TRIBUTARY MITCHELL BROOK
WHITE RIVER WATERSHED
VERMONT

JOHNSON REAL ESTATE DAM
DAM-BREAK FLOOD
ANALYSIS

AUGUST 1989

US Army Corps of Engineers
New England Division

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~~Dam-Break Analysis~~

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Dam-Break Flood Analysis

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Hydraulic & Water Resources Engineers, Inc.
Waltham, MA 02154

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13. ABSTRACT (Maximum 200 words)
This report presents the findings of two dam-break flood analysis performed for Johnson Real Estate Dam in Sharon, Vermont. Included in the report are a description of pertinent features of the dam, the procedure used in the analysis, the assumed dam-break conditions, and the resulting downstream flood depths and timing. This study was not performed because of any known likelihood of a dam-break at Johnson Real Estate Dam. Its two purposes were to provide quantitative information for emergency planning use and to arrive at a dam safety hazard classification. The dam is an earthfill dam, height of 28 feet and 222 feet in length, located on a tributary of Mitchell Brook. There were no computed depths of flow that would of themselves threaten damage to property in the downstream valley. However, high speeds of flow and the expected wave action and high turbulence imply a real threat of loss of life to any persons exposed. Therefore, a hazard classification of "significant" was assigned to the Johnson Real Estate Dam.

14. SUBJECT TERMS
Johnson Real Estate Dam; Sharon, Vermont; dams; White River Watershed; floods; earth dams

15. NUMBER OF PAGES
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Preface

This investigation was performed under the Corps of Engineers' Flood Plain Management Services Authority at the request of the State of Vermont. The Flood Control Act of 1960 which authorizes the U.S. Army Corps of Engineers "... to compile and disseminate information on floods and flood damages ... and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard."

The Dam-Break Analysis study presented in this report was prepared under contract by Hydraulic & Water Resources Engineers, Inc. of Waltham, Massachusetts. Any questions concerning this report should be addressed to the Chief of the Hydrology Engineering Section of the Corps of Engineers, New England Division.

JOHNSON REAL ESTATE DAM
DAM-BREAK FLOOD ANALYSES

TABLE OF CONTENTS

PARAGRAPH	SUBJECT	PAGE
1	INTRODUCTION AND PURPOSE	1
2	DAM DESCRIPTION	1
3	PERTINENT DATA	1
4	VALLEY DESCRIPTION	3
5	MODEL DESCRIPTION	3
6	ASSUMED DAM-BREAK CONDITIONS	3
7	RESULTS	4
8	DAM SAFETY HAZARD CLASSIFICATION	5

PLATE	LIST OF PLATES
1	INDEX MAP
2	PROFILE
3	FLOOD DISCHARGE, STAGES AND TIMING

APPENDIX	TITLE
A	INPUT DATA FILE
B	OUTPUT DATA FILE
C	MAXIMUM SURCHARGE STORAGE INFORMATION

JOHNSON REAL ESTATE DAM
DAM-BREAK FLOOD ANALYSES

1. INTRODUCTION AND PURPOSE

This report presents the findings of two dam-break flood analyses performed for Johnson Real Estate Dam in Sharon, Vermont. The dam is owned, operated and maintained by Johnson Real Estate, Inc., White River Junction, Vermont. Included in the report are a description of pertinent features of the dam, the procedure used in the analyses, the assumed dam-break conditions, and the resulting downstream flood depths and timing. This study was not performed because of any known likelihood of a dam-break at Johnson Real Estate Dam. Its two purposes were to provide quantitative information for emergency planning use and to arrive at a dam safety hazard classification.

2. DAM DESCRIPTION

Name of Dam:	Johnson Real Estate Dam
Town:	Sharon
County and State:	Windsor, VT
Stream:	Unnamed tributary of Mitchell Brook

Johnson Real Estate Dam is located in Windsor County in central Vermont. It is approximately 2 miles east of the junction of Route 132 and Interstate 89, and it is used for recreational purposes.

Johnson R.E. Dam is an earthfill dam with a maximum height of 28 feet and a length of 222 feet. The dam crest is 12 feet wide, with an upstream slope of 3:1 and a downstream slope of 2:1. The dam outlet works consist of an uncontrolled drop inlet spillway with a vertical corrugated metal pipe 36 inches in diameter leading to a 24-inch diameter corrugated metal pipe which conveys water through the dam. There is also a 70-foot-wide earthcut emergency spillway in the left abutment.

3. PERTINENT DATA

Data is taken primarily from an inspection report dated September 5, 1986 and filed at the State of Vermont's Dam Safety Engineer's offices; and from design drawings for the dam, supplied by the Vermont Dam Safety Engineer.

(a) Drainage Area

The location of Johnson Real Estate Dam on an unnamed tributary of Mitchell Brook is shown on Plate 1, which is based on the USGS Sharon Quadrangle for the State of

Vermont. The drainage area consists of 0.45 square miles (290 acres) of forested and steeply sloping hilly terrain.

(b) Elevation (N.G.V.D.)
- (1) Top of Dam - Varies from 1,386.0 to 1,386.8
- (2) Drop inlet crest - 1,380.66
- (3) Normal Pool Elev. - 1,380.66
- (4) Emergency Spwy Crest 1,382.2

(c) Reservoir
- (1) Length of normal pool - 0.25 mile

(d) Storage (Acre-Feet)
- (1) Top of Dam ------ 110
- (2) Normal water elev- 56

(e) Reservoir Surface (Acres)
- (1) Top of Dam (approx)-23.4
- (2) Normal water elev -- 4.3

(f) Dam
- (1) Type: Earthfill embankment
- (2) Length: 222 feet
- (3) Height: 28 feet maximum
- (4) Top Width: 12 feet
- (5) Side Slopes
  - (a) Upstream: 1 on 3
  - (b) Downstream: 1 on 2
- (6) Zoning: (Homogeneous)
- (7) Impervious Core: Not applicable.
- (8) Cutoff (at deepest section)
  - (a) Minimum width: 10 feet
  - (b) Bottom level: 1353.3 feet N.G.V.D.
  - (c) Top level: 1358.7 to 1358.9 feet N.G.V.D.
  - (d) Slopes
    - (i) Upstream: 1:1
    - (ii) Downstream: 1:1

(g) Outlet Works
- (1) Type: Drop inlet
- (2) Diameter of vertical shaft: 36 inches
- (3) Diameter of barrel: 24 inches
- (4) Crest elevation: 1380.66 feet

(h) Emergency Spillway
- (1) Type: Earthcut, vegetated.
- (2) Length: 70 feet
- (3) Width at crest: 20 feet
- (4) Crest elevation: 1382.2 feet NGVD
- (5) Capacity at max. head (top of dam): 1,400 cfs

4. VALLEY DESCRIPTION

The river channel drops at approximately 170 feet per mile below the dam. The valley is a wide and well-wooded deep ravine. The brook flows in a southeasterly direction to the confluence with a small brook which drains a portion of the Charles Downer State Forest about 1.3 miles downstream of the dam. Beaver Meadow Road crosses the brook at this point. The brook meets Mitchell Brook approximately 1.9 miles downstream of the dam.

5. MODEL DESCRIPTION

The Johnson Real Estate Dam dam-break analysis was made using Boss DamBrk, a June 1988 version of the "National Weather Service Dam-Break Flood Forecasting Computer Model", developed by D.L.Fread, Research Hydrologist, Office of Hydrology, National Weather Service, NOAA, Silver Springs, Maryland 20910. Boss DamBrk is copyrighted by Boss Corporation, 210 North Bassett Street, Madison, WI 53703. Input for the model consisted of: (a) storage characteristics of the reservoir, (b) selected geometry and duration of the breach development, (c) hydraulic roughness coefficients, and (d) downstream channel characteristics. Based on the input data, the model computes the dam-break outflow hydrograph and routes it downstream. The analysis provides output on the attenuation of the flood stages, and timing of the flood wave as it progresses downstream.

6. ASSUMED DAM BREAK CONDITIONS

General: These analyses were conducted for each of two failure scenarios. The first was a "Flood of Record" case, in which the initial lake elevation was assumed to be at a level produced by estimated flood of record inflow. The resulting peak lake level was 5 inches above the emergency spillway crest elevation immediately prior to a one-hour dam failure. Because the water level was below the top of the dam, the model simulated a piping breach failure.

The second failure condition was the "Maximum Surcharge Storage" case, in which the pond level was assumed to be at the dam crest elevation prior to a one-hour breach formation (failing from top down) with inflow equal to the combined capacity of the outlet works and emergency spillway.

The magnitude of a flood resulting from the hypothetical failure of Johnson Real Estate Dam is a function of many different parameters including size of breach, initial pool level and storage, rate of breach formation, channel and overbank roughness and antecedent flow conditions. Engineering assumptions used in the analyses for the two cases are presented below.

PARAMETER	FLOOD OF RECORD	MAXIMUM SURCHARGE
(1) Initial Pool Level	1,382.65	1,383.8 ft NGVD (See explanation in Section (8) of this table)
(2) Water Elevation at Start of Breach	1,382.65 ft	1,386.80 ft NGVD
(3) Reservoir Inflow	79 cfs	1,376 cfs
(4) Breach Invert	1,359.66 ft	1,359.66 ft NGVD
(5) Breach Base Width	40 ft	40 ft

(6) Time to Complete Formation of Breach : 1.0 hour (both)

(7) Downstream Channel Roughness: Manning n = 0.025 to 0.045

(8) Pre-Breach River Flows:

The Flood of Record case assumed a dam inflow of 175 cfs per square mile of drainage area which is the estimated runoff rate of the record November 1927 flood. This runoff rate is the estimated flood of record conditions within the White River watershed. Inflow to Johnson Pond was assumed to be 79 cfs. Inflow from the small brook draining Charles Downer State Forest with a drainage area of 0.79 square mile was 138 cfs.

For the Maximum Surcharge Storage case, inflow was set equal to the spillways' combined capacity and the lateral inflow of 2,000 cfs from the Charles Downer State Forest was computed by drainage area ratio raised to the power of 0.7.

The program failed to converge when the lateral inflow was set initially at the required 2,000 cfs and so it was necessary to assume a rising lateral inflow hydrograph reaching the required value at 2.5 hours. The initial lake elevation was set to ensure that the dam-failure flood wave would occur after the 2,000 cfs lateral inflow from the Charles Downer State Forest was reached.

7. RESULTS

The results of the Flood of Record analysis are discussed here and these form the basis of the hazard classification rating. Input and output data files for the flood of record analysis are presented in Appendices A and B. Data files and a tabular summary pertaining to the Maximum Surcharge case are presented in Appendix C.

The peak stage and flood flow profiles for the flood of record failure case are shown on Plates 2 and 3. Stage profiles are shown in feet above the stream bed elevation, as measured by the Hydraulic and Water Resources Engineers survey team. Peak water elevations can be determined by adding these depths of flow to the bed-slope profile elevations, or by adding the depths to field-established stream-bed elevations at points of interest.

Peak flows resulting from the one-hour formation of a dam-breach were 1,321 cfs at the dam and attenuated to 1,188 cfs immediately upstream of the Charles Downer State Forest inflow. Peak flows increased at this point due to the tributary and were 1,316 cfs attenuating to 1,288 cfs at river mile 1.71.

The greatest computed flow depth was immediately downstream of the dam at river mile 0.00, where the peak depth was 4.8 feet. The peak depth at the next surveyed cross-section (river mile 0.38) was 2.9 feet. Peak depth at surveyed sections downstream of this point were computed between 3 and 4.5 feet.

Peak flow velocities were very high, ranging from 14.5 to 21.0 feet per second.

Peak flows and stages occurred 0.6 hour after the start of breach formation, or about midway in the total 1-hour duration of complete breach formation.

8. DAM SAFETY HAZARD CLASSIFICATION

The categories and criteria for the hazard classification of dams, as reported in "Recommended Guidelines For Safety Inspection of Dams", Department of the Army, Nov. 1976, are listed in the following table. The hazard classification pertains to the potential loss of human life or property damage in the area downstream of the dam in the event of the failure of the dam.

DAM HAZARD CLASSIFICATION

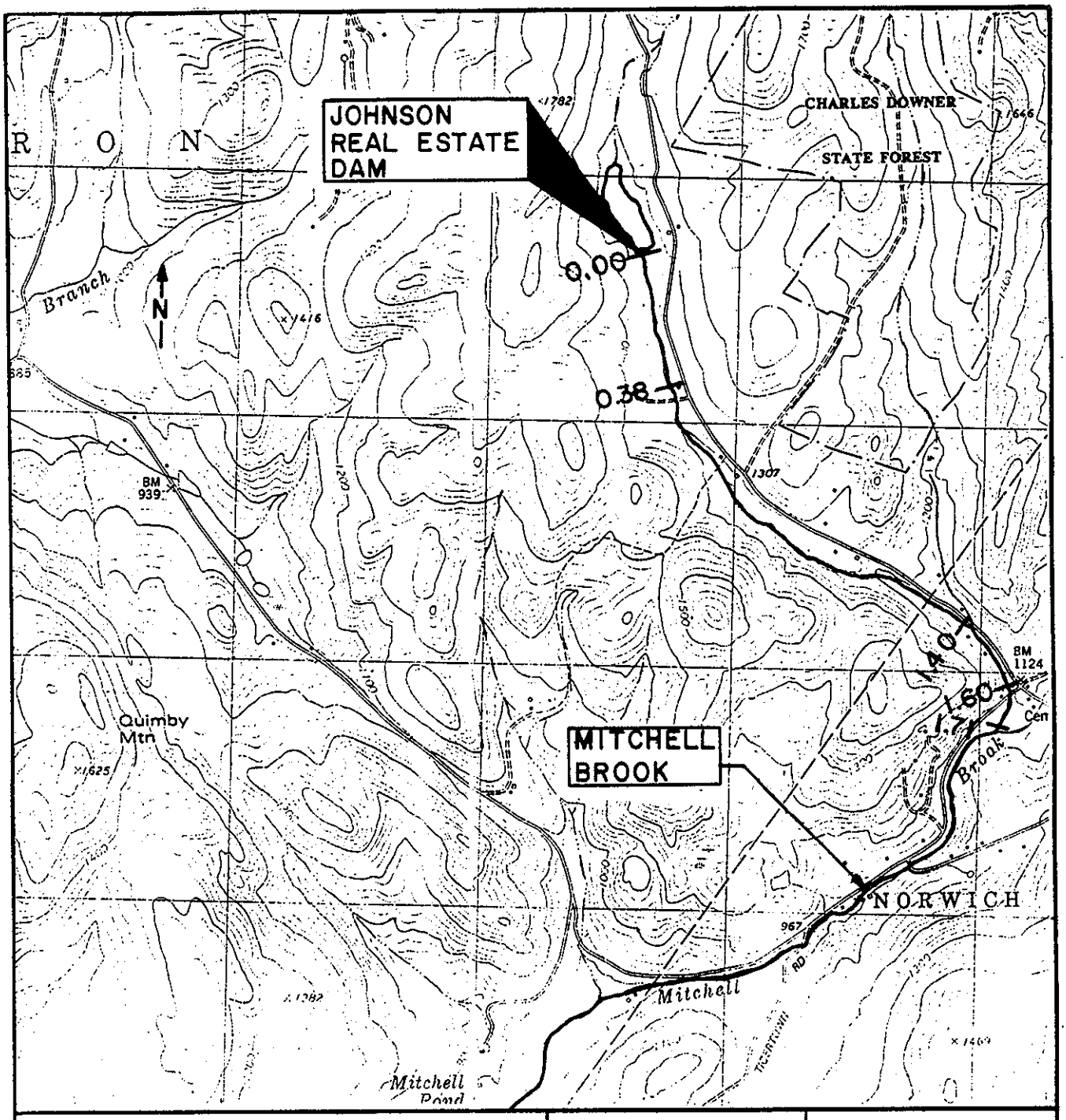
Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

Residential development is sparse downstream of Johnson Real Estate Dam and in fact the first building is situated at River Mile 0.4. There is however a length of stream channel that is flanked on the right bank by houses at regular intervals. This grouping is found from the Charles Downer State Forest inflow (River Mile 1.4) to the end of the study reach (River Mile 1.71).

There were no computed depths of flow that would of themselves threaten damage to property in the downstream valley. The associated flow velocities, however, ranged upwards from 14 feet per second. Damage to property might therefore result from the erosion caused during a dam-breach flood. This would be exacerbated by wave action to be expected in turbulent flow conditions.

The high speeds of flow and the expected wave action and high turbulence imply a real threat of loss of life to any persons exposed.

For these reasons, a hazard classification of "significant" was assigned to the Johnson Real Estate Dam.



MAP BASED UPON U.S.G.S.
SHARON, V.T. QUADRANGLE
1973
CHECKED 1975 EDITED 1981

CROSS SECTION LOCATION IN
MILES BELOW DAM

SCALE IN FEET

2,000 0 2,000

HYDRAULIC & WATER RESOURCES ENGINEERS, INC. CONSULTING ENGINEERS WALTHAM, MASS.	DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.

JOHNSON REAL ESTATE DAM

DAM BREAK FLOOD ANALYSIS

INDEX MAP

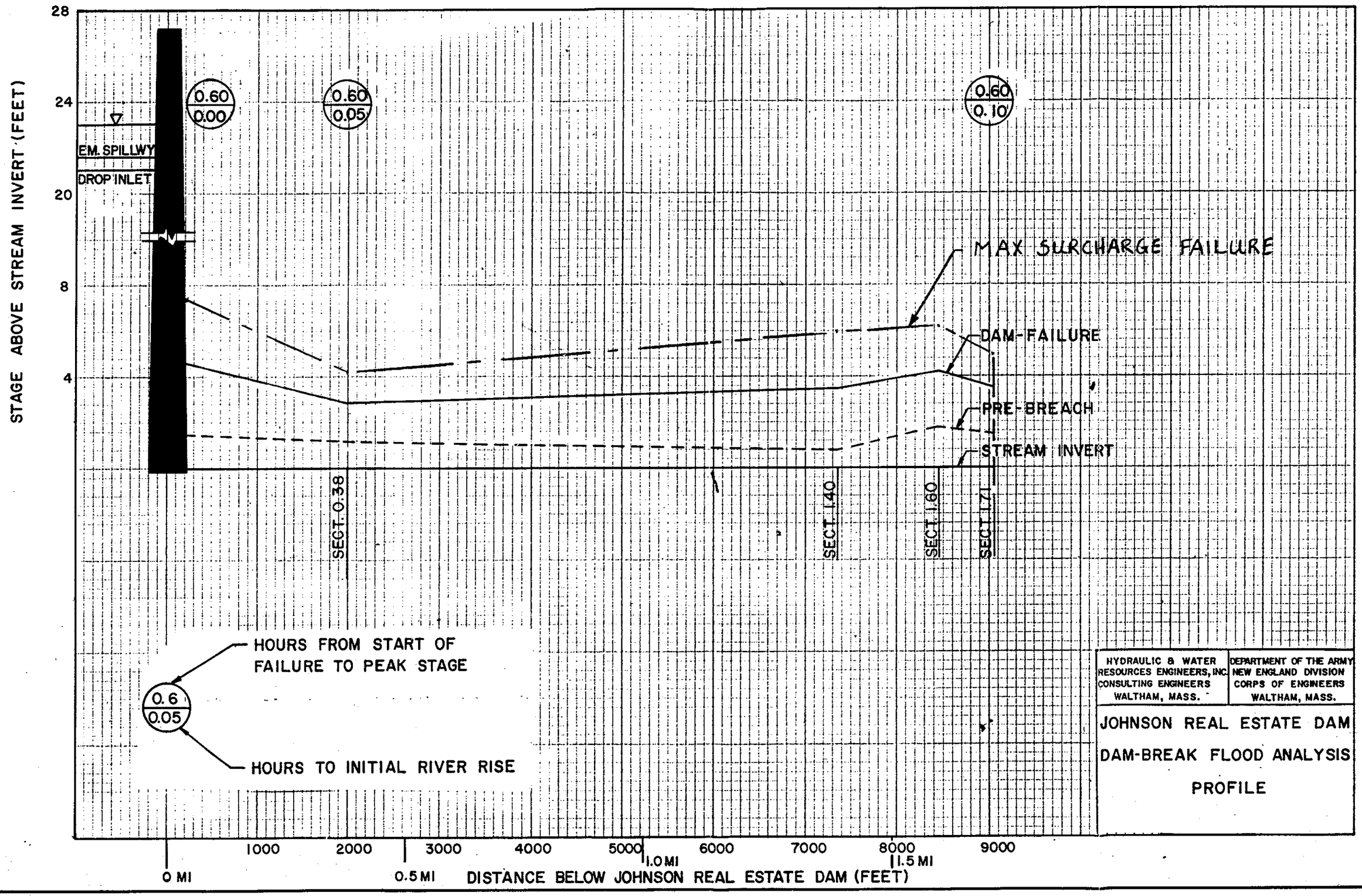
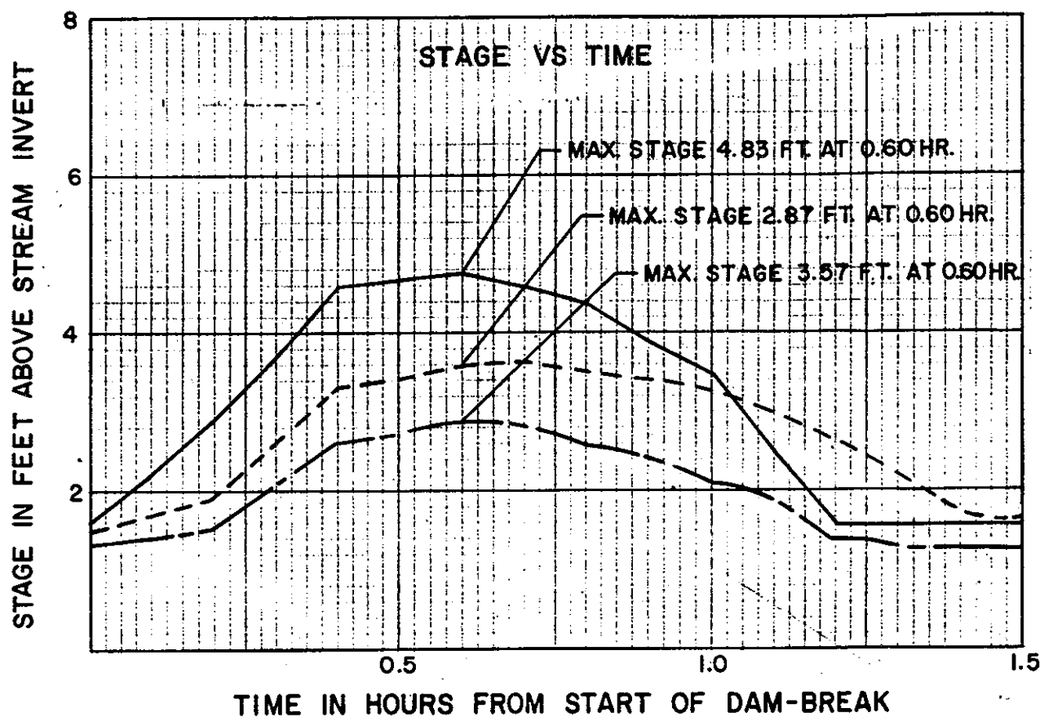
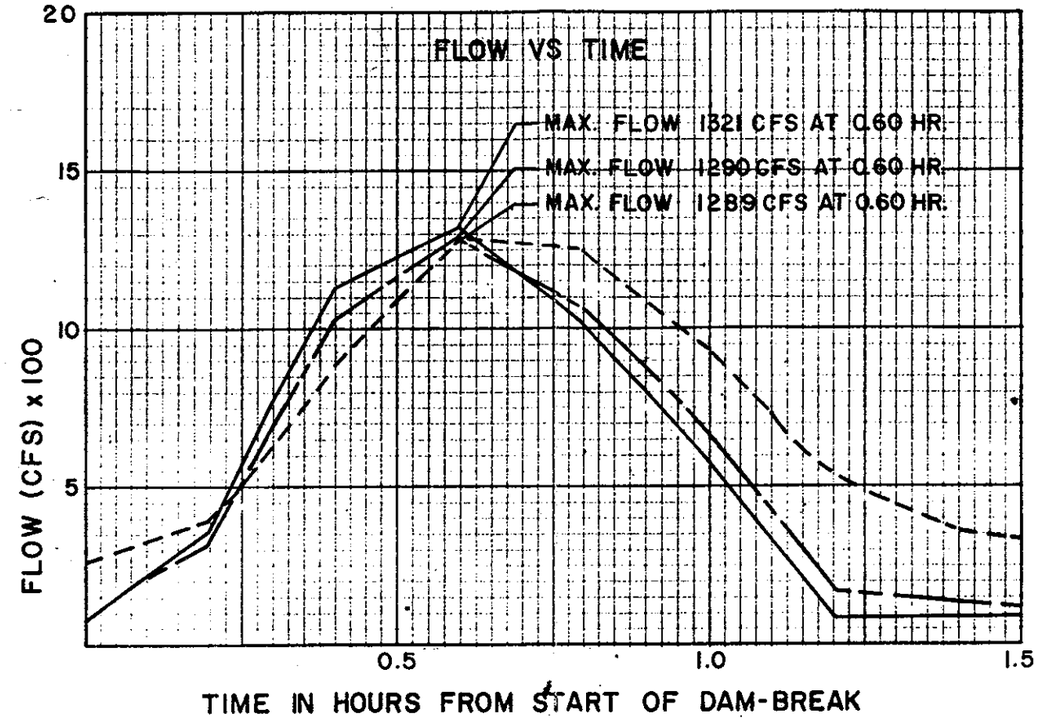
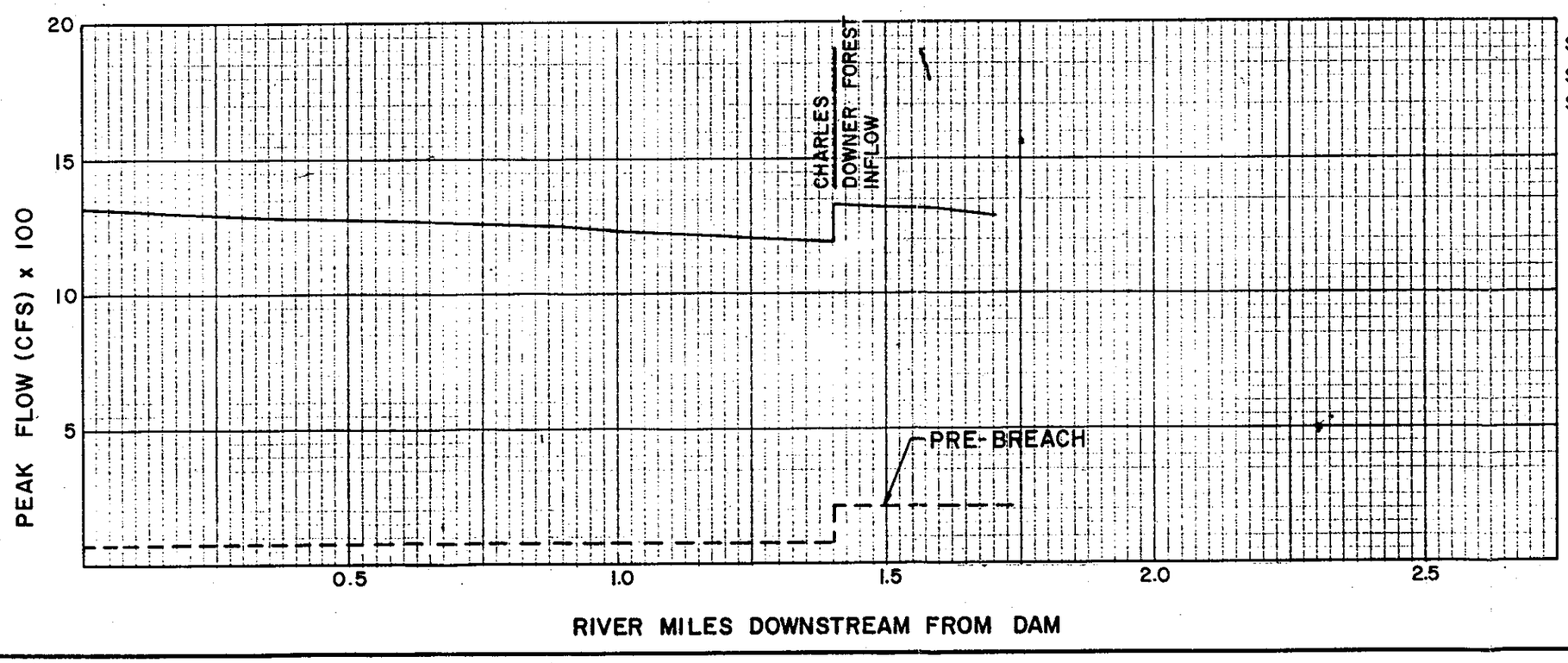

STAGE ABOVE STREAM INVERT (FEET)
28
24
20
8
4
EM. SPILLWY
DROP INLET
0.60
0.00
0.60
0.05
0.60
0.10
MAX SURCHARGE FAILURE
DAM-FAILURE
PRE-BREACH
STREAM INVERT
SECT. 0.38
SECT. 1.40
SECT. 1.60
SECT. 1.71
HOURS FROM START OF FAILURE TO PEAK STAGE
0.6
0.05
HOURS TO INITIAL RIVER RISE
1000
2000
3000
4000
5000
6000
7000
8000
9000
0 MI
0.5 MI
1.0 MI
1.5 MI
DISTANCE BELOW JOHNSON REAL ESTATE DAM (FEET)
HYDRAULIC & WATER RESOURCES ENGINEERS, INC.
CONSULTING ENGINEERS
WALTHAM, MASS.
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
JOHNSON REAL ESTATE DAM
DAM-BREAK FLOOD ANALYSIS
PROFILE

PLATE 2







STREAM INVERT DATUM (FT. NGVD)

STA. 1 RM. 0.00 = 1359.7 ————

STA. 2 RM. 0.38 = 1302.6 —— - ——

STA. 3 RM. 1.71 = 1067.2 - - - - -

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JOHNSON REAL ESTATE DAM

DAM-BREAK FLOOD ANALYSIS

BASE FLOOD DISCHARGES
STAGES & TIMING

```
JOHNSON REAL ESTATE DAM  VERMONT  FLOOD OF RECORD
                         DAM FAILURE BY PIPING
         1         0         0         5         3         0         0         0
0111110100 0 2
     110.0      86.0      56.0       0.0
    1386.8    1385.3   1380.66   1359.66
       0.0  1382.648       1.0   1359.66        40       1.0   1359.66       1.0
  1382.648    1386.8    1382.2       0.0     140.0       0.0      580.      37.0
       0.0       2.0
      79.0      79.0      79.0
       0.0       1.0       2.0
         5         5         5         9         0         1         1         0
         3         3         3         4         5
         1         2         3
       0.0       0.0
   1359.65   1363.66   1380.66   1385.26   1386.66       0.0       0.0       0.0
       1.0      30.0     230.0     330.0     343.0       0.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      0.38       0.0
    1302.6    1307.2    1313.0    1314.7    1316.3       0.0       0.0       0.0
       8.0      65.0     240.0     305.0     333.0       0.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.40       0.0
    1115.9    1123.5    1125.0    1126.2    1127.5       0.0       0.0       0.0
      12.0      30.0     130.0     185.0     252.0       0.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.60       0.0
    1084.5    1092.0    1094.0    1095.3    1096.8       0.0       0.0       0.0
       8.0      33.0      80.0     152.0     225.0       0.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.71       0.0
    1067.2    1069.6   1072.25    1072.8    1072.9       0.0       0.0       0.0
      12.0      22.4     260.0     350.0     350.1       0.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
     0.025     0.025     0.025      0.03      0.03       0.0       0.0       0.0
     0.025     0.025     0.043     0.044     0.045       0.0       0.0       0.0
     0.025     0.028     0.030     0.036     0.040       0.0       0.0       0.0
     0.025     0.028     0.029      0.03     0.035       0.0       0.0       0.0
       0.2       0.2       0.1      0.04
       0.0       0.0       0.0       0.0
    1500.0       0.0       0.2       0.0     171.0       0.0      0.05       0.0
         3
     138.0     138.0     138.0
```

==========
B O S S D A M B R K (tm)
==========

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Version : 1.30
Serial Number : 0001058.130

PROGRAM ORIGIN :

Boss DamBrk (tm) is an enhanced version of Professor D. L. Fread's 1984 NWS DAMBRK program.

DISCLAIMER :

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PROJECT DESCRIPTION :

PROJECT TITLE : Johnson Real Estate Dam Failure
PROJECT NUMBER : JC-127-2B
DESCRIPTION : Record Flood Failure Case Supercritical
ENGINEER : Patrick Blumeris
DATE OF RUN : 4/07/1989
TIME OF RUN : 7:00 am

INPUT DATA SUMMARY :

INPUT CONTROL PARAMETERS :

Number of Dynamic Routing Reaches (KKN)	1	
Type of Reservoir Routing (KUI)	0	(storage routing)
Number of multiple dams/bridges (MULDAM)	0	
No. of Reservoir Inflow Hydrograph Points (ITEH)	3	
No. of Informational Cross-Sections (NPRT)	0	
Flood-Plain Routing (KFLP)	0	(no)
Landslide Simulation (KSL)	0	(no)

RESERVOIR DESCRIPTION :

Elevation vs. Volume Table

Elevation HSA(K) (ft MSL)	Volume SA(K) (acre-ft)
1386.80	110.0
1385.30	86.0
1380.66	56.0
1359.66	.0
.00	.0
.00	.0
.00	.0
.00	.0

RESERVOIR VOLUME DESCRIPTION :

Elevation vs. Surface Area Table

Elevation HSA(K) (ft MSL)	Surface Area SA(K) (acres)
1386.80	23.4
1385.30	8.6
1380.66	4.3
1359.66	1.0
.00	.0
.00	.0
.00	.0
.00	.0

RESERVOIR and BREACH DESCRIPTION :

Initial Elevation of Reservoir Surface (YO, ft MSL)		1382.65
Bottom of Dam Elevation (DATUM, ft MSL)		1359.66
Top of Dam Elevation (HD, ft MSL)		1386.80
Water Surface Elevation at Time of Breach (HF, ft MSL)		1382.65
Breach Side Slope (Z)	1:	1.00
Breach Bottom Elevation (YBMIN, ft MSL)		1359.66
Breach Base Width (BB, ft)		40.00
Time of Breach Formation (TFH, hr)		1.00
Uncontrolled Spillway Crest Elevation (HSP, ft MSL)		1382.20
Uncontrolled Spillway Discharge Coefficient (CS)		140.00
Spillway Gate Center Elevation (HGT, ft MSL)		.00
Spillway Gate Discharge Coefficient (CG)		.00
Dam Overtopping Discharge Coefficient (CDO)		580.00
Turbine Discharge (QT, cfs)		37.00

INFLOW HYDROGRAPH DESCRIPTION :

Hydrograph Time Intervals (DHF, hr)	.00
Routing Period (TEH, hr)	2.00

Time Elapsed TI(K) (hr)	Upstream Inflow QI(K) (cfs)
.00	79.0
1.00	79.0
2.00	79.0

SUMMARY OF PROGRAM CONTROL PARAMETERS :

Number of Cross-Sections Entered (NS)	5	
Number of Top Widths Entered (NCS)	5	
Number of Cross-Sectional Hydrographs to Plot (NTT)	5	
Cross-Sectional Smoothing Parameter (KSA)	0	
Downstream Supercritical Parameter (KSUPC)	1	(supercritical)
Number of Lateral Inflow Hydrographs (LQ)	1	
Number of Points in Gate Control Curve (KCG)	0	

CROSS-SECTIONS WHERE HYDROGRAPH REQUESTED :
(maximum allowed = 6)

1 2 3 4 5

CHANNEL-VALLEY BOUNDARY CONDITIONS :

Max Discharge at Downstream End (QMAXD, cfs)	1500.0
Max Lateral Outflow due to Flood Wave (QLL, cfs/ft)	.0
Initial Time-Step Size (DTHM, hr)	.20
Time at which Dam Starts to Fail (TFI, hr)	.00
Theta Weighting Factor (F1I)	.000
Stage Convergence Criterion (EPSY, ft)	.05
Initial Downstream Water Surface Elevation (YDN, ft MSL)	.00
Slope of Channel Downstream of Dam (SOM, ft/mi)	171.000

LATERAL INFLOW REACH NUMBERS (LQX) :

3

(QL(L, 1),L=1,IFEH)

138 138. 138.

CROSS-SECTION NUMBER : 1

Cross-Section Location (XS(I), mi)	.000
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 1

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.200

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1359.65	1.0	.0250	.0	.0	.0000	.0	.0000
1363.66	30.0	.0250	.0	.0	.0000	.0	.0000
1380.66	230.0	.0250	.0	.0	.0000	.0	.0000
1385.26	330.0	.0300	.0	.0	.0000	.0	.0000
1386.66	343.0	.0300	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 2

Cross-Section Location (XS(I), mi)	.380
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 2

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.200

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1302.60	8.0	.0250	.0	.0	.0000	.0	.0000
1307.20	65.0	.0250	.0	.0	.0000	.0	.0000
1313.00	240.0	.0430	.0	.0	.0000	.0	.0000
1314.70	305.0	.0440	.0	.0	.0000	.0	.0000
1316.30	333.0	.0450	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 3

Cross-Section Location (XS(I), mi)	1.400
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 3

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.100

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1115.90	12.0	.0250	.0	.0	.0000	.0	.0000
1123.50	30.0	.0280	.0	.0	.0000	.0	.0000
1125.00	130.0	.0300	.0	.0	.0000	.0	.0000
1126.20	185.0	.0360	.0	.0	.0000	.0	.0000
1127.50	252.0	.0400	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 4

Cross-Section Location (XS(I), mi)	1.600
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 4

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.040

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1084.50	8.0	.0250	.0	.0	.0000	.0	.0000
1092.00	33.0	.0280	.0	.0	.0000	.0	.0000
1094.00	80.0	.0290	.0	.0	.0000	.0	.0000
1095.30	152.0	.0300	.0	.0	.0000	.0	.0000
1096.80	225.0	.0350	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 5

Cross-Section Location (XS(I), mi)	1.710
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

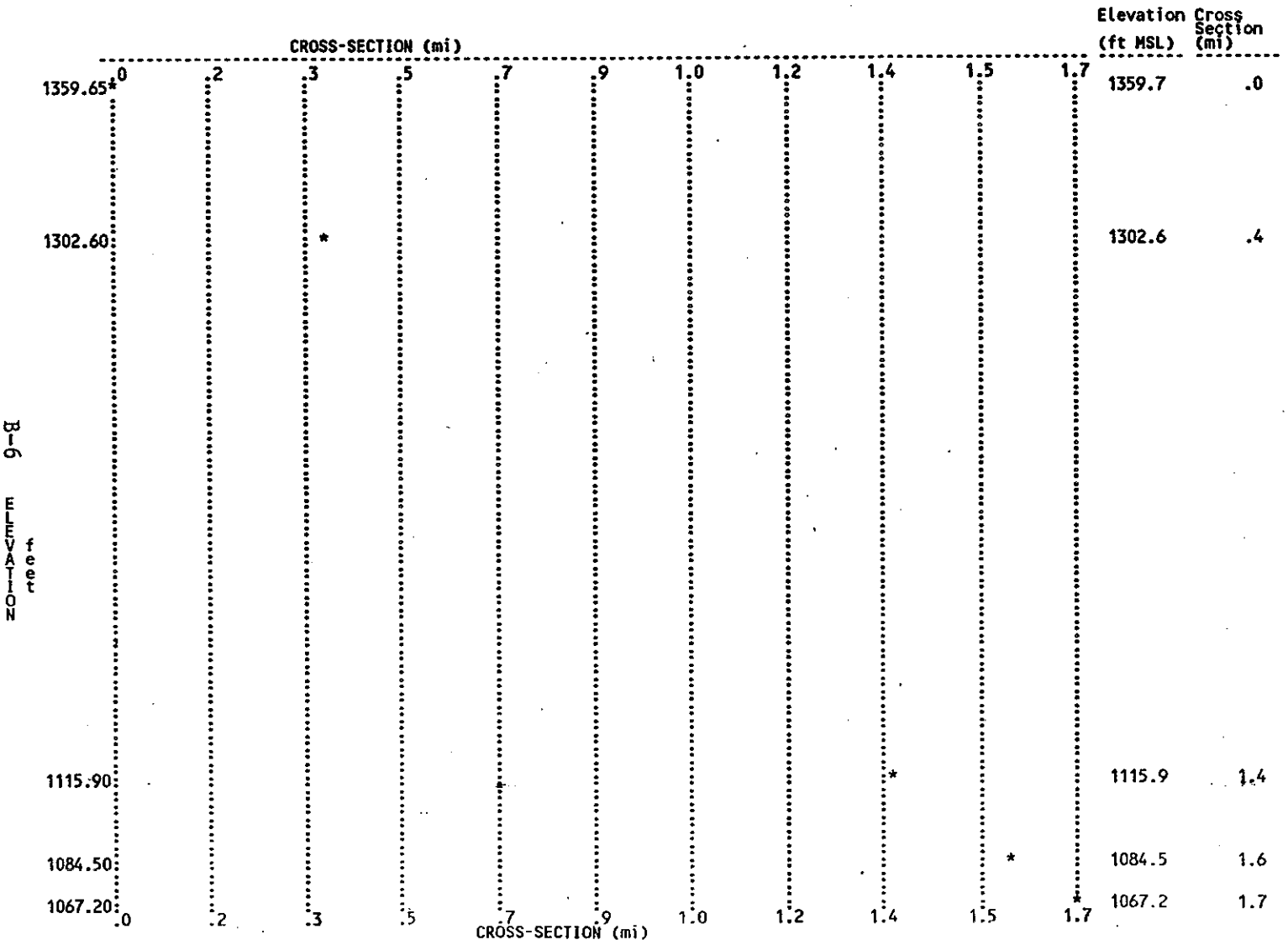
CROSS-SECTION DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Right Top Width BSR(K,I) (ft)
1067.20	12.0	.0	.0	.0
1069.60	22.4	.0	.0	.0
1072.25	260.0	.0	.0	.0
1072.80	350.0	.0	.0	.0
1072.90	350.1	.0	.0	.0

Total number of cross-sections (original+interpolated)	11
Maximum number of cross-sections allowed	200

OUTPUT DATA SUMMARY :

SLOPE PROFILE PLOT :



Elevation (ft MSL)	Cross Section (mi)
1359.7	.0
1302.6	.4
1115.9	1.4
1084.5	1.6
1067.2	1.7

RESERVOIR DEPLETION SUMMARY :

Total Volume in Reservoir (acre-ft) 66.4

DEFINITION OF RESERVOIR DEPLETION TABLE VARIABLES :

PARAMETER	UNITS	VARIABLE
Time step from start of analysis		I
Iterations necessary to solve flow equations		K
Elapsed time from start of analysis	hr	TTP(I)
Total outflow from dam	cfs	Q(I)
Elevation of water surface at dam	ft	H2
Elevation of breach bottom	ft	YB
Estimated depth of downstream flow	ft	D
Submergence coefficient		SUB
Velocity correction		VCOR
Total volume discharged from time of breach	ac-ft	OUTVOL
Breach width	ft	BB
Rectangular breach discharge coefficient		COFR
Inflow to reservoir	cfs	QI(I)
Breach outflow	cfs	QBRECH
Spillway outflow	cfs	QSPIL

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
1	0	.000	78	1382.65	1382.65	1361.18	1.00	1.00	.0	.0	3.10	79.	0.	79.
2	1	.020	80	1382.65	1382.19	1361.19	1.00	1.00	.1	.8	3.10	79.	1.	79.
3	1	.040	85	1382.65	1381.73	1361.23	1.00	1.00	.3	1.6	3.10	79.	6.	79.
4	1	.060	95	1382.64	1381.27	1361.31	1.00	1.00	.4	2.4	3.10	79.	17.	78.
5	1	.080	113	1382.64	1380.81	1361.43	1.00	1.00	.6	3.2	3.10	79.	36.	77.
6	1	.100	137	1382.62	1380.35	1361.59	1.00	1.00	.8	4.0	3.10	79.	62.	76.
7	1	.120	169	1382.60	1379.89	1361.76	1.00	1.00	1.1	4.8	3.10	79.	96.	73.
8	1	.140	208	1382.57	1379.43	1361.94	1.00	1.00	1.4	5.6	3.10	79.	140.	69.
9	2	.160	256	1382.53	1378.97	1362.10	1.00	1.00	1.7	6.4	3.10	79.	192.	64.
10	2	.180	310	1382.48	1378.51	1362.29	1.00	1.00	2.2	7.2	3.10	79.	253.	57.
11	2	.200	372	1382.40	1378.05	1362.49	1.00	1.00	2.8	8.0	3.10	79.	322.	50.
12	2	.220	440	1382.31	1377.52	1362.68	1.00	1.00	3.5	8.8	3.10	79.	399.	42.
13	2	.240	518	1382.20	1377.13	1362.88	1.00	1.00	4.2	9.6	3.10	79.	481.	37.
14	2	.260	603	1382.06	1376.67	1363.08	1.00	1.00	5.2	10.4	3.10	79.	568.	36.
15	2	.280	698	1381.89	1376.21	1363.26	1.00	1.00	6.2	11.2	3.10	79.	658.	33.
16	2	.300	777	1381.69	1375.75	1363.44	1.00	1.00	7.5	12.0	3.10	79.	748.	30.
17	2	.320	863	1381.42	1375.28	1363.59	1.00	1.00	8.8	12.8	3.10	79.	837.	27.
18	2	.340	945	1381.17	1374.83	1363.74	1.00	1.00	10.3	13.6	3.10	79.	922.	24.
19	2	.360	1019	1380.85	1374.37	1363.88	1.00	1.00	11.2	14.4	3.10	79.	988.	21.
20	2	.380	1084	1380.49	1373.91	1364.00	1.00	1.00	13.7	15.2	3.10	79.	1067.	18.
21	2	.400	1141	1380.09	1373.45	1364.09	1.00	1.00	15.5	16.0	3.10	79.	1126.	15.
22	2	.420	1190	1379.66	1372.99	1364.17	1.00	1.00	17.4	16.8	3.10	79.	1179.	12.
23	2	.440	1233	1379.21	1372.53	1364.23	1.00	1.00	19.4	17.6	3.10	79.	1224.	9.
24	2	.460	1267	1378.73	1372.07	1364.28	1.00	1.00	21.5	18.4	3.10	79.	1262.	6.
25	2	.480	1294	1378.23	1371.61	1364.32	1.00	1.00	23.5	19.2	3.10	79.	1292.	3.
26	2	.500	1314	1377.71	1371.15	1364.35	1.00	1.00	25.8	20.0	3.10	79.	1315.	0.
27	2	.520	1329	1377.18	1370.69	1364.37	1.00	1.00	28.0	20.8	3.10	79.	1330.	0.
28	2	.540	1337	1376.62	1370.23	1364.38	1.00	1.00	30.2	21.6	3.10	79.	1337.	0.
29	2	.560	1338	1376.05	1369.77	1364.38	1.00	1.00	32.4	22.4	3.10	79.	1338.	0.
30	2	.580	1332	1375.47	1369.31	1364.38	1.00	1.00	34.6	23.2	3.10	79.	1333.	0.
31	2	.600	1321	1374.87	1368.86	1364.36	1.00	1.01	36.8	24.0	3.10	79.	1321.	0.
32	2	.620	1307	1374.27	1368.40	1364.34	1.00	1.01	39.0	24.8	3.10	79.	1305.	0.
33	1	.640	1283	1373.65	1367.94	1364.31	1.00	1.01	41.1	25.6	3.10	79.	1284.	0.
34	1	.660	1258	1373.03	1367.48	1364.27	1.00	1.01	43.2	26.4	3.10	79.	1259.	0.
35	1	.680	1230	1372.40	1367.02	1364.23	1.00	1.01	45.3	27.2	3.10	79.	1230.	0.
36	1	.700	1198	1371.77	1366.56	1364.18	1.00	1.01	47.3	28.0	3.10	79.	1199.	0.
37	1	.720	1165	1371.14	1366.10	1364.13	1.00	1.02	49.2	28.8	3.10	79.	1165.	0.
38	1	.740	1130	1370.50	1365.64	1364.07	1.00	1.02	51.1	29.6	3.10	79.	1130.	0.
39	1	.760	1093	1369.86	1365.18	1364.01	1.00	1.03	52.9	30.4	3.10	79.	1093.	0.
40	1	.780	1056	1369.22	1364.72	1363.95	1.00	1.03	54.7	31.2	3.10	79.	1056.	0.
41	1	.800	1018	1368.58	1364.26	1363.88	1.00	1.04	56.4	32.0	3.10	79.	1019.	0.
42	1	.820	982	1367.93	1363.80	1363.82	1.00	1.06	58.1	32.8	3.10	79.	982.	0.
43	1	.840	947	1367.29	1363.34	1363.75	1.00	1.09	59.7	33.6	3.10	79.	947.	0.
44	1	.860	914	1366.63	1362.88	1363.69	1.00	1.12	61.2	34.4	3.10	79.	915.	0.
45	1	.880	887	1365.97	1362.42	1363.64	1.00	1.16	62.7	35.2	3.10	79.	888.	0.
46	2	.900	870	1365.29	1361.96	1363.60	1.00	1.22	64.2	36.0	3.10	79.	870.	0.
47	2	.920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	65.4	36.8	3.10	79.	[illegible]	0.
48	2	.940	923	1363.79	1361.04	1363.[illegible]	1.00	2.00	67.1	37.6	3.10	79.	923.	0.
49	2	.960	897	1362.93	1360.58	1363.65	1.00	2.00	68.6	38.4	3.10	79.	897.	0.
50	2	.980	706	1362.10	1360.12	1363.30	1.00	2.00	69.9	39.2	3.10	79.	707.	0.

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
51	2	1.000	588	1361.40	1359.66	1363.05	1.00	2.00	71.0	40.0	3.10	79.	588.	0.
52	2	1.020	542	1360.88	1359.66	1362.40	1.00	2.00	71.8	40.0	3.10	79.	543.	0.
53	2	1.040	522	1360.59	1359.66	1362.01	1.00	2.00	72.2	40.0	3.10	79.	527.	0.
54	2	1.060	166	1360.42	1359.66	1361.73	1.00	2.00	72.6	40.0	3.10	79.	167.	0.
55	2	1.080	152	1360.31	1359.66	1361.54	1.00	2.00	72.8	40.0	3.10	79.	153.	0.
56	2	1.100	113	1360.25	1359.66	1361.42	1.00	2.00	73.0	40.0	3.10	79.	113.	0.
57	2	1.120	100	1360.21	1359.66	1361.37	1.00	2.00	73.2	40.0	3.10	79.	101.	0.
58	2	1.140	93	1360.18	1359.66	1361.29	1.00	2.00	73.3	40.0	3.10	79.	93.	0.
59	1	1.160	88	1360.16	1359.66	1361.24	1.00	2.00	73.5	40.0	3.10	79.	88.	0.
60	1	1.180	85	1360.15	1359.66	1361.22	1.00	2.00	73.6	40.0	3.10	79.	85.	0.
61	1	1.200	83	1360.14	1359.66	1361.21	1.00	2.00	73.8	40.0	3.10	79.	83.	0.
62	1	1.220	81	1360.13	1359.66	1361.20	1.00	2.00	73.9	40.0	3.10	79.	82.	0.
63	1	1.240	80	1360.13	1359.66	1361.19	1.00	2.00	74.1	40.0	3.10	79.	81.	0.
64	1	1.260	80	1360.13	1359.66	1361.19	1.00	2.00	74.2	40.0	3.10	79.	80.	0.
65	1	1.280	79	1360.13	1359.66	1361.19	1.00	2.00	74.3	40.0	3.10	79.	80.	0.
66	1	1.300	79	1360.13	1359.66	1361.18	1.00	2.00	74.4	40.0	3.10	79.	80.	0.
67	1	1.320	79	1360.13	1359.66	1361.18	1.00	2.00	74.6	40.0	3.10	79.	79.	0.
68	1	1.340	79	1360.12	1359.66	1361.18	1.00	2.00	74.7	40.0	3.10	79.	79.	0.
69	1	1.360	79	1360.12	1359.66	1361.18	1.00	2.00	74.8	40.0	3.10	79.	79.	0.
70	1	1.380	79	1360.12	1359.66	1361.18	1.00	2.00	75.0	40.0	3.10	79.	79.	0.
71	1	1.400	79	1360.12	1359.66	1361.18	1.00	2.00	75.1	40.0	3.10	79.	79.	0.
72	1	1.420	79	1360.12	1359.66	1361.18	1.00	2.00	75.2	40.0	3.10	79.	79.	0.
73	1	1.440	79	1360.12	1359.66	1361.18	1.00	2.00	75.4	40.0	3.10	79.	79.	0.
74	1	1.460	79	1360.12	1359.66	1361.18	1.00	2.00	75.5	40.0	3.10	79.	79.	0.
75	1	1.480	79	1360.12	1359.66	1361.18	1.00	2.00	75.6	40.0	3.10	79.	79.	0.
76	1	1.500	79	1360.12	1359.66	1361.18	1.00	2.00	75.8	40.0	3.10	79.	79.	0.
77	1	1.520	79	1360.12	1359.66	1361.18	1.00	2.00	75.9	40.0	3.10	79.	79.	0.
78	1	1.540	79	1360.12	1359.66	1361.18	1.00	2.00	76.0	40.0	3.10	79.	79.	0.
79	1	1.560	79	1360.12	1359.66	1361.18	1.00	2.00	76.1	40.0	3.10	79.	79.	0.
80	1	1.580	79	1360.12	1359.66	1361.18	1.00	2.00	76.3	40.0	3.10	79.	79.	0.
81	1	1.600	79	1360.12	1359.66	1361.18	1.00	2.00	76.4	40.0	3.10	79.	79.	0.
82	1	1.620	79	1360.12	1359.66	1361.18	1.00	2.00	76.5	40.0	3.10	79.	79.	0.
83	1	1.640	79	1360.12	1359.66	1361.18	1.00	2.00	76.7	40.0	3.10	79.	79.	0.
84	1	1.660	79	1360.12	1359.66	1361.18	1.00	2.00	76.8	40.0	3.10	79.	79.	0.
85	1	1.680	79	1360.12	1359.66	1361.18	1.00	2.00	76.9	40.0	3.10	79.	79.	0.
86	1	1.700	79	1360.12	1359.66	1361.18	1.00	2.00	77.1	40.0	3.10	79.	79.	0.
87	1	1.720	79	1360.12	1359.66	1361.18	1.00	2.00	77.2	40.0	3.10	79.	79.	0.
88	1	1.740	79	1360.12	1359.66	1361.18	1.00	2.00	77.3	40.0	3.10	79.	79.	0.
89	1	1.760	79	1360.12	1359.66	1361.18	1.00	2.00	77.5	40.0	3.10	79.	79.	0.
90	1	1.780	79	1360.12	1359.66	1361.18	1.00	2.00	77.6	40.0	3.10	79.	79.	0.
91	1	1.800	79	1360.12	1359.66	1361.18	1.00	2.00	77.7	40.0	3.10	79.	79.	0.
92	1	1.820	79	1360.12	1359.66	1361.18	1.00	2.00	77.8	40.0	3.10	79.	79.	0.
93	1	1.840	79	1360.12	1359.66	1361.18	1.00	2.00	78.0	40.0	3.10	79.	79.	0.
94	1	1.860	79	1360.12	1359.66	1361.18	1.00	2.00	78.1	40.0	3.10	79.	79.	0.
95	1	1.880	79	1360.12	1359.66	1361.18	1.00	2.00	78.2	40.0	3.10	79.	79.	0.
96	1	1.900	79	1360.12	1359.66	1361.18	1.00	2.00	78.4	40.0	3.10	79.	79.	0.
97	1	1.920	79	1360.12	1359.66	1361.18	1.00	2.00	78.5	40.0	3.10	79.	79.	0.
98	1	1.940	79	1360.12	1359.66	1361.18	1.00	2.00	78.6	40.0	3.10	79.	79.	0.
99	1	1.960	79	1360.12	1359.66	1361.18	1.00	2.00	78.8	40.0	3.10	79.	79.	0.
100	1	1.980	79	1360.12	1359.66	1361.18	1.00	2.00	78.9	40.0	3.10	79.	79.	0.

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
101	1	2.000	79	1360.12	1359.66	1361.18	1.00	2.00	79.0	40.0	3.10	79.	79.	0.
102	1	2.020	79	1360.12	1359.66	1361.18	1.00	2.00	79.2	40.0	3.10	79.	79.	0.

RESERVOIR FLOW SUMMARY :

Initial Flow (Q(1), cfs)	79.
Maximum Flow (Qmax, cfs)	1338.
Final Flow (Q(NU), cfs)	79.
Time to Maximum Flow (TP, hr)	.56
Number of Time Steps or Number of Hydrograph Ordinates (NNU)	102
Total Volume Discharged from Reservoir (DISVOL, acre-ft)	79.
Number of Intermediate Cross-Sections (NN(NS))	11
Number of Time Steps (NNU)	102

Interp. Cross Section I	Water Elevation YD(I) (ft MSL)	Initial Flow QDI(I) (cfs)
1	1361.22	79.0
2	1303.89	79.0
3	1266.07	79.0
4	1229.25	79.0
5	1191.35	79.0
6	1154.55	79.0
7	1116.49	79.0
8	1102.20	217.0
9	1086.30	217.0
10	1077.71	217.0
11	1068.71	217.0

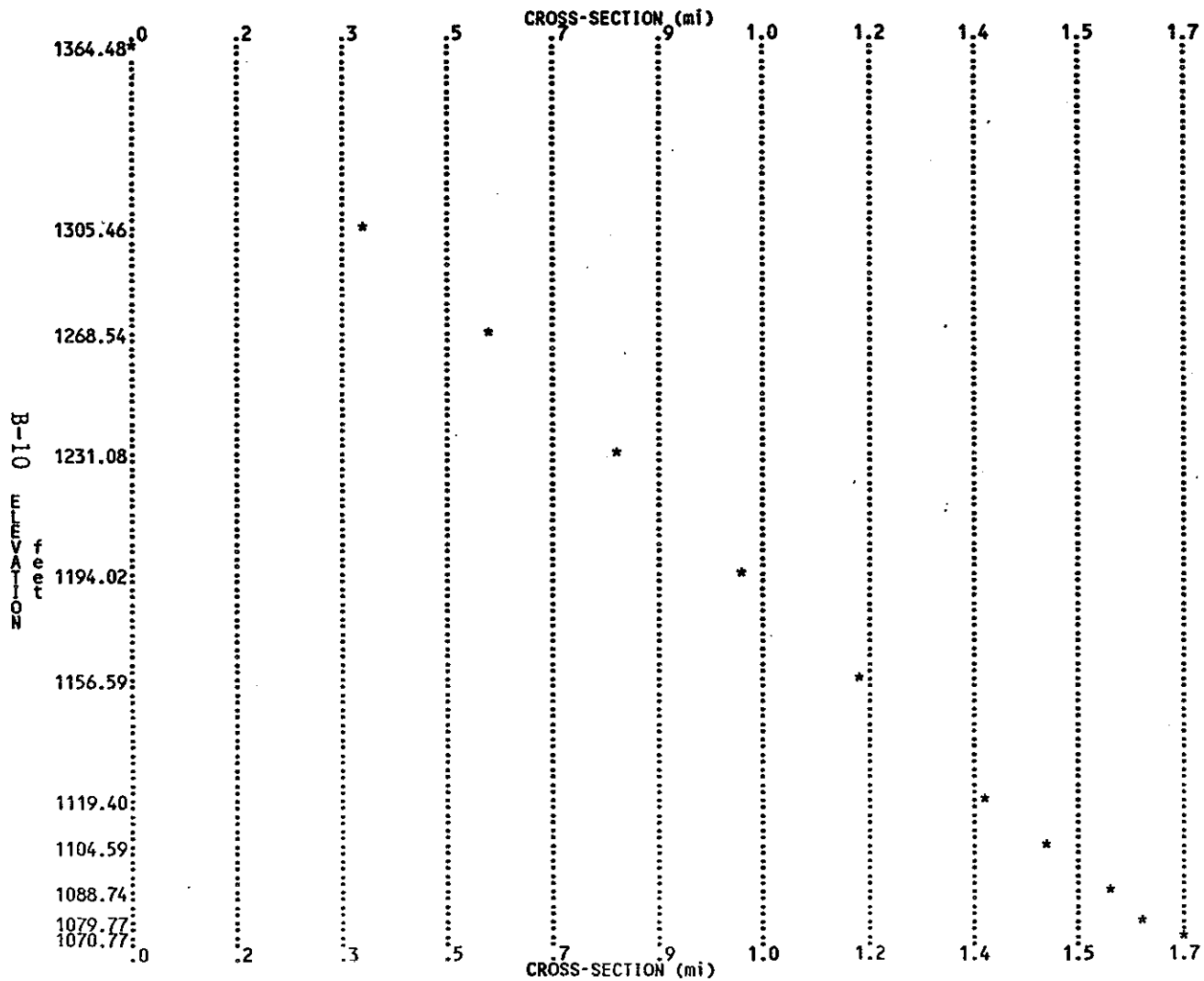
ROUTING COMPLETED :

Number of Time Steps Used (KTIME)	10
Maximum Number of Time Steps Allowed	698
Total Time of Flood Routing (TT, hr)	2.0

FLOOD CREST SUMMARY :

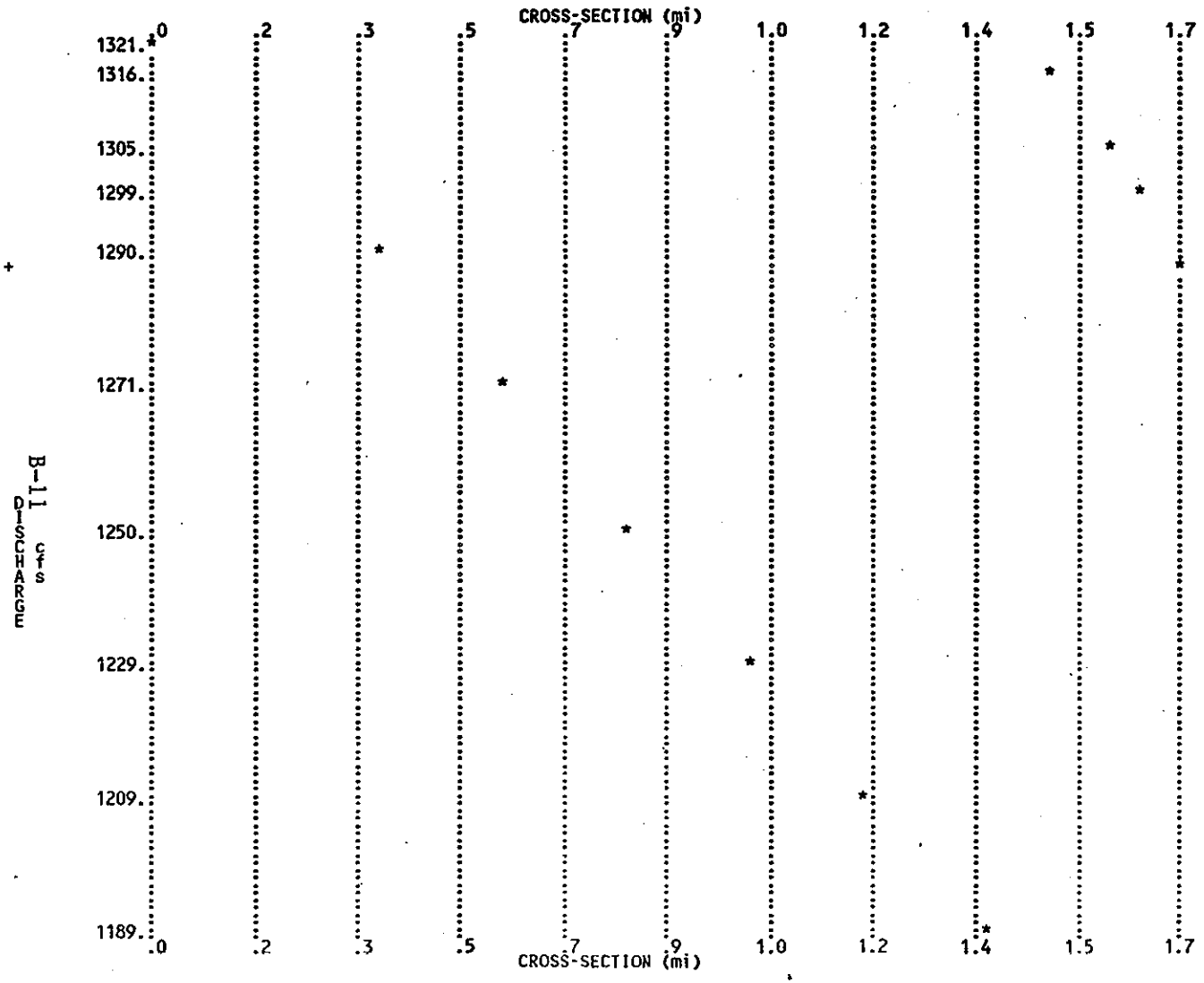
Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)
.000	1364.48	1321	.600	14.54	.00	.00
.380	1305.46	1290	.600	17.79	.00	.00
.584	1268.54	1270	.600	17.97	.00	.00
.788	1231.08	1250	.600	18.97	.00	.00
.992	1194.02	1229	.600	18.37	.00	.00
1.196	1156.55	1208	.600	20.76	.00	.00
1.400	1119.40	1188	.600	21.04	.00	.00
1.500	1104.59	1316	.600	18.43	.00	.00
1.600	1088.74	1304	.600	20.43	.00	.00
1.655	1079.77	1298	.600	19.51	.00	.00
1.710	1070.77	1288	.600	13.09	.00	.00

FLOOD CREST SUMMARY (Peak Water Surface Elevation) :



ELEVATION (ft)	CROSS SECTION (mi)
1364.5	.0
1305.5	.4
1268.5	.6
1231.1	.8
1194.0	1.0
1156.6	1.2
1119.4	1.4
1104.6	1.5
1088.7	1.6
1079.8	1.7
1070.8	1.7

FLOOD DISCHARGE SUMMARY (Peak Water Flow) :



DISCHARGE (cfs)	CROSS SECTION (mi)
1321.4	.0
1316.3	1.5
1304.9	1.6
1298.6	1.7
1290.1	.4
1270.8	.6
1250.1	.8
1229.4	1.0
1208.6	1.2
1188.6	1.4

TIME TO PEAK ELEVATION PROFILE :

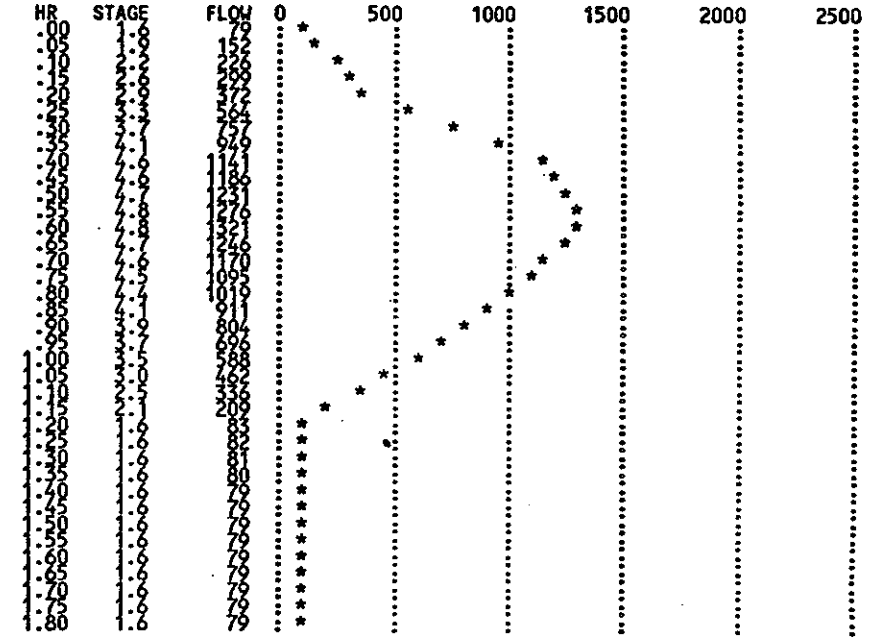
	CROSS-SECTION (mi)	
Peak time is constant at		.60 hou
Peak time is constant at		.00s

DISCHARGE HYDROGRAPH :

Cross-Section Number	1
Cross-Section Location (mi)	.000
Gage Zero (ft MSL)	1359.650
Max Elevation Reached by Flood Wave (ft MSL)	1364.484
Flood Stage (ft)	(not available)
Maximum Stage (ft)	4.834
at Time (hr)	.600
Maximum Flow (cfs)	1321
at Time (hr)	.600

TIME (hr)	CROSS SECTION (mi)	ELEVATION (ft MSL)

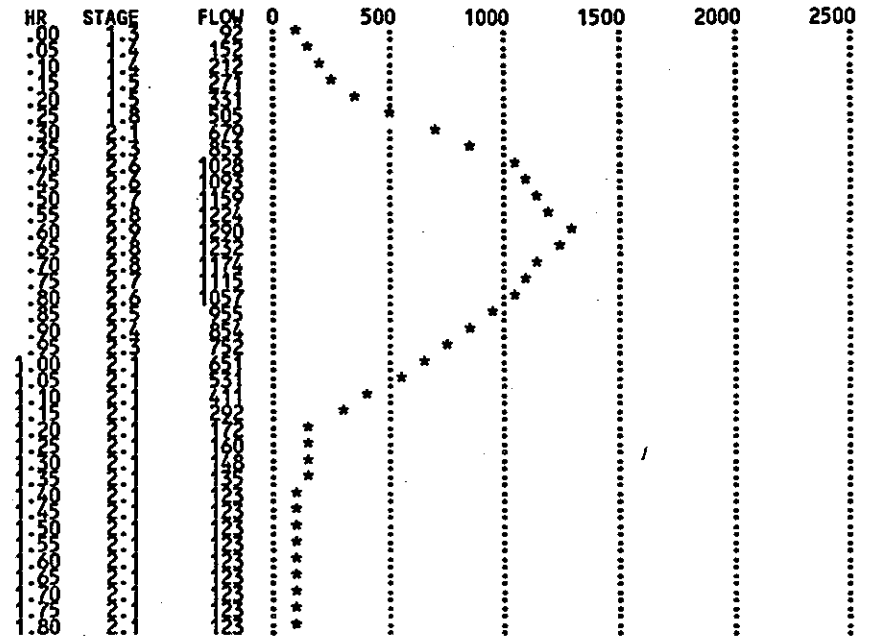
HR	STAGE	FLOW
.00	1.6	79
.05	1.9	152
.10	2.2	226
.15	2.6	299
.20	2.9	372
.25	3.3	564
.30	3.7	757
.35	4.1	949
.40	4.6	1141
.45	4.6	1186
.50	4.7	1231
.55	4.8	1276
.60	4.8	1321
.65	4.7	1246
.70	4.6	1170
.75	4.5	1095
.80	4.4	1019
.85	4.1	911
.90	3.9	804
.95	3.7	696
1.00	3.5	588
1.05	3.0	462
1.10	2.5	336
1.15	2.1	209
1.20	1.6	83
1.25	1.6	82
1.30	1.6	81
1.35	1.6	80
1.40	1.6	79
1.45	1.6	79
1.50	1.6	79
1.55	1.6	79
1.60	1.6	79
1.65	1.6	79
1.70	1.6	79
1.75	1.6	79
1.80	1.6	79



DISCHARGE HYDROGRAPH :

Cross-Section Number	2
Cross-Section Location (mi)	.380
Gage Zero (ft MSL)	1302.600
Max Elevation Reached by Flood Wave (ft MSL)	1305.465
Flood Stage (ft)	(not available)
Maximum Stage (ft)	2.865
at Time (hr)	.600
Maximum Flow (cfs)	1290
at Time (hr)	.600

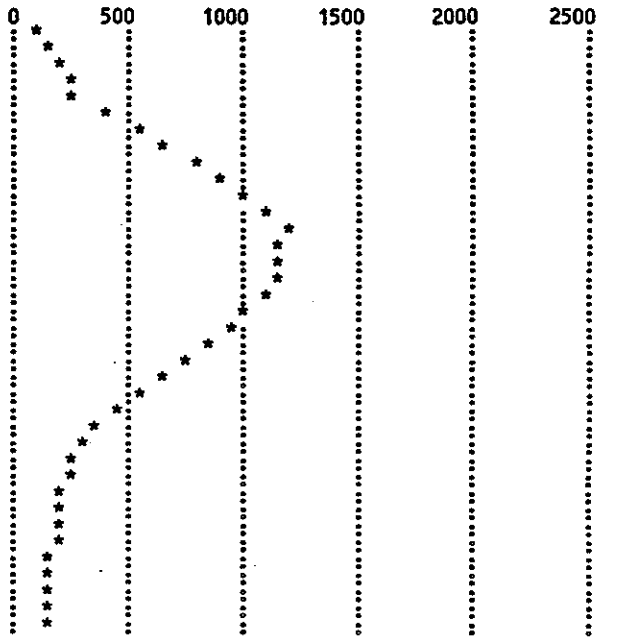
HR	STAGE	FLOW
.00	1.3	92
.05	1.4	152
.10	1.4	212
.15	1.5	271
.20	1.5	331
.25	1.8	505
.30	2.1	679
.35	2.3	853
.40	2.6	1028
.45	2.6	1093
.50	2.7	1158
.55	2.8	1224
.60	2.9	1290
.65	2.8	1232
.70	2.8	1174
.75	2.7	1115
.80	2.6	1057
.85	2.5	955
.90	2.4	854
.95	2.3	752
1.00	2.1	651
1.05	2.1	531
1.10	2.1	411
1.15	2.1	292
1.20	2.1	172
1.25	2.1	160
1.30	2.1	148
1.35	2.1	136
1.40	2.1	123
1.45	2.1	123
1.50	2.1	123
1.55	2.1	123
1.60	2.1	123
1.65	2.1	123
1.70	2.1	123
1.75	2.1	123
1.80	2.1	123



DISCHARGE HYDROGRAPH :

Cross-Section Number	7
Cross-Section Location (mi)	1.400
Gage Zero (ft MSL)	1115.900
Max Elevation Reached by Flood Wave (ft MSL)	1119.399
Flood Stage (ft)	(not available)
Maximum Stage (ft)	3.499
at Time (hr)	.600
Maximum Flow (cfs)	1189
at Time (hr)	.600

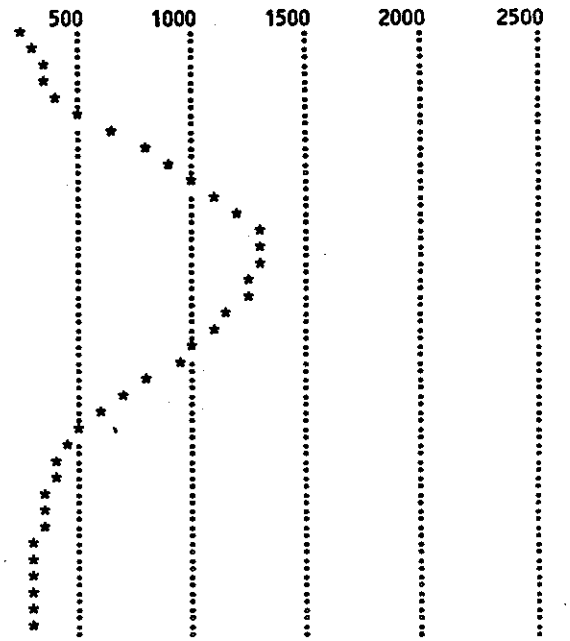
HR	STAGE	FLOW
.00	.9	119
.05	1.1	156
.10	1.2	193
.15	1.4	230
.20	1.5	267
.25	1.6	402
.30	2.2	537
.35	2.5	671
.40	2.8	806
.45	3.0	902
.50	3.3	997
.55	3.4	1093
.60	3.5	1189
.65	3.5	1168
.70	3.4	1147
.75	3.4	1126
.80	3.3	1105
.85	3.2	1021
.90	3.0	937
.95	2.9	854
1.00	2.7	770
1.05	2.5	667
1.10	2.3	557
1.15	2.0	451
1.20	1.7	344
1.25	1.6	305
1.30	1.5	267
1.35	1.3	228
1.40	1.3	190
1.45	1.2	185
1.50	1.2	181
1.55	1.2	176
1.60	1.2	171
1.65	1.2	171
1.70	1.1	170
1.75	1.1	170
1.80	1.1	169



DISCHARGE HYDROGRAPH :

Cross-Section Number	9
Cross-Section Location (mi)	1.600
Gage Zero (ft MSL)	1084.500
Max Elevation Reached by Flood Wave (ft MSL)	1088.739
Flood Stage (ft)	(not available)
Maximum Stage (ft)	4.239
at Time (hr)	.600
Maximum Flow (cfs)	1305
at Time (hr)	.600

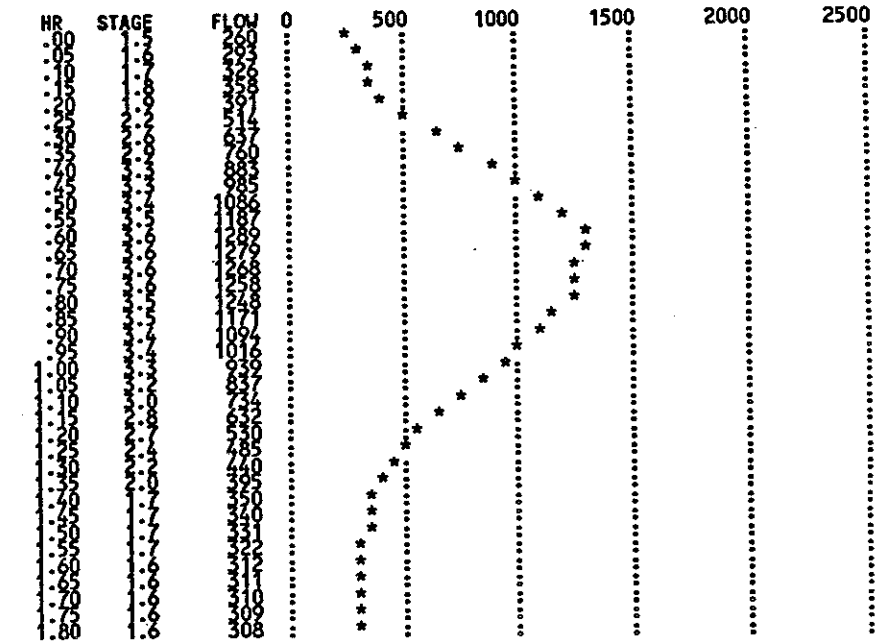
HR	STAGE	FLOW
.00	1.8	259
.05	1.9	293
.10	2.0	327
.15	2.1	361
.20	2.2	395
.25	2.5	524
.30	2.8	653
.35	3.1	781
.40	3.3	910
.45	3.7	1009
.50	3.9	1107
.55	4.0	1206
.60	4.2	1305
.65	4.2	1290
.70	4.2	1276
.75	4.2	1261
.80	4.1	1246
.85	4.0	1166
.90	3.8	1086
.95	3.9	1007
1.00	3.5	927
1.05	3.3	822
1.10	3.0	718
1.15	2.7	613
1.20	2.5	509
1.25	2.3	467
1.30	2.2	424
1.35	2.1	382
1.40	1.9	340
1.45	1.9	333
1.50	1.9	327
1.55	1.9	318
1.60	1.8	311
1.65	1.8	310
1.70	1.8	309
1.75	1.8	308
1.80	1.8	308



DISCHARGE HYDROGRAPH :

Cross-Section Number	11
Cross-Section Location (mi)	1.710
Gage Zero (ft MSL)	1067.200
Max Elevation Reached by Flood Wave (ft MSL)	1070.769
Flood Stage (ft)	(not available)
Maximum Stage (ft)	3.569
at Time (hr)	.600
Maximum Flow (cfs)	1289
at Time (hr)	.600

HR	STAGE	FLOW
.00	1.5	260
.05	1.6	293
.10	1.7	326
.15	1.8	358
.20	1.8	391
.25	2.2	514
.30	2.6	637
.35	2.9	760
.40	3.3	883
.45	3.3	985
.50	3.4	1086
.55	3.5	1187
.60	3.6	1289
.65	3.6	1279
.70	3.6	1268
.75	3.6	1258
.80	3.5	1248
.85	3.5	1171
.90	3.4	1094
.95	3.4	1016
1.00	3.3	939
1.05	3.2	837
1.10	3.0	734
1.15	2.8	632
1.20	2.7	530
1.25	2.4	485
1.30	2.2	440
1.35	2.0	395
1.40	1.7	350
1.45	1.7	340
1.50	1.7	331
1.55	1.7	322
1.60	1.6	312
1.65	1.6	311
1.70	1.6	310
1.75	1.6	309
1.80	1.6	308



END OF OUTPUT

```
JOHNSON REAL ESTATE DAM  VERMONT
                    MAXIMUM SURCHARGE STORAGE DAM FAILURE
         1         0         0         5         4         0         0         0
0111110100 0 2
     110.0      86.0      56.0       0.0
    1386.8    1385.3   1380.66   1359.66
       0.0    1383.8       1.0   1359.66       40.       1.0   1359.66       1.0
    1386.8    1386.8    1382.2       0.0      140.       0.0      580.      37.0
       0.0       2.0
    1420.0    1420.0    1420.0    1420.0
       0.0       1.0       2.5       5.0
         5         6         5         9         0         1         1         0
         1         2         3         4         5
       0.0       0.0
   1359.65   1363.66   1380.66   1385.26   1386.66   1388.88       0.0       0.0
        1.       30.0     230.0     330.0     343.0    8888.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      0.38       0.0
    1302.6    1307.2    1313.0    1314.7    1316.3   1388.888       0.0       0.0
       8.0      65.0     240.0     305.0     333.0   8888.88       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.40       0.0
    1115.9    1123.5    1125.0    1126.2    1127.5    1888.88       0.0       0.0
      12.0      30.0     130.0     185.0     252.0   8888.888       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.60       0.0
    1084.5    1094.0    1095.3    1096.8    1102.0   1102.018       0.0       0.0
       8.0      80.0     152.0     225.0     256.0     258.8       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
      1.71       0.0
    1067.2    1069.6   1072.25    1072.8    1084.0    1095.0       0.0       0.0
      12.0      22.4     270.0     350.0     770.0     800.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
     0.025     0.025     0.025      0.03      0.03   0.03888       0.0       0.0
     0.025     0.025     0.043     0.044     0.045   0.04588       0.0       0.0
     0.025     0.028     0.030     0.036     0.040   0.04888       0.0       0.0
     0.025     0.029      0.03     0.033     0.035   0.03588       0.0       0.0
       0.2       0.2       0.1      0.04
       0.0       0.0       0.0       0.0
       0.0       0.0       0.2       0.0     171.0       0.0      0.05       0.0
         3
     500.0    1500.0    2000.0    2000.0
```

MAXIMUM SURCHARGE
STORAGE INFORMATI
APPENDIX C

==========
B O S S D A M B R K (tm)
==========

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Version : 1.30
Serial Number : 0001058.130

PROGRAM ORIGIN :

Boss DamBrk (tm) is an enhanced version of Professor D. L. Fread's 1984 NWS DAMBRK program.

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PROJECT DESCRIPTION :

PROJECT TITLE : Johnson Real Estate Dam Failure
PROJECT NUMBER : JC-127-2B
DESCRIPTION : Failure starts with WL at dam crest
ENGINEER : Patrick Blumeris
DATE OF RUN : 4/07/1989
TIME OF RUN : 8:56 am

INPUT DATA SUMMARY :

INPUT CONTROL PARAMETERS :

Number of Dynamic Routing Reaches (KKN)	1	
Type of Reservoir Routing (KUI)	0	(storage routing)
Number of multiple dams/bridges (MULDAM)	0	
No. of Reservoir Inflow Hydrograph Points (ITEH)	4	
No. of Informational Cross-Sections (NPRT)	0	
Flood-Plain Routing (KFLP)	0	(no)
Landslide Simulation (KSL)	0	(no)

RESERVOIR DESCRIPTION :

Elevation vs. Volume Table

Elevation HSA(K) (ft MSL)	Volume SA(K) (acre-ft)
1386.80	110.0
1385.30	86.0
1380.66	56.0
1359.66	.0
.00	.0
.00	.0
.00	.0
.00	.0

RESERVOIR VOLUME DESCRIPTION :

Elevation vs. Surface Area Table

Elevation HSA(K) (ft MSL)	Surface Area SA(K) (acres)
1386.80	23.4
1385.30	8.6
1380.66	4.3
1359.66	1.0
.00	.0
.00	.0
.00	.0
.00	.0

RESERVOIR and BREACH DESCRIPTION :

Initial Elevation of Reservoir Surface (YO, ft MSL)		1383.80
Bottom of Dam Elevation (DATUM, ft MSL)		1359.66
Top of Dam Elevation (HD, ft MSL)		1386.80
Water Surface Elevation at Time of Breach (HF, ft MSL)		1386.80
Breach Side Slope (Z)	1:	1.00
Breach Bottom Elevation (YBMIN, ft MSL)		1359.66
Breach Base Width (BB, ft)		40.00
Time of Breach Formation (TFH, hr)		1.00
Uncontrolled Spillway Crest Elevation (HSP, ft MSL)		1382.20
Uncontrolled Spillway Discharge Coefficient (CS)		140.00
Spillway Gate Center Elevation (HGT, ft MSL)		.00
Spillway Gate Discharge Coefficient (CG)		.00
Dam Overtopping Discharge Coefficient (CDO)		580.00
Turbine Discharge (QT, cfs)		37.00

INFLOW HYDROGRAPH DESCRIPTION :

Hydrograph Time Intervals (DHF, hr)	.00
Routing Period (TEH, hr)	5.00

Time Elapsed TI(K) (hr)	Upstream Inflow QI(K) (cfs)
.00	1420.0
1.00	1420.0
2.50	1420.0
5.00	1420.0

SUMMARY OF PROGRAM CONTROL PARAMETERS :

Number of Cross-Sections Entered (NS)	5	
Number of Top Widths Entered (NCS)	6	
Number of Cross-Sectional Hydrographs to Plot (NTT)	5	
Cross-Sectional Smoothing Parameter (KSA)	0	
Downstream Supercritical Parameter (KSUPC)	1	(supercritical)
Number of Lateral Inflow Hydrographs (LQ)	1	
Number of Points in Gate Control Curve (KCG)	0	

CROSS-SECTIONS WHERE HYDROGRAPH REQUESTED :
(maximum allowed = 6)

1 2 3 4 5

CHANNEL-VALLEY BOUNDARY CONDITIONS :

Max Discharge at Downstream End (QMAXD, cfs)	.0
Max Lateral Outflow due to Flood Wave (QLL, cfs/ft)	.0
Initial Time-Step Size (DTHM, hr)	.20
Time at which Dam Starts to Fail (TFI, hr)	.00
Theta Weighting Factor (FII)	.000
Stage Convergence Criterion (EPSY, ft)	.05
Initial Downstream Water Surface Elevation (YDN, ft MSL)	.00
Slope of Channel Downstream of Dam (SOM, ft/mi)	171.000

LATERAL INFLOW REACH NUMBERS (LQX) :

3

(QL(L, 1),L=1,ITEH)

500. 1500. 2000. 2000.

CROSS-SECTION NUMBER : 1

Cross-Section Location (XS(I), mi)	.000
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 1

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.200

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1359.65	1.0	.0250	.0	.0	.0000	.0	.0000
1363.66	30.0	.0250	.0	.0	.0000	.0	.0000
1380.66	230.0	.0250	.0	.0	.0000	.0	.0000
1385.26	330.0	.0300	.0	.0	.0000	.0	.0000
1386.66	343.0	.0300	.0	.0	.0000	.0	.0000
1388.88	8888.0	.0389	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 2

Cross-Section Location (XS(I), mi)	.380
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 2

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.200

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1302.60	8.0	.0250	.0	.0	.0000	.0	.0000
1307.20	65.0	.0250	.0	.0	.0000	.0	.0000
1313.00	240.0	.0430	.0	.0	.0000	.0	.0000
1314.70	305.0	.0440	.0	.0	.0000	.0	.0000
1316.30	333.0	.0450	.0	.0	.0000	.0	.0000
1388.89	8888.9	.0459	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 3

Cross-Section Location (XS(I), mi)	1.400
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 3

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.100

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1115.90	12.0	.0250	.0	.0	.0000	.0	.0000
1123.50	30.0	.0280	.0	.0	.0000	.0	.0000
1125.00	130.0	.0300	.0	.0	.0000	.0	.0000
1126.20	185.0	.0360	.0	.0	.0000	.0	.0000
1127.50	252.0	.0400	.0	.0	.0000	.0	.0000
1888.88	8888.9	.0489	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 4

Cross-Section Location (XS(I), mi)	1.600
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

DOWNSTREAM REACH NUMBER : 4

Reach Contraction-Expansion Coefficient (FKC)	.000
Minimum Distance Between Interpolated Cross-Sections (DXM, mi)	.040

CROSS-SECTION and REACH DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Channel Manning n CM(K,I)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Left Manning n CML(K,I)	Right Top Width BSR(K,I) (ft)	Right Manning n CMR(K,I)
1084.50	8.0	.0250	.0	.0	.0000	.0	.0000
1094.00	80.0	.0290	.0	.0	.0000	.0	.0000
1095.30	152.0	.0300	.0	.0	.0000	.0	.0000
1096.80	225.0	.0330	.0	.0	.0000	.0	.0000
1102.00	256.0	.0350	.0	.0	.0000	.0	.0000
1102.02	258.8	.0359	.0	.0	.0000	.0	.0000

CROSS-SECTION NUMBER : 5

Cross-Section Location (XS(I), mi)	1.710
Left Flood-Plain Cross-Section Location (XSL(I), mi)	.000
Right Flood-Plain Cross-Section Location (XSR(I), mi)	.000
Flooding Elevation (FSTG(I), ft MSL)	.000
Initial Water Surface Elevation (YD, ft MSL)	.000

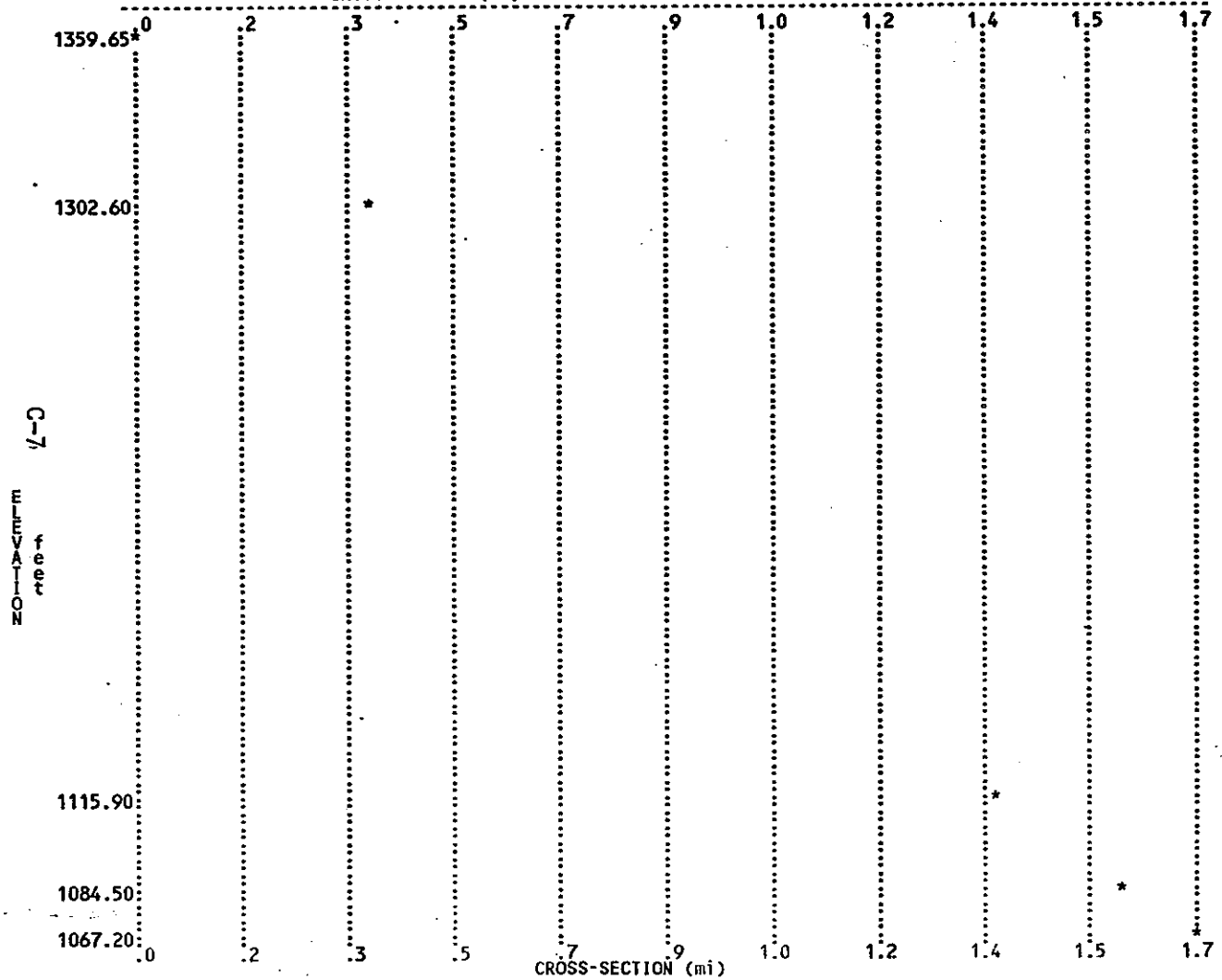
CROSS-SECTION DESCRIPTION :

Elevation HS(K,I) (ft MSL)	Channel Top Width BS(K,I) (ft)	Storage Top Width BSS(K,I) (ft)	Left Top Width BSL(K,I) (ft)	Right Top Width BSR(K,I) (ft)
1067.20	12.0	.0	.0	.0
1069.60	22.4	.0	.0	.0
1072.25	270.0	.0	.0	.0
1072.80	350.0	.0	.0	.0
1084.00	770.0	.0	.0	.0
1095.00	800.0	.0	.0	.0

Total number of cross-sections (original+interpolated)	11
Maximum number of cross-sections allowed	200

OUTPUT DATA SUMMARY :

SLOPE PROFILE PLOT :



Elevation (ft MSL)	Cross Section (mi)
1359.7	.0
1302.6	.4
1115.9	1.4
1084.5	1.6
1067.2	1.7

RESERVOIR DEPLETION SUMMARY :

Total Volume in Reservoir (acre-ft) 110.0

DEFINITION OF RESERVOIR DEPLETION TABLE VARIABLES :

PARAMETER	UNITS	VARIABLE
Time step from start of analysis		I
Iterations necessary to solve flow equations		K
Elapsed time from start of analysis	hr	TTP(I)
Total outflow from dam	cfs	Q(I)
Elevation of water surface at dam	ft	H2
Elevation of breach bottom	ft	YB
Estimated depth of downstream flow	ft	D
Submergence coefficient		SUB
Velocity correction		VCOR
Total volume discharged from time of breach	ac-ft	OUTVOL
Breach width	ft	BB
Rectangular breach discharge coefficient		COFR
Inflow to reservoir	cfs	QI(I)
Breach outflow	cfs	QBRECH
Spillway outflow	cfs	QSPIL

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
1	0	.000	320	1383.80	1386.80	1362.42	1.00	1.00	.0	.0	3.10	1420.	0.	320.
2	3	.100	629	1384.82	1386.80	1363.40	1.00	1.00	.0	.0	3.10	1420.	0.	629.
3	3	.200	852	1385.44	1386.80	1363.73	1.00	1.00	.0	.0	3.10	1420.	0.	852.
4	3	.300	986	1385.79	1386.80	1364.00	1.00	1.00	.0	.0	3.10	1420.	0.	986.
5	3	.400	1078	1386.01	1386.80	1364.17	1.00	1.00	.0	.0	3.10	1420.	0.	1078.
6	3	.500	1142	1386.17	1386.80	1364.27	1.00	1.00	.0	.0	3.10	1420.	0.	1142.
7	3	.600	1192	1386.28	1386.80	1364.35	1.00	1.00	.0	.0	3.10	1420.	0.	1192.
8	3	1.100	1333	1386.61	1386.80	1364.58	1.00	1.00	.0	.0	3.10	1420.	0.	1333.
9	3	1.200	1387	1386.72	1386.80	1364.64	1.00	1.00	.0	.0	3.10	1420.	0.	1387.
10	3	2.100	1704	1386.77	1386.80	1364.66	1.00	1.00	.0	.0	3.10	1420.	0.	1704.
11	2	2.600	1713	1386.79	1386.80	1364.68	1.00	1.00	.0	.0	3.10	1420.	0.	1713.
12	1	2.620	1715	1386.79	1386.79	1364.68	1.00	.01	2.3	.8	3.10	1420.	1.	1714.
13	1	2.640	1722	1386.79	1386.79	1364.69	1.00	.00	4.7	1.6	3.10	1420.	9.	1713.
14	1	2.660	1736	1386.79	1386.71	1364.71	1.00	.00	7.0	2.4	3.10	1420.	24.	1712.
15	1	2.680	1760	1386.79	1385.17	1364.74	1.00	.00	9.4	3.2	3.10	1420.	48.	1712.
16	1	2.700	1794	1386.78	1384.63	1364.79	1.00	.00	11.9	4.0	3.10	1420.	84.	1711.
17	1	2.720	1840	1386.78	1384.09	1364.85	1.00	.00	14.4	4.8	3.10	1420.	133.	1708.
18	1	2.740	1897	1386.78	1383.54	1364.92	1.00	.00	17.0	5.6	3.10	1420.	197.	1703.
19	1	2.760	1966	1386.77	1383.00	1365.01	1.00	.00	19.7	6.5	3.10	1420.	270.	1696.
20	1	2.780	1747	1386.75	1382.46	1365.10	1.00	.00	22.5	7.2	3.10	1420.	361.	1387.
21	1	2.800	1840	1386.73	1381.91	1365.21	1.00	.00	25.5	8.0	3.10	1420.	469.	1374.
22	1	2.820	1925	1386.70	1381.37	1365.33	1.00	.00	28.6	8.8	3.10	1420.	587.	1359.
23	1	2.840	2002	1386.67	1380.83	1365.45	1.00	.00	31.9	9.6	3.10	1420.	723.	1339.
24	2	2.860	2187	1386.62	1380.29	1365.57	1.00	.00	35.4	10.4	3.10	1420.	874.	1314.
25	2	2.880	2320	1386.57	1379.74	1365.70	1.00	.00	39.1	11.2	3.10	1420.	1039.	1282.
26	2	2.900	2461	1386.50	1379.20	1365.83	1.00	.00	43.1	12.0	3.10	1420.	1218.	1242.
27	2	2.920	2608	1386.42	1378.66	1365.96	1.00	.00	47.3	12.8	3.10	1420.	1409.	1200.
28	2	2.940	2758	1386.33	1378.12	1366.08	1.00	.00	51.7	13.6	3.10	1420.	1610.	1148.
29	2	2.960	2906	1386.21	1377.57	1366.21	1.00	.00	56.4	14.4	3.10	1420.	1819.	1088.
30	2	2.980	3048	1386.07	1377.03	1366.32	1.00	.00	61.3	15.2	3.10	1420.	2032.	1017.
31	2	3.000	3174	1385.91	1376.49	1366.41	1.00	.00	66.5	16.0	3.10	1420.	2245.	931.
32	2	3.020	3266	1385.70	1375.94	1366.48	1.00	.00	71.8	16.8	3.10	1420.	2454.	826.
33	2	3.040	3313	1385.43	1375.40	1366.52	1.00	.00	77.2	17.6	3.10	1420.	2657.	697.
34	2	3.060	3337	1385.10	1374.86	1366.54	1.00	.00	82.7	18.4	3.10	1420.	2773.	564.
35	2	3.080	3357	1384.72	1374.32	1366.55	1.00	.00	88.3	19.2	3.10	1420.	2925.	432.
36	2	3.100	3374	1384.31	1373.77	1366.56	1.00	.00	93.8	20.0	3.10	1420.	3069.	305.
37	2	3.120	3390	1383.88	1373.23	1366.56	1.00	.00	99.4	20.8	3.10	1420.	3201.	189.
38	2	3.140	3405	1383.42	1372.69	1366.57	1.00	.00	105.0	21.6	3.10	1420.	3318.	88.
39	2	3.160	3423	1382.93	1372.14	1366.58	1.00	.00	110.7	22.4	3.10	1420.	3412.	12.
40	2	3.180	3472	1382.40	1371.60	1366.60	1.00	.00	116.4	23.2	3.10	1420.	3473.	0.
41	2	3.200	3488	1381.80	1371.06	1366.63	1.00	.00	122.1	24.0	3.10	1420.	3488.	0.
42	2	3.220	3455	1381.13	1370.52	1366.64	1.00	.01	127.9	24.8	3.10	1420.	3456.	0.
43	2	3.240	3400	1380.39	1369.97	1366.62	1.00	.01	133.5	25.6	3.10	1420.	3400.	0.
44	1	3.260	3371	1379.60	1369.43	1366.58	1.00	.01	139.1	26.4	3.10	1420.	3371.	0.
45	1	3.280	3280	1378.81	1368.89	1366.54	1.00	.01	144.7	27.2	3.10	1420.	3280.	0.
46	1	3.300	3217	1378.03	1368.34	1366.49	1.00	.01	150.0	28.0	3.10	1420.	3218.	0.
47	1	3.320	3154	1377.27	1367.80	1366.45	1.00	.01	155.2	28.8	3.10	1420.	3154.	0.
48	1	3.340	3090	1376.46	1367.26	1366.40	1.00	.02	160.4	29.6	3.10	1420.	3091.	0.
49	1	3.360	3027	1375.68	1366.72	1366.35	1.00	.05	165.4	30.4	3.10	1420.	3027.	0.
50	1	3.380	2964	1374.90	1366.17	1366.30	1.00	.02	170.4	31.2	3.10	1420.	2965.	0.

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
51	1	3.400	2903	1373.35	1365.09	1366.20	1.00	1.03	175.2	32.0	3.10	1420.	2903.	0.
52	1	3.420	2844	1372.58	1364.55	1366.15	1.00	1.04	180.0	32.8	3.10	1420.	2844.	0.
53	1	3.440	2788	1371.81	1364.00	1366.11	1.00	1.05	184.6	33.6	3.10	1420.	2788.	0.
54	1	3.460	2735	1371.04	1363.46	1366.06	1.00	1.06	189.2	34.4	3.10	1420.	2735.	0.
55	1	3.480	2686	1370.26	1362.96	1366.03	1.00	1.08	193.7	35.2	3.10	1420.	2687.	0.
56	1	3.500	2647	1369.47	1362.37	1365.99	1.00	1.12	198.1	36.0	3.10	1420.	2647.	0.
57	2	3.520	2620	1368.67	1361.83	1365.97	1.00	1.18	202.4	36.8	3.10	1420.	2620.	0.
58	5	3.540	2615	1367.83	1361.29	1365.96	1.00	1.29	206.8	37.6	3.10	1420.	2616.	0.
59	5	3.560	2659	1366.93	1360.75	1366.00	1.00	1.53	211.1	38.4	3.10	1420.	2657.	0.
60	5	3.580	2805	1365.88	1360.20	1366.13	1.00	2.00	215.6	39.2	3.10	1420.	2806.	0.
61	5	3.600	2977	1364.59	1359.66	1366.28	1.00	2.00	220.4	40.0	3.10	1420.	2978.	0.
62	2	3.620	2033	1363.53	1359.66	1365.42	1.00	2.00	224.6	40.0	3.10	1420.	2034.	0.
63	5	3.640	1672	1363.08	1359.66	1365.01	1.00	2.00	227.6	40.0	3.10	1420.	1673.	0.
64	5	3.660	1526	1362.88	1359.66	1364.85	1.00	2.00	230.3	40.0	3.10	1420.	1527.	0.
65	5	3.680	1465	1362.80	1359.66	1364.75	1.00	2.00	232.7	40.0	3.10	1420.	1465.	0.
66	5	3.700	1439	1362.76	1359.66	1364.71	1.00	2.00	235.1	40.0	3.10	1420.	1439.	0.
67	2	3.720	1428	1362.75	1359.66	1364.70	1.00	2.00	237.5	40.0	3.10	1420.	1428.	0.
68	1	3.740	1423	1362.74	1359.66	1364.68	1.00	2.00	239.9	40.0	3.10	1420.	1424.	0.
69	1	3.760	1421	1362.74	1359.66	1364.68	1.00	2.00	242.2	40.0	3.10	1420.	1422.	0.
70	1	3.780	1420	1362.74	1359.66	1364.68	1.00	2.00	244.6	40.0	3.10	1420.	1421.	0.
71	1	3.800	1420	1362.74	1359.66	1364.68	1.00	2.00	246.9	40.0	3.10	1420.	1420.	0.
72	1	3.820	1420	1362.74	1359.66	1364.68	1.00	2.00	249.3	40.0	3.10	1420.	1420.	0.
73	1	3.840	1420	1362.74	1359.66	1364.68	1.00	2.00	251.6	40.0	3.10	1420.	1420.	0.
74	1	3.860	1420	1362.74	1359.66	1364.68	1.00	2.00	254.0	40.0	3.10	1420.	1420.	0.
75	1	3.880	1420	1362.74	1359.66	1364.68	1.00	2.00	256.3	40.0	3.10	1420.	1420.	0.
76	1	3.900	1420	1362.74	1359.66	1364.68	1.00	2.00	258.7	40.0	3.10	1420.	1420.	0.
77	1	3.920	1420	1362.74	1359.66	1364.68	1.00	2.00	261.0	40.0	3.10	1420.	1420.	0.
78	1	3.940	1420	1362.74	1359.66	1364.68	1.00	2.00	263.4	40.0	3.10	1420.	1420.	0.
79	1	3.960	1420	1362.74	1359.66	1364.68	1.00	2.00	265.7	40.0	3.10	1420.	1420.	0.
80	1	3.980	1420	1362.74	1359.66	1364.68	1.00	2.00	268.0	40.0	3.10	1420.	1420.	0.
81	1	4.000	1420	1362.74	1359.66	1364.68	1.00	2.00	270.4	40.0	3.10	1420.	1420.	0.
82	1	4.020	1420	1362.74	1359.66	1364.68	1.00	2.00	272.7	40.0	3.10	1420.	1420.	0.
83	1	4.040	1420	1362.74	1359.66	1364.68	1.00	2.00	275.1	40.0	3.10	1420.	1420.	0.
84	1	4.060	1420	1362.74	1359.66	1364.68	1.00	2.00	277.4	40.0	3.10	1420.	1420.	0.
85	1	4.080	1420	1362.74	1359.66	1364.68	1.00	2.00	279.8	40.0	3.10	1420.	1420.	0.
86	1	4.100	1420	1362.74	1359.66	1364.68	1.00	2.00	282.1	40.0	3.10	1420.	1420.	0.
87	1	4.120	1420	1362.74	1359.66	1364.68	1.00	2.00	284.5	40.0	3.10	1420.	1420.	0.
88	1	4.140	1420	1362.74	1359.66	1364.68	1.00	2.00	286.8	40.0	3.10	1420.	1420.	0.
89	1	4.160	1420	1362.74	1359.66	1364.68	1.00	2.00	289.2	40.0	3.10	1420.	1420.	0.
90	1	4.180	1420	1362.74	1359.66	1364.68	1.00	2.00	291.5	40.0	3.10	1420.	1420.	0.
91	1	4.200	1420	1362.74	1359.66	1364.68	1.00	2.00	293.9	40.0	3.10	1420.	1420.	0.
92	1	4.220	1420	1362.74	1359.66	1364.68	1.00	2.00	296.2	40.0	3.10	1420.	1420.	0.
93	1	4.240	1420	1362.74	1359.66	1364.68	1.00	2.00	298.6	40.0	3.10	1420.	1420.	0.
94	1	4.260	1420	1362.74	1359.66	1364.68	1.00	2.00	300.9	40.0	3.10	1420.	1420.	0.
95	1	4.280	1420	1362.74	1359.66	1364.68	1.00	2.00	303.3	40.0	3.10	1420.	1420.	0.
96	1	4.300	1420	1362.74	1359.66	1364.68	1.00	2.00	305.6	40.0	3.10	1420.	1420.	0.
97	1	4.320	1420	1362.74	1359.66	1364.68	1.00	2.00	307.9	40.0	3.10	1420.	1420.	0.
98	1	4.340	1420	1362.74	1359.66	1364.68	1.00	2.00	310.3	40.0	3.10	1420.	1420.	0.
99	1	4.360	1420	1362.74	1359.66	1364.68	1.00	2.00	312.6	40.0	3.10	1420.	1420.	0.
100	1	4.380	1420	1362.74	1359.66	1364.68	1.00	2.00	315.0	40.0	3.10	1420.	1420.	0.

RESERVOIR DEPLETION TABLE :

I	K	TTP(I)	Q(I)	H2	YB	D	SUB	VCOR	OUTVOL	BB	COFR	QI(I)	QBRECH	QSPIL
101	1	4.400	1420	1362.74	1359.66	1364.68	1.00	2.00	317.3	40.0	3.10	1420.	1420.	0.
102	1	4.420	1420	1362.74	1359.66	1364.68	1.00	2.00	319.7	40.0	3.10	1420.	1420.	0.
103	1	4.440	1420	1362.74	1359.66	1364.68	1.00	2.00	322.0	40.0	3.10	1420.	1420.	0.
104	1	4.460	1420	1362.74	1359.66	1364.68	1.00	2.00	324.4	40.0	3.10	1420.	1420.	0.
105	1	4.480	1420	1362.74	1359.66	1364.68	1.00	2.00	326.7	40.0	3.10	1420.	1420.	0.
106	1	4.500	1420	1362.74	1359.66	1364.68	1.00	2.00	329.1	40.0	3.10	1420.	1420.	0.
107	1	4.520	1420	1362.74	1359.66	1364.68	1.00	2.00	331.4	40.0	3.10	1420.	1420.	0.
108	1	4.540	1420	1362.74	1359.66	1364.68	1.00	2.00	333.8	40.0	3.10	1420.	1420.	0.
109	1	4.560	1420	1362.74	1359.66	1364.68	1.00	2.00	336.1	40.0	3.10	1420.	1420.	0.
110	1	4.580	1420	1362.74	1359.66	1364.68	1.00	2.00	338.5	40.0	3.10	1420.	1420.	0.
111	1	4.600	1420	1362.74	1359.66	1364.68	1.00	2.00	340.8	40.0	3.10	1420.	1420.	0.
112	1	4.620	1420	1362.74	1359.66	1364.68	1.00	2.00	343.2	40.0	3.10	1420.	1420.	0.
113	1	4.642	1420	1362.74	1359.66	1364.68	1.00	2.00	345.7	40.0	3.10	1420.	1420.	0.
114	1	4.666	1420	1362.74	1359.66	1364.68	1.00	2.00	348.6	40.0	3.10	1420.	1420.	0.
115	1	4.693	1420	1362.74	1359.66	1364.68	1.00	2.00	351.7	40.0	3.10	1420.	1420.	0.
116	1	4.722	1420	1362.74	1359.66	1364.68	1.00	2.00	355.1	40.0	3.10	1420.	1420.	0.
117	1	4.754	1420	1362.74	1359.66	1364.68	1.00	2.00	358.9	40.0	3.10	1420.	1420.	0.
118	1	4.790	1420	1362.74	1359.66	1364.68	1.00	2.00	363.1	40.0	3.10	1420.	1420.	0.
119	1	4.829	1420	1362.74	1359.66	1364.68	1.00	2.00	367.6	40.0	3.10	1420.	1420.	0.
120	1	4.872	1420	1362.74	1359.66	1364.68	1.00	2.00	372.7	40.0	3.10	1420.	1420.	0.
121	1	4.919	1420	1362.74	1359.66	1364.68	1.00	2.00	378.2	40.0	3.10	1420.	1420.	0.
122	1	4.971	1420	1362.74	1359.66	1364.68	1.00	2.00	384.3	40.0	3.10	1420.	1420.	0.
123	1	5.028	1420	1362.74	1359.66	1364.68	1.00	2.00	391.0	40.0	3.10	1420.	1420.	0.

RESERVOIR FLOW SUMMARY :

Initial Flow (Q(1), cfs)	320.
Maximum Flow (Qmax, cfs)	3488.
Final Flow (Q(NU), cfs)	1420.
Time to Maximum Flow (TP, hr)	3.20
Number of Time Steps or Number of Hydrograph Ordinates (NNU)	123
Total Volume Discharged from Reservoir (DISVOL, acre-ft)	391.
Number of Intermediate Cross-Sections (NN(NS))	11
Number of Time Steps (NNU)	123

Interp. Cross Section I	Water Elevation YD(I) (ft MSL)	Initial Flow QDI(I) (cfs)
1	1362.49	320.4
2	1305.03	320.4
3	1267.01	320.4
4	1236.51	320.4
5	1230.26	320.4
6	1192.36	320.4
7	1165.22	320.4
8	1117.37	320.4
9	1103.25	820.4
10	1087.98	820.4
11	1078.88	820.4
	1070.65	820.4

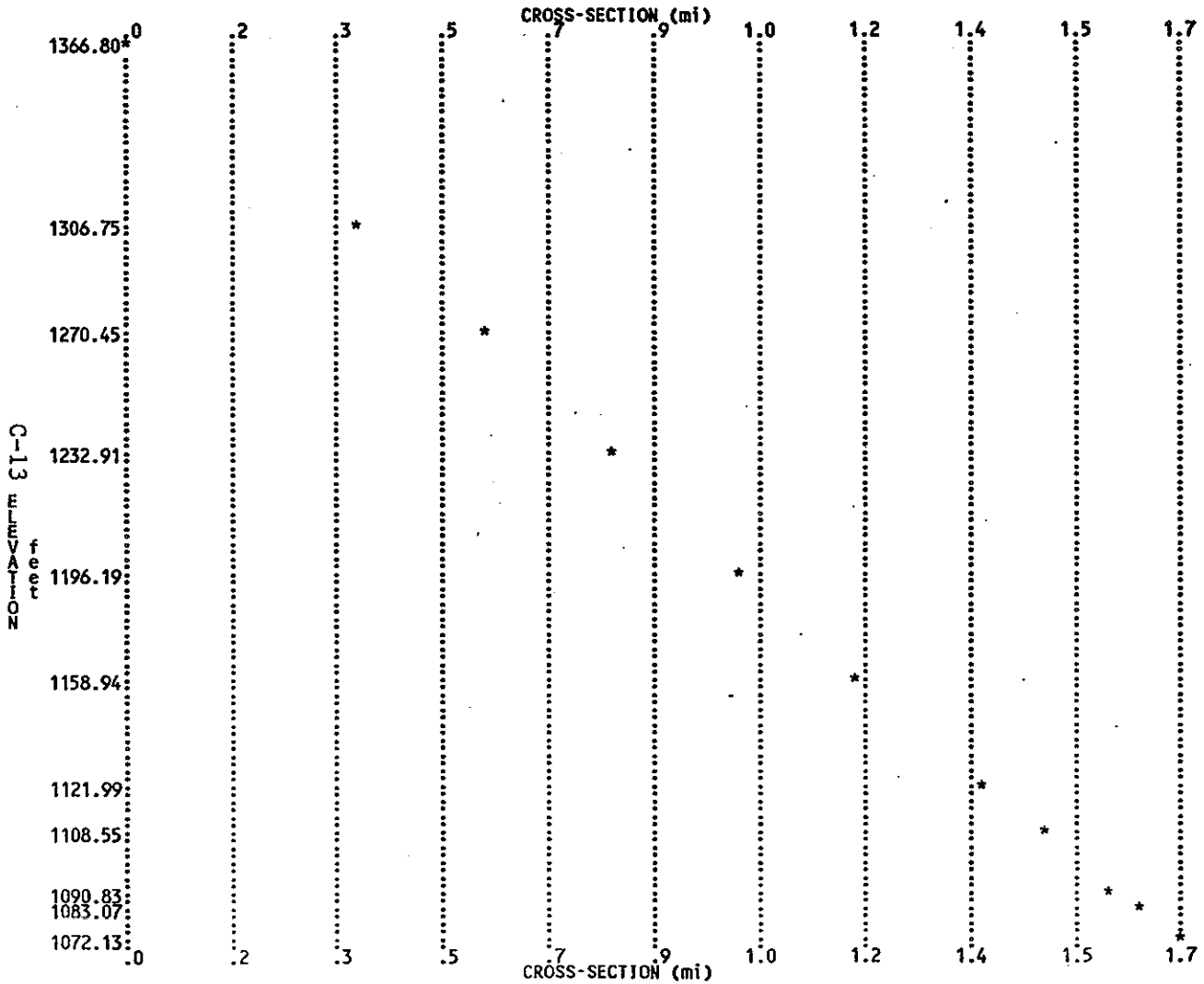
ROUTING COMPLETED :

Number of Time Steps Used (KTIME)	26
Maximum Number of Time Steps Allowed	698
Total Time of Flood Routing (TT, hr)	5.2

FLOOD CREST SUMMARY :

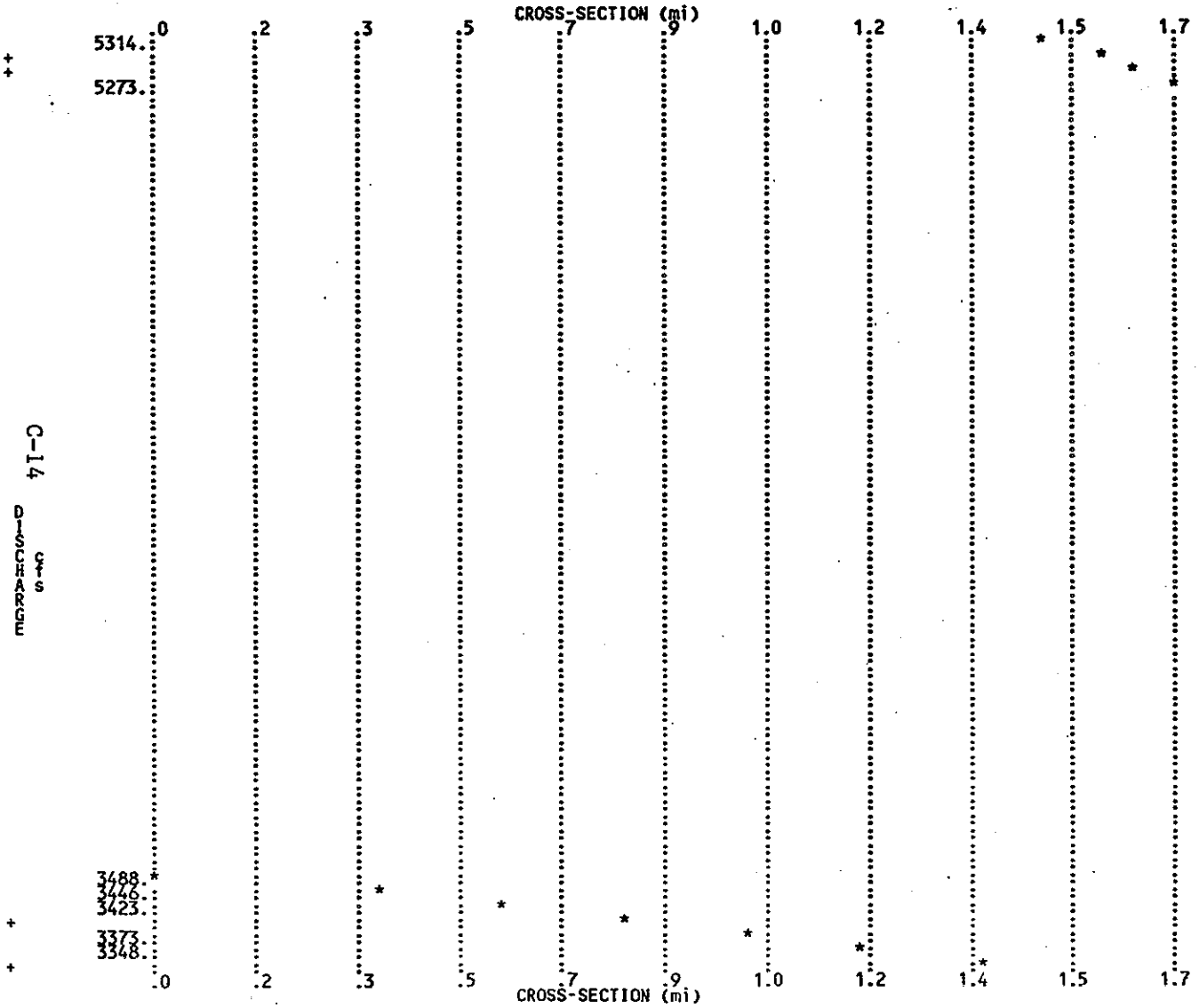
Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)
.000	1366.80	3488	3.200	16.25	.00	.00
.380	1306.75	3446	3.200	24.64	.00	.00
.584	1270.45	3423	3.200	19.76	.00	.00
.788	1232.91	3398	3.200	24.87	.00	.00
.992	1192.19	3373	3.200	23.90	.00	.00
1.196	1158.94	3348	3.200	27.10	.00	.00
1.400	1121.99	3324	3.200	28.44	.00	.00
1.500	1108.55	5314	3.200	19.91	.00	.00
1.600	1090.83	5300	3.200	26.80	.00	.00
1.655	1083.07	5288	3.200	21.23	.00	.00
1.710	1072.13	5273	3.200	13.30	.00	.00

FLOOD CREST SUMMARY (Peak Water Surface Elevation) :



ELEVATION (ft)	CROSS SECTION (mi)
1366.8	.0
1306.7	.4
1270.5	.6
1232.9	.8
1196.2	1.0
1158.9	1.2
1122.0	1.4
1108.5	1.5
1090.8	1.6
1083.1	1.7
1072.1	1.7

FLOOD DISCHARGE SUMMARY (Peak Water Flow) :



DISCHARGE (cfs)	CROSS SECTION (mi)
5314.1	1.5
5273.3	1.7
3488.0	.0
3446.5	.4
3423.3	.6
3373.1	1.0
3348.4	1.2

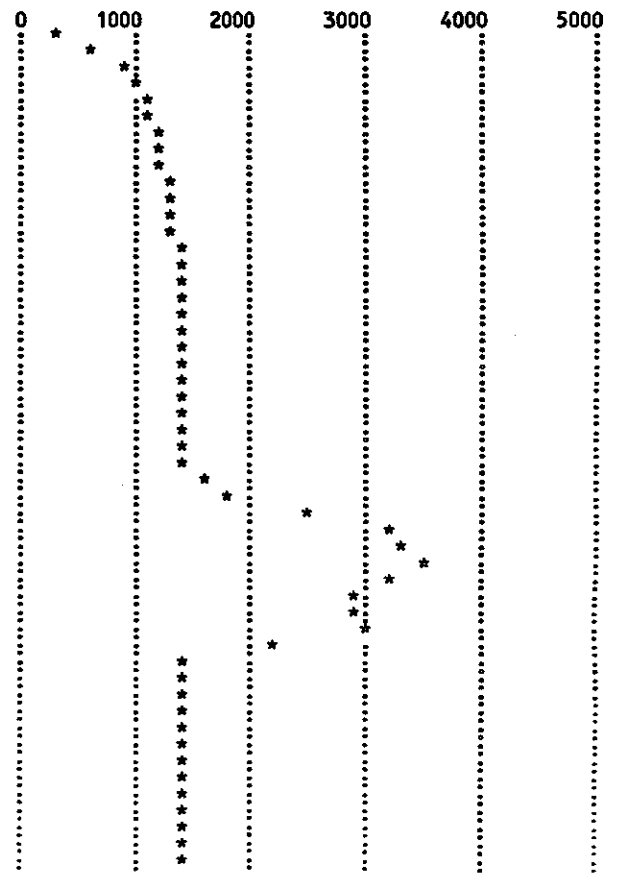
TIME TO PEAK ELEVATION PROFILE :

	CROSS-SECTION (mi)	
Peak time is constant at		3.20 hou
Peak time is constant at		.00s

DISCHARGE HYDROGRAPH :

Cross-Section Number	1
Cross-Section Location (mi)	.000
Gage Zero (ft MSL)	1359.650
Max Elevation Reached by Flood Wave (ft MSL)	1366.805
Flood Stage (ft)	(not available)
Maximum Stage (ft)	7.155
at Time (hr)	3.200
Maximum Flow (cfs)	3488
at Time (hr)	3.200

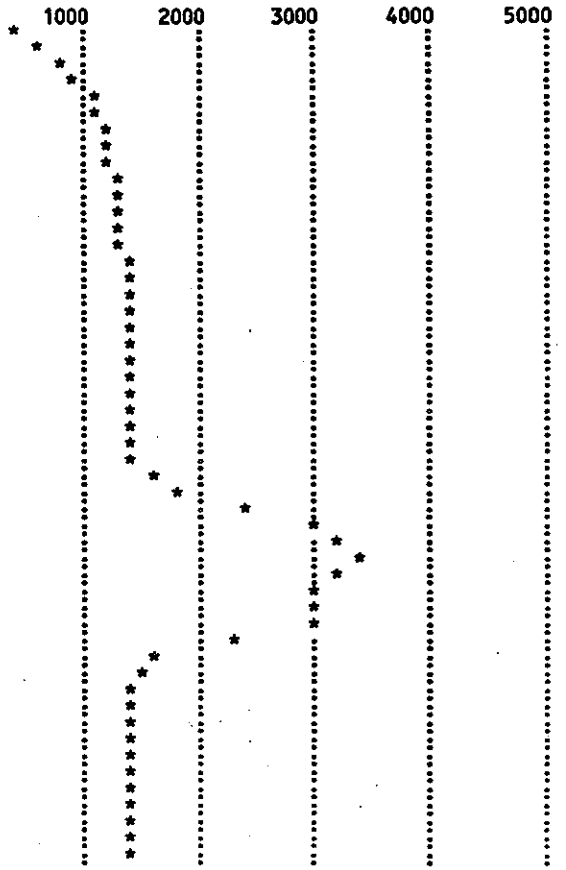
TIME (hr)	CROSS SECTION (mi)	ELEVATION (ft MSL)
.0	2.8	320
.1	3.3	586
.2	4.2	852
.3	4.4	925
.4	4.6	1078
.5	4.7	1135
.6	4.8	1192
.7	4.9	1221
.8	4.9	1249
.9	5.0	1277
1.0	5.0	1305
1.1	5.0	1327
1.2	5.1	1349
1.3	5.1	1354
1.4	5.1	1367
1.5	5.1	1374
1.6	5.1	1384
1.7	5.1	1388
1.8	5.1	1392
1.9	5.1	1397
2.0	5.1	1401
2.1	5.1	1404
2.2	5.1	1407
2.3	5.1	1408
2.4	5.1	1410
2.5	5.1	1412
2.6	5.2	1413
2.7	5.4	1427
2.8	5.7	1841
2.9	6.3	2508
3.0	6.9	3175
3.1	7.0	3331
3.2	7.2	3488
3.3	6.6	3196
3.4	6.7	2903
3.5	6.7	2941
3.6	6.8	2978
3.7	6.0	2199
3.8	5.2	1420
3.9	5.2	1420
4.0	5.2	1420
4.1	5.2	1420
4.2	5.2	1420
4.3	5.2	1420
4.4	5.2	1420
4.5	5.2	1420
4.6	5.2	1420
4.7	5.2	1420
4.8	5.2	1420
4.9	5.2	1420
5.0	5.2	1420



DISCHARGE HYDROGRAPH :

Cross-Section Number	2
Cross-Section Location (mi)	.380
Gage Zero (ft MSL)	1302.600
Max Elevation Reached by Flood Wave (ft MSL)	1306.750
Flood Stage (ft)	(not available)
Maximum Stage (ft)	4.150
at Time (hr)	3.200
Maximum Flow (cfs)	3446
at Time (hr)	3.200

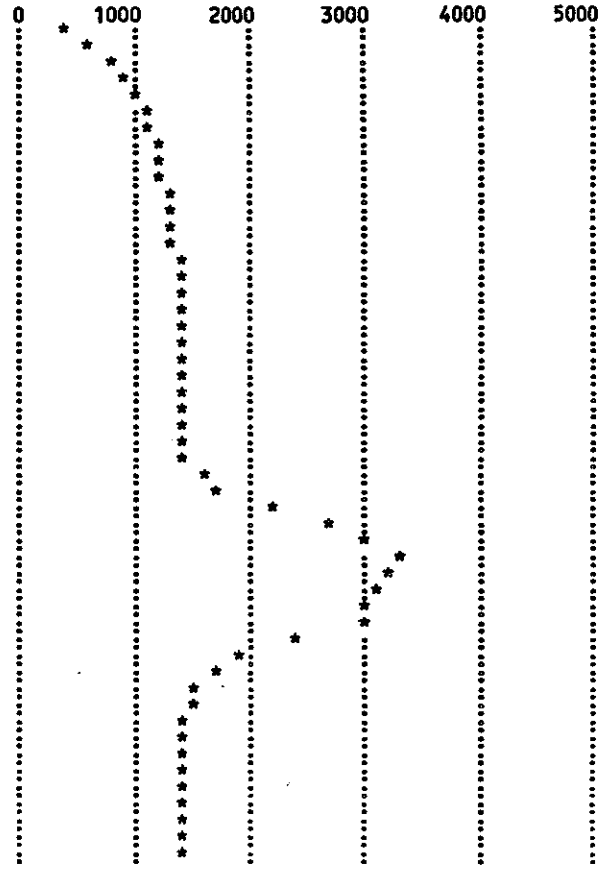
HR	STAGE	FLOW
.0	2.4	360
.1	2.4	587
.2	2.4	813
.3	2.5	933
.4	2.5	1054
.5	2.5	1115
.6	2.6	1175
.7	2.6	1208
.8	2.7	1240
.9	2.7	1269
1.0	2.7	1287
1.1	2.7	1318
1.2	2.8	1338
1.3	2.8	1350
1.4	2.8	1361
1.5	2.8	1371
1.6	2.8	1381
1.7	2.8	1386
1.8	2.8	1391
1.9	2.8	1395
2.0	2.8	1400
2.1	2.8	1403
2.2	2.8	1406
2.3	2.8	1408
2.4	2.8	1410
2.5	2.8	1411
2.6	2.8	1413
2.7	3.0	1600
2.8	3.1	1788
2.9	3.5	2404
3.0	3.9	3021
3.1	4.0	3234
3.2	4.1	3446
3.3	4.0	3205
3.4	3.9	2963
3.5	3.9	2968
3.6	3.9	2973
3.7	3.5	2287
3.8	3.0	1600
3.9	2.9	1516
4.0	2.8	1431
4.1	2.8	1426
4.2	2.8	1421
4.3	2.8	1420
4.4	2.8	1420
4.5	2.8	1420
4.6	2.8	1420
4.7	2.8	1420
4.8	2.8	1420
4.9	2.8	1420
5.0	2.8	1420



DISCHARGE HYDROGRAPH :

Cross-Section Number	7
Cross-Section Location (mi)	1.400
Gage Zero (ft MSL)	1115.900
Max Elevation Reached by Flood Wave (ft MSL)	1121.986
Flood Stage (ft)	(not available)
Maximum Stage (ft)	6.086
at Time (hr)	3.200
Maximum Flow (cfs)	3325
at Time (hr)	3.200

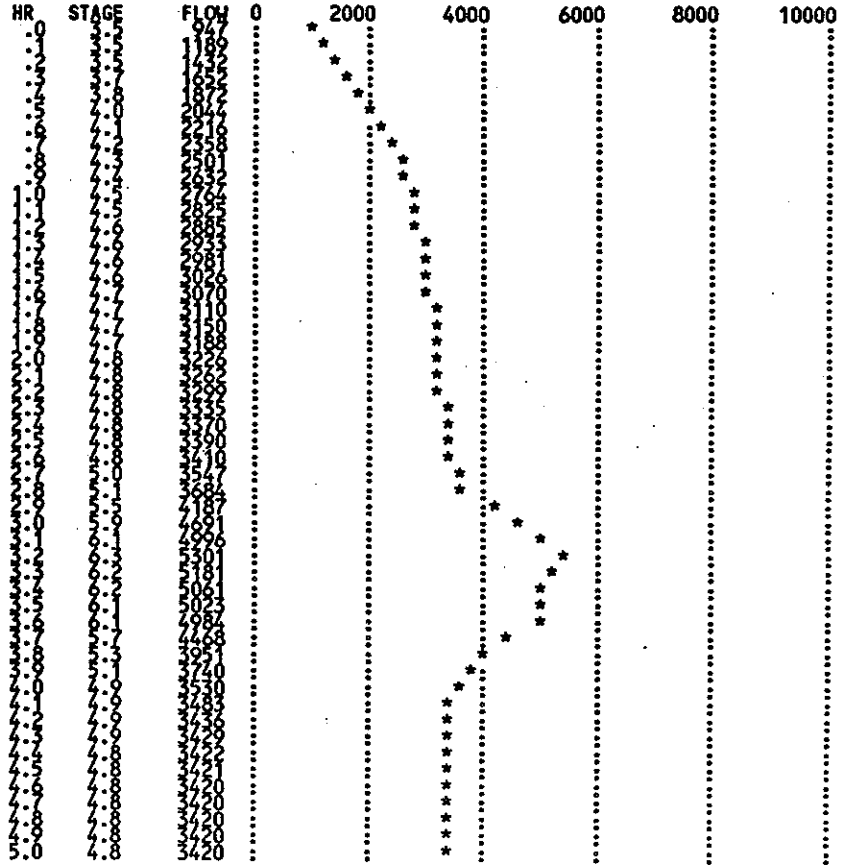
HR	STAGE	FLOW
.0	2.0	440
.1	2.4	598
.2	2.8	757
.3	3.0	877
.4	3.2	998
.5	3.5	1067
.6	3.5	1136
.7	3.2	1177
.8	3.6	1218
.9	3.6	1249
1.0	3.7	1280
1.1	3.7	1303
1.2	3.8	1325
1.3	3.8	1340
1.4	3.8	1357
1.5	3.8	1364
1.6	3.8	1375
1.7	3.8	1382
1.8	3.8	1388
1.9	3.9	1393
2.0	3.9	1397
2.1	3.9	1400
2.2	3.9	1404
2.3	3.9	1406
2.4	3.9	1408
2.5	3.9	1410
2.6	3.9	1412
2.7	4.1	1554
2.8	4.3	1697
2.9	4.6	2215
3.0	5.2	2733
3.1	5.8	3029
3.2	6.1	3325
3.3	6.0	3188
3.4	5.8	3051
3.5	5.8	3016
3.6	5.8	2982
3.7	5.1	2445
3.8	4.5	1908
3.9	4.3	1710
4.0	4.0	1513
4.1	4.0	1473
4.2	3.9	1433
4.3	3.9	1427
4.4	3.9	1421
4.5	3.9	1421
4.6	3.9	1420
4.7	3.9	1420
4.8	3.9	1420
4.9	3.9	1420
5.0	3.9	1420



DISCHARGE HYDROGRAPH :

Cross-Section Number	9
Cross-Section Location (mi)	1.600
Gage Zero (ft MSL)	1084.500
Max Elevation Reached by Flood Wave (ft MSL)	1090.829
Flood Stage (ft)	(not available)
Maximum Stage (ft)	6.329
at Time (hr)	3.200
Maximum Flow (cfs)	5301
at Time (hr)	3.200

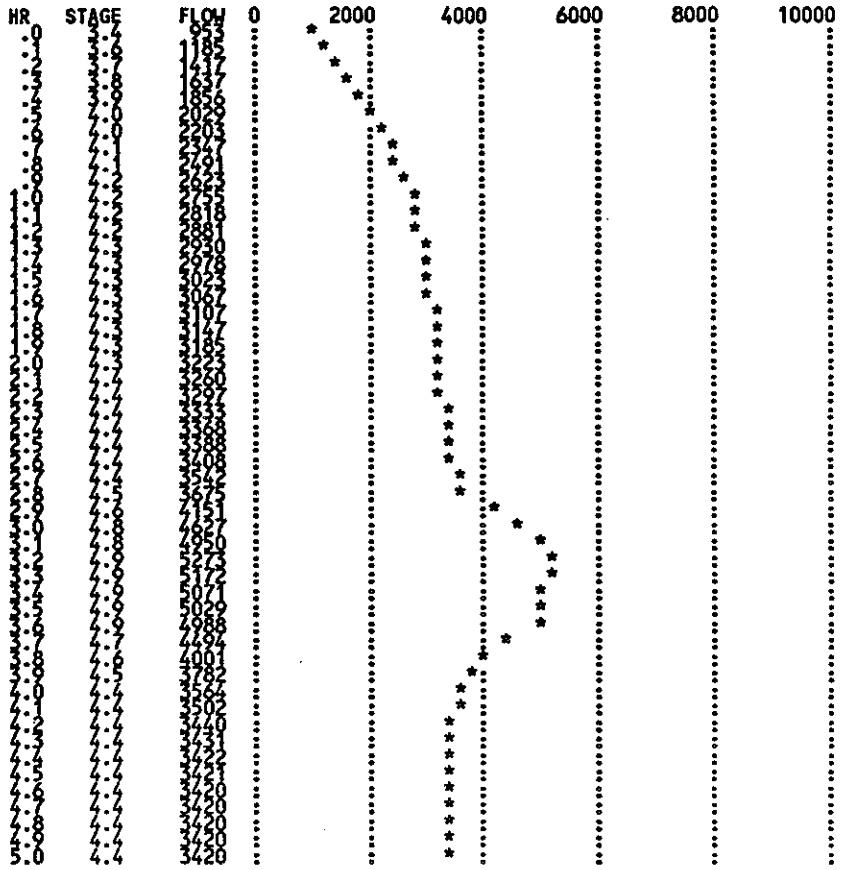
HR	STAGE	FLOW
.0	3.5	947
.1	3.5	1189
.2	3.5	1432
.3	3.7	1625
.4	3.8	1872
.5	4.0	2044
.6	4.1	2216
.7	4.2	2358
.8	4.3	2501
.9	4.4	2632
1.0	4.5	2764
1.1	4.5	2825
1.2	4.6	2885
1.3	4.6	2933
1.4	4.6	2981
1.5	4.6	3026
1.6	4.7	3070
1.7	4.7	3110
1.8	4.7	3150
1.9	4.7	3188
2.0	4.8	3229
2.1	4.8	3262
2.2	4.8	3299
2.3	4.8	3335
2.4	4.8	3370
2.5	4.8	3390
2.6	4.8	3410
2.7	5.0	3547
2.8	5.1	3684
2.9	5.5	4187
3.0	5.9	4891
3.1	6.1	4996
3.2	6.3	5301
3.3	6.2	5181
3.4	6.2	5061
3.5	6.1	5023
3.6	6.1	4987
3.7	5.7	4468
3.8	5.3	3951
3.9	5.1	3740
4.0	4.9	3530
4.1	4.9	3483
4.2	4.9	3436
4.3	4.9	3438
4.4	4.8	3442
4.5	4.8	3421
4.6	4.8	3420
4.7	4.8	3420
4.8	4.8	3420
4.9	4.8	3420
5.0	4.8	3420



DISCHARGE HYDROGRAPH :

Cross-Section Number	11
Cross-Section Location (mi)	1.710
Gage Zero (ft MSL)	1067.200
Max Elevation Reached by Flood Wave (ft MSL)	1072.128
Flood Stage (ft)	(not available)
Maximum Stage (ft)	4.928
at Time (hr)	3.200
Maximum Flow (cfs)	5273
at Time (hr)	3.200

HR	STAGE	FLOW
.0	3.4	993
.1	3.6	1185
.2	3.7	1417
.3	3.8	1637
.4	3.9	1856
.5	3.9	2058
.6	4.0	2203
.7	4.1	2347
.8	4.1	2491
.9	4.2	2523
1.0	4.2	2552
1.1	4.2	2618
1.2	4.2	2881
1.3	4.3	2930
1.4	4.3	2978
1.5	4.3	3023
1.6	4.3	3067
1.7	4.3	3107
1.8	4.3	3147
1.9	4.3	3185
2.0	4.3	3223
2.1	4.3	3260
2.2	4.4	3297
2.3	4.4	3333
2.4	4.4	3368
2.5	4.4	3388
2.6	4.4	3408
2.7	4.4	3429
2.8	4.5	3675
2.9	4.6	4151
3.0	4.8	4627
3.1	4.8	4950
3.2	4.8	5273
3.3	4.9	5172
3.4	4.9	5071
3.5	4.9	5029
3.6	4.9	4988
3.7	4.7	4494
3.8	4.6	4001
3.9	4.5	3782
4.0	4.4	3564
4.1	4.4	3502
4.2	4.4	3440
4.3	4.4	3431
4.4	4.4	3422
4.5	4.4	3421
4.6	4.4	3420
4.7	4.4	3420
4.8	4.4	3420
4.9	4.4	3420
5.0	4.4	3420



END OF OUTPUT

JOHNSON REAL ESTATE DAM
PROFILE DATA SUMMARY
MAXIMUM SURCHARGE DAM-BREAK ANALYSIS

RIVER MILE	0.00	0.38	1.40	1.60	1.71
STREAM BED ELEV. ft NGVD (Stage Datum)	1359.65	1302.60	1115.90	1084.50	1067.20
DEPTHS IN FEET					
Pre-Breach	5.20	2.80	3.90	4.80	4.40
Peak Stage	7.16	4.15	6.09	6.33	4.93
Hours to Peak	0.60	0.60	0.60	0.60	0.60
Hours to Start of Rise	0.00	0.05	0.10	0.15	0.20
DISCHARGES IN CFS					
Pre-Breach	1420.00	1420.00	1420.00	3420.00	3420.00
Max Flow	3488.00	3446.00	3325.00	5301.00	5273.00
Hours to Max Flow	0.60	0.60	0.60	0.60	0.60