10.2       10.7
                               11.2       11.7       12.3       12.8       13.4       14.1       14.7       14.9       15.1       15.6

49 SE          ELEVATION    9159.90    9160.00    9162.00    9164.00    9166.00    9168.00    9170.00    9172.00    9174.00    9176.00
                            9178.00    9180.00    9182.00    9184.00    9186.00    9188.00    9190.00    9191.00    9192.00    9194.00

51 SS          SPILLWAY
                      CREL      9190.50  SPILLWAY CREST ELEVATION
                     SPWID         4.80  SPILLWAY WIDTH
                      COQW         2.65  WEIR COEFFICIENT
                      EXPW         1.50  EXPONENT OF HEAD

52 ST          TOP OF DAM
                     TOPEL      9191.50  ELEVATION AT TOP OF DAM
                    DAMWID         7.20  DAM WIDTH
                      COQD         2.65  WEIR COEFFICIENT
                      EXPD         1.50  EXPONENT OF HEAD

                                                             ***

                                              COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00        .02       2.68       8.31      17.25      29.03      42.39      59.02      78.94      99.85
          ELEVATION    9159.90    9160.00    9162.00    9164.00    9166.00    9168.00    9170.00    9172.00    9174.00    9176.00

            STORAGE     121.76     144.71     168.72     193.83     220.05     247.56     276.39     291.21     306.25     336.97
          ELEVATION    9178.00    9180.00    9182.00    9184.00    9186.00    9188.00    9190.00    9191.00    9192.00    9194.00

                                              COMPUTED OUTFLOW-ELEVATION DATA

                                                (EXCLUDING FLOW OVER DAM)

            OUTFLOW        .00        .00        .01        .11        .39        .91       1.79       3.08       4.90       7.31
          ELEVATION    9159.90    9190.50    9190.51    9190.54    9190.60    9190.67    9190.77    9190.89    9191.03    9191.19

            OUTFLOW      10.41      14.28      19.00      24.68      31.37      39.19      48.20      58.50      70.17      83.29
          ELEVATION    9191.38    9191.58    9191.81    9192.06    9192.33    9192.62    9192.93    9193.27    9193.62    9194.00
```

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.02	2.68	8.31	17.25	29.03	42.39	59.02	78.94	99.85
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9159.90	9160.00	9162.00	9164.00	9166.00	9168.00	9170.00	9172.00	9174.00	9176.00
STORAGE	121.76	144.71	168.72	193.83	220.05	247.56	276.39	283.77	283.93	284.41
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.01	.11
ELEVATION	9178.00	9180.00	9182.00	9184.00	9186.00	9188.00	9190.00	9190.50	9190.51	9190.54
STORAGE	285.22	286.34	287.79	289.55	291.21	291.65	294.07	296.82	299.91	303.32
OUTFLOW	.39	.91	1.79	3.08	4.50	4.90	7.31	10.41	14.71	22.24
ELEVATION	9190.60	9190.67	9190.77	9190.89	9191.00	9191.03	9191.19	9191.38	9191.58	9191.81
STORAGE	306.25	307.09	311.18	315.64	320.44	325.59	331.10	336.97		
OUTFLOW	30.11	32.58	45.67	61.72	80.85	103.27	129.15	158.71		
ELEVATION	9192.00	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00		

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

HYDROGRAPH AT STATION ODR
FOR PLAN 1, RATIO = .90

PEAK OUTFLOW IS 37. AT TIME 4.02 HOURS

PEAK FLOW	TIME			MAXIMUM AVERAGE FLOW		
(CFS)	(HR)		6-HR	24-HR	72-HR	6.00-HR
37.	4.02	(CFS)	19.	19.	19.	19.
		(INCHES)	3.427	3.427	3.427	3.427
		(AC-FT)	9.	9.	9.	9.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE		
(AC-FT)	(HR)	6-HR	24-HR	72-HR	6.00-HR
308.	4.02	298.	298.	298.	298.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE		
(FEET)	(HR)	6-HR	24-HR	72-HR	6.00-HR
9192.14	4.02	9191.45	9191.45	9191.45	9191.45

CUMULATIVE AREA = .05 SQ MI

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .90
HYD. PH AT	H[NE]	.01	1	FLOW	58.
				TIME	2.78
HYDROGRAPH AT	H[SW]	.01	1	FLOW	68.
				TIME	2.97
HYDROGRAPH AT	water	.03	1	FLOW	132.
				TIME	2.03
3 COMBINED AT	combn	.05	1	FLOW	258.
				TIME	2.97
ROUTED TO	ODR	.05	1	FLOW	37.
				TIME	4.02
			** PEAK STAGES IN FEET **		
			1	STAGE	9192.14
				TIME	4.02

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION ODR
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	9190.50	9190.50	9191.50
STORAGE	284.	284.	299.
OUTFLOW	0.	0.	13.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.90	9192.14	.64	308.	37.	3.33	4.02	.00

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

USBR

General

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: HEC-1 Calculations for ODR - General PMP - USBR hydrographs

Total Number of Pages (including cover sheet): 12

Total Number of Computer Runs:

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

Calculate / Route flows tributary to ODR through reservoir & out the spillway to determine max. discharge & elevation

Design Basis/References/Assumptions:

- Input data from USBR hydrographs & rating curves for stage-storage-discharge into HEC-1 & calculate
- Rule 5.9.1.4 - 'Small Dam, High Hazard' - 0.9 IDF reduction

Remarks/Conclusions/Results:

Q = 20 cfs

Max. Elev. = 9191.73

Calculation Approved by: Project Manager 10/24/08 Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

```
*****************************************                         ***************************************
*                                       *                         *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                         *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN  1998                *                         *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                         *         609 SECOND STREET           *
*                                       *                         *      DAVIS, CALIFORNIA 95616        *
* RUN DATE   24OCT08  TIME  14:46:16    *                         *          (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
```

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

            *DIAGRAM
   1        ID  Old Dillon Reservior
   2        ID  Proposed Reservoir - GENERAL PMP
   3        ID  USBR hydrographs
   4        ID  Maximum water surface and discharge determination for proposed spillway struct
   5        ID  10/22/2008
   6        ID  file name: PMP_USBR_GENERAL.ihl
            *
   7        IT       3 01JUL09    1200    1441
   8        IO       3       0
            * Rule 5.9.1.4 - From Table 5.2 - Small Dam, High Hazard
   9        JR    PREC     0.9
            *

  10        KK   H[NE]
  11        KM  Rainfall runoff for Basin NE
  12        BA   0.012
  13        PH   0.002   0.049    0.62    1.61    2.33    3.37    4.18     5.8     8.8    13.1
  14        PH    18.7    21.4
  15        KO                                      22
  16        UI       4      11      30      22      16      13      10       8       6       5
  17        UI       4       4       3       3       2       2       2       1       1       1
  18        UI       1       1       1       1       0       0       0       0       0       0
            *
            *
            *

  19        KK   H[SW]
  20        KM  Rainfall runoff for Basin SW
  21        BA   0.014
            *     60
            * 0.25 0.58 8.4 1.18 0.34 0.17
  22        KO                                      22
  23        UI       2       7      18      27      21      16      13      11       9       8
  24        UI       6       5       5       4       3       3       3       2       2       2
  25        UI       2       1       1       1       1       1       1       1       1       1
            *
            *
            *

  26        KK   water
  27        KM  Rainfall falling on ODR
  28        KO                                      22
  29        BA   0.025
            * Base flow = 10 cfs from dillon ditch
  30        BF      10
  31        UI       0     323
            *

  32        KK   combn
  33        KM
  34        KO                                      22
  35        HC       3
            *
```

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

  36          KK     ODR
  37          KO                                      22
  38          RS       1    ELEV  9190.5
  39          SA       0   0.684   2.104   3.592   5.406   6.391   6.977   9.722  10.205  10.702
  40          SA  11.213  11.738  12.276   12.83  13.398  14.115  14.714  14.929  15.145   15.58
  41          SE  9159.9    9160    9162    9164    9166    9168    9170    9172    9174    9176
  42          SE    9178    9180    9182    9184    9186    9188    9190    9191    9192    9194
              *
              * Outflow structure - lower opening - FL = 90.5; L = 8'; 40% obstruction
              * due to screening
  43          SS  9190.5     4.8    2.65     1.5
              * Outflow structure - upper openings - FL = 91.5; L = 12'; 40% obstruction
              * due to screening
  44          ST  9191.5     7.2    2.65     1.5
              *
  45          ZZ
```

```
                  SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING             (--->) DIVERSION OR PUMP FLOW

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

   10        H[NE]
                .
                .
   ?            .         H[SW]
                .             .
                .             .
   26           .             .          water
                .             .              .
                .             .              .
   32        combn.......................
                V
                V
   36          ODR

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                               ***************************************
*                                       *                               *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                               *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                               *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                               *         609 SECOND STREET           *
*                                       *                               *      DAVIS, CALIFORNIA 95616        *
* RUN DATE   24OCT08  TIME  14:46:16    *                               *          (916) 756-1104             *
*                                       *                               *                                     *
*****************************************                               ***************************************



                          Old Dillon Reservior
                          Proposed Reservoir - GENERAL PMP
                          USBR hydrographs
                          Maximum water surface and discharge determination for proposed spillway struct
                          10/22/2008
                          file name: PMP_USBR_GENERAL.ih1

   8 IO           OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE

     IT           HYDROGRAPH TIME DATA
                        NMIN            3  MINUTES IN COMPUTATION INTERVAL
                       IDATE       1JUL 9  STARTING DATE
                       ITIME         1200  STARTING TIME
                          NQ         1441  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE       4JUL 9  ENDING DATE
                      NDTIME         1200  ENDING TIME
                       ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL      .05 HOURS
                         TOTAL TIME BASE    72.00 HOURS

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

     JP           MULTI-PLAN OPTION
                       NPLAN            1  NUMBER OF PLANS

     JR           MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                        .90


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


             **************
             *            *
  10 KK      *   H[NE]    *
             *            *
             **************
                          Rainfall runoff for Basin NE

  15 KO           OUTPUT CONTROL VARIABLES
                       IPRNT            3  PRINT CONTROL
                       IPLOT            0  PLOT CONTROL
                       QSCAL           0.  HYDROGRAPH PLOT SCALE
                       IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                        IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT         .050  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  12 BA           SUBBASIN CHARACTERISTICS
                       TAREA          .01  SUBBASIN AREA

                  PRECIPITATION DATA

  13 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                    .62    1.61    2.33    3.37    4.18    5.80    8.80   13.10    18.70   21.40     .00     .00

                                                  STORM AREA =        .05

  16 UI           INPUT UNITGRAPH,  24 ORDINATES,  VOLUME =  .98
                        4.0      11.0      30.0      22.0      16.0      13.0      10.0       8.0       6.0       5.0
                        4.0       4.0       3.0       3.0       2.0       2.0       2.0       1.0       1.0       1.0
                        1.0       1.0       1.0       1.0

                                                              ***

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

                         HYDROGRAPH AT STATION    H[NE]
                           FOR PLAN 1, RATIO =  .90
```

```
  TOTAL RAINFALL =   20.23, TOTAL LOSS =      .00, TOTAL EXCESS =   20.23

PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                     6-HR        24-HR       72-HR      72.00-HR
    34.       36.20        (CFS)          7.           4.          2.           2.
                         (INCHES)      5.735       12.849      19.841       19.841
                          (AC-FT)         4.           8.         13.          13.

                        CUMULATIVE AREA =      .01 SQ MI


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

                         HYDROGRAPH AT STATION     H[NE]
                           FOR PLAN 1, RATIO =   .90

  TOTAL RAINFALL =   18.21, TOTAL LOSS =      .00, TOTAL EXCESS =   18.21

PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                     6-HR        24-HR       72-HR      72.00-HR
    31.       36.20        (CFS)          7.           4.          2.           2.
                         (INCHES)      5.162       11.564      17.857       17.857
                          (AC-FT)         3.           7.         11.          11.

                        CUMULATIVE AREA =      .01 SQ MI


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

           **************
           *            *
 19 KK     *    H[SW]   *
           *            *
           **************
                        Rainfall runoff for Basin SW

 22 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                       IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .050  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 21 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 13 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .62    1.61    2.33    3.37    4.18    5.80    8.80   13.10   18.70   21.40     .00     .00

                                                   STORM AREA =       .05

 23 UI          INPUT UNITGRAPH,  30 ORDINATES,  VOLUME =  .99
                     2.0       7.0      18.0      27.0      21.0      16.0      13.0      11.0       9.0       8.0
                     6.0       5.0       5.0       4.0       3.0       3.0       3.0       2.0       2.0       2.0
                     2.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
                                                             ***

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

                         HYDROGRAPH AT STATION     H[SW]
                           FOR PLAN 1, RATIO =   .90

  TOTAL RAINFALL =   20.23, TOTAL LOSS =      .00, TOTAL EXCESS =   20.23

PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                     6-HR        24-HR       72-HR      72.00-HR
    36.       36.25        (CFS)          9.           5.          2.           2.
                         (INCHES)      5.756       12.896      19.911       19.911
                          (AC-FT)         4.          10.         15.          15.

                        CUMULATIVE AREA =      .01 SQ MI


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

                         HYDROGRAPH AT STATION     H[SW]
                           FOR PLAN 1, RATIO =   .90

      AL RAINFALL =   18.21, TOTAL LOSS =      .00, TOTAL EXCESS =   18.21

PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                     6-HR        24-HR       72-HR      72.00-HR
    32.       36.25        (CFS)          8.           4.          2.           2.
                         (INCHES)      5.180       11.606      17.920       17.920
                          (AC-FT)         4.           9.         13.          13.

                        CUMULATIVE AREA =      .01 SQ MI
```

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

          **************
          *            *
 26 KK    *    water   *
          *            *
          **************
                    Rainfall falling on ODR

 28 KO        OUTPUT CONTROL VARIABLES
                   IPRNT          3  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE
                   IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                    IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2       1441  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT       .050  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 29 BA        SUBBASIN CHARACTERISTICS
                   TAREA        .03  SUBBASIN AREA

 30 BF        BASE FLOW CHARACTERISTICS
                   STRTQ      10.00  INITIAL FLOW
                   QRCSN        .00  BEGIN BASE FLOW RECESSION
                   RTIOR    1.00000  RECESSION CONSTANT

              PRECIPITATION DATA

 13 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .62    1.61    2.33    3.37    4.18    5.80    8.80   13.10   18.70   21.40     .00     .00

                                               STORM AREA =       .05

 29 UI        INPUT UNITGRAPH,   2 ORDINATES,  VOLUME = 1.00
                    .0     323.0

                                                             ***

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

                   HYDROGRAPH AT STATION    water
                     FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =    20.23, TOTAL LOSS =      .00, TOTAL EXCESS =    20.23

PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                  6-HR         24-HR        72-HR      72.00-HR
    130.     36.10       (CFS)        26.           19.          15.          15.
                       (INCHES)     9.574        27.988       64.879       64.879
                        (AC-FT)       13.           37.          87.          87.

                   CUMULATIVE AREA =       .03 SQ MI


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

                   HYDROGRAPH AT STATION    water
                     FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =    18.21, TOTAL LOSS =      .00, TOTAL EXCESS =    18.21

PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                  6-HR         24-HR        72-HR      72.00-HR
    118.     36.10       (CFS)        24.           18.          14.          14.
                       (INCHES)     8.988        26.677       62.854       62.854
                        (AC-FT)       12.           36.          84.          84.

                   CUMULATIVE AREA =       .03 SQ MI


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

          **************
          *            *
 32 KK    *    combn   *
          *            *
          **************


 3            OUTPUT CONTROL VARIABLES
                   IPRNT          3  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE
                   IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                    IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2       1441  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT       .050  TIME INTERVAL IN HOURS
```

```
35 HC         HYDROGRAPH COMBINATION
                   ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                               ***

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

                     HYDROGRAPH AT STATION    combn
                       FOR PLAN 1, RATIO =  .90

PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                   6-HR        24-HR       72-HR      72.00-HR
   169.      36.15        (CFS)       39.          26.         18.          18.
                        (INCHES)    7.042       18.982      39.932       39.932
                         (AC-FT)      19.          52.        109.         109.

                     CUMULATIVE AREA =      .05 SQ MI


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

           **************
           *            *
36 KK      *      ODR   *
           *            *
           **************

37 KO         OUTPUT CONTROL VARIABLES
                   IPRNT            3  PRINT CONTROL
                   IPLOT            0  PLOT CONTROL
                   QSCAL           0.  HYDROGRAPH PLOT SCALE
                   IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                    IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT         .050  TIME INTERVAL IN HOURS

            HYDROGRAPH ROUTING DATA

38 RS         STORAGE ROUTING
                   NSTPS            1  NUMBER OF SUBREACHES
                    ITYP         ELEV  TYPE OF INITIAL CONDITION
                  RSVRIC      9190.50  INITIAL CONDITION
                       X          .00  WORKING R AND D COEFFICIENT

3                   AREA           .0        .7       2.1       3.6       5.4       6.4       7.0       9.7      10.2      10.7
                                 11.2      11.7      12.3      12.8      13.4      14.1      14.7      14.9      15.1      15.6

41 SE         ELEVATION       9159.90   9160.00   9162.00   9164.00   9166.00   9168.00   9170.00   9172.00   9174.00   9176.00
                              9178.00   9180.00   9182.00   9184.00   9186.00   9188.00   9190.00   9191.00   9192.00   9194.00

43 SS         SPILLWAY
                    CREL      9190.50  SPILLWAY CREST ELEVATION
                   SPWID         4.80  SPILLWAY WIDTH
                    COQW         2.65  WEIR COEFFICIENT
                    EXPW         1.50  EXPONENT OF HEAD

44 ST         TOP OF DAM
                   TOPEL      9191.50  ELEVATION AT TOP OF DAM
                  DAMWID         7.20  DAM WIDTH
                    COQD         2.65  WEIR COEFFICIENT
                    EXPD         1.50  EXPONENT OF HEAD

                                                               ***

                                              COMPUTED STORAGE-ELEVATION DATA

       STORAGE        .00       .02      2.68      8.31     17.25     29.03     42.39     59.02     78.94     99.85
     ELEVATION    9159.90   9160.00   9162.00   9164.00   9166.00   9168.00   9170.00   9172.00   9174.00   9176.00

       STORAGE     121.76    144.71    168.72    193.83    220.05    247.56    276.39    291.21    306.25    336.97
     ELEVATION    9178.00   9180.00   9182.00   9184.00   9186.00   9188.00   9190.00   9191.00   9192.00   9194.00


                                              COMPUTED OUTFLOW-ELEVATION DATA

                                                 (EXCLUDING FLOW OVER DAM)

       OUTFLOW        .00       .00       .01       .11       .39       .91      1.79      3.08      4.90      7.31
     ELEVATION    9159.90   9190.50   9190.51   9190.54   9190.60   9190.67   9190.77   9190.89   9191.03   9191.19

       OUTFLOW      10.41     14.28     19.00     24.68     31.37     39.19     48.20     58.50     70.17     83.29
     ELEVATION    9191.38   9191.58   9191.81   9192.06   9192.33   9192.62   9192.93   9193.27   9193.62   9194.00


                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

                                                 (INCLUDING FLOW OVER DAM)

       STORAGE        .00       .02      2.68      8.31     17.25     29.03     42.39     59.02     78.94     99.85
       OUTFLOW        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
     ELEVATION    9159.90   9160.00   9162.00   9164.00   9166.00   9168.00   9170.00   9172.00   9174.00   9176.00

       STORAGE     121.76    144.71    168.72    193.83    220.05    247.56    276.39    283.77    283.93    284.41
       OUTFLOW        .00       .00       .00       .00       .00       .00       .00       .00       .01       .11
     ELEVATION    9178.00   9180.00   9182.00   9184.00   9186.00   9188.00   9190.00   9190.50   9190.51   9190.54
```

STORAGE	285.22	286.34	287.79	289.55	291.21	291.65	294.07	296.82	299.91	303.32
OUTFLOW	.39	.91	1.79	3.08	4.50	4.90	7.31	10.41	14.71	22.24
ELEVATION	9190.60	9190.67	9190.77	9190.89	9191.00	9191.03	9191.19	9191.38	9191.58	9191.81
STORAGE	306.25	307.09	311.18	315.64	320.44	325.59	331.10	336.97		
OUTFLOW	30.11	32.58	45.67	61.72	80.85	103.27	129.15	158.71		
ELEVATION	9192.00	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00		

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

HYDROGRAPH AT STATION ODR
FOR PLAN 1, RATIO = .90

PEAK OUTFLOW IS 37. AT TIME 37.20 HOURS

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	72.00-HR
37.	37.20	(CFS)	33.	25.	16.	16.
		(INCHES)	6.052	18.366	34.395	34.395
		(AC-FT)	16.	50.	94.	94.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	72.00-HR
309.	37.20	307.	304.	299.	299.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	72.00-HR
9192.15	37.20	9192.07	9191.91	9191.64	9191.64

CUMULATIVE AREA = .05 SQ MI

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .90
HYD PH AT	H[NE]	.01	1	FLOW	31.
				TIME	36.20
HYDROGRAPH AT	H[SW]	.01	1	FLOW	32.
				TIME	36.25
HYDROGRAPH AT	water	.03	1	FLOW	118.
				TIME	36.10
3 COMBINED AT	combn	.05	1	FLOW	169.
				TIME	36.15
ROUTED TO	ODR	.05	1	FLOW	37.
				TIME	37.20
			** PEAK STAGES IN FEET **		
			1	STAGE	9192.15
				TIME	37.20

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION ODR
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	9190.50	9190.50	9191.50
STORAGE	284.	284.	299.
OUTFLOW	0.	0.	13.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.90	9192.15	.65	309.	37.	49.25	37.20	.00

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

NRCS

LOCAL

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir**

Title: HEC-1 Calculations for ODR - Local PMP - NRCS hydrographs

Total Number of Pages (including cover sheet): 13

Total Number of Computer Runs:

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

Calculate / Route flows tributary to ODR through reservoir & out the spillway to determine max. discharge & elevation

Design Basis/References/Assumptions:

- Input data from SCS hydrographs & rating curves for stage - storage - discharge into HEC-1 & calculate
- Rule 5.9.1.4 - 'Small Dam, High Hazard' - 0.9 IDF reduction

Remarks/Conclusions/Results:

Q = 47 cfs

Max. Elev. = 9192.35

Calculation Approved by: [signature] 10/24/08

Project Manager Date

Revision No.: Description of Revision: Approved by:

Project Manager/Date

P:\133_1187_004_03_Old_Dillon_Res\SupportDocs\Calcs\Calculation Cover Sheet_Tt.doc

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            JUN   1998                 *
*         VERSION 4.1                   *
*                                       *
* RUN DATE   24OCT08  TIME  14:46:51    *
*                                       *
*****************************************
```

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

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

              *DIAGRAM
   1          ID  Old Dillon Reservoir
   2          ID  Proposed Reservoir - LOCAL PMP
   3          ID  NRCS SCS hydrographs
   4          ID  Maximum water surface and discharge determination for proposed spillway struct
   5          ID  10/22/2008
   6          ID  file name: PMP_NRCS_LOCAL.ihl
              *
   7          IT       1 01JUL09    1200     361
   8          IO       3       0
              *
              *
              * Rule 5.9.1.4 - From Table 5.2 - Small Dam, High Hazard
   9          JR    PREC     0.9

  10          KK   H[NE]
  11          KM  Rainfall runoff for Basin NE
  12          BA   0.012
  13          LS       0      86
  14          UD   0.104
  15          IN      60
  16          PI    0.25    0.58     8.4    1.18    0.34    0.17
              *        2
              * 0.002 0.049 0.62 1.61 2.33 3.37 4.18 5.8 8.8 13.1
              * 18.7 21.4
  17          KO                                      22
              *

  18          KK   H[SW]
  19          KM  Rainfall runoff for Basin SW
  20          BA   0.014
  21          LS       0      86
  22          UD   0.117
  23          KO                                      22
              *

  24          KK   water
  25          KM  Rainfall falling on ODR
  26          BA   0.025
              * Base flow = 10 cfs from dillon ditch
  27          BF      10
  28          LS       0      98
  29          UD   0.083
  30          KO                                      22
              *

  31          KK   combn
  32          KM
  33          KO                                      22
  34          HC       3
              *
```

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

 35           KK     ODR
 36           KO                                22
 37           RS       1    ELEV  9190.5
 38           SA       0   0.684   2.104   3.592   5.406   6.391   6.977   9.722  10.205  10.702
 39           SA  11.213  11.738  12.276   12.83  13.398  14.115  14.714  14.929  15.145   15.58
 40           SE  9159.9    9160    9162    9164    9166    9168    9170    9172    9174    9176
 41           SE    9178    9180    9182    9184    9186    9188    9190    9191    9192    9194
              *
              * Outflow structure - lower opening - FL = 90.5; L = 8'; 40% obstruction
              * due to screening
 42           SS  9190.5     4.8    2.65     1.5
              * Outflow structure - upper openings - FL = 91.5; L = 12'; 40% obstruction
              * due to screening
 43           ST  9191.5     7.2    2.65     1.5
              *
 44           ZZ
```

```
              SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

  10       H[NE]
              .
              .
  .           .       H[SW]
              .           .
              .           .
  24          .           .       water
              .           .           .
              .           .           .
  31       combn.......................
              V
              V
  35         ODR

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                              ***************************************
*                                       *                              *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                              *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                              *         609 SECOND STREET           *
*                                       *                              *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE    24OCT08  TIME  14:46:51  *                              *          (916) 756-1104             *
*                                       *                              *                                     *
*****************************************                              ***************************************



                    Old Dillon Reservoir
                    Proposed Reservoir - LOCAL PMP
                    NRCS SCS hydrographs
                    Maximum water surface and discharge determination for proposed spillway struct
                    10/22/2008
                    file name: PMP_NRCS_LOCAL.ih1

   8 IO         OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE

     IT         HYDROGRAPH TIME DATA
                      NMIN            1  MINUTES IN COMPUTATION INTERVAL
                     IDATE       1JUL 9  STARTING DATE
                     ITIME         1200  STARTING TIME
                        NQ          361  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE       1JUL 9  ENDING DATE
                    NDTIME         1800  ENDING TIME
                     ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL     .02 HOURS
                   TOTAL TIME BASE     6.00 HOURS

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

     JP         MULTI-PLAN OPTION
                     NPLAN            1  NUMBER OF PLANS

     JR         MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                  .90

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

          **************
          *            *
  10 KK   *    H[NE]   *
          *            *
          **************
                    Rainfall runoff for Basin NE

  15 IN         TIME DATA FOR INPUT TIME SERIES
                    JXMIN           60  TIME INTERVAL IN MINUTES
                   JXDATE       1JUL 9  STARTING DATE
                   JXTIME         1200  STARTING TIME

  17 KO         OUTPUT CONTROL VARIABLES
                    IPRNT            3  PRINT CONTROL
                    IPLOT            0  PLOT CONTROL
                    QSCAL           0.  HYDROGRAPH PLOT SCALE
                    IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                     IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2          361  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT         .017  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

  12 BA         SUBBASIN CHARACTERISTICS
                    TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

  16 PB             STORM        10.92  BASIN TOTAL PRECIPITATION

  16 PI           INCREMENTAL PRECIPITATION PATTERN
                      .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                      .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                      .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                      .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                      .00        .00        .00        .00        .00        .00        .00        .00        .00        .00
                      .00        .00        .00        .00        .00        .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
                      .01        .01        .01        .01        .01        .01        .01        .01        .01        .01
                      .01        .01        .01        .01        .01        .01        .01        .01        .01        .01
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 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .14   .14   .14   .14   .14   .14   .14   .14   .14   .14
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .02   .02   .02   .02   .02   .02   .02   .02   .02   .02
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
 .01   .01   .01   .01   .01   .01   .01   .01   .01   .01
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 .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
 .00   .00   .00   .00   .00   .00   .00   .00   .00   .00

13 LS        SCS LOSS RATE
                STRTL          .33  INITIAL ABSTRACTION
               CRVNBR        86.00  CURVE NUMBER
                RTIMP          .00  PERCENT IMPERVIOUS AREA

14 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG          .10  LAG

                                   ***

                              UNIT HYDROGRAPH
                         33 END-OF-PERIOD ORDINATES
     3.     10.     20.     33.     45.     51.     51.     48.     43.     36.
    27.     21.     16.     13.     10.      8.      6.      5.      4.      3.
     2.      2.      1.      1.      1.      1.      1.      0.      0.      0.
     0.      0.      0.

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

             HYDROGRAPH AT STATION    H[NE]
               FOR PLAN 1, RATIO =  .90

 TOTAL RAINFALL =   10.92, TOTAL LOSS =    1.74, TOTAL EXCESS =    9.18

PE[illegible] OW   TIME                  MAXIMUM AVERAGE FLOW
[illegible]        (HR)              6-HR       24-HR      72-HR      6.00-HR
[illegible]        3.00    (CFS)      12.        12.        12.         12.
                        (INCHES)    9.160      9.160      9.160       9.160
                         (AC-FT)       6.         6.         6.          6.

                  CUMULATIVE AREA =     .01 SQ MI

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

             HYDROGRAPH AT STATION    H[NE]
               FOR PLAN 1, RATIO =  .90

 TOTAL RAINFALL =    9.83, TOTAL LOSS =    1.72, TOTAL EXCESS =    8.11

PEAK FLOW    TIME                  MAXIMUM AVERAGE FLOW
  (CFS)      (HR)              6-HR       24-HR      72-HR      6.00-HR
    56.      3.00    (CFS)      10.        10.        10.         10.
                  (INCHES)    8.092      8.092      8.092       8.092
                   (AC-FT)       5.         5.         5.          5.

                  CUMULATIVE AREA =     .01 SQ MI


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

         **************
         *            *
18 KK    *    H[SW]   *
         *            *
         **************
                 Rainfall runoff for Basin SW

23 KO        OUTPUT CONTROL VARIABLES
                IPRNT          3  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE
                IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                 IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2        361  LAST ORDINATE PUNCHED OR SAVED
               TIMINT       .017  TIME INTERVAL IN HOURS

            SUBBASIN RUNOFF DATA

20 BA        SUBBASIN CHARACTERISTICS
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                 TAREA          .01  SUBBASIN AREA

             PRECIPITATION DATA

 16 PB           STORM       10.92  BASIN TOTAL PRECIPITATION

 16 PI         INCREMENTAL PRECIPITATION PATTERN
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .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
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                 .01      .01      .01      .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      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                 .00      .00      .00      .00      .00      .00      .00      .00      .00      .00

 21 LS         SCS LOSS RATE
                 STRTL          .33  INITIAL ABSTRACTION
                CRVNBR        86.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

 22 UD         SCS DIMENSIONLESS UNITGRAPH
                  TLAG          .12  LAG

                                                   ***

                                             UNIT HYDROGRAPH
                                        37 END-OF-PERIOD ORDINATES
          3.        9.       17.       29.       41.       50.       54.       54.       50.       45.
         39.       31.       24.       19.       15.       13.       10.        8.        7.        5.
          4.        3.        3.        2.        2.        1.        1.        1.        1.        1.
          1.        0.        0.        0.        0.        0.        0.

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

                  HYDROGRAPH AT STATION    H[SW]
                    FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =    10.92, TOTAL LOSS =     1.74, TOTAL EXCESS =     9.18

PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                        6-HR        24-HR       72-HR       6.00-HR
     73.       3.00           (CFS)         14.          14.         14.          14.
                            (INCHES)      9.158        9.158       9.158        9.158
                             (AC-FT)        7.           7.          7.           7.

                  CUMULATIVE AREA =      .01 SQ MI

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

                  HYDROGRAPH AT STATION    H[SW]
                    FOR PLAN 1, RATIO =  .90

  TOTAL RAINFALL =     9.83, TOTAL LOSS =     1.72, TOTAL EXCESS =     8.11

PEAK FLOW      TIME                             MAXIMUM AVERAGE FLOW
  (CFS)        (HR)                        6-HR        24-HR       72-HR       6.00-HR
     66.       3.00           (CFS)         12.          12.         12.          12.
                            (INCHES)      8.090        8.090       8.090        8.090
                             (AC-FT)        6.           6.          6.           6.

                  CUMULATIVE AREA =      .01 SQ MI


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

          **************
          *            *
 24 KK    *    water   *
          *            *
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**************
                      Rainfall falling on ODR

 30 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
                      IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                       IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2        361  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       .017  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 26 BA          SUBBASIN CHARACTERISTICS
                      TAREA        .03  SUBBASIN AREA

 27 BF          BASE FLOW CHARACTERISTICS
                      STRTQ      10.00  INITIAL FLOW
                      QRCSN        .00  BEGIN BASE FLOW RECESSION
                      RTIOR    1.00000  RECESSION CONSTANT

                PRECIPITATION DATA

 16 PB                STORM      10.92  BASIN TOTAL PRECIPITATION

 16 PI            INCREMENTAL PRECIPITATION PATTERN
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .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
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .14      .14      .14      .14      .14      .14      .14      .14      .14      .14
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .02      .02      .02      .02      .02      .02      .02      .02      .02      .02
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .01      .01      .01      .01      .01      .01      .01
                       .01      .01      .01      .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      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                       .00      .00      .00      .00      .00      .00      .00      .00      .00      .00

 28 LS          SCS LOSS RATE
                      STRTL        .04  INITIAL ABSTRACTION
                     CRVNBR      98.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

 29 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG        .08  LAG

                                                          ***

                                                       UNIT HYDROGRAPH
                                                  27 END-OF-PERIOD ORDINATES
            12.       35.       74.      113.      131.      131.      116.       95.       68.       50.
            37.       28.       21.       15.       11.        8.        6.        5.        3.        3.
             2.        1.        1.        1.        1.        0.        0.

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

                         HYDROGRAPH AT STATION     water
                           FOR PLAN 1, RATIO =  .90

 TOTAL RAINFALL =   10.92, TOTAL LOSS =      .24, TOTAL EXCESS =    10.68

PEAK FLOW     TIME                                MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                         6-HR         24-HR         72-HR        6.00-HR
   145.       3.00            (CFS)         39.           39.           39.            39.
                           (INCHES)     14.379        14.379        14.379         14.379
                            (AC-FT)         19.           19.           19.            19.

                         CUMULATIVE AREA =      .03 SQ MI


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

                         HYDROGRAPH AT STATION     water
                           FOR PLAN 1, RATIO =  .90
```

```
  TOTAL RAINFALL =    9.83, TOTAL LOSS =     .24, TOTAL EXCESS =    9.59

PEAK FLOW    TIME                          MAXIMUM AVERAGE FLOW
  (CFS)      (HR)                 6-HR         24-HR        72-HR       6.00-HR
   132.      3.00       (CFS)      36.          36.          36.          36.
                      (INCHES)  13.290       13.290       13.290       13.290
                       (AC-FT)     18.          18.          18.          18.

                      CUMULATIVE AREA =     .03 SQ MI


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

          **************
          *            *
 31 KK    *    combn   *
          *            *
          **************


 33 KO        OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                     IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         361  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .017  TIME INTERVAL IN HOURS


 34 HC        HYDROGRAPH COMBINATION
                    ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

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

                     HYDROGRAPH AT STATION    combn
                       FOR PLAN 1, RATIO =   .90

PEAK FLOW    TIME                          MAXIMUM AVERAGE FLOW
  (CFS)      (HR)                 6-HR         24-HR        72-HR       6.00-HR
   254.      3.00       (CFS)      58.          58.          58.          58.
                      (INCHES)  10.639       10.639       10.639       10.639
                       (AC-FT)     29.          29.          29.          29.

                      CUMULATIVE AREA =     .05 SQ MI


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

          **************
          *            *
 35 KK    *     ODR    *
          *            *
          **************

 36 KO        OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                     IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         361  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .017  TIME INTERVAL IN HOURS


            HYDROGRAPH ROUTING DATA

 37 RS        STORAGE ROUTING
                    NSTPS           1  NUMBER OF SUBREACHES
                     ITYP        ELEV  TYPE OF INITIAL CONDITION
                   RSVRIC     9190.50  INITIAL CONDITION
                        X         .00  WORKING R AND D COEFFICIENT

 38 SA              AREA        .0         .7        2.1        3.6        5.4        6.4        7.0        9.7       10.2       10.7
                              11.2       11.7       12.3       12.8       13.4       14.1       14.7       14.9       15.1       15.6

 40 SE         ELEVATION   9159.90    9160.00    9162.00    9164.00    9166.00    9168.00    9170.00    9172.00    9174.00    9176.00
                           9178.00    9180.00    9182.00    9184.00    9186.00    9188.00    9190.00    9191.00    9192.00    9194.00

 42 SS        SPILLWAY
                     CREL     9190.50  SPILLWAY CREST ELEVATION
                    SPWID        4.80  SPILLWAY WIDTH
                     COQW        2.65  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

 43 ST        TOP OF DAM
                    TOPEL     9191.50  ELEVATION AT TOP OF DAM
                   DAMWID        7.20  DAM WIDTH
                     COQD        2.65  WEIR COEFFICIENT
                     EXPD        1.50  EXPONENT OF HEAD
```

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	.02	2.68	8.31	17.25	29.03	42.39	59.02	78.94	99.85
ELEVATION	9159.90	9160.00	9162.00	9164.00	9166.00	9168.00	9170.00	9172.00	9174.00	9176.00
STORAGE	121.76	144.71	168.72	193.83	220.05	247.56	276.39	291.21	306.25	336.97
ELEVATION	9178.00	9180.00	9182.00	9184.00	9186.00	9188.00	9190.00	9191.00	9192.00	9194.00

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	.01	.11	.39	.91	1.79	3.08	4.90	7.31
ELEVATION	9159.90	9190.50	9190.51	9190.54	9190.60	9190.67	9190.77	9190.89	9191.03	9191.19
OUTFLOW	10.41	14.28	19.00	24.68	31.37	39.19	48.20	58.50	70.17	83.29
ELEVATION	9191.38	9191.58	9191.81	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.02	2.68	8.31	17.25	29.03	42.39	59.02	78.94	99.85
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9159.90	9160.00	9162.00	9164.00	9166.00	9168.00	9170.00	9172.00	9174.00	9176.00
STORAGE	121.76	144.71	168.72	193.83	220.05	247.56	276.39	283.77	283.93	284.41
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.01	.11
ELEVATION	9178.00	9180.00	9182.00	9184.00	9186.00	9188.00	9190.00	9190.50	9190.51	9190.54
STORAGE	285.22	286.34	287.79	289.55	291.21	291.65	294.07	296.82	299.91	303.32
OUTFLOW	.39	.91	1.79	3.08	4.50	4.90	7.31	10.41	14.71	22.24
ELEVATION	9190.60	9190.67	9190.77	9190.89	9191.00	9191.03	9191.19	9191.38	9191.58	9191.81
STORAGE	306.25	307.09	311.18	315.64	320.44	325.59	331.10	336.97		
OUTFLOW	30.11	32.58	45.67	61.72	80.85	103.27	129.15	158.71		
ELEVATION	9192.00	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00		

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

HYDROGRAPH AT STATION ODR
FOR PLAN 1, RATIO = .90

PEAK OUTFLOW IS 31. AT TIME 4.10 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
	(HR)		6-HR	24-HR	72-HR	6.00-HR
	4.10	(CFS)	16.	16.	16.	16.
		(INCHES)	2.838	2.838	2.838	2.838
		(AC-FT)	8.	8.	8.	8.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
(AC-FT)	(HR)	6-HR	24-HR	72-HR	6.00-HR
306.	4.10	297.	297.	297.	297.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
(FEET)	(HR)	6-HR	24-HR	72-HR	6.00-HR
9192.01	4.10	9191.38	9191.38	9191.38	9191.38

CUMULATIVE AREA = .05 SQ MI

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .90
HYD. PH AT	H[NE]	.01	1	FLOW	56.
				TIME	3.00
HYDROGRAPH AT	H[SW]	.01	1	FLOW	66.
				TIME	3.00
HYDROGRAPH AT	water	.03	1	FLOW	132.
				TIME	3.00
3 COMBINED AT	combn	.05	1	FLOW	254.
				TIME	3.00
ROUTED TO	ODR	.05	1	FLOW	31.
				TIME	4.10
			** PEAK STAGES IN FEET **		
			1	STAGE	9192.01
				TIME	4.10

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION ODR
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	9190.50	9190.50	9191.50
STORAGE	284.	284.	299.
OUTFLOW	0.	0.	13.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.90	9192.01	.51	306.	31.	3.22	4.10	.00

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

NRCS

GENERAL

CALCULATION COVER SHEET

Client: **Colorado River Water Conservation District** Project No.: 133-1187.004.03

Project Name: **Enlargement of Old Dillon Reservoir** NRCS

Title: HEC-1 Calculations for ODR - General PMP - SCS hydrographs

Total Number of Pages (including cover sheet): 12

Total Number of Computer Runs:

Prepared by: PGS Date: 10/22/08

Checked by: Date:

Description and Purpose:

Calculate/Route flows tributary to ODR through reservoir & out the spillway to determine max. discharge & elevation

Design Basis/References/Assumptions:

- Input data from SCS hydrographs & rating curves for stage-storage-discharge into HEC-1 & calculate
- Rule 5.9.1.4 - 'Small Dam, High Hazard' - 0.9 IDF reduction

Remarks/Conclusions/Results:

Q = 19 cfs

Max. Elev. = 9191.71

Calculation Approved by: Project Manager 10/24/08 Date

Revision No.:	Description of Revision:	Approved by:
		Project Manager/Date

```
*****************************************                    ***************************************
*                                       *                    *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                    *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                    *         609 SECOND STREET           *
*                                       *                    *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE    24OCT08   TIME  14:47:33 *                    *          (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
```

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

              *DIAGRAM
  1           ID  Old Dillon Reservoir
  2           ID  Proposed Reservoir - GENERAL PMP
  3           ID  NRCS SCS hydrographs
  4           ID  Maximum water surface and discharge determination for proposed spillway struct
  5           ID  10/22/2008
  6           ID  file name: PMP_NRCS_GENERAL.ih1
              *
  7           IT       3 01JUL09    1200    1441
  8           IO       3       0
              * Rule 5.9.1.4 - From Table 5.2 - Small Dam, High Hazard
  9           JR    PREC     0.9
              *

 10           KK   H[NE]
 11           KM  Rainfall runoff for Basin NE
 12           BA   0.012
 13           LS       0      86
 14           UD   0.104
 15           PH   0.002   0.049    0.62    1.61    2.33    3.37    4.18     5.8     8.8    13.1
 16           PH    18.7    21.4
              *
              *
              *
 17           KO                                      22
              *

 18           KK   H[SW]
 19           KM  Rainfall runoff for Basin SW
 20           BA   0.014
 21           LS       0      86
 22           UD   0.117
 23           KO                                      22
              *

 24           KK   water
 25           KM  Rainfall falling on ODR
 26           BA   0.025
 27           LS       0      98
              * Base flow = 10 cfs from dillon ditch
 28           BF      10
 29           UD   0.083
 30           KO                                      22
              *

 31           KK   combn
 32           KM
 33           KO                                      22
 34           HC       3
              *
```

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

  35          KK     ODR
  36          KO                                    22
  37          RS       1    ELEV  9190.5
  38          SA       0   0.684   2.104   3.592   5.406   6.391   6.977   9.722  10.205  10.702
  39          SA  11.213  11.738  12.276   12.83  13.398  14.115  14.714  14.929  15.145   15.58
  40          SE  9159.9    9160    9162    9164    9166    9168    9170    9172    9174    9176
  41          SE    9178    9180    9182    9184    9186    9188    9190    9191    9192    9194
              *
              * Outflow structure - lower opening - FL = 90.5; L = 8'; 40% obstruction
              * due to screening
  42          SS  9190.5     4.8    2.65     1.5
              * Outflow structure - upper openings - FL = 91.5; L = 12'; 40% obstruction
              * due to screening
  43          ST  9191.5     7.2    2.65     1.5
              *
  44          ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING            (--->) DIVERSION OR PUMP FLOW

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

  10        H[NE]
              .
              .
              .       H[SW]
              .         .
              .         .
  24          .         .        water
              .         .          .
              .         .          .
  31        combn......................
              V
              V
  35         ODR

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                                     ***************************************
*                                       *                                     *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                     *   U.S. ARMY CORPS OF ENGINEERS      *
*             JUN   1998                *                                     *   HYDROLOGIC ENGINEERING CENTER     *
*           VERSION 4.1                 *                                     *         609 SECOND STREET           *
*                                       *                                     *     DAVIS, CALIFORNIA 95616         *
* RUN DATE   24OCT08  TIME  14:47:33    *                                     *         (916) 756-1104              *
*                                       *                                     *                                     *
*****************************************                                     ***************************************



                   Old Dillon Reservoir
                   Proposed Reservoir - GENERAL PMP
                   NRCS SCS hydrographs
                   Maximum water surface and discharge determination for proposed spillway struct
                   10/22/2008
                   file name: PMP_NRCS_GENERAL.ih1

  8 IO          OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN            3  MINUTES IN COMPUTATION INTERVAL
                     IDATE       1JUL 9  STARTING DATE
                     ITIME         1200  STARTING TIME
                        NQ         1441  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE       4JUL 9  ENDING DATE
                    NDTIME         1200  ENDING TIME
                     ICENT           19  CENTURY MARK

             COMPUTATION INTERVAL     .05 HOURS
                  TOTAL TIME BASE   72.00 HOURS

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

    JP          MULTI-PLAN OPTION
                     NPLAN            1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                     .90

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


          **************
          *            *
 10 KK    *    H[NE}   *
          *            *
          **************
                   Rainfall runoff for Basin NE

 17 KO          OUTPUT CONTROL VARIABLES
                     IPRNT            3  PRINT CONTROL
                     IPLOT            0  PLOT CONTROL
                     QSCAL           0.  HYDROGRAPH PLOT SCALE
                     IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                      IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT         .050  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 12 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 15 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .62    1.61    2.33    3.37    4.18    5.80    8.80   13.10   18.70   21.40     .00     .00

                                               STORM AREA =      .05

 13 LS          SCS LOSS RATE
                     STRTL          .33  INITIAL ABSTRACTION
                    CRVNBR        86.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 14 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .10  LAG

                                                         ***

                                                   UNIT HYDROGRAPH
```

```
                                                    12 END-OF-PERIOD ORDINATES
          13.        41.        43.        28.        14.         8.         4.         2.         1.         1.
           0.         0.

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

                     HYDROGRAPH AT STATION     H[NE]
                       FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =    20.23, TOTAL LOSS =    1.83, TOTAL EXCESS =    18.40

PE    )W      TIME                               MAXIMUM AVERAGE FLOW
  (C  )       (HR)                      6-HR        24-HR        72-HR        72.00-HR
    48.      36.15        (CFS)           7.           4.           2.            2.
                        (INCHES)       5.730       12.702       18.396        18.396
                         (AC-FT)          4.           8.          12.           12.

                    CUMULATIVE AREA =     .01 SQ MI

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

                     HYDROGRAPH AT STATION     H[NE]
                       FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =    18.21, TOTAL LOSS =    1.82, TOTAL EXCESS =    16.39

PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                      6-HR        24-HR        72-HR        72.00-HR
    43.      36.15        (CFS)           7.           4.           2.            2.
                        (INCHES)       5.136       11.365       16.386        16.386
                         (AC-FT)          3.           7.          10.           10.

                    CUMULATIVE AREA =     .01 SQ MI


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

          **************
          *            *
 18 KK    *    H[SW]   *
          *            *
          **************
                    Rainfall runoff for Basin SW

 23 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        1441  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .050  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 20 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

 15 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......    ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN     2-HR     3-HR     6-HR    12-HR    24-HR    2-DAY    4-DAY    7-DAY  10-DAY
                  .62    1.61    2.33     3.37     4.18     5.80     8.80    13.10    18.70    21.40      .00     .00

                                                 STORM AREA =      .05

 21 LS          SCS LOSS RATE
                    STRTL          .33  INITIAL ABSTRACTION
                   CRVNBR        86.00  CURVE NUMBER
                    RTIMP          .00  PERCENT IMPERVIOUS AREA

 22 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG          .12  LAG

                                                              ***

                                                         UNIT HYDROGRAPH
                                                   14 END-OF-PERIOD ORDINATES
          12.        39.        47.        37.        20.        11.         6.         4.         2.         1.
           1.         0.         0.         0.

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

                     HYDROGRAPH AT STATION     H[SW]
                       FOR PLAN 1, RATIO =  .90

     RAINFALL =    20.23, TOTAL LOSS =    1.83, TOTAL EXCESS =    18.40

PEAK FLOW     TIME                               MAXIMUM AVERAGE FLOW
  (CFS)       (HR)                      6-HR        24-HR        72-HR        72.00-HR
    54.      36.15        (CFS)           9.           5.           2.            2.
                        (INCHES)       5.730       12.701       18.395        18.395
                         (AC-FT)          4.           9.          14.           14.

                    CUMULATIVE AREA =     .01 SQ MI
```

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

                           HYDROGRAPH AT STATION    H[SW]
                             FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =   18.21, TOTAL LOSS =    1.82, TOTAL EXCESS =   16.39

 PEAK FLOW       TIME                            MAXIMUM AVERAGE FLOW
                 (HR)                  6-HR          24-HR          72-HR        72.00-HR
        .       36.15       (CFS)         8.            4.             2.              2.
                          (INCHES)     5.136        11.365         16.385          16.385
                           (AC-FT)        4.            8.            12.             12.

                          CUMULATIVE AREA =      .01 SQ MI


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

            **************
            *            *
  24 KK     *    water   *
            *            *
            **************
                            Rainfall falling on ODR

  30 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                        IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        1441  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .050  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  26 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .03  SUBBASIN AREA

  28 BF          BASE FLOW CHARACTERISTICS
                       STRTQ       10.00  INITIAL FLOW
                       QRCSN         .00  BEGIN BASE FLOW RECESSION
                       RTIOR     1.00000  RECESSION CONSTANT

                 PRECIPITATION DATA

  1[illegible]                                  DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ...... HYDRO-35 ......    ............... TP-40 ...............    ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR    2-DAY   4-DAY   7-DAY  10-DAY
                   .62    1.61    2.33    3.37    4.18    5.80    8.80   13.10    18.70   21.40     .00     .00

                                                     STORM AREA =       .05

  27 LS          SCS LOSS RATE
                       STRTL         .04  INITIAL ABSTRACTION
                      CRVNBR       98.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  29 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .08  LAG

                                                               ***

                                                          UNIT HYDROGRAPH
                                                     10 END-OF-PERIOD ORDINATES
                46.       112.        89.        40.        19.         9.         4.         2.         1.         0.
     ***              ***              ***              ***              ***

                           HYDROGRAPH AT STATION    water
                             FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =   20.23, TOTAL LOSS =     .24, TOTAL EXCESS =   19.99

 PEAK FLOW       TIME                            MAXIMUM AVERAGE FLOW
   (CFS)         (HR)                  6-HR          24-HR          72-HR        72.00-HR
    114.        36.15       (CFS)        26.           19.            14.             14.
                          (INCHES)     9.565        27.965         64.613          64.613
                           (AC-FT)       13.           37.            86.             86.

                          CUMULATIVE AREA =      .03 SQ MI


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

                           HYDROGRAPH AT STATION    water
                             FOR PLAN 1, RATIO =  .90

   TOTAL RAINFALL =   18.21, TOTAL LOSS =     .24, TOTAL EXCESS =   17.97

 PEAK FLOW       TIME                            MAXIMUM AVERAGE FLOW
   (CFS)         (HR)                  6-HR          24-HR          72-HR        72.00-HR
    104.        36.15       (CFS)        24.           18.            14.             14.
                          (INCHES)     8.980        26.654         62.591          62.591
                           (AC-FT)       12.           36.            83.             83.
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                    CUMULATIVE AREA =      .03 SQ MI


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

          **************
          *            *
  3.      *    combn   *
          *            *
          **************


  33 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                       IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .050  TIME INTERVAL IN HOURS


  34 HC          HYDROGRAPH COMBINATION
                      ICOMP            3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                ***

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

                     HYDROGRAPH AT STATION    combn
                       FOR PLAN 1, RATIO =  .90

 PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
   (CFS)        (HR)                 6-HR         24-HR       72-HR      72.00-HR
     195.      36.15       (CFS)       39.          26.         18.          18.
                       (INCHES)     7.020       18.858      39.035       39.035
                        (AC-FT)       19.          51.        106.         106.

                    CUMULATIVE AREA =      .05 SQ MI


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

          **************
          *            *
  35      *     ODR    *
          *            *
          **************

  36 KO          OUTPUT CONTROL VARIABLES
                      IPRNT            3  PRINT CONTROL
                      IPLOT            0  PLOT CONTROL
                      QSCAL           0.  HYDROGRAPH PLOT SCALE
                      IPNCH            0  PUNCH COMPUTED HYDROGRAPH
                       IOUT           22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1            1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         1441  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT         .050  TIME INTERVAL IN HOURS


               HYDROGRAPH ROUTING DATA

  37 RS          STORAGE ROUTING
                      NSTPS            1  NUMBER OF SUBREACHES
                       ITYP         ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC      9190.50  INITIAL CONDITION
                          X          .00  WORKING R AND D COEFFICIENT

  38 SA               AREA          .0         .7        2.1        3.6        5.4        6.4        7.0        9.7       10.2       10.7
                                  11.2       11.7       12.3       12.8       13.4       14.1       14.7       14.9       15.1       15.6

  40 SE          ELEVATION     9159.90    9160.00    9162.00    9164.00    9166.00    9168.00    9170.00    9172.00    9174.00    9176.00
                               9178.00    9180.00    9182.00    9184.00    9186.00    9188.00    9190.00    9191.00    9192.00    9194.00

  42 SS          SPILLWAY
                       CREL      9190.50  SPILLWAY CREST ELEVATION
                      SPWID         4.80  SPILLWAY WIDTH
                       COQW         2.65  WEIR COEFFICIENT
                       EXPW         1.50  EXPONENT OF HEAD

  43 ST          TOP OF DAM
                      TOPEL      9191.50  ELEVATION AT TOP OF DAM
                     DAMWID         7.20  DAM WIDTH
                       COQD         2.65  WEIR COEFFICIENT
                       EXPD         1.50  EXPONENT OF HEAD

                                                                ***

                                                COMPUTED STORAGE-ELEVATION DATA

           STORAGE         .00        .02       2.68       8.31      17.25      29.03      42.39      59.02      78.94      99.85
         ELEVATION     9159.90    9160.00    9162.00    9164.00    9166.00    9168.00    9170.00    9172.00    9174.00    9176.00

           STORAGE      121.76     144.71     168.72     193.83     220.05     247.56     276.39     291.21     306.25     336.97
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ELEVATION	9178.00	9180.00	9182.00	9184.00	9186.00	9188.00	9190.00	9191.00	9192.00	9194.00

COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	.01	.11	.39	.91	1.79	3.08	4.90	7.31
ELEVATION	9159.90	9190.50	9190.51	9190.54	9190.60	9190.67	9190.77	9190.89	9191.03	9191.19
OUTFLOW	10.41	14.28	19.00	24.68	31.37	39.19	48.20	58.50	70.17	83.29
ELEVATION	9191.38	9191.58	9191.81	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.02	2.68	8.31	17.25	29.03	42.39	59.02	78.94	99.85
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9159.90	9160.00	9162.00	9164.00	9166.00	9168.00	9170.00	9172.00	9174.00	9176.00
STORAGE	121.76	144.71	168.72	193.83	220.05	247.56	276.39	283.77	283.93	284.41
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.01	.11
ELEVATION	9178.00	9180.00	9182.00	9184.00	9186.00	9188.00	9190.00	9190.50	9190.51	9190.54
STORAGE	285.22	286.34	287.79	289.55	291.21	291.65	294.07	296.82	299.91	303.32
OUTFLOW	.39	.91	1.79	3.08	4.50	4.90	7.31	10.41	14.71	22.24
ELEVATION	9190.60	9190.67	9190.77	9190.89	9191.00	9191.03	9191.19	9191.38	9191.58	9191.81
STORAGE	306.25	307.09	311.18	315.64	320.44	325.59	331.10	336.97		
OUTFLOW	30.11	32.58	45.67	61.72	80.85	103.27	129.15	158.71		
ELEVATION	9192.00	9192.06	9192.33	9192.62	9192.93	9193.27	9193.62	9194.00		

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

HYDROGRAPH AT STATION ODR
FOR PLAN 1, RATIO = .90

PEAK OUTFLOW IS 37. AT TIME 37.00 HOURS

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	72.00-HR
37.	37.00	(CFS)	33.	25.	15.	15.
		(INCHES)	5.995	18.229	33.694	33.694
		(AC-FT)	16.	50.	92.	92.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	72.00-HR
308.	37.00	307.	304.	299.	299.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	72.00-HR
9192.14	37.00	9192.07	9191.89	9191.62	9191.62

CUMULATIVE AREA = .05 SQ MI

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .90
HYD. PH AT	H[NE]	.01	1	FLOW	43.
				TIME	36.15
HYDROGRAPH AT	H[SW]	.01	1	FLOW	48.
				TIME	36.15
HYDROGRAPH AT	water	.03	1	FLOW	104.
				TIME	36.15
3 COMBINED AT	combn	.05	1	FLOW	195.
				TIME	36.15
ROUTED TO	ODR	.05	1	FLOW	37.
				TIME	37.00
			** PEAK STAGES IN FEET **		
			1	STAGE	9192.14
				TIME	37.00

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION ODR
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	9190.50	9190.50	9191.50
STORAGE	284.	284.	299.
OUTFLOW	0.	0.	13.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.90	9192.14	.64	308.	37.	47.55	37.00	.00

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