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NATIONAL DAM SAFETY PROGRAM. KATY LAKE DAM (MO 11048), MISSOURI--ETC(U)
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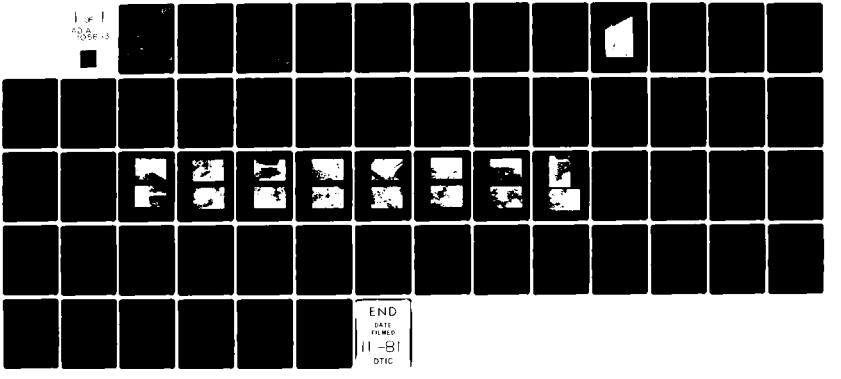

LEVEL II

MISSOURI - KANSAS CITY BASIN

AD A105683

KATY LAKE DAM

CALLAWAY COUNTY, MISSOURI

MO. 11048

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
... Serving the Army
... Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST, 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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		6. PERFORMING ORG. REPORT NUMBER
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Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

KATY LAKE DAM
CALLAWAY COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. 11048

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

AUGUST, 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Katy Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Katy Lake Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

SUBMITTED BY: _____ DATE 20 MAR 1980
Chief, Engineering Division

SIGNED

APPROVED: _____ DATE 20 MAR 1980
Colonel, CE, District Engineer

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Katy Lake Dam
State Located	Missouri
County Located	Callaway County
Stream	Tributary Clabber Creek
Date of Inspection	August 13, 1979

Katy Lake Dam was inspected by an interdisciplinary team of engineers, ~~from Hoskins-Western-Sonderegger, Inc~~. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are 3 dwellings, State Highway 94 and the Missouri-Kansas-Texas Railroad.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for an intermediate dam having a high hazard potential. The Probable Maximum Flood is the appropriate spillway design flood. The spillway will pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillway will pass 20% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

No design data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other deficiencies observed during the inspection are willows and cottonwood trees growing on the upstream slope; small trees and brush growing on the crest of the dam at west end; heavy overgrowth of trees and brush on the downstream slope; rodent holes in the downstream

slope; and small trees growing in the entrance to the spillway.

The tree and brush growth on the slopes and crest of the dam as well as rodent holes indicate the lack of regular maintenance. Items of preventative maintenance need to be initiated by the owner as described in the body of the report.

Rey S. Decker
E-3703

Garold Ulmer
E-4777

H. P. Hoskins
Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696

PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

KATY LAKE DAM - MO 11048
CALLAWAY COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Katy Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth fill approximately 335 feet in length and 42.5 feet in height. It is located in the rolling hill country of east central Missouri about 2 miles north of the Missouri River bluff line. Soils in the area consist of thin loess over limestone on the uplands with residual cherty clay soils and limestone exposed on the abutments.

(2) The spillway consists of a channel excavated through limestone on the right (west) abutment. There is a concrete sill across the upper end acting as a control section. The channel bottom is approximately 45 feet in width with near vertical side slopes.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the south central portion of Callaway County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SW¼ of Section 1, T45N, R9W. The lake formed behind the dam is shown in the W½ of Section 1, T45N, R9W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the intermediate size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are 3 dwellings, State Highway 94 and the Missouri-Kansas-Texas Railroad.

e. Ownership. The dam is owned by Mr. Henry Ample, c/o W.A. Eicks, 2045 Parker, Florrisant, Missouri 63033.

f. Purpose of Dam. The dam was constructed to provide a water supply for the M-K-T Railroad at Mokane, Missouri. Two 16-inch cast iron water mains extend from an intake tower in the reservoir to the Village of Mokane. Mrs. Nadyne Roewe, Mayor of Mokane, stated that the two water mains,formerly used by the railroad, are in good condition and deliver non-potable water for fire protection and irrigation purposes to the village. There are no storage facilities in Mokane for water delivered through the two water mains. Water is taken from the mains on a demand basis through fire hydrants and resident service lines which are tapped into the mains. The impoundment behind the dam is used for recreation, and the dam provides some flood retardation.

g. Design and Construction History. The dam was constructed in 1905 by the M-K-T Railroad. Two 16-inch cast iron water mains extend from an intake tower in the reservoir to the village of Mokane. No other information was available on design or construction.

h. Normal Operating Procedure. There are no operating procedures in force for this structure. The Railroad no longer uses the reservoir. Water is now withdrawn from the reservoir for use, as needed, by residents of Mokane for fire protection and watering lawns and gardens. The pool level behind this dam is controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillway and the fire and irrigation requirements of Mokane.

1.3 PERTINENT DATA

a. Drainage Area. 575 acres (0.898 square miles).

b. Discharge at Damsite.

(1) Discharges at the damsite are through an uncontrolled trapezoidal shaped spillway channel cut through limestone on the right abutment of the dam. Minimal amounts are withdrawn by the Village of Mokane through the two 16-inch water mains.

(2) Estimated maximum flood at damsite -- unknown.

(3) The spillway capacity varies from 0 cfs at elevation 659.0 feet to 960 cfs at the minimum top of dam (elevation 662.5 feet).

(4) Total spillway capacity at the minimum top of dam is 960 cfs ±.

c. Elevations (feet above MSL).

(1) Top of dam (minimum) - 662.5
(2) Spillway crest - 659.0
(3) Streambed at centerline - 620 ±
(4) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 2400 ±.

e. Storage (Acre-feet).

(1) Spillway Crest - 90
(2) Top of dam - 150±

f. Reservoir Surface (Acres).

(1) Top of dam - 20 ±
(2) Spillway crest - 14 ±

g. Dam.

(1) Type - earth fill
(2) Length - 335 feet ± (measured)
(3) Height - 42.5 feet ± (measured)
(4) Top width - 14 feet ± (measured)
(5) Side Slopes.
  (a) Downstream 2.2H on 1V (measured)
  (b) Upstream - 3H on 1V (measured on exposed slope)
(6) Zoning - unknown
(7) Impervious core - unknown
(8) Cutoff - unknown
(9) Grout curtain - unknown
(10) Wave protection - thin plating of durable limestone and chert boulders.

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal (and only).

(a) Type - Channel excavated in limestone with concrete sill across the inlet section.

(b) Control Section - Concrete sill extending 45 feet ± across the bottom of the spillway.

(c) Crest elevation - 659.0 feet

(d) Upstream Channel - Excavated in earth and rock.

(e) Downstream Channel - Excavated in limestone with slope of 0.05 to 0.2 ft./ft. dropping vertically into stream channel.

j. Regulating Outlets. Two 16-inch cast iron water mains extend from an intake tower in the reservoir to the Village of Mokane. Water is withdrawn from the reservoir by residents of Mokane for use, as needed, for fire protection and watering lawns and gardens.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by M-K-T Railroad personnel that the dam was constructed in 1905.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusion of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Katy Lake Dam was made on August 13, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R.S. Decker, Geotechnical; and Garold Ulmer, Hydrology. The Owner was not present during the inspection.

b. Dam.

(1) Geology and Soils (Abutment and Embankment)

Limestone (probably Jefferson City formation) is exposed in the right abutment spillway excavation. The left abutment is covered with a thin mantle of residual cherty clay derived from limestone bedrock. Materials in the dam consist of red-brown to gray cherty clay (CL or CH). Some of the embankment material was apparently borrowed from the left abutment area above and eastward from the damsite.

(2) Upstream Slope. The upstream slope is sparsely covered with limestone, chert gravel and boulders. No significant erosion was noted on the slope. Several willow and cottonwood trees are growing on the slope. No cracks, slumps or other abnormal deformations were noted on the upstream slope.

(3) Crest. The crest is covered with cherty gravel. The right end (Sta. 2 + 50 to 3 + 50±) is overgrown with shrubs and small trees. No cracks, rodent holes or abnormal deformation were noted along the crest. Measurements along the crest indicate that both ends of the dam are about 1 foot higher than the central section of the dam (see Appendix C).

(4) Downstream Slope. The downstream slope is heavily overgrown with brush and hardwood trees up to 18 inches in diameter. Several large trees have died and fallen on the slope. Several large rodent holes were observed, particularly in the area downstream from Stations 2 + 00 to 3 + 00. The lower one-half of the slope seems to be steeper and contains more rock and cobble than the upper section of the slope. It would appear that the dam was

constructed with a rock toe section (steeper lower one half) with flatter slopes for the upper earthen section. This variance in slope did not appear to be caused by lateral deformation of the dam. No cracks were observed on the slope, and there was no indication of any seepage along the toe or on the slope. A slight gulley was developing from surface runoff in the left abutment trough. No evidence was discovered that would indicate that this dam has ever been overtopped.

(5) Miscellaneous. The apparent nature of materials in the dam indicate that minor overtopping would not cause any major damage to this structure.

c. Appurtenant Structures.

(1) The spillway consists of a channel excavated in limestone on the right abutment of the dam. A concrete sill or weir section is located across the spillway entrance. The sill is rounded on top and varies from 1 to 3 feet in width. The sill is founded in bedrock. A series of 7 steel fence posts (2 inch diameter) are set at 6 foot intervals along the crest of the sill. The base of the concrete sill shows some spalling and deterioration along the downstream side. A few small trees are growing in the entrance section and along the upstream face of the sill. The spillway channel is cut through and into durable limestone. The bottom is rough and irregular due to the nature of the excavation, but very little scouring or deterioration of the limestone was apparent. The spillway channel outlets over a limestone cliff with some 20 to 25 feet of drop down to the stream channel which also bottoms in rock. The stream channel is open and stable.

Spillway discharges should not affect the safety of the dam.

(2) Drawdown Facilities. The two 16-inch cast iron pipes which pass under the dam at about Station 2 + 50 are controlled by two gate valves located just downstream from the toe of the dam (see photos 9 and 10). These valves appear to be in good shape and operable. They are normally kept in open position. There was no sign of seepage in the valve housings.

The condition of the intake tower could not be determined nor could it be determined at what level the water is

drawn off from the reservoir. The level of the reservoir could be lowered an indeterminate amount by opening fire hydrants in Mokane.

d. Reservoir Area. No significant erosion was noted around the shoreline of the reservoir.

e. Downstream Channel. The channel downstream from the dam is overgrown with trees and brush. The channel appears to be stable and is either cut into limestone or heavily armored with limestone and chert boulders and cobbles.

3.2 EVALUATION

The dam and appurtenances appeared to be in reasonably good structural shape. Deficiencies in maintaining the dam (trees on both slopes and rodent holes on the downstream slope) could ultimately endanger the safety of the structure. Deficiencies in maintaining the concrete sill in the spillway should not affect the safety of the dam since the spillway is cut into durable rock. The apparent nature of materials in the embankment indicate that minor overtopping would not seriously damage this structure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The only controlled outlets for this dam are the two valve controlled 16" water mains that extend from the reservoir to the Village of Mokane. The gate valves located at the toe of the dam are kept in the open position in order to deliver water for fire protection and irrigation in Mokane when required.

The pool level behind this dam is controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillway and the fire and irrigation requirements of Mokane.

4.2 MAINTENANCE OF DAM

The tree growth and rodent holes on the dam and deterioration of the concrete sill in the spillway indicate the lack of any regular maintenance on this dam for a number of years.

4.3 MAINTENANCE OF OPERATING FACILITIES

The valves controlling the 16-inch water mains appeared to be operable and are normally kept in open position. The condition of the intake structure is not known. Mrs. Roewe stated that the two 16-inch water mains are in good condition.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam. All computations are based on field inspection and surveys by the consultant. The plan, profiles, and cross sections from the survey are attached in Appendix C.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Mokane West, Missouri 7 1/2 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) The spillway is cut through limestone in the right abutment. Spillway releases should not endanger the integrity of the dam.

(2) The concrete sill in the spillway showed signs of deterioration. There were a few small trees located in the spillway entrance.

(3) The intake tower for the two 16" diameter water mains was visible. The condition of the intake tower could not be determined from the view from the dam. The operating valves at the toe of dam appeared to be operable and are normally kept in open position.

d. Overtopping Potential. The spillway is too small to pass one-half of the probable maximum flood without overtopping. The spillway will pass the 100-year flood without overtopping the dam. The spillway will pass 0.2 of the probable maximum flood without overtopping the dam. Overtopping by one-half the probable maximum flood would not seriously damage the dam. The results of the routings through the dam are tabulated in regards to the following conditions.

Frequency	Inflow Discharge cfs	Outflow Discharge cfs	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 662.5	Time Dam Overtopping Hr.
100 Yr.	1020	570	661.6	+0.9	--
0.5 PMF	3400	3200	664.0	-1.5	3-
PMF	6700	6500*	665.2	-2.7	6-
0.2 PMF	1350	960	662.5	0	-

*(Maximum discharge overtopping the dam = 4,000 cfs; maximum discharge through the spillway = 2,500 cfs.)

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillway. The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. This dam appears to be structurally stable. There were no seeps, slides or deformations noted on the embankment or abutments. Uncontrolled tree growth and rodent activity on the embankment could ultimately have an adverse affect on structural stability. Additional studies would be required to determine the effect of overtopping on structural and erosional stability. However, it appears that the safety of the dam would not be seriously impaired by overtopping by one-half the Probable Maximum Flood.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. The inspection team is not aware of any post-construction changes on this structure, and there was no evidence to indicate any post construction changes.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The safety of this structure does not appear to be in any immediate danger. Uncontrolled tree growth and rodent activity on the slopes could ultimately impair the structural integrity of the dam. Deterioration (to the point of failure) of the concrete weir sill in the spillway should not affect the safety of the dam. Using the approximate data available for analysis, the spillway will pass the 100 year flood, but will be overtopped with 2.7 feet of flow for about 6 hours by the Probable Maximum Flood. The effects of such overtopping on the structural and erosional stability are not known. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

c. Urgency. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. Phase II investigation is not considered necessary.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass the Probable Maximum Flood without overtopping the dam.

(2) Eliminating the concrete sill in the spillway and rehabilitating the cross section of the spillway channel would reduce the potential for overtopping.

(3) The services of an engineer experienced in the design and construction of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability analyses of the present dam, and to design protective measures, if required.

b. O & M Procedures

(1) Trees and shrubs should be removed from the upstream slope of the dam.

(2) Shrubs and trees up to 8-10 inches in diameter should be removed from the downstream slope. The few trees larger than 8-10 inches have probably done about as much damage as possible and their removal would not enhance the present safety of the dam.

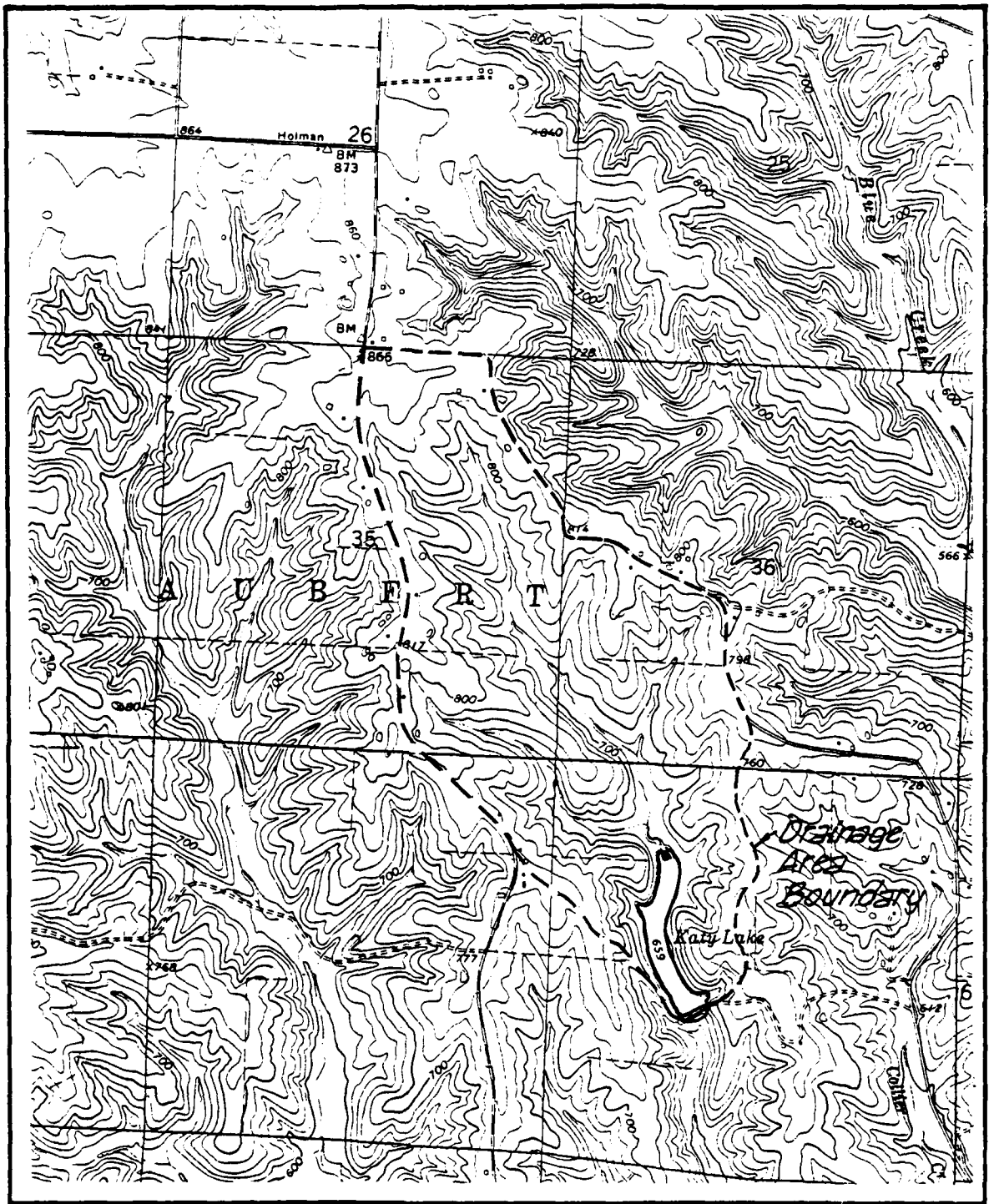
(3) Removal of trees from the spillway entrance would improve spillway operation.

(4) Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams. Indiscriminate clearing could jeopardize the safety of the dam.

(5) Rodent holes on the downstream slope of the dam should be repaired and measures taken to control future rodent activity.

(6) A program of regular inspections and maintenance should be initiated to prevent the recurrence of uncontrolled vegetative growth and rodent activity on the dam.

APPENDIX A
MAPS



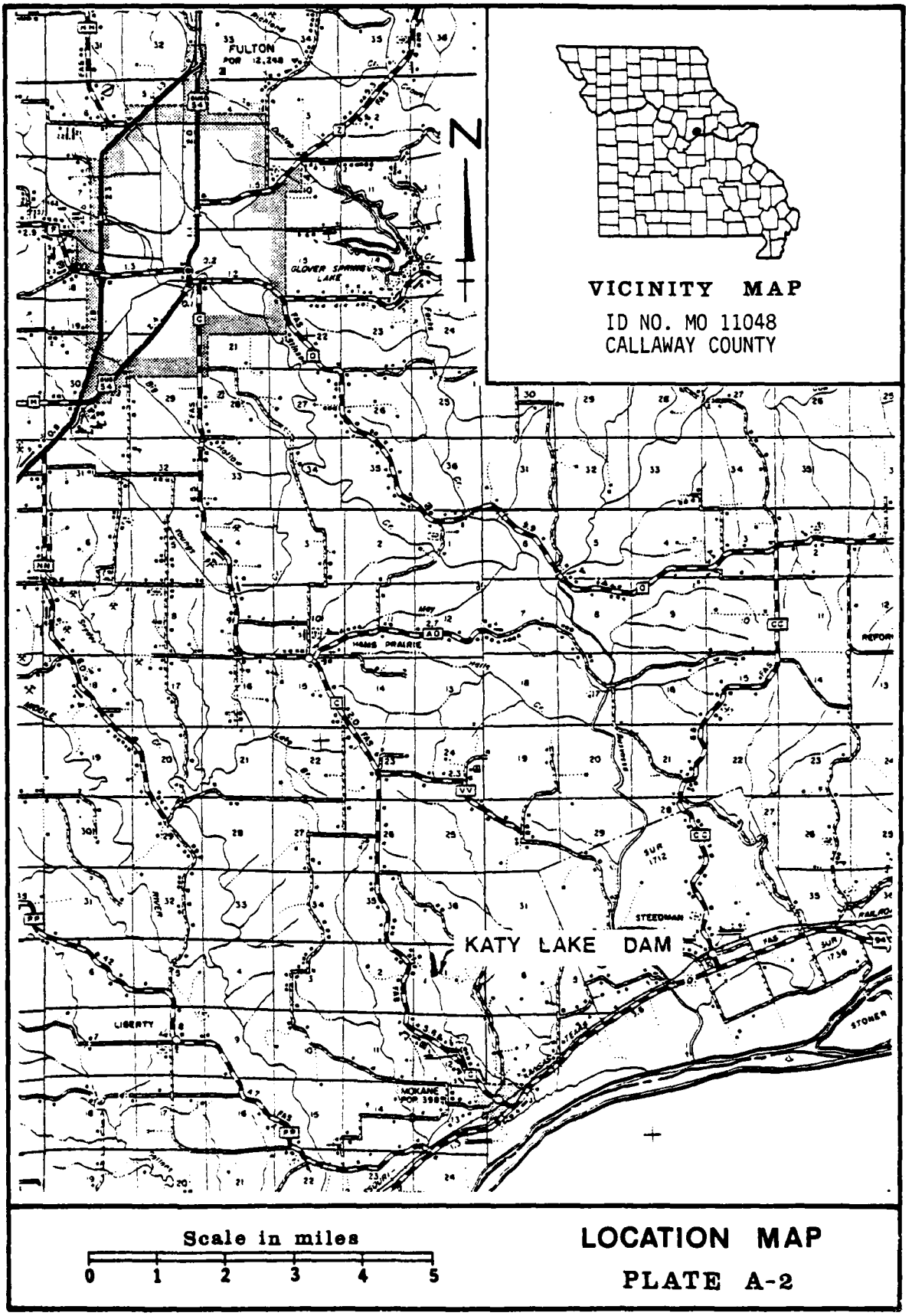
VICINITY TOPOGRAPHY

KATY LAKE DAM

CALLAWAY COUNTY, MO.

MO. 11048

PLATE A-1


FULTON
POP 12,248
GLOVER SPRINGS LAKE
HAMS PRAIRIE
KATY LAKE DAM
STEEDMAN
LIBERTY
MOKANE
POP 398
STONER
N
VICINITY MAP
ID NO. MO 11048
CALLAWAY COUNTY
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

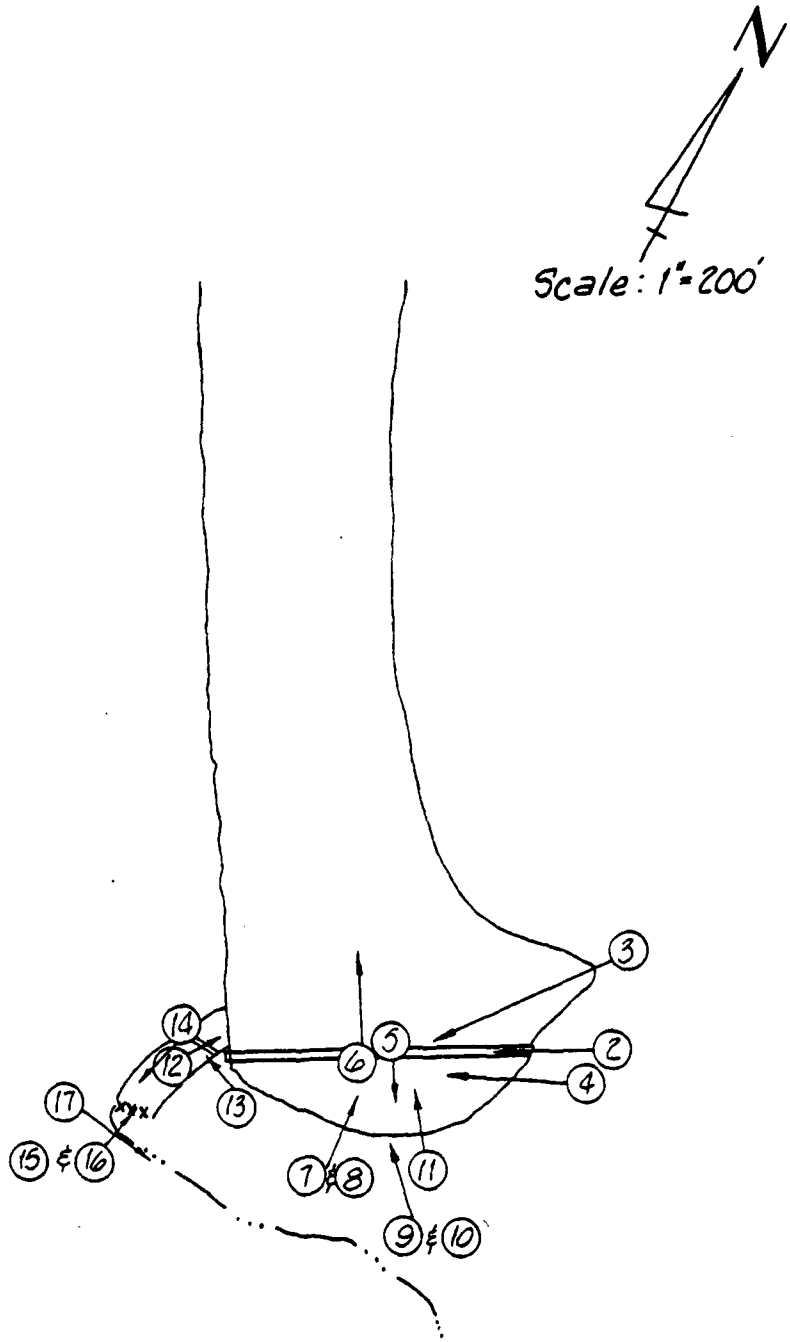


PHOTO INDEX

KATY LAKE DAM

CALLAWAY COUNTY, MISSOURI

MO. 11048

PLATE B-1

PHOTO NO. 2 - CREST FROM LEFT ABUTMENT.

PHOTO NO. 3 - UPSTREAM SLOPE FROM LEFT SIDE.

PHOTO NO. 4 - DOWNSTREAM SLOPE FROM LEFT SIDE.

PHOTO NO. 5 - VIEW DOWNSTREAM FROM STATION 2+00.

PHOTO NO. 6 - VIEW UPSTREAM FROM STATION 2+00.
INTAKE TOWER IN CENTER.

PHOTO NO. 7 - FALLEN TIMBER ON DOWNSTREAM SLOPE.

PHOTO NO. 8 - RODENT HOLE ON DOWNSTREAM SLOPE.

PHOTO NO. 9 - VALVE PITS FOR 16" WATER MAINS.

PHOTO NO. 10 - VALVE ON WATER MAIN.

PHOTO NO. 11 - DOWNSTREAM SLOPE FROM TOE.

PHOTO NO. 12 - VIEW UPSTREAM IN SPILLWAY. CONCRETE SILL CONTROL WEIR AT CENTER OF PICTURE.

PHOTO NO. 13 - VIEW ACROSS SPILLWAY WEIR FROM RIGHT END OF DAM.

PHOTO NO. 14 - VIEW DOWNSTREAM IN SPILLWAY CHANNEL.

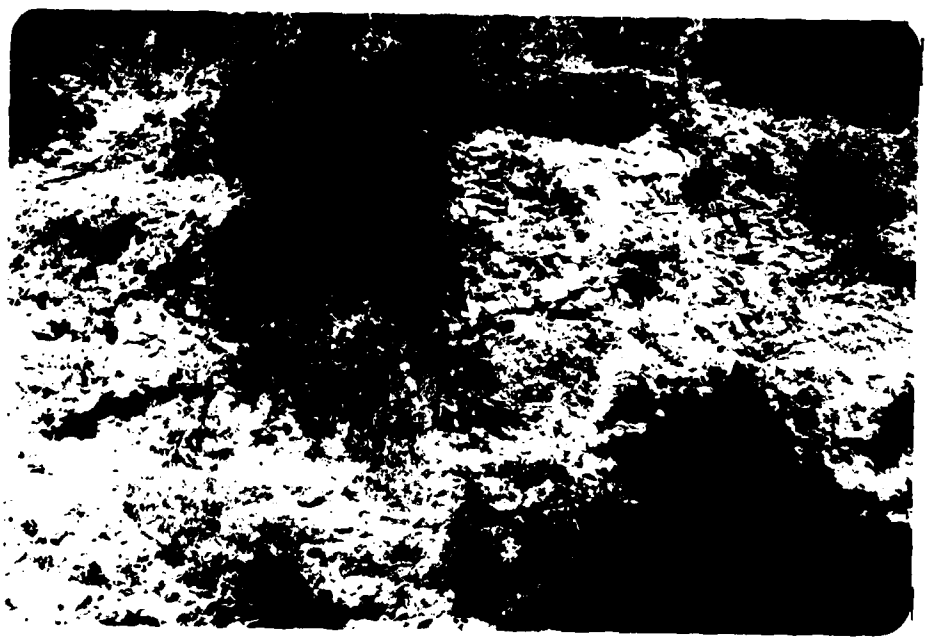


PHOTO NO. 15 - VIEW UPSTREAM SHOWING VERTICAL DROPOFF OF SPILLWAY.

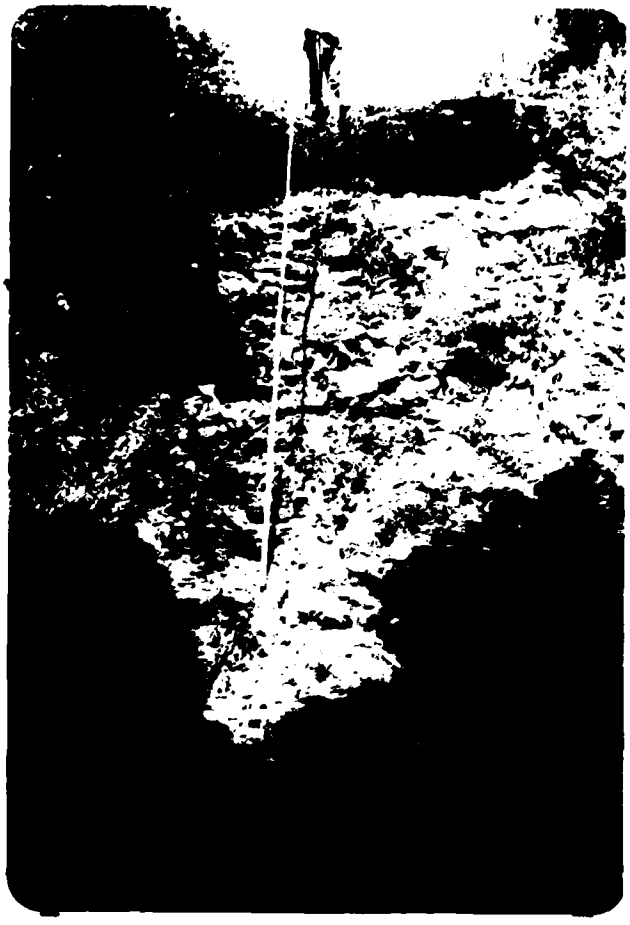
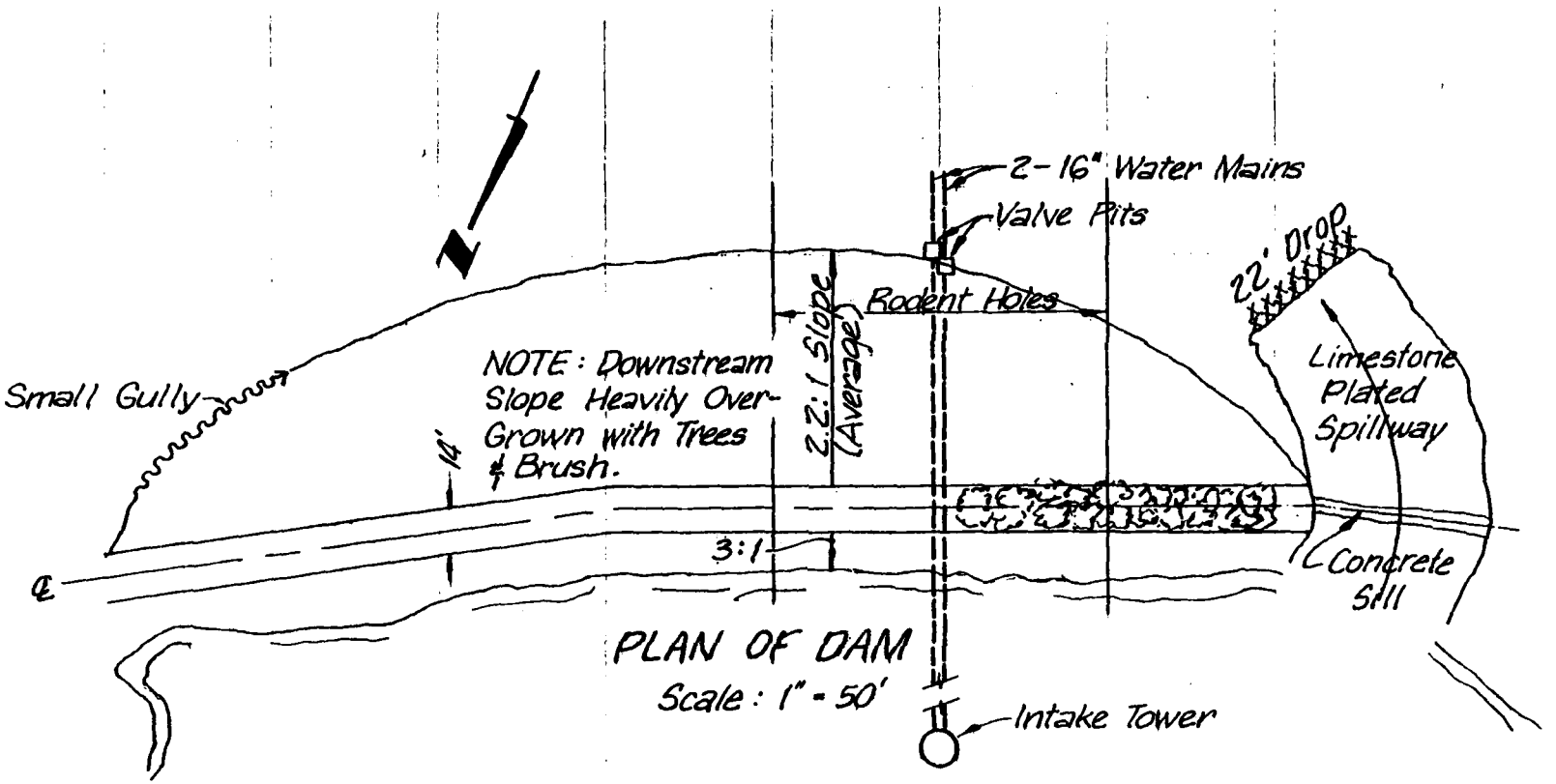


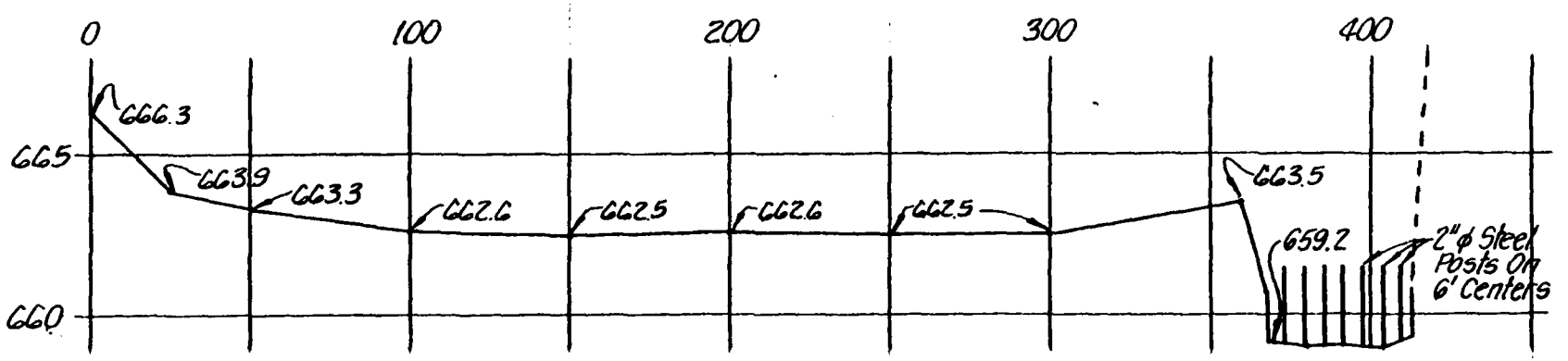
PHOTO NO. 16 - VERTICAL DROPOFF OF SPILLWAY

PHOTO NO. 17 - VIEW OF CHANNEL DOWNSTREAM FROM VERTICAL DROPOFF.

APPENDIX C
PROJECT PLATES

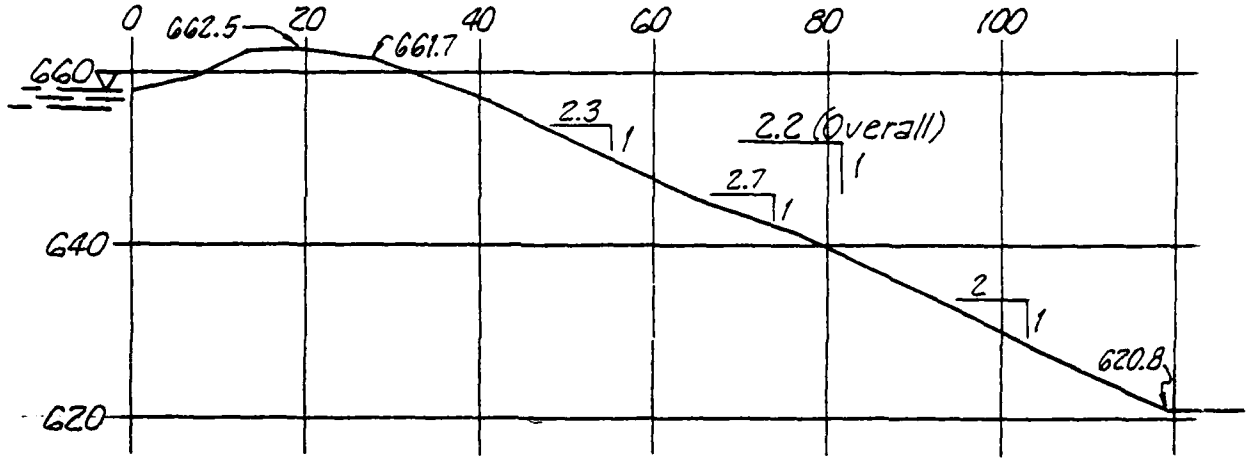


PLAN OF DAM
Scale: 1" = 50'

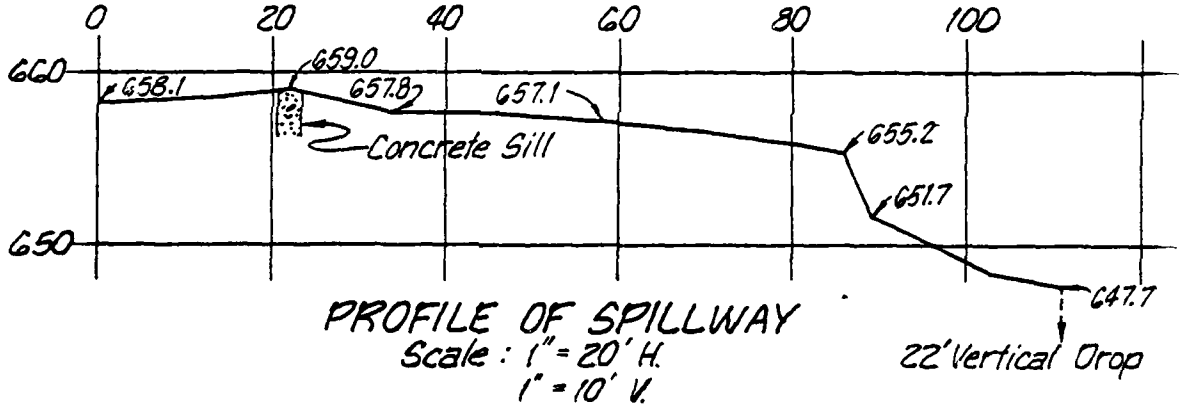


CENTERLINE PROFILE
Scale: 1" = 50' H.
1" = 5' V.

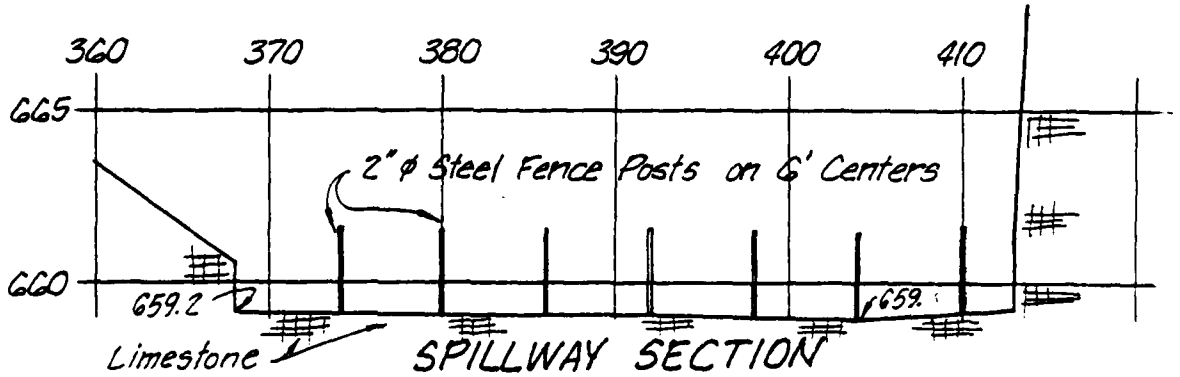
PLATE C-1



DAM SECTION
(Sta 2+18)
Scale: 1" = 20'



PROFILE OF SPILLWAY
Scale: 1" = 20' H.
1" = 10' V.



SPILLWAY SECTION
Scale: 1" = 10' H.
1" = 5' V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs.

   a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Jefferson City, MO as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.898 square miles (575 acres).

   c. Time of concentration of runoff = 45 minutes (computed from "Kirpich" formula).

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the spillway.

   e. The total twenty-four hour storm duration losses for the 100-year storm were 4.41 inches. The total losses for the PMF storm were 3.16 inches. These data are based on SCS runoff curve No. 78 and No. 61 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil group B (Menfro-Winfield-Lindley) and consists primarily of woodland with some grass or hayland on the uplands.

   f. Average soil loss rates = 0.10 inch per hour approximately.

2. The spillway discharge rating was developed using the Corps of Engineers Water Surface Profile HEC-2 computer program.

   The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program with a discharge coefficient of 2.9 and a value of 1.5 for the exponent of head.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. Discharge through the two 16-inch water mains was not included in the routings. The output and plotted hydrographs are shown in this Appendix.

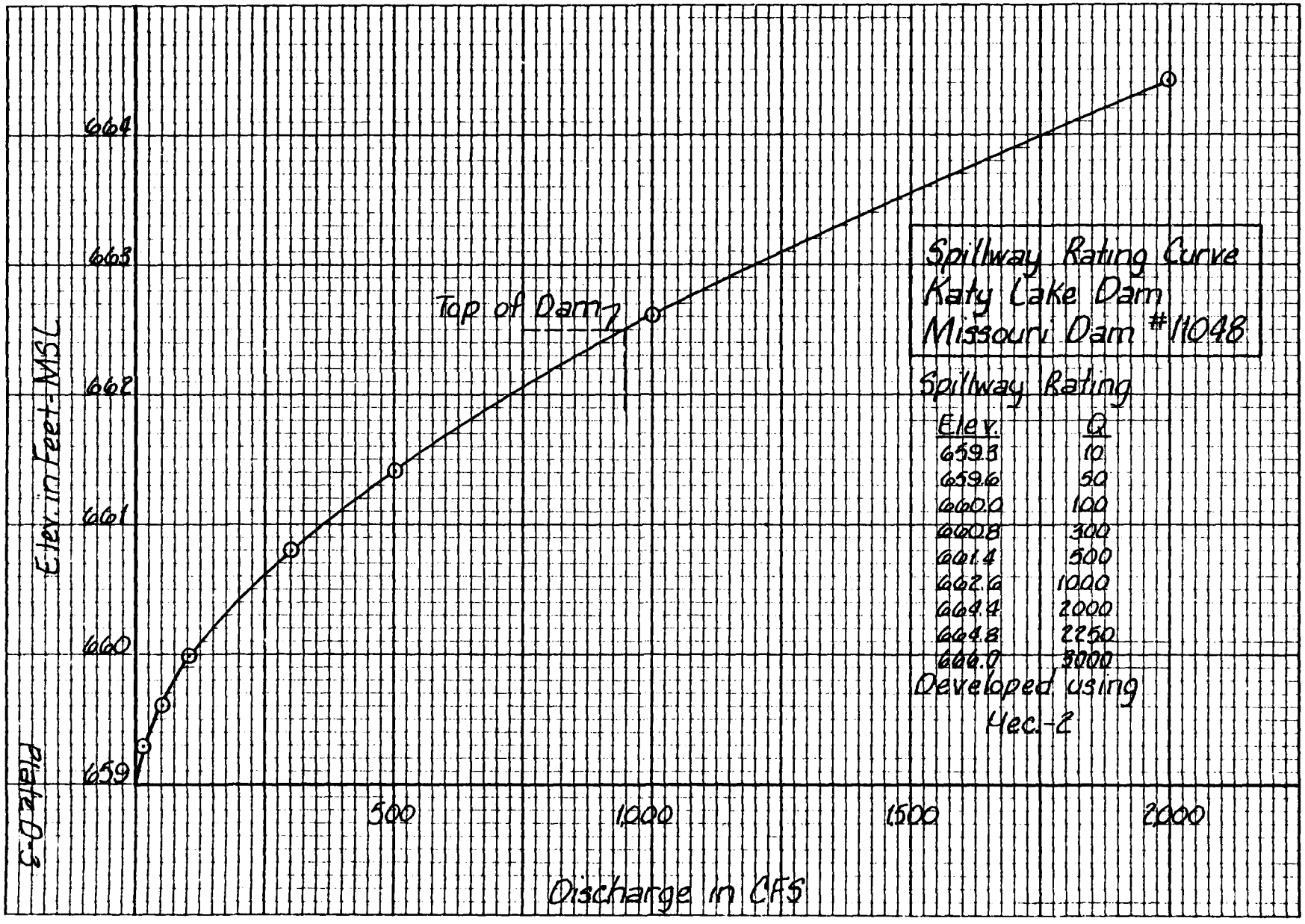


Plate D-3

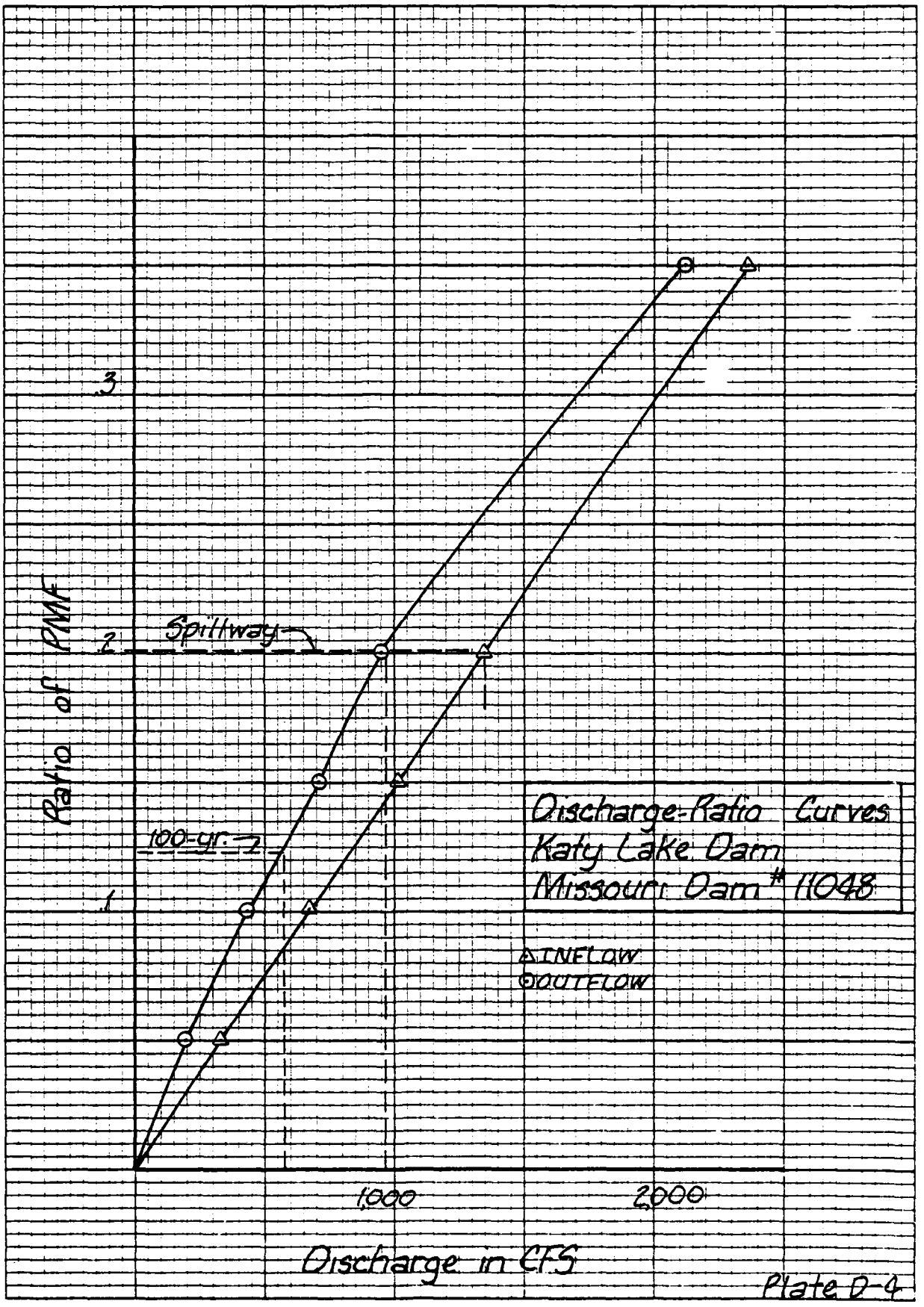


Plate D-4

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KATY LAKE DAM 11048
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 000288000000000000305                           000000000000000000000003
B1000005
J 000010000000000000001
J1000.0500000.1000000.1500000.2000000.3500000.5000000.6500000.80000001.0
K 00000000000001              00000000000000000000001
K1       CALCULATION OF INFLO HYDRO TO RES 11048
M 00000100000020300.998       0000.898000001.0                  00000001
P 000000000025.000000102000001210000130
T                                             -1.0   -78.0
W2       C0000.45
X 000000     -.0100000001
K 00000100000002              00000002000000000000001
K1       ROUTED FLOWS THRU RES 11048
Y                      000000100000001
Y1000001                                     -659.0      -1
Y40659.0000659.3000659.6000660.0000660.8000661.4000662.6000664.4000664.8
Y5000000000000101000005000000100000003000000005000000100000002000000002250
$S000000000000116000000330000005100000079000000900000112
$E0659.0000660.0000661.0000662.0000663.0000664.0000665.0
$$0659.0
$D0662.5000002.9000001.500000340
$L00005000000205000000260000002950000032000000335000000340
$V0662.5000662.7000663.0000663.3000663.5000663.9000664.5
K 000099
A
A
A
A
A
```

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE  79/08/17.
     TIME  13.20.27.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KATY LAKE DAM 11048
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	NWT	IROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .05 .10 .15 .20 .35 .50 .65 .80 1.00

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLO HYDRO TO RES 11048

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.90	0.00	.90	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.00	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-78.00	0.00	0.00

CURVE NO = -78.00 RTIMESS = -1.00 EFFECT CN = 78.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .45

RECESSION DATA

STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 29 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .45 VOL= 1.00

69.	209.	429.	693.	846.	881.	828.	720.	573.	411.
310.	236.	132.	137.	105.	80.	60.	45.	34.	26.
20.	15.	12.	9.	7.	5.	4.	2.	1.	

PLATE D-6

END-OF-PERIOD FLOW													
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.21	.19	.03	402.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.21	.19	.02	430.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.21	.19	.02	487.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.21	.19	.02	570.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.21	.19	.02	689.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.21	.19	.02	806.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.21	.19	.02	917.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.21	.19	.02	1015.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.21	.19	.02	1094.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.21	.20	.02	1153.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.21	.20	.02	1198.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.21	.20	.02	1235.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.24	.02	1267.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.26	.24	.02	1298.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.26	.24	.02	1334.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.26	.24	.02	1377.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.26	.24	.02	1424.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.26	.24	.01	1470.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.26	.24	.01	1512.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.26	.24	.01	1549.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.26	.24	.01	1579.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.26	.24	.01	1602.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.26	.24	.01	1621.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.26	.24	.01	1636.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.32	.31	.01	1652.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.32	.31	.01	1675.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	.32	.31	.01	1710.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.32	.31	.01	1760.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.32	.31	.01	1818.
1.01	2.30	30	.01	0.00	.01	0.	1.01	14.30	174	.32	.31	.01	1877.
1.01	2.35	31	.01	0.00	.01	0.	1.01	14.35	175	.32	.31	.01	1933.
1.01	2.40	32	.01	0.00	.01	0.	1.01	14.40	176	.32	.31	.01	1981.
1.01	2.45	33	.01	0.00	.01	0.	1.01	14.45	177	.32	.31	.01	2021.
1.01	2.50	34	.01	0.00	.01	0.	1.01	14.50	178	.32	.31	.01	2050.
1.01	2.55	35	.01	0.00	.01	0.	1.01	14.55	179	.32	.31	.01	2073.
1.01	3.00	36	.01	0.00	.01	0.	1.01	15.00	180	.32	.31	.01	2091.
1.01	3.05	37	.01	0.00	.01	0.	1.01	15.05	181	.39	.39	.01	2097.
1.01	3.10	38	.01	0.00	.01	0.	1.01	15.10	182	.39	.38	.01	2096.
1.01	3.15	39	.01	0.00	.01	0.	1.01	15.15	183	.39	.38	.01	2092.
1.01	3.20	40	.01	0.00	.01	0.	1.01	15.20	184	.58	.57	.01	2110.
1.01	3.25	41	.01	0.00	.01	0.	1.01	15.25	185	.68	.66	.01	2190.
1.01	3.30	42	.01	0.00	.01	0.	1.01	15.30	186	1.65	1.62	.03	2415.
1.01	3.35	43	.01	0.00	.01	0.	1.01	15.35	187	2.71	2.67	.04	2930.
1.01	3.40	44	.01	0.00	.01	0.	1.01	15.40	188	1.07	1.05	.01	3746.
1.01	3.45	45	.01	0.00	.01	0.	1.01	15.45	189	.68	.67	.01	4810.
1.01	3.50	46	.01	.00	.01	0.	1.01	15.50	190	.58	.57	.01	5867.
1.01	3.55	47	.01	.00	.01	0.	1.01	15.55	191	.39	.38	.00	6537.
1.01	4.00	48	.01	.00	.01	0.	1.01	16.00	192	.39	.38	.00	6749.
1.01	4.05	49	.01	.00	.01	0.	1.01	16.05	193	.30	.29	.00	6560.
1.01	4.10	50	.01	.00	.01	0.	1.01	16.10	194	.30	.29	.00	6072.
1.01	4.15	51	.01	.00	.01	1.	1.01	16.15	195	.30	.29	.00	5391.
1.01	4.20	52	.01	.00	.01	1.	1.01	16.20	196	.30	.29	.00	4674.
1.01	4.25	53	.01	.00	.01	1.	1.01	16.25	197	.30	.29	.00	4092.
1.01	4.30	54	.01	.00	.01	2.	1.01	16.30	198	.30	.29	.00	3623.
1.01	4.35	55	.01	.00	.01	3.	1.01	16.35	199	.30	.29	.00	3252.
1.01	4.40	56	.01	.00	.01	3.	1.01	16.40	200	.30	.29	.00	2962.
1.01	4.45	57	.01	.00	.01	4.	1.01	16.45	201	.30	.29	.00	2741.
1.01	4.50	58	.01	.00	.01	4.	1.01	16.50	202	.30	.29	.00	2575.
1.01	4.55	59	.01	.00	.01	5.	1.01	16.55	203	.30	.29	.00	2447.

1.01	5.00	60	.01	.00	.01	6.	1.01	17.00	204	.30	.29	.00	2350.
1.01	5.05	61	.01	.00	.01	6.	1.01	17.05	205	.23	.23	.00	2273.
1.01	5.10	62	.01	.00	.01	7.	1.01	17.10	206	.23	.23	.00	2205.
1.01	5.15	63	.01	.00	.01	8.	1.01	17.15	207	.23	.23	.00	2137.
1.01	5.20	64	.01	.00	.01	8.	1.01	17.20	208	.23	.23	.00	2061.
1.01	5.25	65	.01	.00	.01	9.	1.01	17.25	209	.23	.23	.00	1984.
1.01	5.30	66	.01	.00	.01	10.	1.01	17.30	210	.23	.23	.00	1911.
1.01	5.35	67	.01	.00	.01	10.	1.01	17.35	211	.23	.23	.00	1846.
1.01	5.40	68	.01	.00	.01	11.	1.01	17.40	212	.23	.23	.00	1789.
1.01	5.45	69	.01	.00	.01	12.	1.01	17.45	213	.23	.23	.00	1742.
1.01	5.50	70	.01	.00	.01	12.	1.01	17.50	214	.23	.23	.00	1708.
1.01	5.55	71	.01	.00	.01	13.	1.01	17.55	215	.23	.23	.00	1681.
1.01	6.00	72	.01	.00	.01	13.	1.01	18.00	216	.23	.23	.00	1662.
1.01	6.05	73	.07	.01	.05	15.	1.01	18.05	217	.02	.02	.00	1634.
1.01	6.10	74	.07	.02	.05	18.	1.01	18.10	218	.02	.02	.00	1580.
1.01	6.15	75	.07	.02	.05	24.	1.01	18.15	219	.02	.02	.00	1482.
1.01	6.20	76	.07	.02	.05	34.	1.01	18.20	220	.02	.02	.00	1329.
1.01	6.25	77	.07	.02	.04	48.	1.01	18.25	221	.02	.02	.00	1144.
1.01	6.30	78	.07	.02	.04	63.	1.01	18.30	222	.02	.02	.00	954.
1.01	6.35	79	.07	.03	.04	79.	1.01	18.35	223	.02	.02	.00	775.
1.01	6.40	80	.07	.03	.04	95.	1.01	18.40	224	.02	.02	.00	619.
1.01	6.45	81	.07	.03	.04	110.	1.01	18.45	225	.02	.02	.00	496.
1.01	6.50	82	.07	.03	.04	124.	1.01	18.50	226	.02	.02	.00	407.
1.01	6.55	83	.07	.03	.04	137.	1.01	18.55	227	.02	.02	.00	340.
1.01	7.00	84	.07	.03	.03	150.	1.01	19.00	228	.02	.02	.00	289.
1.01	7.05	85	.07	.03	.03	162.	1.01	19.05	229	.02	.02	.00	250.
1.01	7.10	86	.07	.03	.03	173.	1.01	19.10	230	.02	.02	.00	221.
1.01	7.15	87	.07	.03	.03	183.	1.01	19.15	231	.02	.02	.00	198.
1.01	7.20	88	.07	.04	.03	193.	1.01	19.20	232	.02	.02	.00	181.
1.01	7.25	89	.07	.04	.03	202.	1.01	19.25	233	.02	.02	.00	168.
1.01	7.30	90	.07	.04	.03	211.	1.01	19.30	234	.02	.02	.00	158.
1.01	7.35	91	.07	.04	.03	220.	1.01	19.35	235	.02	.02	.00	151.
1.01	7.40	92	.07	.04	.03	228.	1.01	19.40	236	.02	.02	.00	145.
1.01	7.45	93	.07	.04	.03	235.	1.01	19.45	237	.02	.02	.00	141.
1.01	7.50	94	.07	.04	.03	242.	1.01	19.50	238	.02	.02	.00	138.
1.01	7.55	95	.07	.04	.02	249.	1.01	19.55	239	.02	.02	.00	135.
1.01	8.00	96	.07	.04	.02	256.	1.01	20.00	240	.02	.02	.00	134.
1.01	8.05	97	.07	.04	.02	262.	1.01	20.05	241	.02	.02	.00	132.
1.01	8.10	98	.07	.04	.02	268.	1.01	20.10	242	.02	.02	.00	131.
1.01	8.15	99	.07	.04	.02	274.	1.01	20.15	243	.02	.02	.00	130.
1.01	8.20	100	.07	.04	.02	279.	1.01	20.20	244	.02	.02	.00	130.
1.01	8.25	101	.07	.05	.02	284.	1.01	20.25	245	.02	.02	.00	129.
1.01	8.30	102	.07	.05	.02	289.	1.01	20.30	246	.02	.02	.00	129.
1.01	8.35	103	.07	.05	.02	294.	1.01	20.35	247	.02	.02	.00	129.
1.01	8.40	104	.07	.05	.02	298.	1.01	20.40	248	.02	.02	.00	129.
1.01	8.45	105	.07	.05	.02	303.	1.01	20.45	249	.02	.02	.00	129.
1.01	8.50	106	.07	.05	.02	307.	1.01	20.50	250	.02	.02	.00	129.
1.01	8.55	107	.07	.05	.02	311.	1.01	20.55	251	.02	.02	.00	129.
1.01	9.00	108	.07	.05	.02	315.	1.01	21.00	252	.02	.02	.00	129.
1.01	9.05	109	.07	.05	.02	319.	1.01	21.05	253	.02	.02	.00	129.
1.01	9.10	110	.07	.05	.02	322.	1.01	21.10	254	.02	.02	.00	129.
1.01	9.15	111	.07	.05	.02	326.	1.01	21.15	255	.02	.02	.00	129.
1.01	9.20	112	.07	.05	.02	329.	1.01	21.20	256	.02	.02	.00	129.
1.01	9.25	113	.07	.05	.02	332.	1.01	21.25	257	.02	.02	.00	129.
1.01	9.30	114	.07	.05	.02	335.	1.01	21.30	258	.02	.02	.00	129.
1.01	9.35	115	.07	.05	.01	338.	1.01	21.35	259	.02	.02	.00	129.
1.01	9.40	116	.07	.05	.01	341.	1.01	21.40	260	.02	.02	.00	129.
1.01	9.45	117	.07	.05	.01	344.	1.01	21.45	261	.02	.02	.00	129.
1.01	9.50	118	.07	.05	.01	346.	1.01	21.50	262	.02	.02	.00	129.
1.01	9.55	119	.07	.05	.01	349.	1.01	21.55	263	.02	.02	.00	129.
1.01	10.00	120	.07	.05	.01	351.	1.01	22.00	264	.02	.02	.00	129.
1.01	10.05	121	.07	.05	.01	354.	1.01	22.05	265	.02	.02	.00	129.

PLATE D-8

1.01	10.10	122	.07	.05	.01	356.	1.01	22.10	266	.02	.02	.00	129.
1.01	10.15	123	.07	.05	.01	358.	1.01	22.15	267	.02	.02	.00	129.
1.01	10.20	124	.07	.05	.01	360.	1.01	22.20	268	.02	.02	.00	129.
1.01	10.25	125	.07	.05	.01	363.	1.01	22.25	269	.02	.02	.00	129.
1.01	10.30	126	.07	.05	.01	365.	1.01	22.30	270	.02	.02	.00	129.
1.01	10.35	127	.07	.05	.01	367.	1.01	22.35	271	.02	.02	.00	129.
1.01	10.40	128	.07	.05	.01	368.	1.01	22.40	272	.02	.02	.00	129.
1.01	10.45	129	.07	.05	.01	370.	1.01	22.45	273	.02	.02	.00	129.
1.01	10.50	130	.07	.06	.01	372.	1.01	22.50	274	.02	.02	.00	129.
1.01	10.55	131	.07	.06	.01	374.	1.01	22.55	275	.02	.02	.00	129.
1.01	11.00	132	.07	.06	.01	376.	1.01	23.00	276	.02	.02	.00	129.
1.01	11.05	133	.07	.06	.01	377.	1.01	23.05	277	.02	.02	.00	129.
1.01	11.10	134	.07	.06	.01	379.	1.01	23.10	278	.02	.02	.00	129.
1.01	11.15	135	.07	.06	.01	380.	1.01	23.15	279	.02	.02	.00	129.
1.01	11.20	136	.07	.06	.01	382.	1.01	23.20	280	.02	.02	.00	129.
1.01	11.25	137	.07	.06	.01	383.	1.01	23.25	281	.02	.02	.00	129.
1.01	11.30	138	.07	.06	.01	385.	1.01	23.30	282	.02	.02	.00	129.
1.01	11.35	139	.07	.06	.01	386.	1.01	23.35	283	.02	.02	.00	129.
1.01	11.40	140	.07	.06	.01	387.	1.01	23.40	284	.02	.02	.00	129.
1.01	11.45	141	.07	.06	.01	389.	1.01	23.45	285	.02	.02	.00	129.
1.01	11.50	142	.07	.06	.01	390.	1.01	23.50	286	.02	.02	.00	129.
1.01	11.55	143	.07	.06	.01	391.	1.01	23.55	287	.02	.02	.00	129.
1.01	12.00	144	.07	.06	.01	392.	1.02	0.00	288	.02	.02	.00	129.
									SUM	32.50	29.34	3.16	203079.
										(825.1(	745.1(	80.1(	5750.56)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6749.	2338.	705.	705.	203035.
CMS	191.	66.	20.	20.	5749.
INCHES		24.22	29.21	29.21	29.21
MM		615.23	741.97	741.97	741.97
AC-FT		1159.	1398.	1398.	1398.
THOUS CU M		1430.	1725.	1725.	1725.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	337.	117.	35.	35.	10152.
CMS	10.	3.	1.	1.	287.
INCHES		1.21	1.46	1.46	1.46
MM		30.76	37.10	37.10	37.10
AC-FT		58.	70.	70.	70.
THOUS CU M		72.	86.	86.	86.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	675.	234.	70.	70.	20304.
CMS	19.	7.	2.	2.	575.
INCHES		2.42	2.92	2.92	2.92
MM		61.52	74.20	74.20	74.20
AC-FT		116.	140.	140.	140.
THOUS CU M		143.	172.	172.	172.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1012.	351.	106.	106.	30455.
CMS	29.	10.	3.	3.	862.
INCHES		3.69	4.38	4.38	4.38
MM		92.28	111.30	111.30	111.30
AC-FT		174.	210.	210.	210.
THOUS CU M		215.	259.	259.	259.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1350.	468.	141.	141.	40607.
CMS	38.	13.	4.	4.	1150.
INCHES		4.84	5.84	5.84	5.84
MM		123.05	148.39	148.39	148.39
AC-FT		232.	280.	280.	280.
THOUS CU M		286.	345.	345.	345.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2362.	818.	247.	247.	71062.
CMS	67.	23.	7.	7.	2012.
INCHES		8.48	10.22	10.22	10.22
MM		215.33	259.69	259.69	259.69
AC-FT		406.	489.	489.	489.
THOUS CU M		501.	604.	604.	604.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6 0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3374.	1169.	352.	352.	101518.
CMS	96.	33.	10.	10.	2875.
INCHES		12.11	14.61	14.61	14.61
MM		307.61	370.99	370.99	370.99
AC-FT		580.	699.	699.	699.
THOUS CU M		715.	862.	862.	862.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4387.	1520.	458.	458.	131973.
CMS	124.	43.	13.	13.	3737.
INCHES		15.74	18.99	18.99	18.99
MM		399.90	482.28	482.28	482.28
AC-FT		754.	909.	909.	909.
THOUS CU M		930.	1121.	1121.	1121.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CFS	5399.	1871.	564.	564.	162428.
CMS	153.	53.	16.	16.	4599.
INCHES		19.38	23.37	23.37	23.37
MM		492.18	593.58	593.58	593.58
AC-FT		929.	1119.	1119.	1119.
THOUS CU M		1144.	1380.	1380.	1380.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6749.	2338.	705.	705.	203035.
CMS	191.	66.	20.	20.	5749.
INCHES		24.22	29.21	29.21	29.21
MM		615.23	741.97	741.97	741.97
AC-FT		1159.	1398.	1398.	1398.
THOUS CU M		1430.	1725.	1725.	1725.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RES 11048

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-659.	-1

STAGE	659.00	659.30	659.60	660.00	660.80	661.40	662.60	664.40	664.80
FLOW	0.00	10.00	50.00	100.00	300.00	500.00	1000.00	2000.00	2250.00
CAPACITY=	0.	16.	31.	51.	70.	90.	112.		
ELEVATION=	659.	660.	661.	662.	663.	664.	665.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
659.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
662.5	2.9	1.5	340.

CREST LENGTH	50.	205.	260.	295.	320.	335.	340.
AT OR BELOW ELEVATION	662.5	662.6	663.0	663.3	663.5	663.9	664.5

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

PLATE D-11

CVN

STATION 000002, PLAN 1, RATIO 9 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	2.	2.	3.	3.	4.	5.	6.
8.	9.	14.	21.	28.	36.	44.	52.	60.	67.
75.	83.	90.	98.	111.	125.	137.	150.	161.	172.
183.	193.	202.	212.	220.	228.	236.	243.	250.	257.
264.	270.	276.	281.	286.	292.	296.	301.	307.	313.
318.	322.	327.	331.	335.	338.	342.	345.	348.	351.
354.	356.	359.	361.	364.	366.	368.	370.	372.	373.
375.	377.	379.	380.	382.	386.	395.	411.	438.	475.
526.	591.	660.	728.	792.	852.	908.	960.	1028.	1121.
1209.	1290.	1362.	1424.	1476.	1519.	1555.	1583.	1607.	1630.
1655.	1687.	1729.	1778.	1832.	1886.	1936.	1980.	2017.	2046.
2068.	2081.	2087.	2094.	2120.	2206.	2434.	2903.	3646.	4609.
5591.	6254.	6512.	6385.	5967.	5380.	4772.	4232.	3787.	3419.
3113.	2866.	2678.	2514.	2423.	2333.	2254.	2181.	2107.	2034.
1964.	1899.	1842.	1792.	1751.	1718.	1690.	1656.	1606.	1528.
1419.	1284.	1146.	1018.	940.	872.	802.	732.	664.	601.
543.	493.	454.	420.	388.	359.	332.	307.	289.	274.
261.	248.	237.	227.	217.	209.	201.	194.	188.	182.
177.	173.	169.	165.	161.	158.	155.	153.	151.	149.
147.	145.	144.	142.	141.	140.	139.	138.	137.	136.
136.	135.	135.	134.	134.	133.	133.	133.	132.	132.
132.	132.	131.	131.	131.	131.	131.	131.		

STORAGE

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	3.
4.	5.	6.	7.	8.	9.	10.	11.	12.	
13.	14.	15.	16.	17.	18.	19.	19.	20.	21.
22.	22.	23.	24.	24.	25.	25.	26.	26.	27.
27.	28.	28.	28.	29.	29.	29.	30.	30.	30.
31.	31.	31.	31.	31.	32.	32.	32.	32.	32.
32.	32.	33.	33.	33.	33.	33.	33.	33.	33.
33.	34.	34.	34.	34.	34.	35.	35.	37.	39.
41.	44.	47.	50.	53.	56.	58.	61.	63.	65.
66.	68.	69.	70.	71.	71.	72.	72.	72.	73.
73.	74.	74.	75.	75.	76.	77.	77.	78.	78.
78.	78.	78.	79.	79.	80.	82.	87.	94.	102.
110.	115.	117.	116.	113.	108.	103.	99.	95.	92.
89.	87.	85.	83.	82.	81.	80.	80.	79.	78.
77.	76.	76.	75.	74.	74.	74.	73.	72.	71.
70.	68.	65.	63.	60.	57.	54.	50.	47.	45.
42.	40.	38.	36.	34.	33.	31.	30.	29.	28.

27.	26.	25.	25.	24.	23.	23.	22.	22.	22.
21.	21.	21.	20.	20.	20.	20.	20.	19.	19.
19.	19.	19.	19.	19.	19.	19.	19.	19.	18.
18.	18.	19.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.		

STAGE

659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0	659.0
659.1	659.1	659.1	659.1	659.1	659.1	659.1	659.1	659.2	659.2
659.2	659.3	659.3	659.4	659.4	659.5	659.6	659.6	659.7	659.7
659.9	659.9	659.9	660.0	660.0	660.1	660.1	660.2	660.2	660.3
660.3	660.4	660.4	660.4	660.5	660.5	660.5	660.6	660.6	660.6
660.7	660.7	660.7	660.7	660.7	660.8	660.8	660.8	660.8	660.8
660.9	660.9	660.9	660.9	660.9	660.9	660.9	660.9	660.9	661.0
661.0	661.0	661.0	661.0	661.0	661.0	661.0	661.0	661.0	661.0
661.0	661.0	661.0	661.0	661.0	661.1	661.1	661.1	661.2	661.3
661.5	661.6	661.8	661.9	662.1	662.2	662.4	662.5	662.6	662.7
662.8	662.9	662.9	663.0	663.0	663.1	663.1	663.1	663.1	663.1
663.2	663.2	663.2	663.2	663.3	663.3	663.3	663.4	663.4	663.4
663.4	663.4	663.4	663.4	663.4	663.5	663.6	663.8	664.2	664.6
664.9	665.1	665.2	665.2	665.0	664.8	664.6	664.4	664.2	664.1
663.9	663.8	663.7	663.7	663.6	663.6	663.5	663.5	663.4	663.4
663.4	663.3	663.3	663.2	663.2	663.2	663.2	663.2	663.1	663.1
663.0	662.9	662.7	662.6	662.5	662.3	662.1	662.0	661.8	661.6
661.5	661.4	661.3	661.2	661.1	661.0	660.9	660.8	660.8	660.7
660.6	660.6	660.5	660.5	660.5	660.4	660.4	660.4	660.4	660.3
660.3	660.3	660.3	660.3	660.2	660.2	660.2	660.2	660.2	660.2
660.2	660.2	660.2	660.2	660.2	660.2	660.2	660.2	660.1	660.1
660.1	660.1	660.1	660.1	660.1	660.1	660.1	660.1	660.1	660.1
660.1	660.1	660.1	660.1	660.1	660.1	660.1	660.1		

PEAK OUTFLOW IS 6512. AT TIME 16.08 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6512.	2306.	696.	696.	200410.
CMS	184.	65.	20.	20.	5675.
INCHES		23.89	28.83	28.83	28.83
MM		606.82	732.38	732.38	732.38
AC-FT		1144.	1380.	1380.	1380.
THOUS CU M		1411.	1702.	1702.	1702.

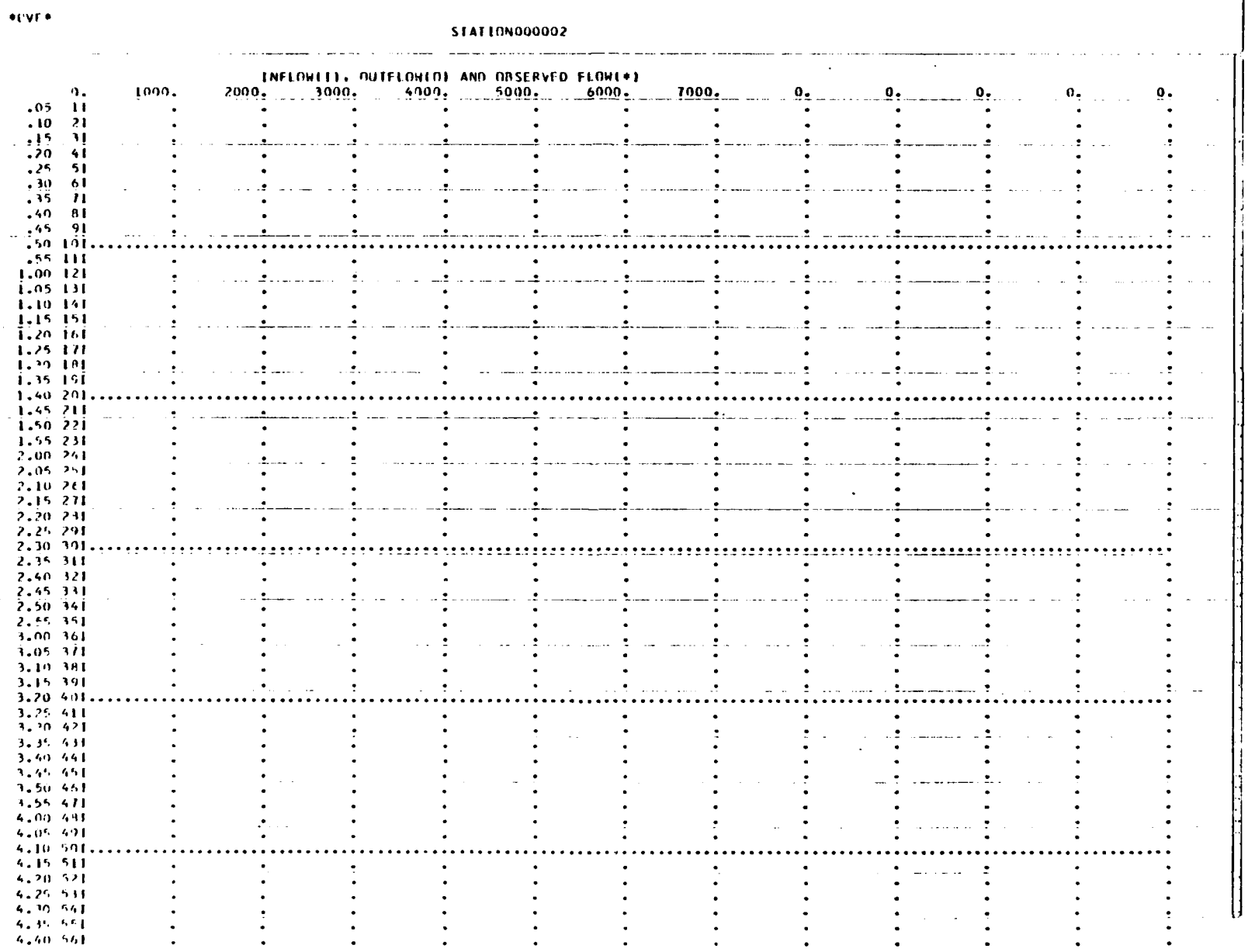

EVE
STATION000002
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 1000. 2000. 3000. 4000. 5000. 6000. 7000. 0. 0. 0. 0. 0.

PLATE D-14

PLATE D-15

PLATE D-16

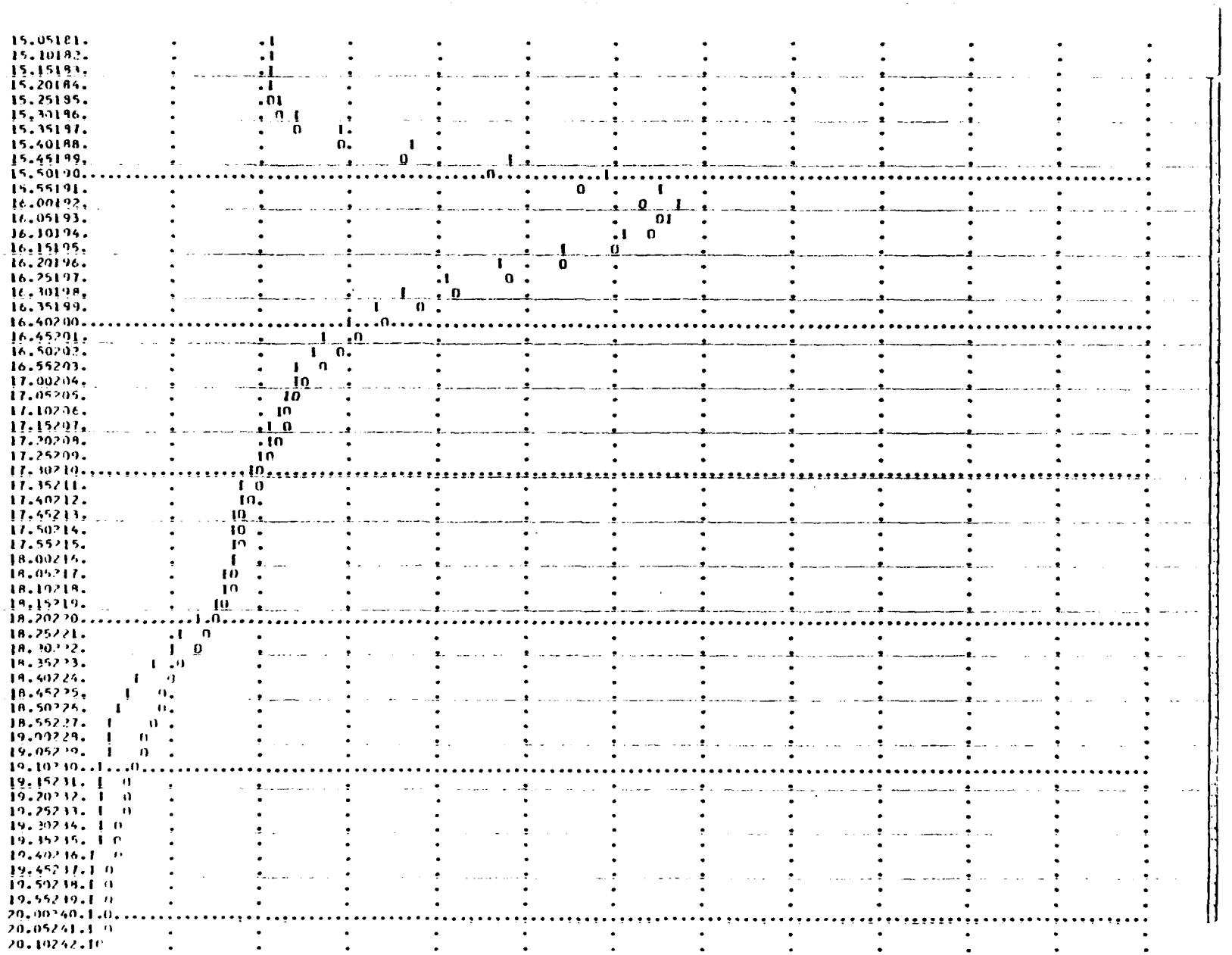


PLATE D-17

PLATE D-18

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .20	RATIO 5 .35	RATIO 6 .50	RATIO 7 .65	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT	000001	.90	1	337.	675.	1012.	1350.	2362.	3374.	4387.	5399.	6749.
	(	2.33)	(	9.56)(	19.11)(	28.67)(	38.22)(	66.89)(	95.55)(	124.22)(	152.88)(	191.11)
ROUTED TO	000002	.90	1	198.	438.	702.	949.	2115.	3165.	4159.	5171.	6512.
	(	2.33)	(	5.59)(	12.41)(	19.87)(	26.88)(	59.89)(	89.62)(	117.76)(	146.43)(	184.41)

PLATE D-19

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	659.00	659.00	662.50
STORAGE	0.	0.	61.
OUTFLOW	0.	0.	958.

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
.05	660.39	0.00	23.	198.	0.00	16.42	0.00
.10	661.21	0.00	37.	438.	0.00	16.42	0.00
.15	661.88	0.00	49.	702.	0.00	16.33	0.00
.20	662.48	0.00	60.	949.	0.00	16.33	0.00
.35	663.44	.94	79.	2115.	1.33	16.17	0.00
.50	663.96	1.46	89.	3165.	2.67	16.08	0.00
.65	664.38	1.88	98.	4159.	4.25	16.08	0.00
.80	664.75	2.25	107.	5171.	5.08	16.08	0.00
1.00	665.21	2.71	117.	6512.	5.58	16.08	0.00