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water environment resources

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January 11, 1989 File: 1093

Golder Associates (Western Canada) Ltd.
7017 Farrell Road S.E.
Calgary, Alberta
T2H 0T3

Attention: Mr. H. G. Gilchrist, P.Eng.
Project Director

RE: CURRAGH RESOURCES INC., FARO, YUKON
ROSE CREEK RESERVOIR FLOOD ROUTING

Dear Mr. Gilchrist:

Further to your December 28, 1988 letter requesting an analysis of the flood attenuation capability of the Rose Creek water supply reservoir, we hereby present a brief summary of the adopted methodology and the results of analysis.

METHODOLOGY

Inflow hydrographs were derived based on the peak flows supplied by Golder Associates. The peak flows given on Figure 1 (Faro Mine Flood Frequency) dated October 20, 1988, were assumed to be peak daily flows. Inflow hydrographs were derived in accordance with the methodology set out in the report "Cyprus Anvil Mine, Rose Creek Reservoir, Hydrology Study" dated March, 1985 by Acres Consulting Services. The design peak flows supplied by Golder were applied to two types of hydrographs; one caused by rainfall during snowmelt and the other produced by rainfall independant of snowmelt. The ordinates of each unit hydrograph were multiplied by the design peak daily discharge. The maximum discharge of the rainfall hydrograph was factored upwards by 40% to represent the peak instantaneous flood discharge as recommended in the Acres report. Plots of the resulting rainfall and rain on snow design hydrographs for the 10, 100, 1,000, and 10,000 year recurrence intervals are given on Figures 1 and 2.

The effectiveness of the Rose Creek dam in attenuating a flood depends upon the size of the reservoir and the invert level and rating curve of the service spillway. The reservoir elevation-volume curve on Figure 3 was taken from the Acres report.

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Five service spillway configurations were analysed as follows.

1) The existing service spillway of Rose Creek Dam has a rectangular cross-section, an effective weir length of 30.5 m and a spillway invert elevation of 1096.0 m. The top of dam elevation is 1099.1 m. The broad-crested weir coefficient is 1.56 as per the report by Acres Consulting Services.

2) A rectangular service spillway in cross-section with an effective weir length of 5.0 m and a spillway invert elevation of 1088.0 m. The broad-crested wier coefficient is assumed to be 1.56 as per the Acres report.

3) A rectangular service spillway in cross-section with an effective weir length of 5.0 m and spillway invert elevation of 1092.0 m. The broad-crested weir coefficient is assumed to be 1.56 as per the Acres report.

4) A trapezoidal service spillway in cross-section with a bottom width of 5.0 m, 1:1 side slopes and a spillway invert elevation of 1088.0 m. The broad-crested weir coefficient varies depending upon the head on the weir.

5) A trapezoidal service spillway in cross-section with a bottom width of 5.0 m, 1:1 side slopes and a spillway invert elevation of 1092.0 m. The broad-crested weir coefficient varies depending upon the head on the weir.

Spillway rating curves for each of these configurations were derived based on the broad-crested wier formula and are shown on Figures 4, 5, 6 and 7.

Flood routing was conducted by computer using the level pool routing methodology.

RESULTS OF ANALYSIS

The results of routing the hydrographs caused by rainfall and by rain on snow, through the five spillway configurations of the Rose Creek reservoir are given on Tables 1 to 5. A plot showing the inflow and outflow hydrographs for the 10,000 year return period flood is given on Figure 8 to illustrate the flood attenuation caused by the presence of Rose Creek Reservoir.

The results on Tables 1 to 5 show that the Rose Creek reservoir does not reduce the peak discharge of the rain on snow flood events. The peak discharge of this type of flood occurs over an extended period of time such that the reservoir has time to fill until the rate of inflow equals outflow.

In contrast, floods caused by rainfall have a very short duration peak flow and therefore, the Rose Creek reservoir is large enough to reduce the peak inflow. The 5 m wide rectangular weir reduces the flood peak by about 10%. The 5 m wide trapezoidal weir is less effective. A triangular weir was checked and was also found to be less effective than the 5 m wide rectangular weir.

The results on the tables also show that the spillway invert level is not a sensitive parameter. The invert should be selected so that the design flood does not overtop the dam.

RECOMMENDATION

The hydrology study by Acres indicates that the peak daily discharge obtained by regional analysis, applies to floods caused by rainfall and also to floods caused by rain on snow. We question that assumption. If the regional peak daily flood applies only to the rain on snow event, then the above computed attenuation benefits of the Rose Creek reservoir are not valid.

Therefore, if you decide to retain the Rose Creek reservoir because of its flood attenuation benefits, we would recommend that the hydrology study be checked.

If you have any questions pertaining to the analysis or to the results herein, please contact me. We appreciate the opportunity to provide subconsulting services to Golder Associates Ltd. on this project.

Sincerely,

W-E-R ENGINEERING LTD.

L.F. Sawatsky, P.Eng.
Project Manager

CS:jc
encl.

TABLE 1) EXISTING SERVICE SPILLWAY
- EFFECTIVE WEIR LENGTH = 30.5m
- SPILLWAY INVERT ELEVATION = 1096.0m

SNOWMELT/RAINFALL EVENT				RAINFALL EVENT		
RETURN PERIOD (years)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)
10	13.40	13.38	1096.42	18.50	18.07	1096.52
100	22.00	21.97	1096.60	31.23	30.91	1096.75
1000	31.00	30.98	1096.75	43.39	43.31	1096.94
10000	40.00	40.00	1096.89	56.02	56.02	1097.12

TABLE 2) RECTANGULAR SPILLWAY
- EFFECTIVE WEIR LENGTH = 5m
- SPILLWAY INVERT ELEVATION = 1088m

SNOWMELT/RAINFALL EVENT				RAINFALL EVENT		
RETURN PERIOD (years)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)
10	13.40	13.26	1089.42	18.50	16.28	1089.63
100	22.00	21.81	1089.98	31.23	27.85	1090.34
1000	31.00	30.78	1090.50	43.39	39.09	1090.93
10000	40.00	39.77	1090.96	56.02	50.76	1091.49

TABLE 3) RECTANGULAR SPILLWAY

- EFFECTIVE WEIR LENGTH = 5m
- SPILLWAY INVERT ELEVATION = 1092m

SNOWMELT/RAINFALL EVENT				RAINFALL EVENT		
RETURN PERIOD (years)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)
10	13.40	13.25	1093.42	18.50	16.12	1093.60
100	22.00	21.78	1093.98	31.23	27.26	1094.30
1000	31.00	30.67	1094.49	43.39	38.17	1094.88
10000	40.00	39.65	1094.96	56.02	49.68	1095.44

TABLE 4) TRAPEZOIDAL SPILLWAY

- BOTTOM WIDTH = 5.0m WITH 1:1 SIDE SLOPES
- SPILLWAY INVERT ELEVATION = 1088.0m

SNOWMELT/RAINFALL EVENT				RAINFALL EVENT		
RETURN PERIOD (years)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)
10	13.40	13.32	1089.22	18.50	16.78	1089.41
100	22.00	21.91	1089.64	31.23	29.08	1089.94
1000	31.00	30.91	1090.01	43.39	41.45	1090.36
10000	40.00	39.92	1090.31	56.02	54.58	1090.74

TABLE 5) TRAPEZOIDAL SPILLWAY

- BOTTOM WIDTH = 5.0m WITH 1:1 SIDE SLOPES
- SPILLWAY INVERT ELEVATION = 1092.0m

	SNOWMELT/RAINFALL EVENT			RAINFALL EVENT		
RETURN PERIOD (years)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)	PEAK INFLOW (cms)	PEAK OUTFLOW (cms)	MAXIMUM RESERVOIR LEVEL (m)
10	13.40	13.31	1093.22	18.50	16.69	1093.40
100	22.00	21.90	1093.64	31.23	28.81	1093.93
1000	31.00	30.86	1094.01	43.39	40.40	1094.33
10000	40.00	39.85	1094.31	56.02	53.08	1094.70

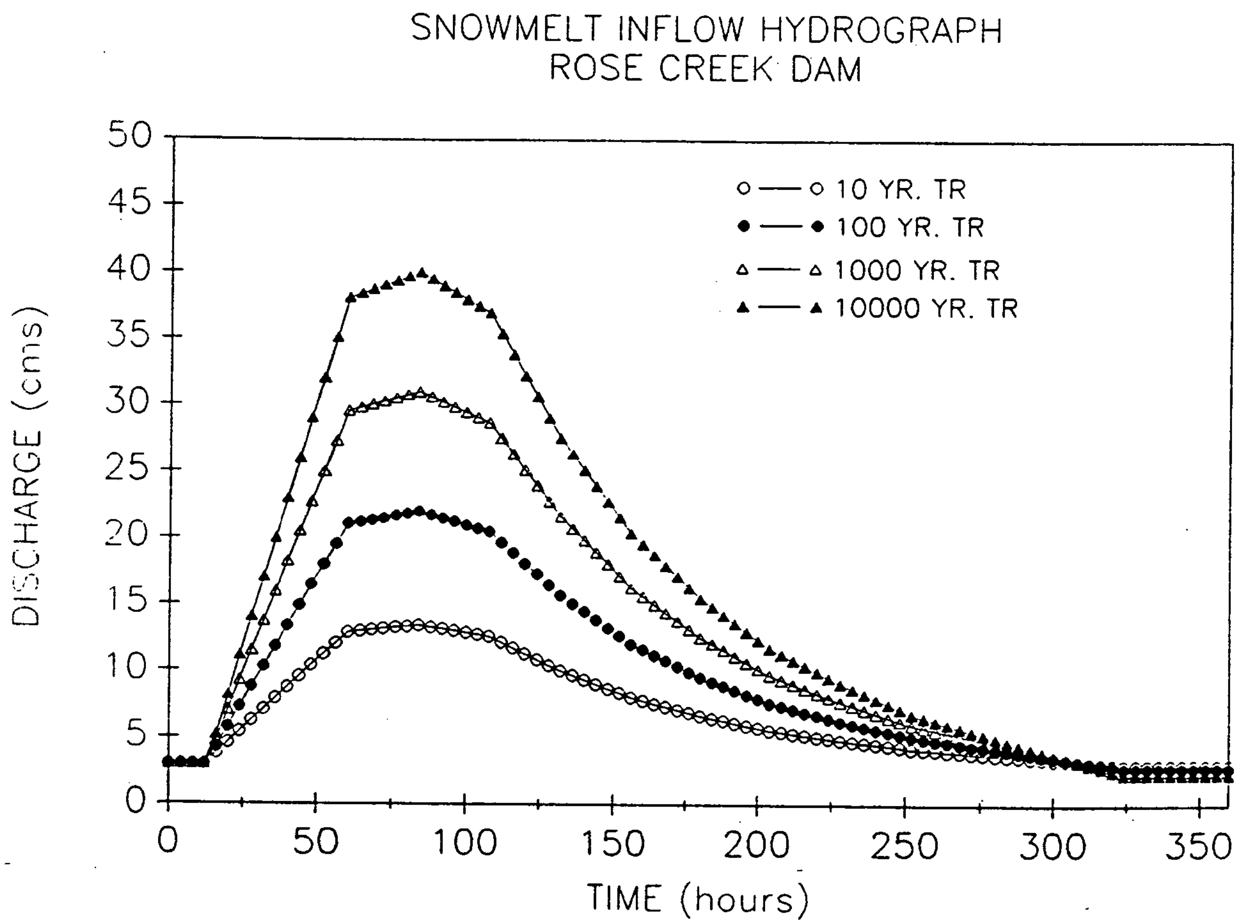

SNOWMELT INFLOW HYDROGRAPH
ROSE CREEK DAM
10 YR. TR
100 YR. TR
1000 YR. TR
10000 YR. TR
DISCHARGE (cms)
TIME (hours)
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
300
350

FIGURE 1

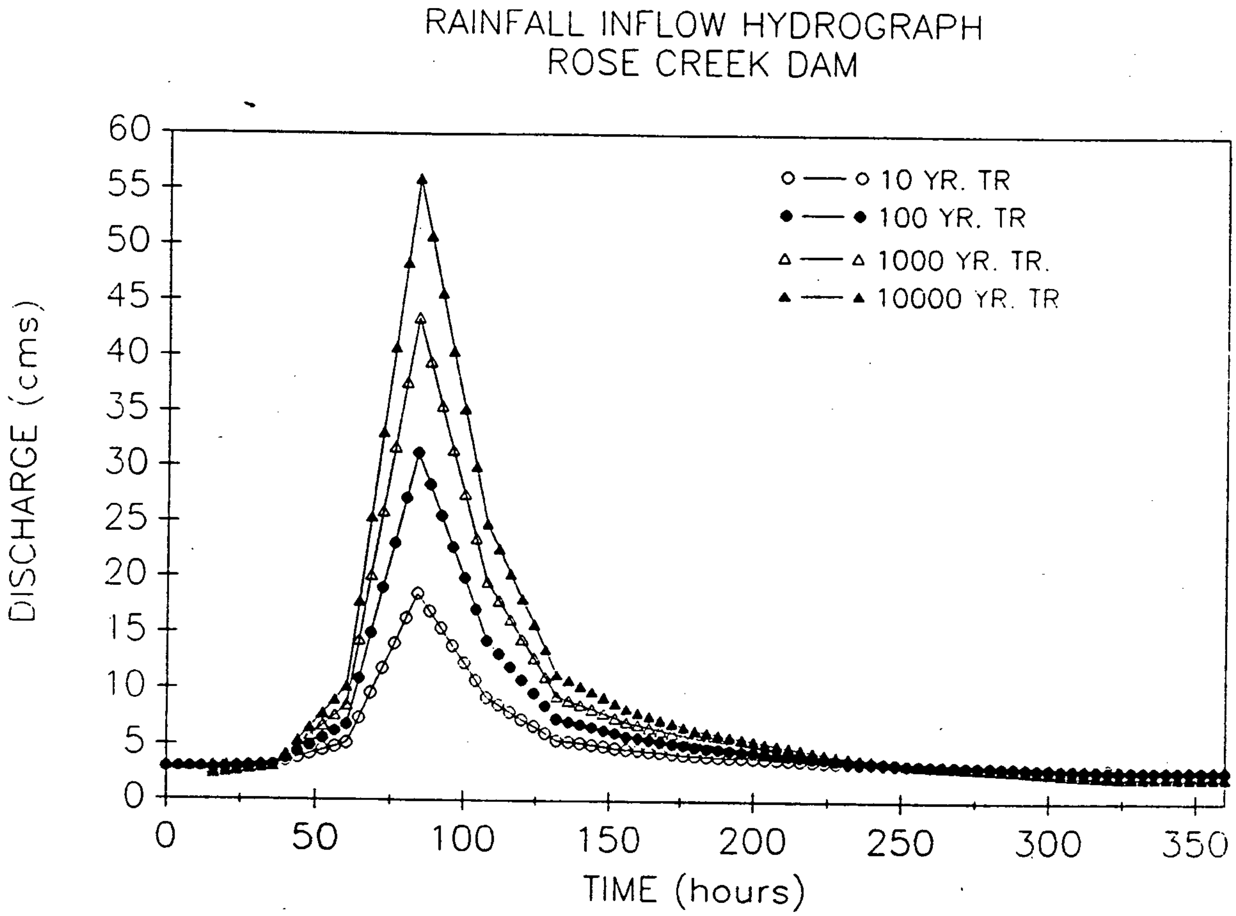

RAINFALL INFLOW HYDROGRAPH
ROSE CREEK DAM
10 YR. TR
100 YR. TR
1000 YR. TR.
10000 YR. TR
DISCHARGE (cms)
TIME (hours)
0
5
10
15
20
25
30
35
40
45
50
55
60
0
50
100
150
200
250
300
350

FIGURE 2

GEODETIC WATER ELEVATION vs. RESERVOIR VOLUME
ROSE CREEK DAM

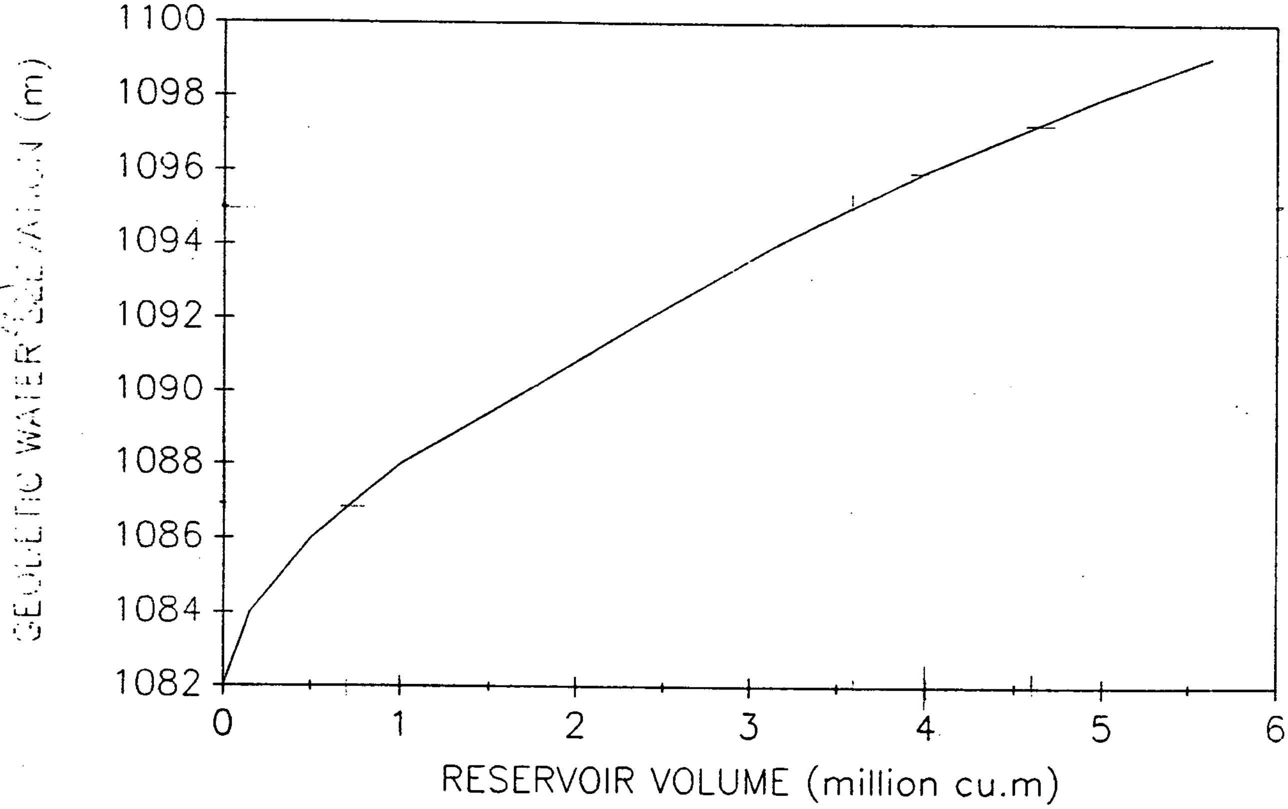


FIGURE 3

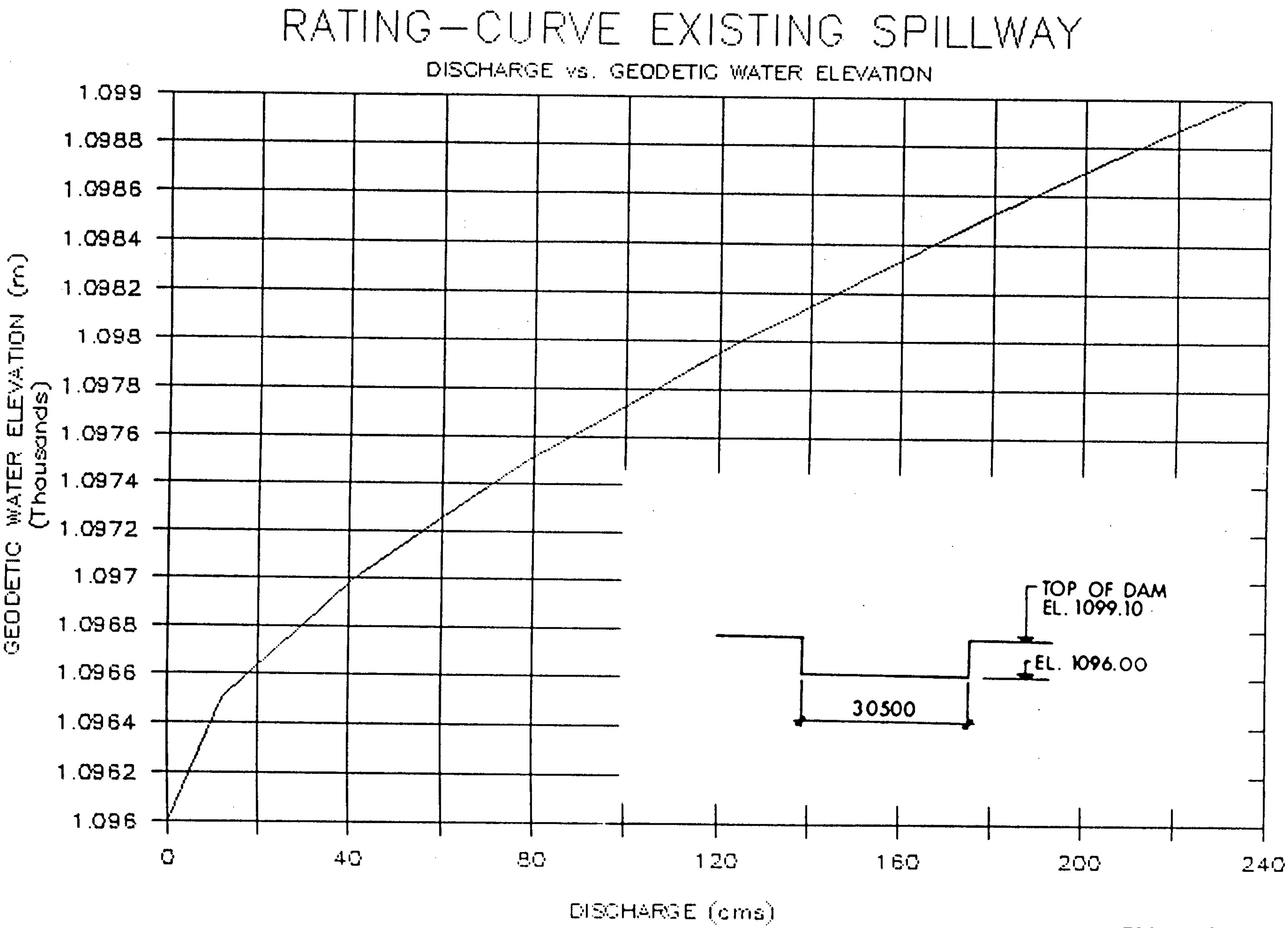

RATING-CURVE EXISTING SPILLWAY
DISCHARGE vs. GEODETIC WATER ELEVATION
GEODETIC WATER ELEVATION (m)
(Thousands)
1.099
1.0988
1.0986
1.0984
1.0982
1.098
1.0978
1.0976
1.0974
1.0972
1.097
1.0968
1.0966
1.0964
1.0962
1.096
0
40
80
120
160
200
240
DISCHARGE (cms)
TOP OF DAM
EL. 1099.10
EL. 1096.00
30500

FIGURE 4

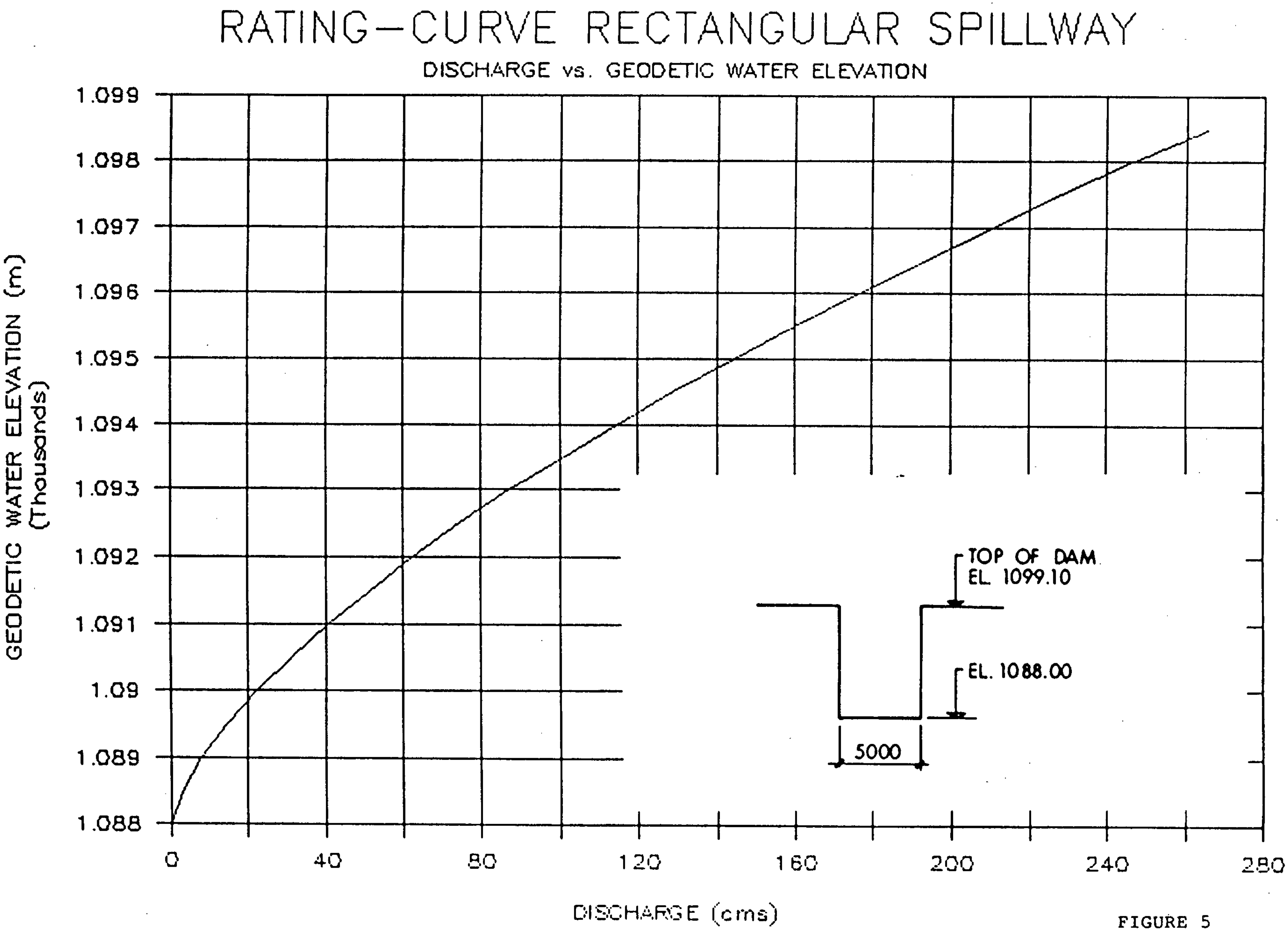
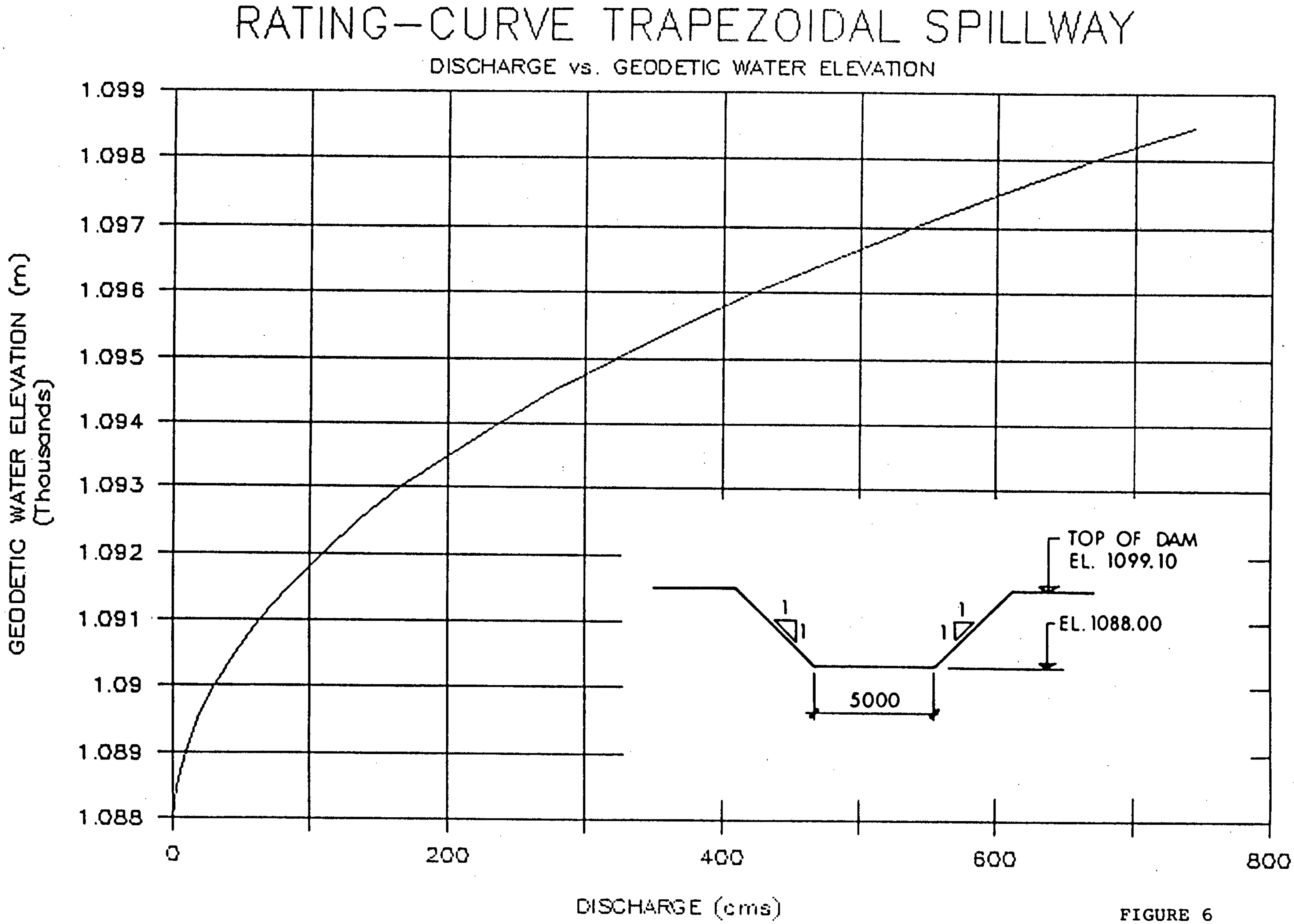

RATING—CURVE RECTANGULAR SPILLWAY
DISCHARGE vs. GEODETIC WATER ELEVATION
GEODETIC WATER ELEVATION (m)
(Thousands)
1.099
1.098
1.097
1.096
1.095
1.094
1.093
1.092
1.091
1.09
1.089
1.088
0
40
80
120
160
200
240
280
DISCHARGE (cms)
TOP OF DAM
EL. 1099.10
EL. 1088.00
5000

FIGURE 5



RATING–CURVE TRAPEZOIDAL SPILLWAY
DISCHARGE vs. GEODETIC WATER ELEVATION
GEODETIC WATER ELEVATION (m)
(Thousands)
1.099
1.098
1.097
1.096
1.095
1.094
1.093
1.092
1.091
1.09
1.089
1.088
0
200
400
600
800
DISCHARGE (cms)
TOP OF DAM
EL. 1099.10
EL. 1088.00
5000

FIGURE 6

RATING—CURVE TRIANGULAR SPILLWAY

DISCHARGE vs. GEODETIC WATER ELEVATION

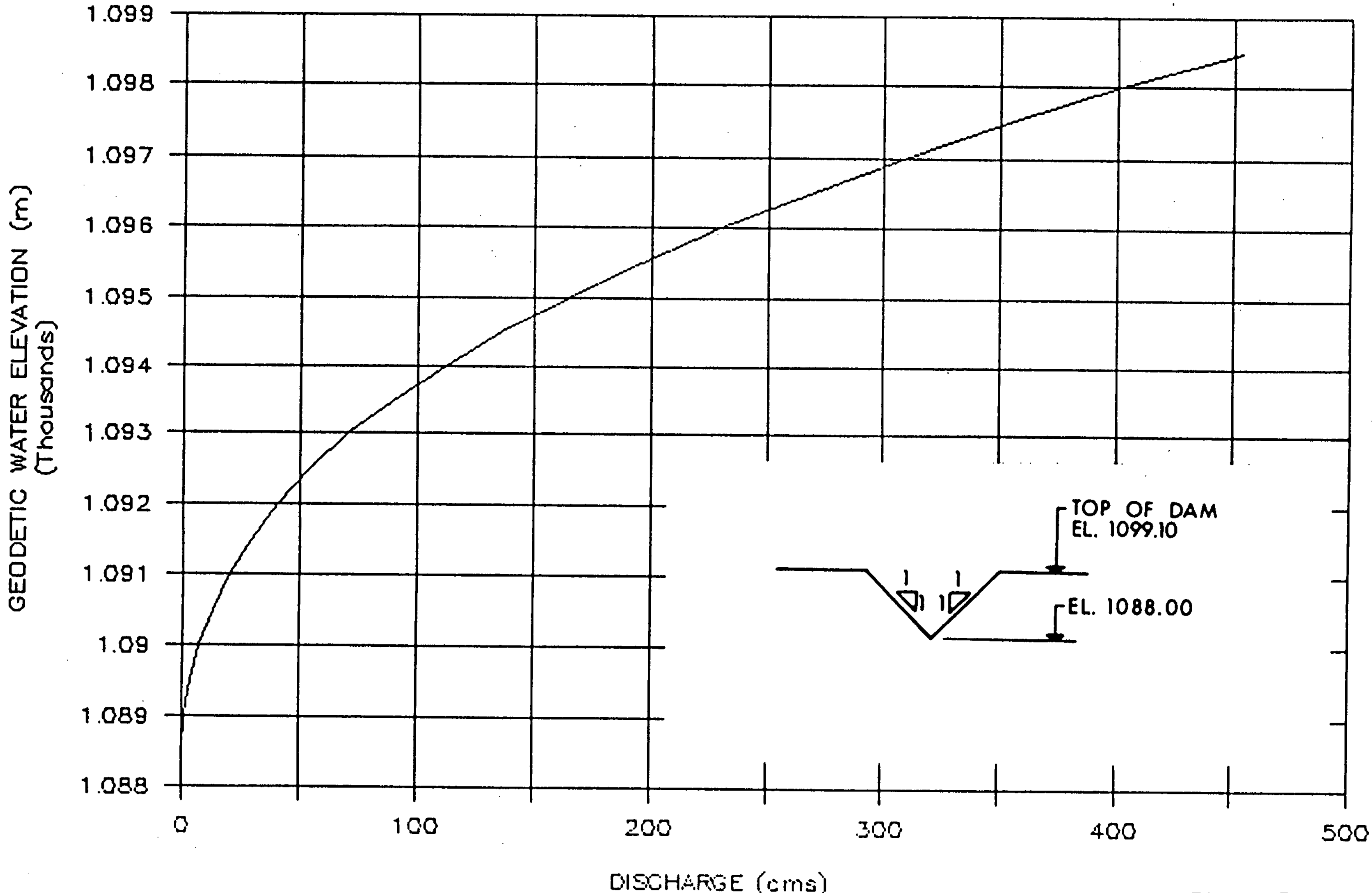


FIGURE 7

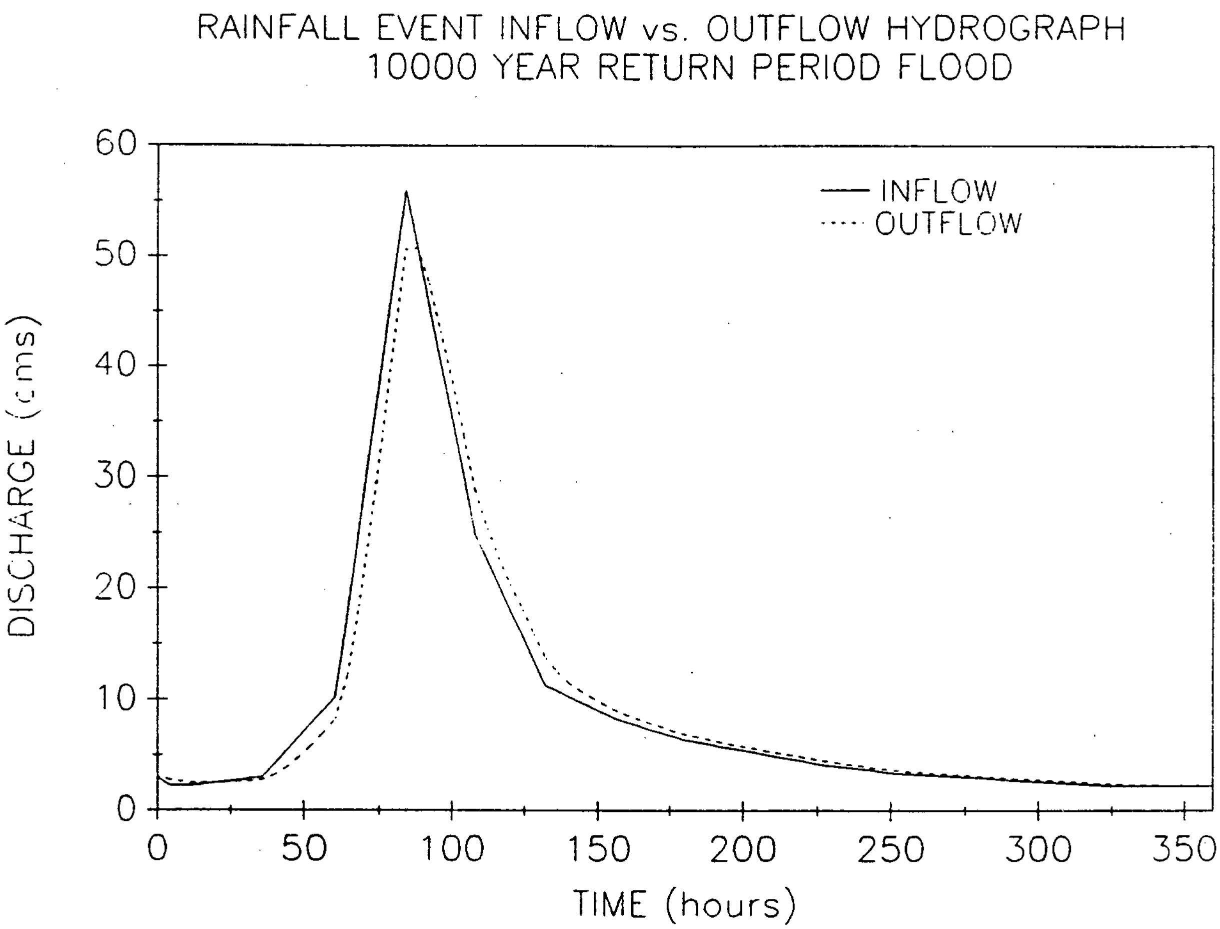

RAINFALL EVENT INFLOW vs. OUTFLOW HYDROGRAPH
10000 YEAR RETURN PERIOD FLOOD
INFLOW
OUTFLOW
DISCHARGE (cms)
TIME (hours)
0
10
20
30
40
50
60
0
50
100
150
200
250
300
350

FIGURE 8