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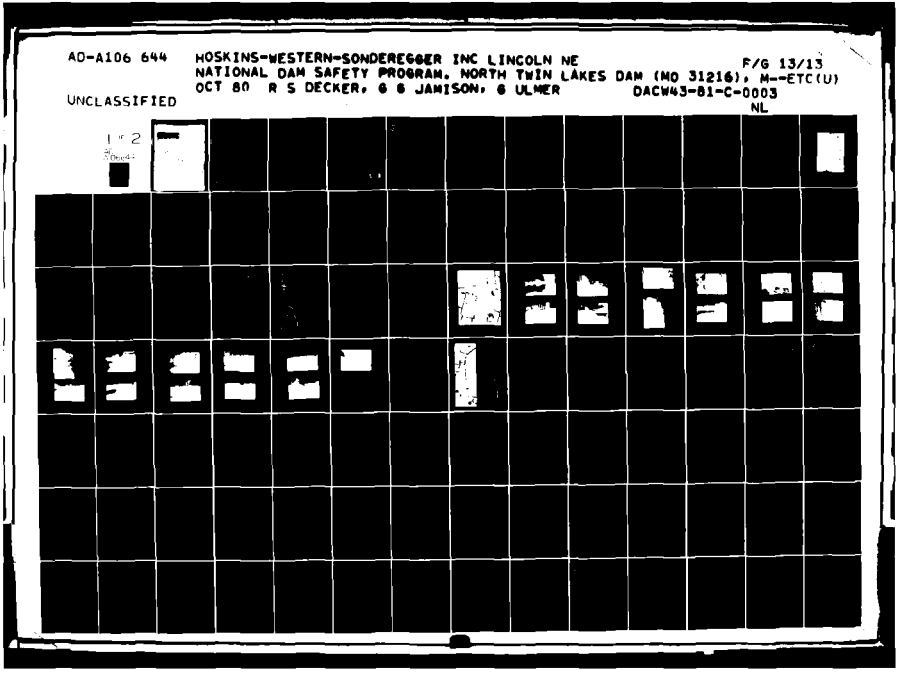

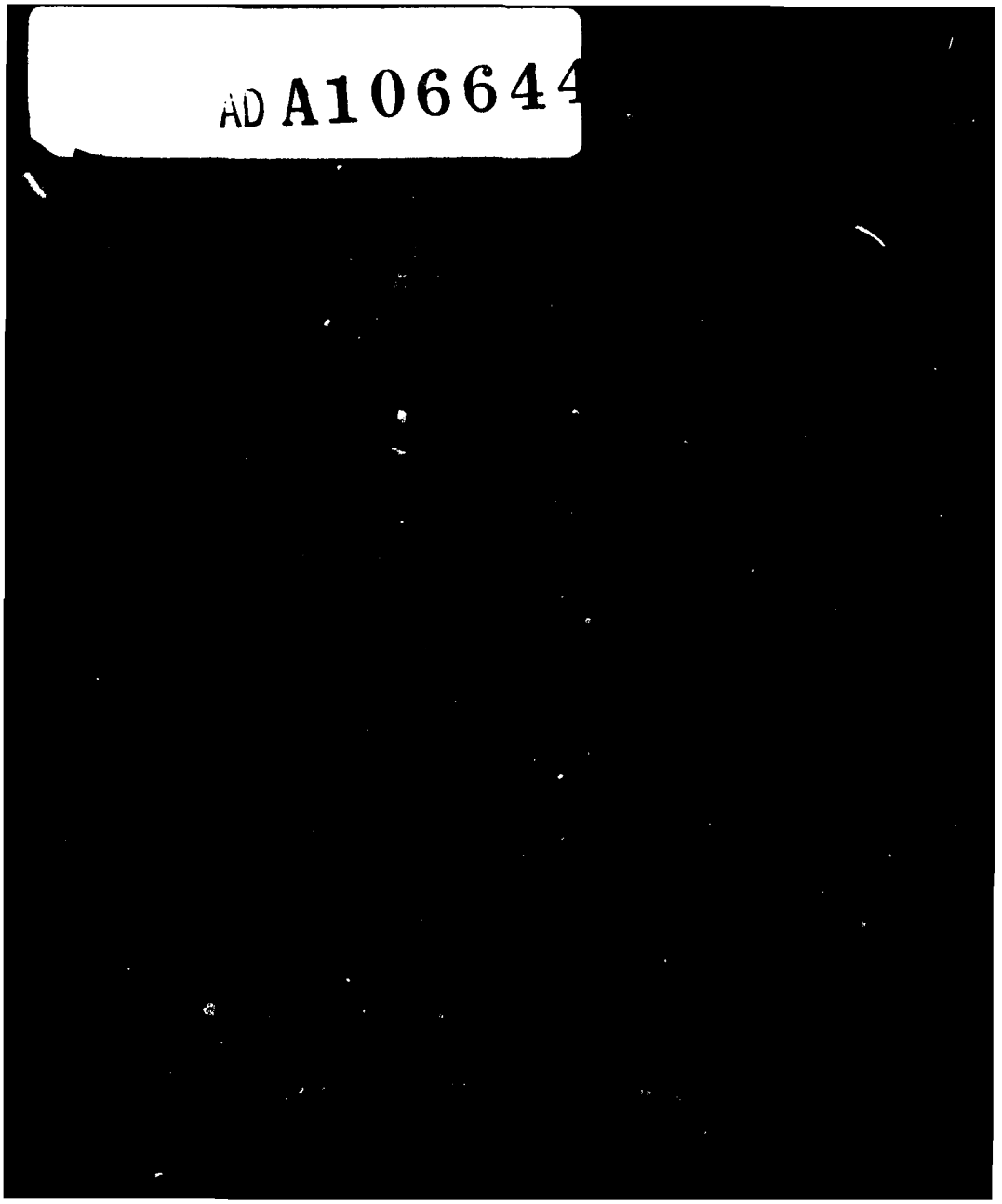
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National Dam Safety Program. North Twin Lakes Dam (MO 31216), Mississippi - Kaskaskia - St. Louis Basin, Cape Girardeau County, Missouri. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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.

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NORTH TWIN LAKES DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. MO 31216

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

OCTOBER, 1980

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REPLY TO ATTENTION OF

SUBJECT: North Twin Lakes Dam - MO 31216

This report presents the results of field inspection and evaluation of the North Twin Lakes Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

7 MAY 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

11 MAY 1981
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

APPENDIX A - MAPS

APPENDIX B - PHOTOGRAPHS

APPENDIX C - PROJECT PLATES

Plate C-1	Phase I - Plan and Centerline Profile of Dam
Plate C-2	Phase I - Maximum Cross Section of Dam at Sta. 1+50 and Profile along Centerline of Emergency Spillway

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 and D-2	Hydrologic Computations
Plate D-3	Principal Spillway Discharge Rating Curve
Plate D-4	Emergency Spillway Discharge Rating Curve
Plate D-5	Elevation-Area Curve
Plates D-6 through D-53	Computer Input and Output for Ratios of PMF

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	North Twin Lakes Dam
State Located	Missouri
County Located	Cape Girardeau County
Stream	Tributary to Tributary to Ramsey Branch
Date of Inspection	October 30, 1980

North Twin Lakes 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 conditions 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.

North Twin Lakes Dam has a height of twenty-seven (27) feet and a storage capacity at the minimum top elevation of the dam of eighty-seven (87) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. North Twin Lakes Dam is classified as a small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately one (1) mile downstream of the dam. Within the damage zone are eight dwellings and two garages (0.05 to 0.2 miles downstream) and one dwelling (0.35 miles downstream).

Our inspection and evaluation indicates that the spillways meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the small volume of water impounded and the broad downstream floodplain, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (1% probability flood - a flood having a one percent chance of being exceeded in any one year) without overtopping the dam. The spillways will pass 50% 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.

North Twin Lakes Dam is in excellent condition. The deficiencies noted are the growth of trees on the downstream slope, rodent activity on the downstream slope and the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential.

Design data were not available for this dam. Based on visual observation and on the analyses made during and subsequent to the inspection, the following recommendations are made:

a. Alternatives.

(1) The spillways will accommodate 50 percent of the probable maximum flood without overtopping the dam. No alternatives are required.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.

(2) The trees growing on the downstream crestline and slope should be removed. Tree removal should be done under the guidance of an engineer experienced in the design and construction of dams.

(3) Rodent holes on the downstream slope should be repaired. A program should be developed to eliminate rodent activity on the dam.

(4) The crawfish holes along and above the water's edge are shallow and probably do not endanger the dam. They do, however, constitute a weakness where erosion can begin. In lieu of attempting to eliminate the crawfish population, it is recommended that monitoring of the holes and repair of eroded areas become a part of the maintenance program.

(5) The low volume seep in the left (south) abutment trough should be monitored on a periodic basis.

(6) The excellent maintenance program that accounts for the neat and clean appearance of this dam should be continued.

(7) A program of periodic inspections should be initiated. Records of the inspections should be made a part of this project file.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-19246

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

PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NORTH TWIN LAKES DAM - MO 31216
CAPE GIRARDEAU 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 North Twin Lakes 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) Embankment. The embankment is an earthfill structure approximately 300 feet in length and 27 feet in height with a maximum storage capacity at the minimum top of dam elevation of 87 acre-feet. Photo No. 1 and Plate A-1 show a small dam and reservoir approximately 900 feet upstream from this dam. Survey data were obtained on the upstream dam and its spillways during the inspection. This information was used in the hydraulic/hydrologic analyses presented in Section 5 of this report.

(2) Principal Spillway.

(a) Inlet Structure. The inlet structure is an 18-inch corrugated metal pipe riser. The crest of the riser is at elevation 444.8 feet and the bottom is at elevation 427.2 feet. There is a trash rack and straining screen over the inlet. Photo No. 8 shows the inlet to the riser.

(b) Conduit. The conduit consists of 121 feet of 15-inch corrugated metal pipe. It has an invert elevation at the floor of the riser of 427.2 feet and an outlet invert elevation of 422.5 feet. The inlet is at Station 1+50 and the outlet is downstream from Station 1+30. Photos 12 and 13 show the outlet end of the conduit.

(c) Stilling Basin. There is no constructed stilling basin. The principal spillway outlets into the natural channel where a plunge pool has developed by scouring down to bedrock. Photo No. 13 shows the plunge pool.

(3) Emergency Spillway. The emergency spillway is uncontrolled and is located in the right (north) abutment of the dam. It consists of a vegetated earth entrance channel leading to a parabolic shaped depression in the asphalt surfaced road that crosses the dam. The road section serves as the control section. Flows downstream from the control section will follow an asphalt surfaced street through a residential area downstream from the dam. Photos 15, 16 and 17 show views of the emergency spillway.

(4) Low-Level Outlet. There is no low-level outlet.

(5) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in the east-central portion of Cape Girardeau County, Missouri, approximately 2 miles west of the northwest corner of the City of Cape Girardeau, as shown on Plate A-2. The dam and reservoir are shown on Plate A-1 in the NW 1/4 Sec. 34, T.31N., R.13E.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. North Twin Lakes Dam has a height of 27 feet and a storage capacity of 87 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines, this dam is in the High Hazard Potential

Classification. The estimated damage zone extends approximately one mile downstream of the dam. Within the damage zone are eight dwellings and two garages (0.05 to 0.2 miles downstream) and one dwelling (0.35 miles downstream).

e. Ownership. This dam is owned by the Twin Lakes Home Owners Association, Route 2, Box 533B, Cape Girardeau, Missouri 63701 - Attention: John Mills, President.

f. Purpose of Dam. The dam was built to provide a recreational reservoir for the home owners.

g. Design and Construction History. Information provided by Mr. C. R. Hertling, local home owner, and Mr. John Mills indicates that the dam was built about 10 years ago by a Calvin Phillips under the supervision of the Soil Conservation Service, Jackson, Missouri. They said the dam had a core trench about 12 feet wide at the bottom and 20 feet across the top. No other information was available.

h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

1.3 PERTINENT DATA

a. Drainage Area. 70.1 acres (0.11 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through the following:

(a) An uncontrolled principal spillway consisting of an 18-inch corrugated metal pipe drop inlet which is connected to a 15-inch corrugated metal pipe conduit that extends through the base of the dam.

(b) An uncontrolled emergency spillway formed by a parabolic shaped depression in the road profile at the right (north) end of the dam.

(2) Estimated maximum flood at damsite - Mr. Hertling and Mr. Mills indicated that the emergency spillway had flowed 6 to 8 inches deep about five years ago following a 7 to 8-inch rainstorm.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 444.8 feet to 13 c.f.s. at the crest of the emergency spillway (elevation 447.3 feet) to 14 c.f.s. at the minimum top of dam (elevation 449.2 feet).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest (elevation 447.3 feet) to 511 c.f.s. at the minimum top of dam (elevation 449.2 feet).

(5) Total spillway capacity at the minimum top of dam is 525 c.f.s. ±.

c. Elevations (feet above M.S.L.)

(1) Observed pool - 443.0

(2) Normal pool - 444.8

(3) Spillway crests

Principal - 444.8

Emergency - 447.3

(4) Maximum experienced pool - 447.9±

(5) Top of dam (minimum) - 449.2

(6) Streambed - 422±

(7) Maximum tailwater - unknown

d. Reservoir. Length (feet) of pool.

(1) At principal spillway crest - 850±
(2) At emergency spillway crest - 850± } At base of upper dam
(3) At top of dam (minimum) - 900±

e. Storage (acre-feet).

(1) Observed pool - 47±

(2) Normal pool - 57±

(3) Spillway crests

Principal - 57±

Emergency - 76±

(4) Maximum experienced pool - 79±

(5) Top of dam (minimum) - 87±

f. Reservoir Surface (acres).

(1) Observed pool - 5.5±

(2) Normal pool - 6.0±

(3) Spillway crests

Principal - 6.0±

Emergency - 6.6±

(4) Maximum experienced pool - 6.7±

(5) Top of dam (minimum) - 7.1±

g. Dam.

(1) Type - Earthfill

(2) Length - 300 feet

(3) Height - 27 feet

(4) Top width - 25 feet

(5) Side slopes

(a) Downstream - 1V on 3.0± H

(b) Upstream - 1V on 3.5± H

(6) Zoning - unknown

(7) Impervious core - Mr. Hertling stated it had a core trench with about 12-foot bottom width and 20-foot top width

(8) Cutoff - unknown

(9) Grout curtain - none

(10) Wave protection - vegetated earth

(11) Drains - unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillways.

(1) Principal

(a) Type - uncontrolled, 18-inch diameter corrugated metal pipe drop inlet connected to a 15-inch corrugated metal pipe conduit that extends through the base of dam

(b) Crest (invert) elevation - 444.8 feet

Outlet - 422.5 feet

(c) Length - 121 feet

(2) Emergency

(a) Type - Depression in road profile at right abutment

(b) Control section - Paved (asphalt mat) road surface about 21 feet wide

(c) Crest elevation - Minimum top of road - 447.3 feet

(d) Upstream channel - Well vegetated, open

(e) Downstream channel - Asphalt surfaced road and side ditches (see Photos 16 and 17)

j. Regulating Outlets. None

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 Mr. Hertling and Mr. Mills that the dam was constructed approximately 10 years ago by a Mr. Calvin Phillips, and that construction was supervised by the Soil Conservation Service, Jackson, Missouri.

2.3 OPERATION

There are no operation facilities for this dam.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observations presented in this report are considered adequate to support the conclusions 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 North Twin Lakes Dam was made on October 30, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology

Mr. John Mills, President of the Twin Lakes Home Owners Association, and Mr. C. R. Hertling, local home owner, visited the inspection team on site and were interviewed for a short period during the inspection.

b. Dam.

(1) Geology and Soils (abutment and embankment). The embankment is situated in the loess mantled uplands on the eastern border of the Ozark Physiographic Province. The predominate soil association is the Memphis-Loring silty clay loam. The predominate structural features are the Radio Tower Structure, Jackson Fault and Cape Girardeau Fault. The embankment is located in Seismic Zone 3 (coefficient 0.10).

Samples taken on the embankment by hand auger at a depth of approximately 2 feet were field classified as CL-CH and are derived from the loess mantle. This mantle is 5 to 20 feet thick and covers a bedrock of Ordovician age. Dolomitic gravels in the alluvium suggest that the unexposed bedrock formation is the Rock Levee formation of intercolated limestones and dolomites without significant secondary porosity. Local wells developed in this formation are low in yield and specific gravity. The abutments rest on the loess mantle.

Seepage from the impoundment is controlled by the alluvium which is a gravelly and clayey silt. Catastrophic collapse due to leakage from the impoundment is not reported in this region. Solution cavitation was not found in the outcrops of the local limestones.

The embankment occurs in a seismic zone with a major probability of seismic activity. Earthquakes with Modified Mercalli intensities equal to or greater than V occurred in 1812, 1819, 1878, 1882, 1903, 1905, 1909, 1930, 1974, and 1977. These quakes are within a fifty-mile radial distance of the dam.

(2) Upstream Slope. The upstream slope is well vegetated with fescue and native grasses which have provided very good protection against erosion. There are a number of crawfish

or salamander holes bored into the upstream slope varying from just above the water surface to approximately 2 feet above the water surface. There was no evidence of excessive erosion along the water line; no trees or shrubs on the slope; and no cracks, slumps, or abnormal deformations. The slope had been recently mowed and was very attractive in appearance. The lake level was approximately 1.8 feet below normal pool level at the time of inspection. Photos 5, 6 and 7 show views of the upstream slope.

(3) Crest. The crest of this dam was constructed unusually wide (25 feet) in order to carry vehicular traffic. The length of the dam is traversed by a 21-foot wide asphaltic concrete street. The pavement was in excellent condition with no evidence of cracking or uneven settlement. The remaining crest width on each side of the pavement is well vegetated, uniform in appearance and free from cracks or erosion. A view of the crest is shown in Photo No. 4.

(4) Downstream Slope. The downstream slope is also well vegetated with fescue and native grasses which had been recently mowed. There was no evidence of cracks, slides, slumps or erosion on the slope. There also was no evidence to indicate that the dam has been overtopped. Minimal rodent activity was observed as shown in Photo No. 14. There was no seepage along the toe of the dam or on the slope. A hand auger boring made approximately 10 feet above the toe showed no indications of water. A low volume (0.1 gallon per minute or less) seep was observed in the left (south) abutment trough as shown in Photo No. 11. The seep is iron stained and emerges at about the elevation of the principal spillway conduit. A screen of Poplar trees has been planted along the downstream crestline from Station 1+00 to Station 4+00. The screen angles at Station 1+00 and follows down the slope to the approximate location of the outlet end of the principal spillway conduit. The trees are 3 to 4 inches in diameter and 20 to 30 feet in height. Several Apple trees have also been planted on the downstream slope. Photos 3 and 10 show views of the downstream slope.

c. Appurtenant Structures.

(1) Principal Spillway.

(a) Inlet Structure. The inlet structure consisting of an 18-inch corrugated metal pipe drop inlet equipped with a trash rack appears to be in good operating condition. The area around the inlet was free of debris as was the trash rack. The inlet is shown in Photo No. 8.

(b) Conduit. The inspection of the conduit was limited to a length of approximately six feet that was exposed at the

outlet end. The pipe appeared to be in excellent condition. Water standing in the plunge pool is believed to be surface runoff from the dam and abutment troughs. There was no flow from the conduit, and there was no evidence that would indicate seepage along the conduit. Photos 12 and 13 show views of the outlet end of the conduit and the plunge pool.

(c) Stilling Basin. There is no constructed stilling basin. The principal spillway conduit outlets into the nature channel. Flows through the conduit have formed a plunge pool as shown in Photos 12 and 13. The pool is bottomed on bedrock and appears to be stable with no signs of recent erosion.

(2) Emergency Spillway. The emergency spillway is in excellent condition. The approach channel upstream from the control section is well vegetated and free of obstructions. The asphaltic concrete control section is in excellent condition as is the downstream channel. Views of the downstream channel are shown in Photos 15, 16 and 17.

(3) Low-Level Outlet. There is no low-level outlet.

d. Reservoir Area. The perimeter of the reservoir is well vegetated with grass and trees. There was no evidence of excessive erosion around the water line. The reservoir does not have a siltation problem. The small upstream reservoir would act as a silt basin. Portions of the reservoir can be seen in Photos 2, 4, 5, 9, and 18.

e. Downstream Channel.

(1) Principal Spillway. The downstream channel that carries discharges from the principal spillway is tree lined and appears to be stable. The channel passes under a residential street approximately 600 feet downstream from the dam and merges with a natural drainageway from the north approximately 800 feet downstream from the dam.

(2) Emergency Spillway. The downstream channel of the emergency spillway is unobstructed. Spillway discharges will enter the natural drainageway from the north approximately 700 feet downstream from the dam and 600 feet to the north from the principal spillway channel. Photo No. 1 shows a portion of the drainageway from the north in the extreme lower left corner. The area shown is the approximate location where emergency spillway flows will discharge.

3.2 EVALUATION

The structure appears to be in excellent condition with no serious potential of failure. The rodent activity should be curtailed, and the trees on the downstream crest and slope should be removed.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance of the dam appears to be excellent. The trees on the downstream crestline and slope should be removed, and rodent activity should be controlled.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The overall appearance of this dam after 10 years of operation is excellent and can be attributed to an ongoing maintenance program. The trees which have been planted on the downstream crestline and slope are a detriment to the safety of the dam and should be removed. Rodent activity on the downstream slope, although not widespread, should be eliminated.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were available for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Cape Girardeau, MO.-ILL. 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. Hydraulic/hydrologic computations are included as Appendix D of this report.

c. Visual Observations.

(1) The principal spillway is in excellent condition and no problems should be encountered during operation.

(2) The emergency spillway is in excellent condition. Flow through the spillway will not endanger the integrity of the dam.

d. Overtopping Potential. Survey data that was obtained on the small upstream dam and its spillway system was used in routing the probable maximum flood through it into the lower reservoir. It was determined that 24 percent of the probable maximum flood would be accommodated by the spillways of the upstream dam prior to overtopping of the dam. Two hydrologic routings were made through the upstream reservoir and dam - one assuming breaching of the dam and the other assuming no breaching. The results of the two routings did not indicate significant differences on the lower dam as shown in the table below:

Frequency		*Maximum Depth Over Dam (Feet)	Duration Over Top (Hours)
0.50 PMF:	No Breach	-	-
	Breach	-	-
0.75 PMF:	No Breach	0.4	0.4
	Breach	0.4	0.7
PMF:	No Breach	0.7	0.6
	Breach	0.5	0.8

*Minimum top of dam elevation - 449.2

The spillways are too small to pass the probable maximum flood without overtopping the dam. The spillways will pass 50% of the probable maximum flood and the 1% probability flood without overtopping. The overtopping which the embankment would experience

during the PMF (0.7 foot for 0.6 hour) is such that it should not cause excessive damage.

The results of the routings through the dam (assuming no breaching of the upper dam) are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam Feet	Duration Over Top Hours
1/2 PMF	645	495	449.2	-	-
PMF	1360	1240	449.9	0.7	0.6

* Minimum top of dam elevation - 449.2 feet

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 a small size. Therefore, the 1/2 PMF to 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. Based on visual observation this dam appears to be in excellent condition and structurally stable with little potential of failure. There were no cracks, slides, slumps, eroded areas, or abnormal deformations. The crest shows no signs of abnormal settlement. The only seep observed was very low volume coming from the left abutment trough and does not appear to affect the stability of the dam. The growth of trees along the downstream crestline and on the downstream slope could ultimately impair the structural stability of the dam. Rodent activity should be eliminated.

b. Design and Construction Data. Design and construction data were not available. The dam was constructed by Mr. Calvin Phillips. 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 in the dam.

e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of the magnitude predicted in this area could be hazardous to this dam. Stability analyses for this dam should include earthquake forces applicable to Seismic Zone 3.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Based on visual observation, this dam appears to be structurally stable and in excellent condition with little potential of failure. The spillways are unobstructed; appear to be in excellent condition; and will pass 50 percent of the probable maximum flood without overtopping the dam. Deficiencies observed during the inspection which could eventually be detrimental to the safety of this dam are the growth of trees and the rodent activity on the downstream slope. The low volume seep in the left (south) abutment trough does not appear to affect the stability of the dam but should be monitored on a periodic basis. 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 for all dams having a high hazard potential classification.

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. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2b should be accomplished in the near future.

d. Necessity for Further Investigation. The seepage and stability analyses recommended in paragraph 7.2b should be accomplished by the owner in the near future.

e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of this magnitude could be hazardous to this dam. It is recommended that the prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

a. Alternatives.

(1) The spillways will accommodate 50 percent of the probable maximum flood without overtopping the dam. No alternatives are required.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.

(2) The trees growing on the downstream crestline and slope should be removed. Tree removal should be done under the guidance of an engineer experienced in the design and construction of dams.

(3) Rodent holes on the downstream slope should be repaired. A program should be developed to eliminate rodent activity on the dam.

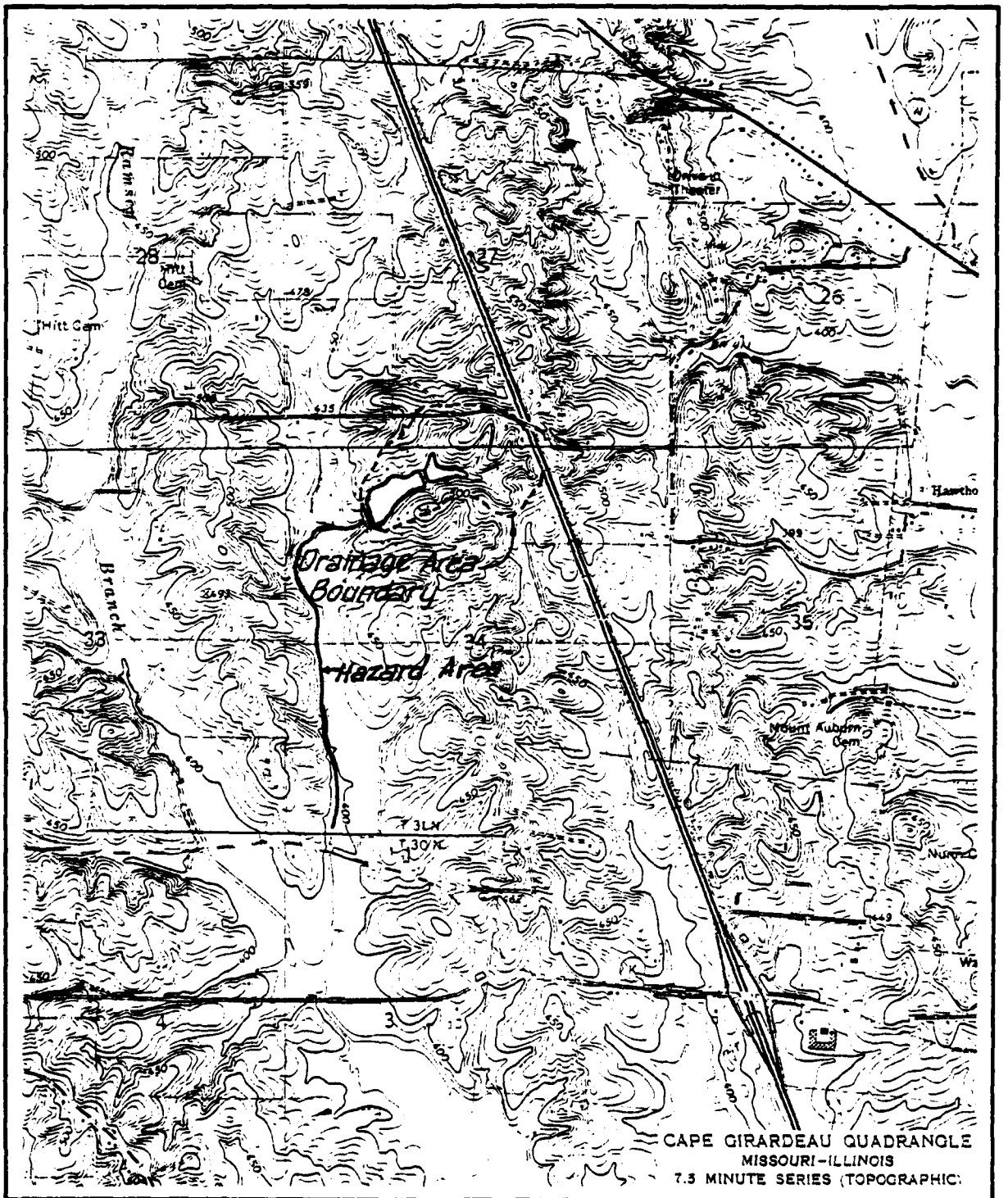
(4) The crawfish holes along and above the water's edge are shallow and probably do not endanger the dam. They do, however, constitute a weakness where erosion can begin. In lieu of attempting to eliminate the crawfish population, it is recommended that monitoring of the holes and repair of eroded areas become a part of the maintenance program.

(5) The low volume seep in the left (south) abutment trough should be monitored on a periodic basis.

(6) The excellent maintenance program that accounts for the neat and clean appearance of this dam should be continued.

(7) A program of periodic inspections should be initiated. Records of the inspections should be made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval – 10'

N

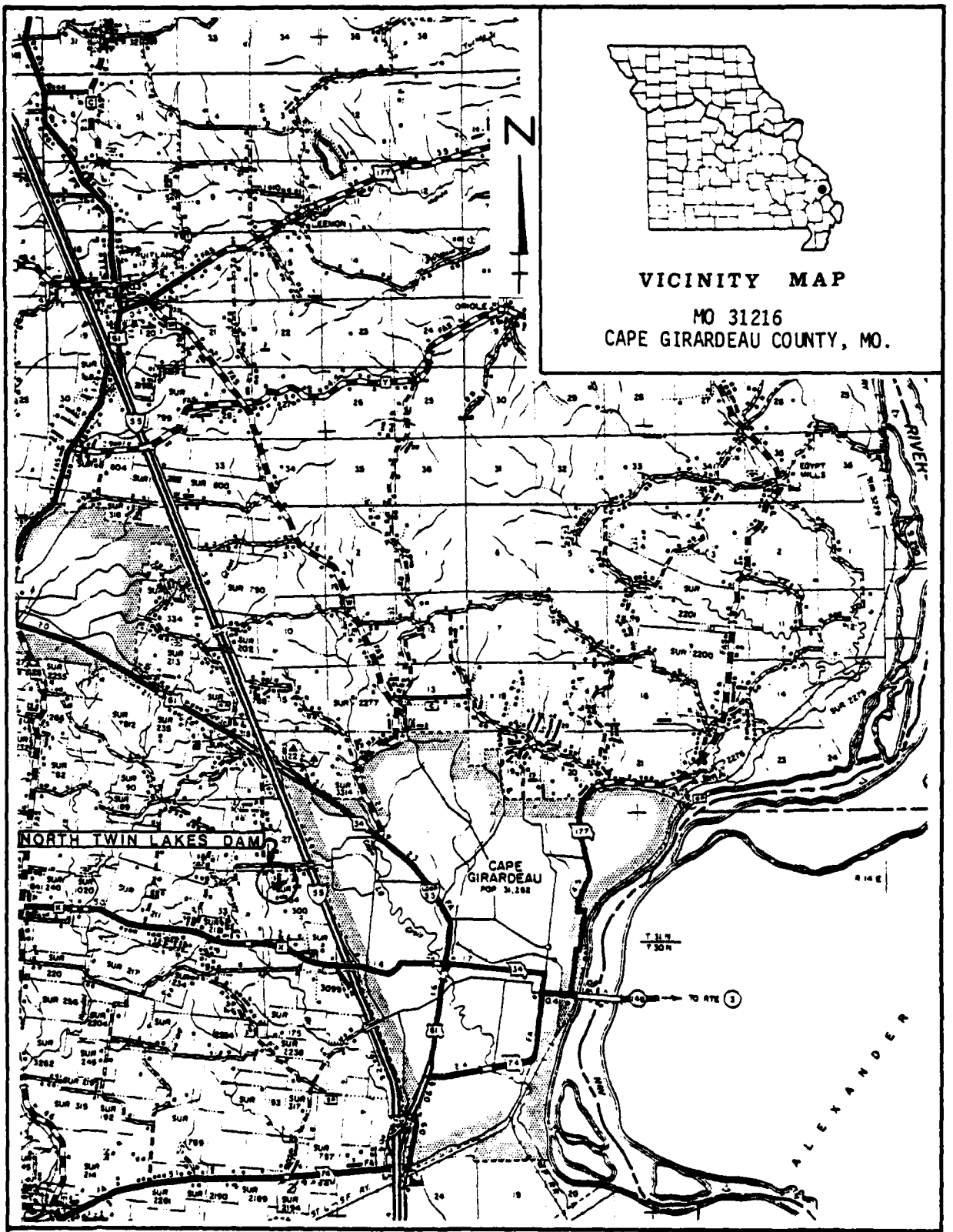
VICINITY TOPOGRAPHY

NORTH TWIN LAKES DAM

CAPE GIRARDEAU COUNTY, MISSOURI

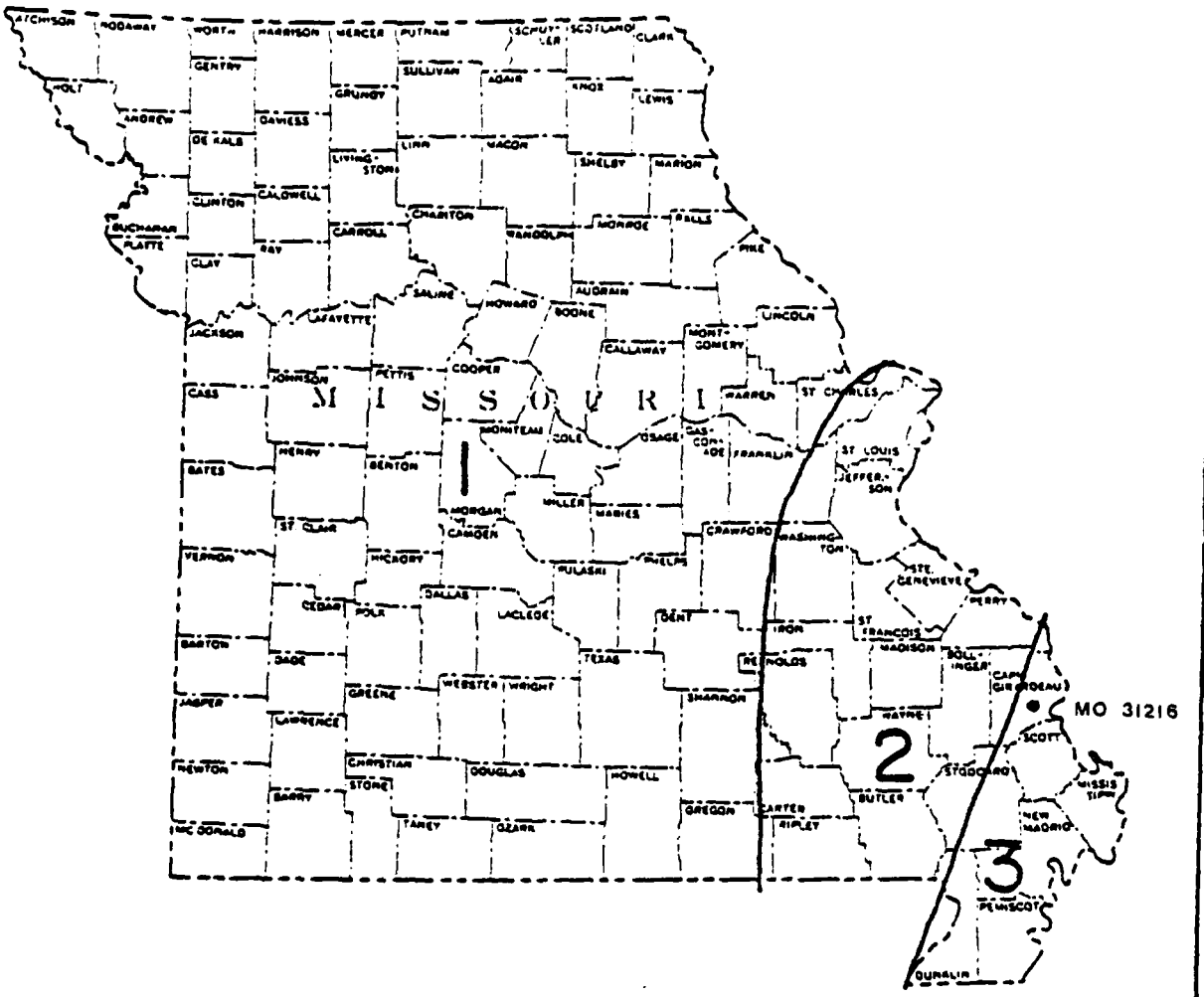
MO 31216

PLATE A-1



LOCATION MAP

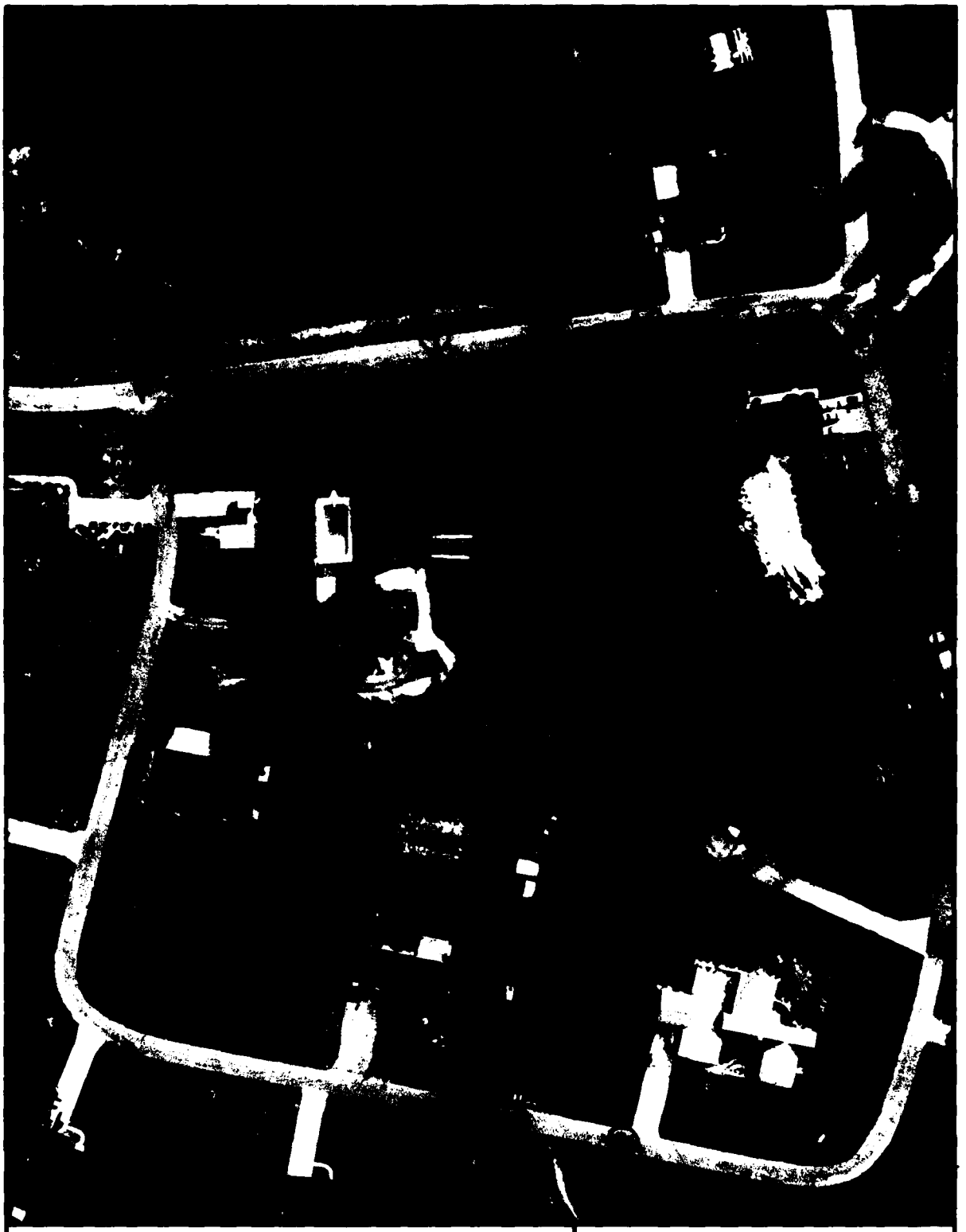
PLATE A-2



MISSOURI
SEISMIC ZONE MAP

PLATE A-3

APPENDIX B
PHOTOGRAPHS



NORTH TWIN LAKES DAM
CAPE GIRARDEAU COUNTY,
MISSOURI, MO. 31216

PHOTO INDEX

PLATE B-1

PHOTO NO. 2 - OVERVIEW FROM RIGHT UPSTREAM BANK

PHOTO NO. 3 - DOWNSTREAM SLOPE FROM LEFT END

PHOTO NO. 4 - CREST OF DAM FROM LEFT END

PHOTO NO. 5 - UPSTREAM SLOPE FROM LEFT END

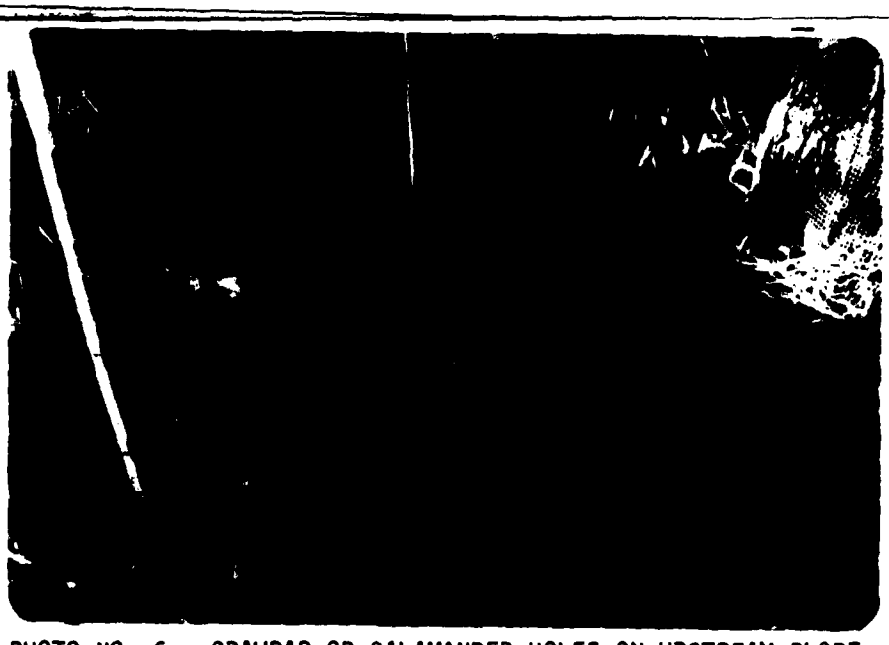


PHOTO NO. 6 - CRAWDAD OR SALAMANDER HOLES ON UPSTREAM SLOPE

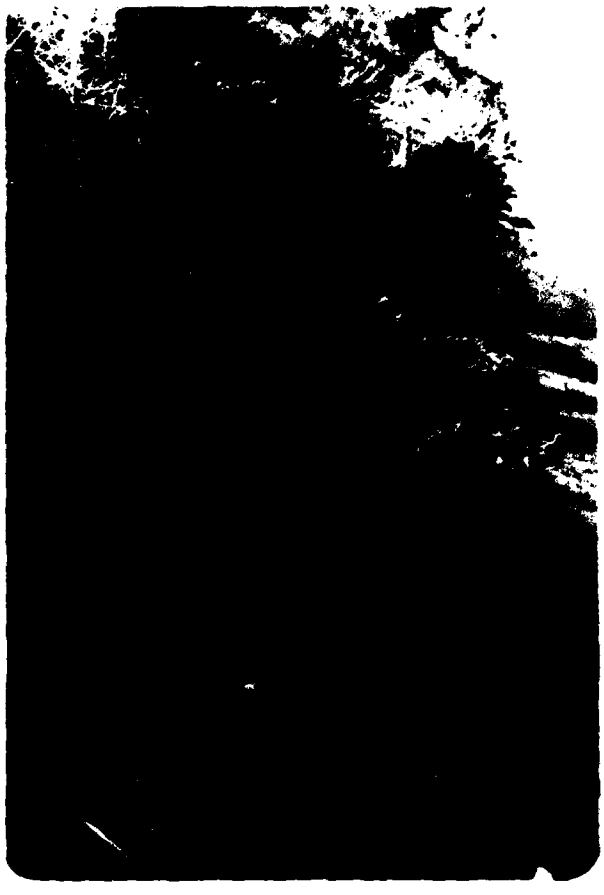


PHOTO NO. 7 - CLOSEUP VIEW OF MUD MOUNDED AT THE TOP OF DAUBER HOLES NEAR WATERS EDGE

PHOTO NO. 8 - INLET TO PRINCIPAL SPILLWAY (18-INCH CMP)

PHOTO NO. 9 - LOOKING UPSTREAM FROM STATION 2 + 00

FORM 9

PHOTO NO. 10 - LOOKING ALONG DOWNSTREAM CREST AT OUTLET OF PIPE SPILLWAY .

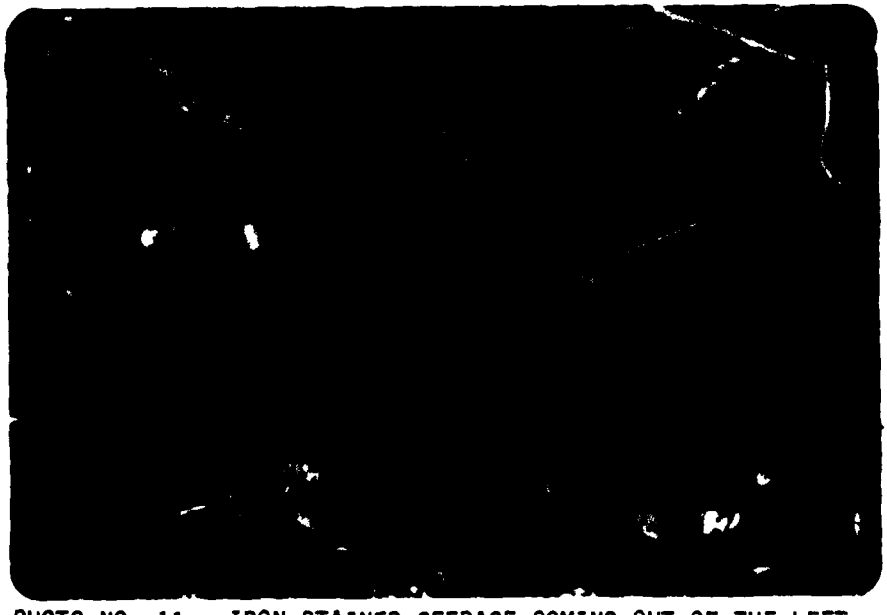


PHOTO NO. 11 - IRON STAINED SEEPAGE COMING OUT OF THE LEFT ABUTMENT TROUGH AT ELEVATION OF THE OUTLET OF THE PIPE SPILLWAY

PHOTO NO. 12 - OUTLET OF THE PRINCIPAL SPILLWAY PIPE

PHOTO NO. 13 - OUTLET OF PRINCIPAL SPILLWAY PIPE AND PLUNGE POOL

PHOTO NO. 14 - RODENT HOLE ON DOWNSTREAM SLOPE ABOUT FOUR TO FIVE FEET ABOVE TOE

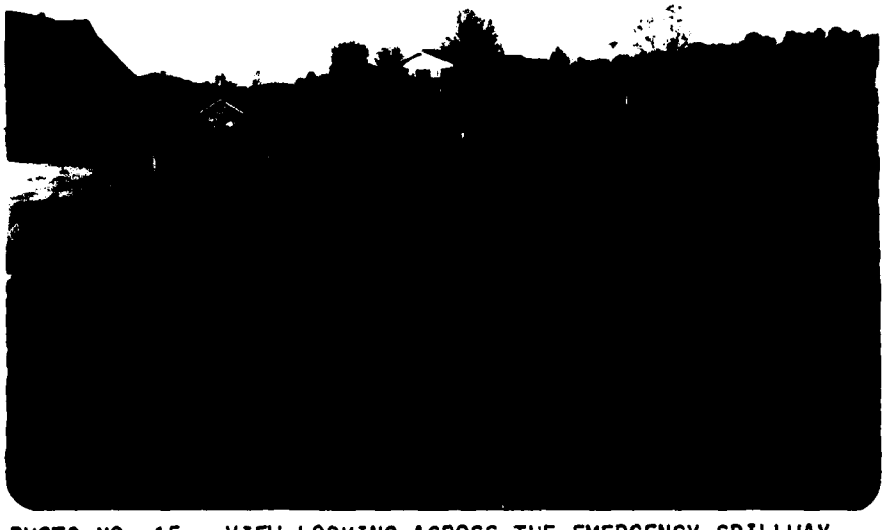


PHOTO NO. 15 - VIEW LOOKING ACROSS THE EMERGENCY SPILLWAY FROM RIGHT END OF DAM (LOOKING NORTH)

PHOTO NO. 16 - VIEW LOOKING UPSTREAM THROUGH THE SPILLWAY

PHOTO NO. 17 - VIEW LOOKING DOWNSTREAM THROUGH THE SPILLWAY

PHOTO NO. 18 - VIEW LOOKING RIGHT TO LEFT (NORTH TO SOUTH) ACROSS THE RESERVOIR

PHOTO NO. 19 - DOWNSTREAM HAZARDS JUST BELOW DAM

PHOTO NO. 20 - DOWNSTREAM HAZARDS JUST BELOW DAM

PHOTO NO. 21 - HOUSES DOWNSTREAM FROM DAM ON RIGHT SIDE

PHOTO NO. 22 - HOUSES DOWNSTREAM FROM DAM ON RIGHT SIDE

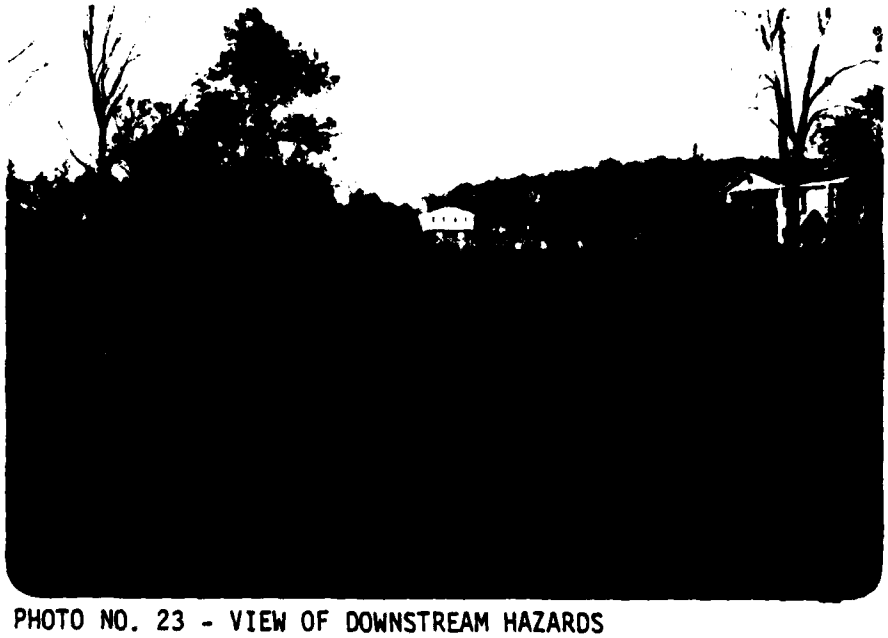
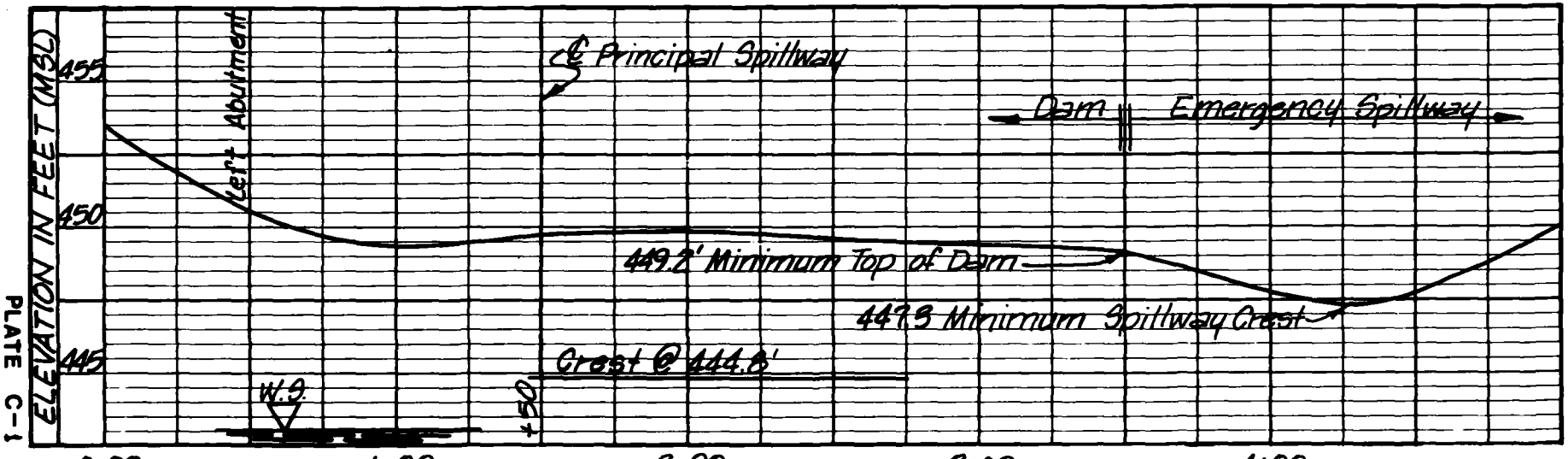


PHOTO NO. 23 - VIEW OF DOWNSTREAM HAZARDS

PHOTO NO. 24 - VIEW OF DOWNSTREAM HAZARDS

APPENDIX C
PROJECT PLATES

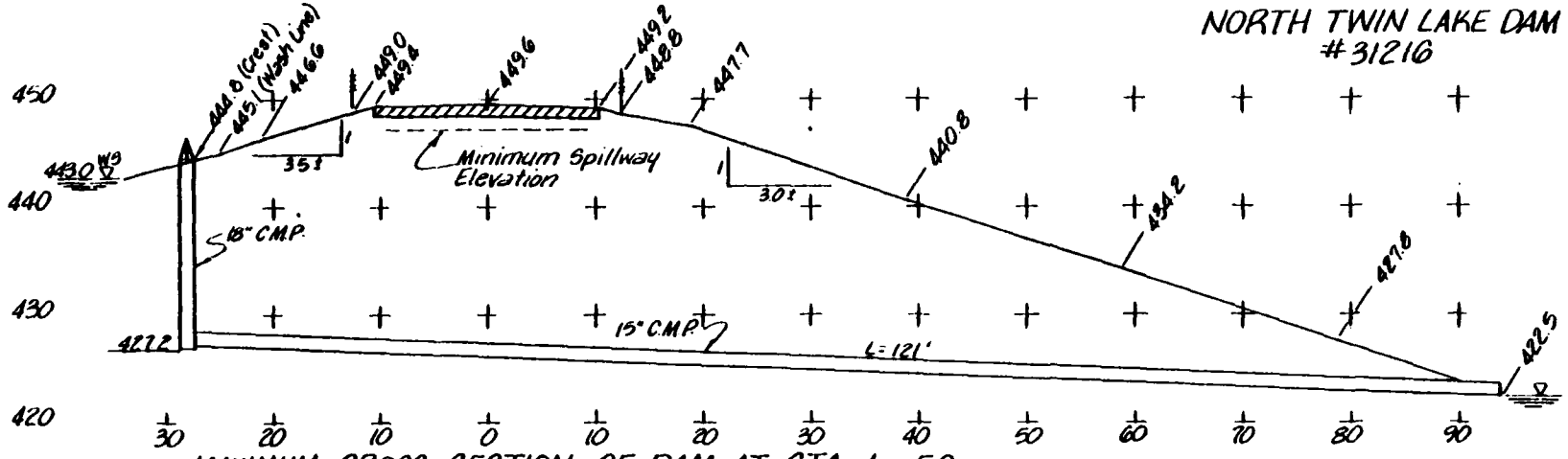
PLAN OF DAM
Scale: 1"= 100'



CENTERLINE PROFILE OF DAM
Scale As Shown

PLATE C-1

NORTH TWIN LAKE DAM
#31216



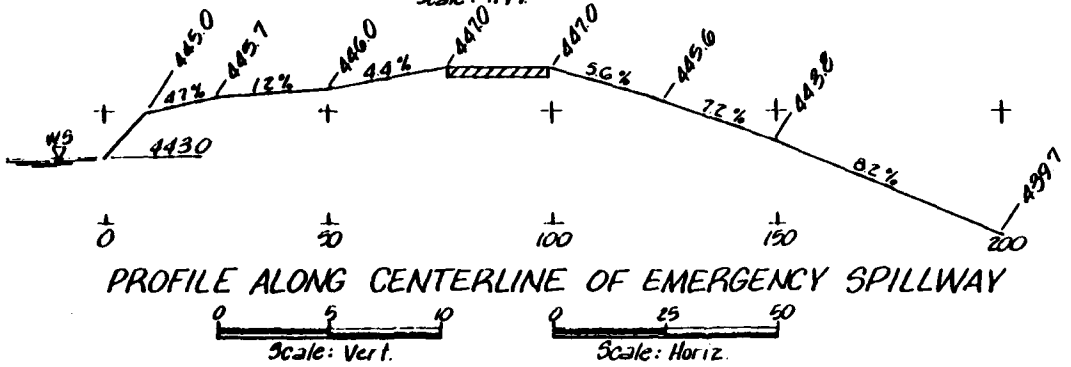


PLATE C-2

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 (see this section).

   a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at St. Genevieve, MO. as supplied by the St. Louis District, Corps of Engineers. 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 District policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.11 square miles (70.1 acres).

   c. Time of concentration of runoff = 15 minutes (computed from the Kirpich formula and verified by the formula from California Culverts Practice, California Highways and Public Works).

   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 one percent probabilistic 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 invert of the principal spillway.

   e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 4.12 inches. The total losses for the PMF storm were 4.27 inches. These data are based on SCS runoff curve No. 77 and No. 89 for antecedent moisture conditions SCS AMC II and MAC III respectively. The watershed is composed primarily of SCS soil group B (Menfro soils). Land cover is approximately 80% wooded and the remainder is grass and water.

   f. Average soil loss rates = 0.15 inch per hour approximately (for PMF storm, AMC III).

2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow going over the top of the dam.

a. The principal spillway rating was developed by using the weir, orifice, and full conduit flow equations.

1) Weir flow equation ($Q = CLH^{1.5}$)
where C = weir coefficient = 3.4 (from SCS Engr. Memo 50)
L = effective weir length, ft. = 4.71
H = total head, ft.

2) Orifice equation - $Q = CA\sqrt{2gh}$
where C = orifice coefficient = 0.6
A = area of riser, sq. ft. = 1.77
h = total head, ft.

3) Full conduit flow equation

$$Q = a\sqrt{\frac{2gH}{1 + Kr + K_pL}}$$

where a = cross-sectional area of pipe, ft^2 = 1.23
H = total head, ft.
K_r = coefficient for riser = 1.0
K_p = coefficient for pipe friction loss = 0.0859
(ES-42, SCS NEH, Section 5)
L = length of pipe, ft. = 121

b. The flows over the dam and emergency spillway were determined by using the dam overtopping analyses (irregular top of dam) within the HEC-1 (Dam Safety Version) program.

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. The input, output and plotted hydrographs are attached in this section.

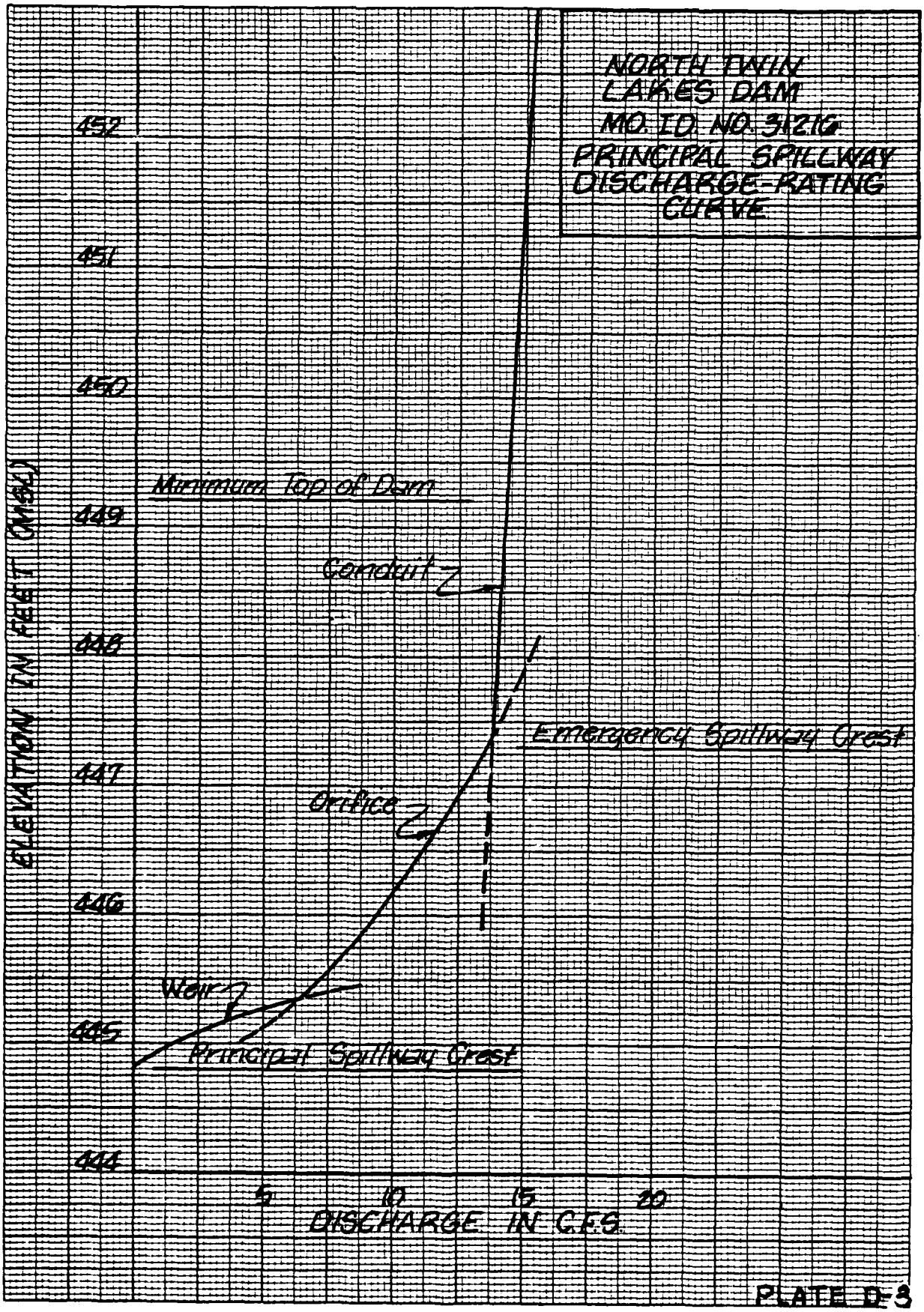


PLATE D-3

GRAPH PAPER GRAPHIC CONTROLS CORPORATION Buffalo, New York Printed in U.S.A. SQUARE 10 X 10 TO THE HALF INCH AS 0813 -5

GRAPH PAPER GRAPHIC CONTROLS CORPORATION Buffalo New York Printed in U.S.A. SQUARE 10 X 10 TO THE HALF INCH AS 0813 C1

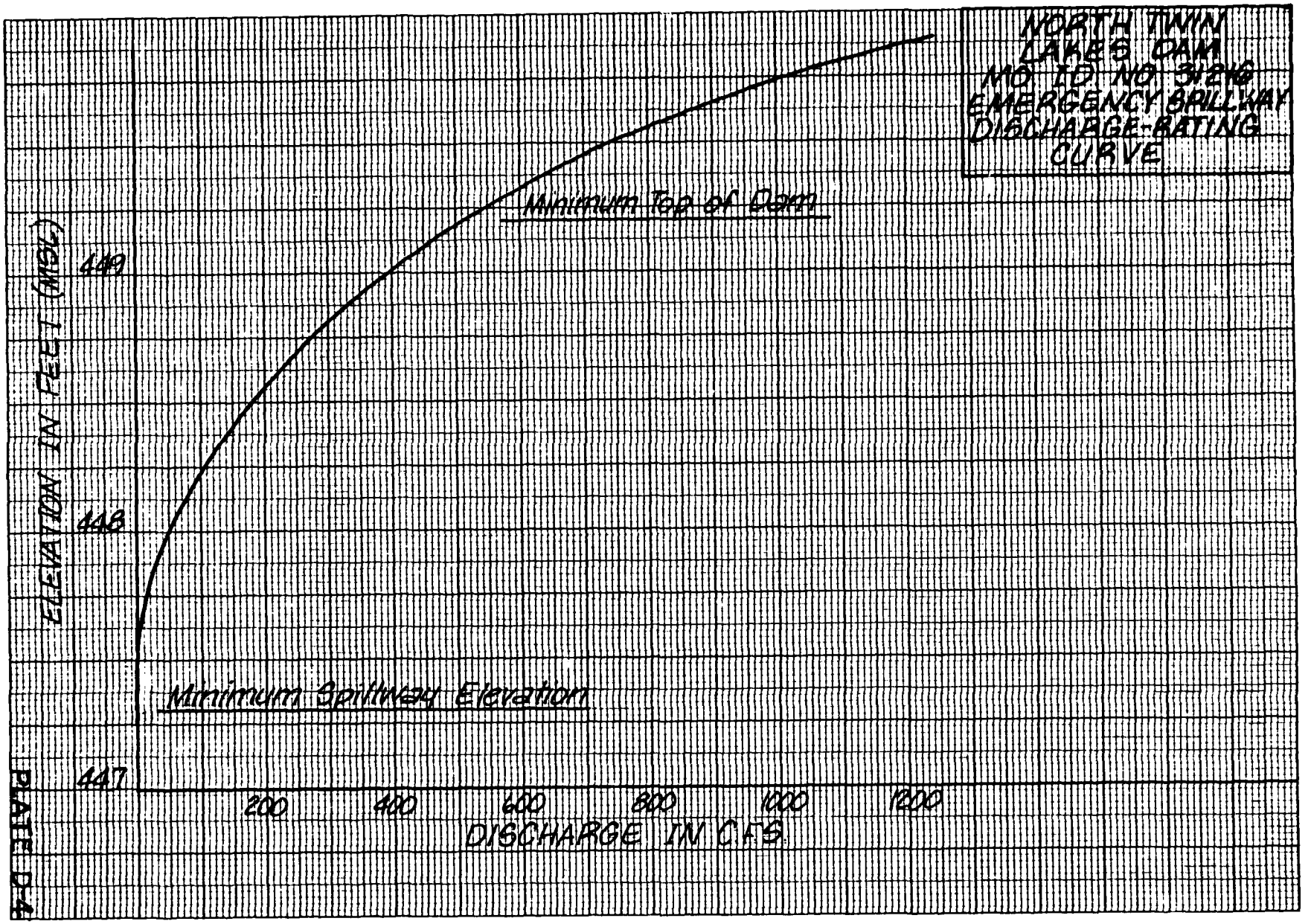
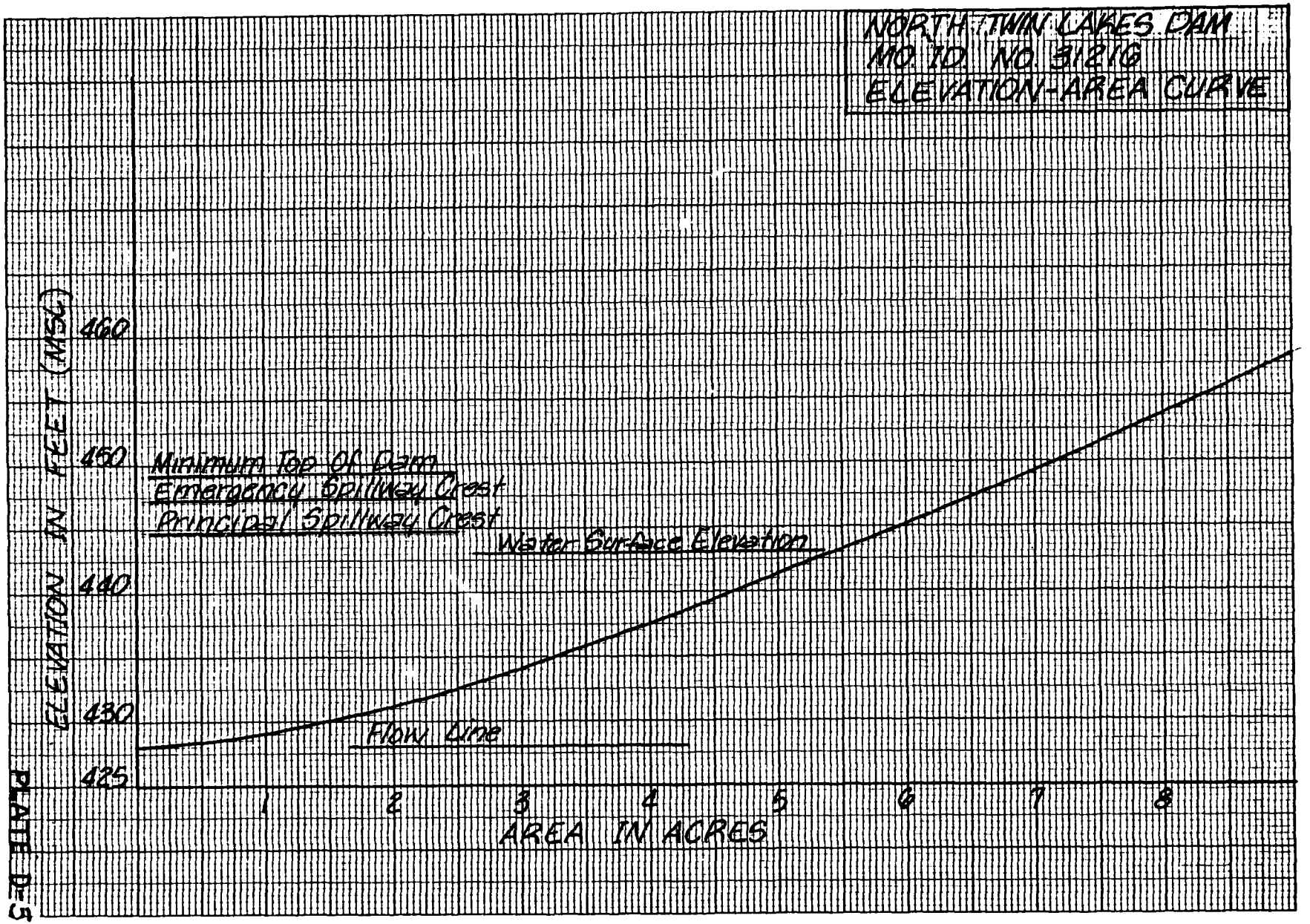


PLATE D-4

GRAPH PAPER GRAPHIC CONTROLS CORPORATION
Buffalo New York Printed in U.S.A.
SQUARE 10 X 10 TO THE HALF INCH AS 8813 GT



```
A1              NORTH TWIN LAKES DAM / MO. ID. NO. 31216
A2        SAFETY ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES
A3              H & H ANALYSIS BY ROUTING PMF RATIOS THRU THE RESERVOIR
B     288000000000000005                            000000000000000000000003
B1       5
J        1000000080000001
J1    .0500000.1000000.1500000.2000000.3500000.5000000.75000001.0
K        000000001                000000000000000000000001
K1        CALCULATION OF INFLOW HYDRO TO UPPER LAKE
M        100000020000.075         0000.075000001.000000000000000000000001
P        0000027.000000102000001210000130
T                                                          -1.0    -80.0
W2        00000.17
X        0     -.0100000001
K        100000002                000000020000000000000001
K1        ROUTED FLOWS THRU UPPER DAM - NORTH TWIN LAKES
Y                       000000001000000001
Y1       1                                                 -455.3       -1
Y4  455.3000455.5000455.7000455.9000456.5000457.0000457.3000458.2000459.0000459.5
Y4  459.8000460.0000460.5000461.0000462.0000463.0
Y5       0000001.4000004.1000006.6000009.3000011.1000011.9000012.30000003300000069
Y5    10300000130000002030000030400000564000000914
$A       0000000.5000001.1000002.1000002.5000004.0000005.6000007.2
$E  445.0000447.5000450.0000453.6000455.0000460.0000465.0000470.0
$$  455.3
$D  459.8000002.8000001.500000275
$L      75000001150000028000000305
$V  459.8000460.0000460.5000463.0
K        000000003                000000000000000000000001
K1        CALCULATION OF INFLO HYDRO TO NO TWIN LAKES RES-NO. 31216
M        100000020000.034         0000.034000001.0                 00000001
P        0000027.000000102000001210000130
T                                                          -1.0    -89.0
W2        00000.17
X        0     -.0100000001
K        2 SUM 2+3                000000020000000000000001
K1        COMBINED-INFLO HYDRO TO NO TWIN LAKES RES NO 31216
K        100000004                000000020000000000000001
K1        ROUTED FLOWS THRU NO TWIN LAKES DAM NO. 31216
Y                       000000001000000001
Y1       1                                                 -444.8       -1
Y4  444.8000445.0000445.2000445.4000445.5000446.0000446.5000447.0000447.3000447.4
Y4  448.0000449.2000450.0000451.0000452.0000453.0
Y5       0000001.4000004.1000006.5000007.1000009.3000011.1000012.6000013.5000013.8
Y5     14.0000014.3000014.5000014.8000015.1000015.3
$A       0000001.5000003.3000004.7000006.0000006.6000007.1000007.5000008.4
$E  428.0000430.0000435.0000440.0000444.8000447.3000449.2000451.0000455.0
$$  444.8
$D  449.2000002.8000001.500000300
$L       0000000450000001070000001340000001660000003120000004250000004530000005070000000547
$V  447.3000447.7000448.7000449.2000449.3000449.6000449.8000450.2000451.8000453.0
K       99
A
A
A
```

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

RUN  DATE= 80/11/26.
     TIME= 10.44.29.
```

NORTH TWIN LAKES DAM / MO. ID. NO. 31216
SAFETY ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES
H & H ANALYSIS BY ROUTING PMF RATIOS THRU THE RESERVOIR

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 8 LRTIO= 1

RTIOS= .05 .10 .15 .20 .35 .50 .75 1.00

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDRO TO UPPER LAKE

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	.08	0.00	.08	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	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	-80.00	0.00	0.00

CURVE NO = -80.00 WETNESS = -1.00 EFFECT CN = 80.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .17

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00

52. 157. 162. 101. 51. 27. 14. 8. 4. 2.
1. 0.

0

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	.23	.21	.02	45.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.21	.02	68.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.21	.02	91.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.21	.02	106.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.21	.02	114.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.21	.02	118.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.21	.02	121.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.21	.01	122.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.22	.01	123.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.22	.01	124.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.22	.01	125.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.22	.01	125.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.26	.01	128.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.26	.01	135.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.26	.01	142.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.26	.01	147.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.26	.01	150.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.26	.01	151.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.28	.26	.01	152.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.28	.27	.01	153.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.28	.27	.01	153.

PLATE D-7

PLATE D-8

1.01	9.15	111	.07	.06	.01	33.	1.01	21.15	255	.02	.02	.00	12.
1.01	9.20	112	.07	.06	.01	33.	1.01	21.20	256	.02	.02	.00	12.
1.01	9.25	113	.07	.06	.01	33.	1.01	21.25	257	.02	.02	.00	12.
1.01	9.30	114	.07	.06	.01	34.	1.01	21.30	258	.02	.02	.00	12.
1.01	9.35	115	.07	.06	.01	34.	1.01	21.35	259	.02	.02	.00	12.
1.01	9.40	116	.07	.06	.01	34.	1.01	21.40	260	.02	.02	.00	12.
1.01	9.45	117	.07	.06	.01	34.	1.01	21.45	261	.02	.02	.00	12.
1.01	9.50	118	.07	.06	.01	34.	1.01	21.50	262	.02	.02	.00	12.
1.01	9.55	119	.07	.06	.01	34.	1.01	21.55	263	.02	.02	.00	12.
1.01	10.00	120	.07	.06	.01	35.	1.01	22.00	264	.02	.02	.00	12.
1.01	10.05	121	.07	.06	.01	35.	1.01	22.05	265	.02	.02	.00	12.
1.01	10.10	122	.07	.06	.01	35.	1.01	22.10	266	.02	.02	.00	12.
1.01	10.15	123	.07	.06	.01	35.	1.01	22.15	267	.02	.02	.00	12.
1.01	10.20	124	.07	.06	.01	35.	1.01	22.20	268	.02	.02	.00	12.
1.01	10.25	125	.07	.06	.01	35.	1.01	22.25	269	.02	.02	.00	12.
1.01	10.30	126	.07	.06	.01	35.	1.01	22.30	270	.02	.02	.00	12.
1.01	10.35	127	.07	.06	.01	36.	1.01	22.35	271	.02	.02	.00	12.
1.01	10.40	128	.07	.06	.01	36.	1.01	22.40	272	.02	.02	.00	12.
1.01	10.45	129	.07	.06	.01	36.	1.01	22.45	273	.02	.02	.00	12.
1.01	10.50	130	.07	.06	.01	36.	1.01	22.50	274	.02	.02	.00	12.
1.01	10.55	131	.07	.06	.01	36.	1.01	22.55	275	.02	.02	.00	12.
1.01	11.00	132	.07	.06	.01	36.	1.01	23.00	276	.02	.02	.00	12.
1.01	11.05	133	.07	.06	.01	36.	1.01	23.05	277	.02	.02	.00	12.
1.01	11.10	134	.07	.06	.01	36.	1.01	23.10	278	.02	.02	.00	12.
1.01	11.15	135	.07	.06	.01	36.	1.01	23.15	279	.02	.02	.00	12.
1.01	11.20	136	.07	.06	.01	37.	1.01	23.20	280	.02	.02	.00	12.
1.01	11.25	137	.07	.06	.01	37.	1.01	23.25	281	.02	.02	.00	12.
1.01	11.30	138	.07	.06	.01	37.	1.01	23.30	282	.02	.02	.00	12.
1.01	11.35	139	.07	.06	.01	37.	1.01	23.35	283	.02	.02	.00	12.
1.01	11.40	140	.07	.06	.01	37.	1.01	23.40	284	.02	.02	.00	12.
1.01	11.45	141	.07	.06	.01	37.	1.01	23.45	285	.02	.02	.00	12.
1.01	11.50	142	.07	.06	.01	37.	1.01	23.50	286	.02	.02	.00	12.
1.01	11.55	143	.07	.06	.01	37.	1.01	23.55	287	.02	.02	.00	12.
1.01	12.00	144	.07	.06	.01	37.	1.02	0.00	288	.02	.02	.00	12.
									SUM	35.10	32.27	2.83	18724.
										(892.)	(820.)	(72.)	(530.20)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	929.	215.	65.	65.	18699.
CMS	26.	6.	2.	2.	530.
INCHES		26.69	32.21	32.21	32.21
MM		678.03	818.19	818.19	818.19
AC-FT		107.	129.	129.	129.
THOUS CU M		132.	159.	159.	159.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	46.	11.	3.	3.	935.
CMS	1.	0.	0.	0.	26.
INCHES		1.33	1.61	1.61	1.61
MM		33.90	40.91	40.91	40.91
AC-FT		5.	6.	6.	6.
THOUS CU M		7.	8.	8.	8.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	93.	22.	6.	6.	1870.
CMS	3.	1.	0.	0.	53.
INCHES		2.67	3.22	3.22	3.22
MM		67.80	81.82	81.82	81.82
AC-FT		11.	13.	13.	13.
THOUS CU M		13.	16.	16.	16.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	139.	32.	10.	10.	2805.
CMS	4.	1.	0.	0.	79.
INCHES		4.00	4.83	4.83	4.83
MM		101.70	122.73	122.73	122.73
AC-FT		16.	19.	19.	19.
THOUS CU M		20.	24.	24.	24.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

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

PLATE D-9

CFS	186.	45.	15.	15.	3740.
CMS	5.	1.	0.	0.	106.
INCHES		5.34	6.44	6.44	6.44
MM		135.61	163.64	163.64	163.64
AC-FT		21.	26.	26.	26.
THOUS CU M		26.	32.	32.	32.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	325.	75.	23.	23.	6545.
CMS	9.	2.	1.	1.	185.
INCHES		9.34	11.27	11.27	11.27
MM		237.31	286.37	286.37	286.37
AC-FT		37.	45.	45.	45.
THOUS CU M		46.	56.	56.	56.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6 — 1/2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	465.	108.	32.	32.	9350.
CMS	13.	3.	1.	1.	265.
INCHES		13.35	16.11	16.11	16.11
MM		339.01	409.09	409.09	409.09
AC-FT		53.	64.	64.	64.
THOUS CU M		66.	79.	79.	79.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	697.	161.	49.	49.	14024.
CMS	20.	5.	1.	1.	397.
INCHES		20.02	24.16	24.16	24.16
MM		508.52	613.64	613.64	613.64
AC-FT		80.	97.	97.	97.
THOUS CU M		99.	119.	119.	119.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8 — PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	929.	215.	65.	65.	18699.
CMS	26.	6.	2.	2.	530.
INCHES		26.69	32.21	32.21	32.21
MM		678.03	818.19	818.19	818.19
AC-FT		107.	129.	129.	129.
THOUS CU M		132.	159.	159.	159.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU UPPER DAM - NORTH TWIN LAKES

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	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-455.	-1

STAGE	455.30	455.50	455.70	455.90	456.50	457.00	457.30	458.20	459.00	459.50
	459.80	460.00	460.50	461.00	462.00	463.00				
FLOW	0.00	1.40	4.10	6.60	9.30	11.10	11.90	12.30	33.00	69.00
	105.00	130.00	203.00	304.00	564.00	914.00				

SURFACE AREA=	0.	1.	1.	2.	3.	4.	6.	7.
CAPACITY=	0.	0.	2.	8.	11.	27.	51.	83.
ELEVATION=	445.	448.	450.	454.	455.	460.	465.	470.

CRLL	SPWID	COOW	EXPW	CLEVL	COOL	CAREA	EXPL
455.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

	TOPEL	COQU	EXPD	DAMWID
	459.0	2.8	1.5	275.

CREST LENGTH AT OR BELOW ELEVATION	75.	115.	280.	305.
	459.8	460.0	460.5	463.0

---STATION 000002, PLAN 1, RATIO 1 -

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

STORAGE

STAGE

PLATE D-11

STATION 000002, PLAN 1, RATIO 6 1/2 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.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	3.	3.	3.	4.
4.	4.	5.	5.	5.	5.	6.	6.	6.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	10.	10.	10.	11.	11.	11.	11.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	15.
18.	21.	23.	26.	29.	31.	33.	39.	44.	48.
53.	58.	62.	66.	71.	75.	79.	83.	85.	87.
89.	89.	90.	92.	98.	114.	174.	311.	430.	422.
347.	277.	223.	184.	155.	136.	123.	114.	108.	105.
102.	101.	99.	98.	97.	96.	94.	91.	88.	86.
84.	82.	80.	79.	78.	77.	76.	73.	67.	62.
56.	51.	45.	41.	36.	33.	32.	30.	29.	28.
27.	26.	25.	24.	23.	22.	22.	21.	20.	19.
19.	18.	17.	17.	16.	16.	15.	15.	14.	14.
14.	13.	13.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.		

STORAGE

12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	13.	13.	13.	13.	13.	13.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	17.	17.	17.	17.
18.	18.	18.	19.	19.	20.	20.	20.	21.	21.
21.	22.	22.	23.	23.	23.	24.	24.	24.	24.
25.	25.	25.	25.	25.	26.	26.	26.	26.	26.
26.	26.	26.	26.	26.	27.	28.	29.	29.	29.
29.	28.	28.	28.	27.	27.	27.	27.	27.	27.
27.	26.	26.	26.	26.	26.	26.	26.	26.	26.
26.	26.	26.	26.	26.	26.	26.	26.	25.	25.
25.	24.	24.	24.	24.	23.	23.	23.	23.	23.
23.	23.	22.	22.	22.	22.	22.	22.	22.	22.
22.	21.	21.	21.	21.	21.	21.	21.	21.	21.
21.	21.	21.	21.	21.	21.	21.	21.	20.	20.
20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
20.	19.	19.	19.	19.	19.	19.	19.		

STAGE

455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.4	455.4	455.4	455.4	455.4	455.4
455.5	455.5	455.5	455.5	455.6	455.6	455.6	455.6	455.7	455.7
455.7	455.7	455.7	455.8	455.8	455.8	455.8	455.9	455.9	455.9
455.9	455.9	456.0	456.0	456.0	456.0	456.0	456.1	456.1	456.1
456.1	456.2	456.2	456.2	456.2	456.2	456.3	456.3	456.3	456.3
456.3	456.4	456.4	456.4	456.4	456.5	456.5	456.5	456.5	456.5
456.6	456.6	456.6	456.6	456.6	456.7	456.7	456.7	456.7	456.7
456.7	456.8	456.8	456.8	456.8	456.9	456.9	457.0	457.1	457.2
457.3	457.4	457.5	457.6	457.7	457.9	458.0	458.1	458.2	458.3

PLATE D-12

458.4	458.3	458.3	458.7	458.8	459.2	459.6	459.1	459.1	459.2
459.4	459.3	459.4	459.5	459.5	459.6	459.6	459.6	459.6	459.7
459.7	459.7	459.7	459.7	459.8	459.9	460.1	460.3	460.5	460.5
460.4	460.3	460.2	460.1	460.0	459.9	459.9	459.9	459.8	459.8
459.8	459.8	459.8	459.8	459.7	459.7	459.7	459.7	459.7	459.6
459.6	459.6	459.6	459.6	459.6	459.6	459.6	459.5	459.5	459.4
459.3	459.2	459.2	459.1	459.0	459.0	458.9	458.9	458.9	458.8
458.8	458.7	458.7	458.7	458.6	458.6	458.6	458.5	458.5	458.6
458.4	458.4	458.4	458.4	458.4	458.3	458.3	458.3	458.3	458.3
458.2	458.2	458.2	458.2	458.2	458.2	458.2	458.2	458.1	458.1
458.1	458.1	458.1	458.1	458.1	458.0	458.0	458.0	458.0	458.0
458.0	458.0	458.0	457.9	457.9	457.9	457.9	457.9	457.9	457.9
457.9	457.8	457.8	457.8	457.8	457.8	457.8	457.8		

PEAK OUTFLOW IS 430. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	430.	95.	29.	29.	8314..
CMS	12.	3.	1.	1.	235.
INCHES		11.83	14.32	14.32	14.32
MM		300.55	363.79	363.79	363.79
AC-FT		47.	57.	57.	57.
THOUS CU M		58.	71.	71.	71.

PLATE D-13

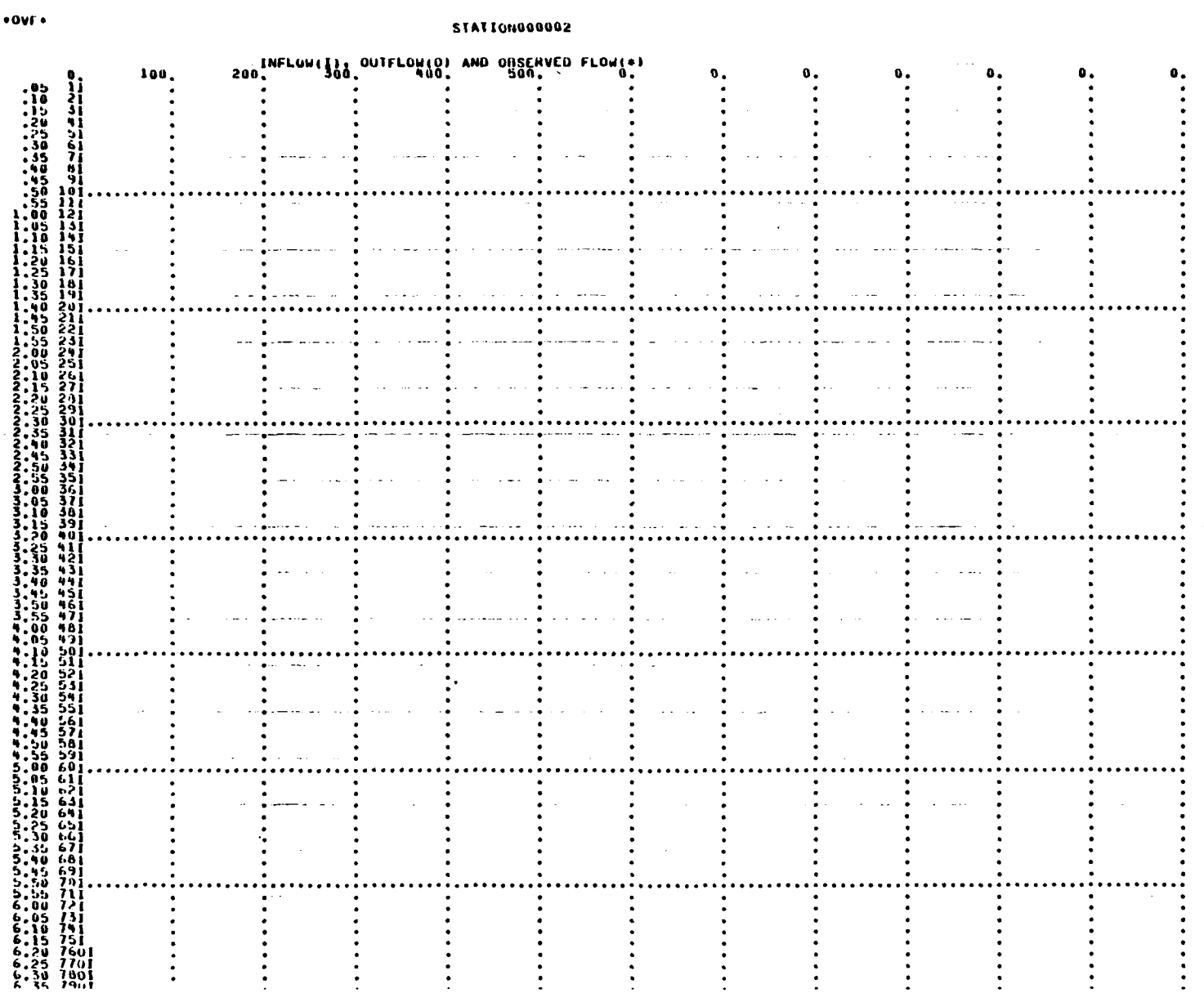

OVF
STATION000002
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 100. 200. 300. 400. 500. 0. 0. 0. 0. 0. 0. 0.

PLATE D-14

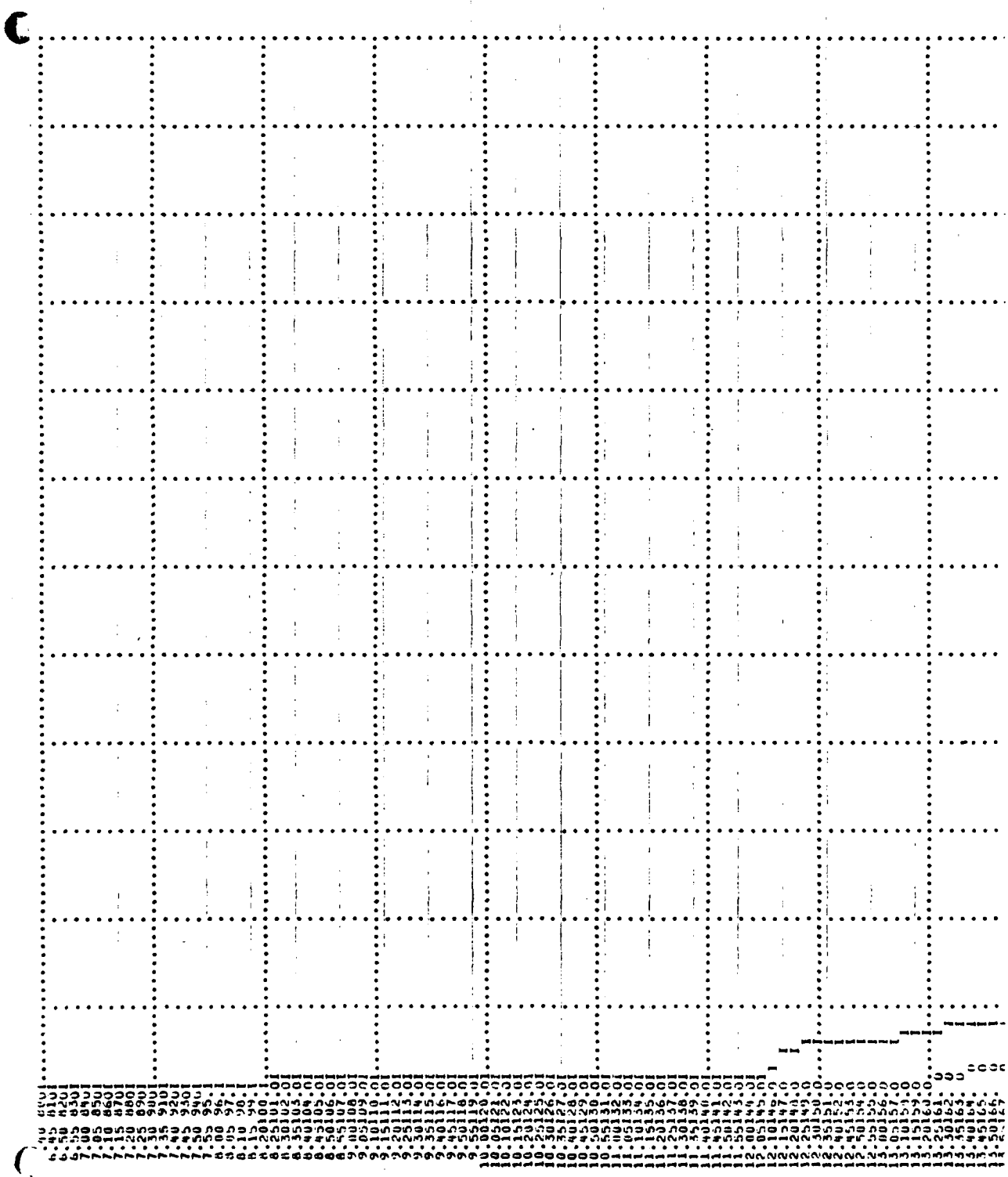


PLATE D-15

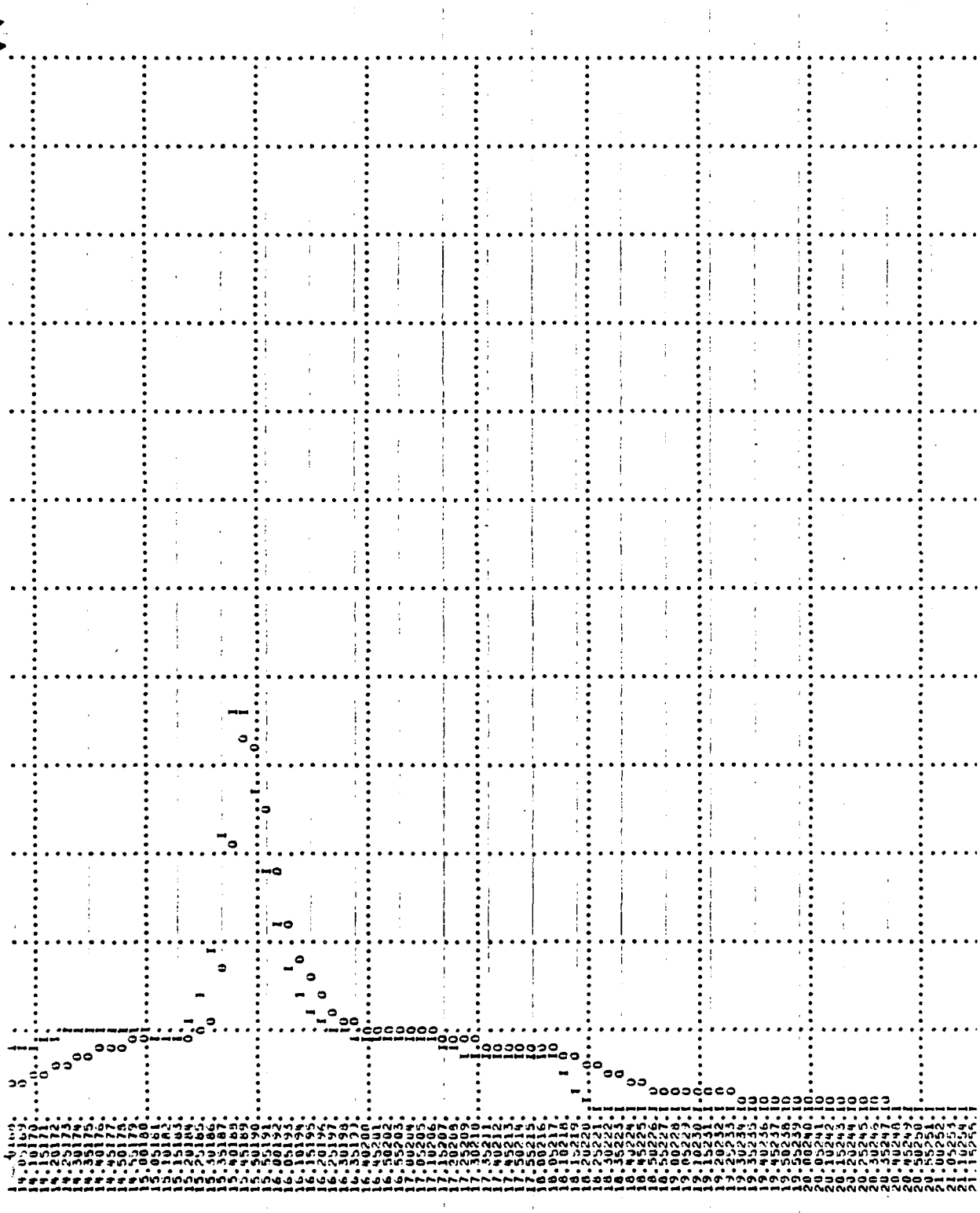


PLATE D-16

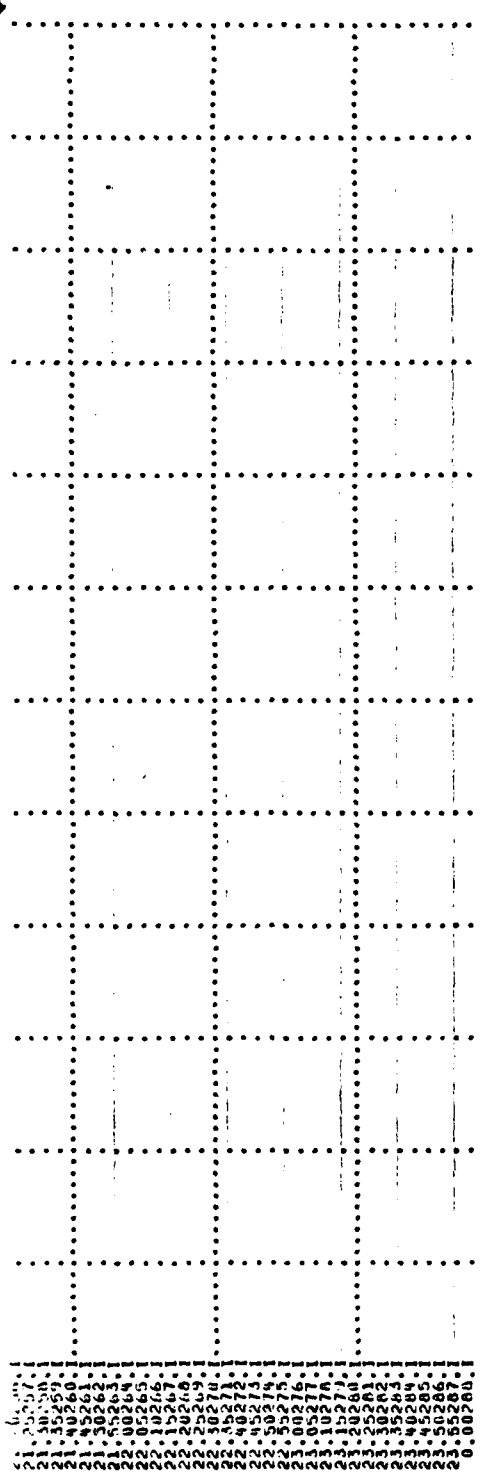


PLATE D-17

STATION 000002, PLAN 1, RATIO 8 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.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	3.
3.	4.	4.	5.	5.	6.	6.	7.	7.	7.
7.	8.	8.	8.	8.	8.	9.	9.	9.	9.
9.	10.	10.	10.	10.	10.	11.	11.	11.	11.
11.	11.	11.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	14.	15.	16.	17.	18.
19.	20.	21.	21.	22.	24.	27.	30.	35.	46.
55.	63.	71.	81.	89.	95.	101.	108.	118.	128.
136.	141.	146.	148.	150.	152.	153.	153.	154.	158.
165.	174.	181.	186.	190.	192.	193.	194.	195.	195.
194.	189.	187.	196.	226.	293.	468.	777.	933.	835.
655.	506.	402.	329.	276.	241.	219.	205.	197.	192.
189.	187.	186.	186.	185.	181.	173.	166.	159.	155.
152.	150.	148.	147.	147.	146.	144.	132.	113.	98.
85.	74.	65.	59.	53.	48.	44.	40.	36.	33.
32.	31.	30.	29.	28.	28.	27.	26.	25.	25.
24.	24.	23.	22.	22.	21.	21.	20.	20.	20.
19.	19.	19.	18.	18.	18.	17.	17.	17.	16.
16.	16.	16.	16.	15.	15.	15.	15.	15.	15.
14.	14.	14.	14.	14.	14.	14.	14.	13.	13.
13.	13.	13.	13.	13.	13.	13.	13.		

STORAGE

12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	13.	13.	13.
13.	13.	13.	13.	13.	13.	14.	14.	14.	14.
14.	14.	14.	14.	15.	15.	15.	15.	15.	15.
15.	16.	16.	16.	16.	16.	16.	16.	17.	17.
17.	17.	17.	17.	18.	18.	18.	18.	18.	18.
18.	19.	19.	19.	19.	19.	19.	20.	20.	20.
20.	20.	20.	21.	21.	21.	21.	21.	21.	21.
22.	22.	22.	22.	22.	22.	23.	23.	24.	24.
25.	25.	25.	26.	26.	26.	26.	27.	27.	27.
27.	27.	27.	27.	27.	27.	27.	27.	27.	27.
27.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	28.	29.	31.	31.	31.
30.	30.	29.	29.	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	28.	28.	27.	27.	27.
27.	27.	27.	27.	27.	27.	27.	27.	27.	26.
26.	26.	25.	25.	25.	24.	24.	24.	24.	24.
23.	23.	23.	23.	23.	23.	23.	23.	22.	22.
22.	22.	22.	22.	22.	22.	22.	22.	22.	22.
22.	22.	22.	21.	21.	21.	21.	21.	21.	21.
21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
21.	21.	21.	21.	21.	21.	21.	21.		

STAGE

455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3	455.3
455.3	455.3	455.3	455.4	455.4	455.4	455.4	455.4	455.4	455.4
455.4	455.4	455.4	455.4	455.4	455.4	455.5	455.5	455.5	455.6
455.6	455.7	455.7	455.8	455.8	455.8	455.9	455.9	456.0	456.0
456.1	456.1	456.2	456.2	456.3	456.3	456.3	456.4	456.4	456.5
456.5	456.6	456.6	456.7	456.7	456.8	456.8	456.9	456.9	457.0
457.0	457.1	457.1	457.2	457.2	457.3	457.3	457.4	457.4	457.5
457.5	457.6	457.6	457.7	457.7	457.8	457.8	457.9	457.9	458.0
458.0	458.1	458.1	458.2	458.2	458.2	458.3	458.3	458.4	458.4
458.5	458.5	458.5	458.6	458.6	458.7	458.8	458.9	459.0	459.2
[illegible]	459.4	459.5	459.6	459.7	459.7	459.8	459.8	459.9	459.9

460.0	460.0	460.0	460.0	460.0	460.0	460.0	460.0	460.0	460.0
460.0	460.0	460.1	460.1	460.1	460.1	460.1	460.1	460.1	460.1
460.1	460.1	460.1	460.1	460.2	460.3	460.5	460.8	460.9	460.8
460.7	460.5	460.4	460.3	460.3	460.2	460.2	460.1	460.1	460.1
460.1	460.1	460.1	460.1	460.1	460.1	460.0	460.0	460.0	460.0
460.0	460.0	460.0	460.0	460.0	460.0	460.0	459.9	459.9	459.8
459.6	459.5	459.4	459.4	459.3	459.2	459.1	459.1	459.0	459.0
459.0	458.9	458.9	458.9	458.8	458.8	458.8	458.7	458.7	458.7
458.7	458.6	458.6	458.6	458.6	458.6	458.5	458.5	458.5	458.5
458.5	458.5	458.4	458.4	458.4	458.4	458.4	458.4	458.4	458.4
458.4	458.3	458.3	458.3	458.3	458.3	458.3	458.3	458.3	458.3
458.3	458.3	458.3	458.3	458.3	458.3	458.3	458.2	458.2	458.2
458.2	458.2	458.2	458.2	458.2	458.2	458.2	458.2		

PEAK OUTFLOW IS 933. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	933.	210.	61.	61.	17450.
CMS	26.	6.	2.	2.	494.
INCHES		26.00	30.03	30.03	30.03
MM		660.38	762.64	762.64	762.64
AC-FT		104.	120.	120.	120.
THOUS-CU M		128.	148.	148.	148.

PLATE D-19

OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

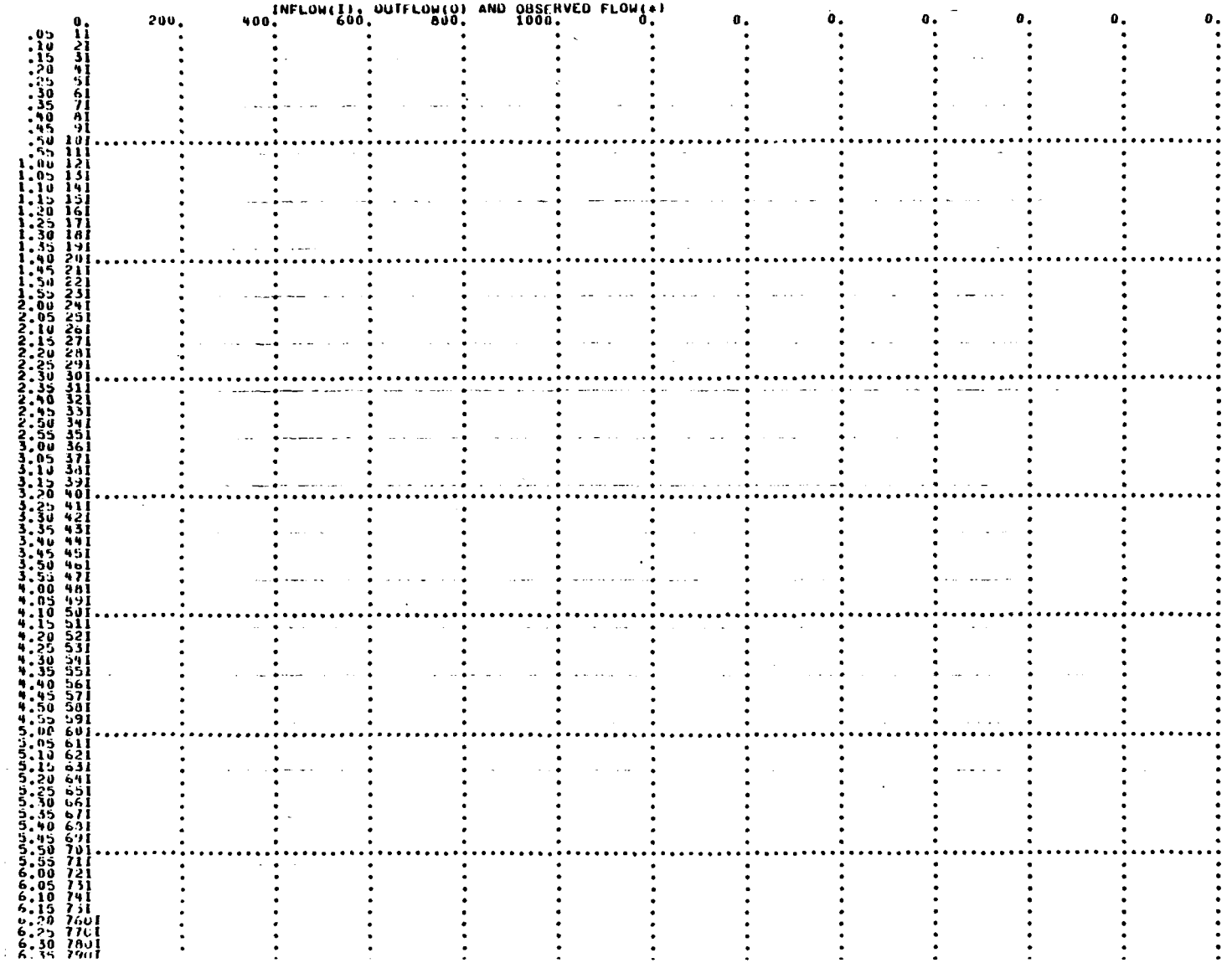


PLATE D-20

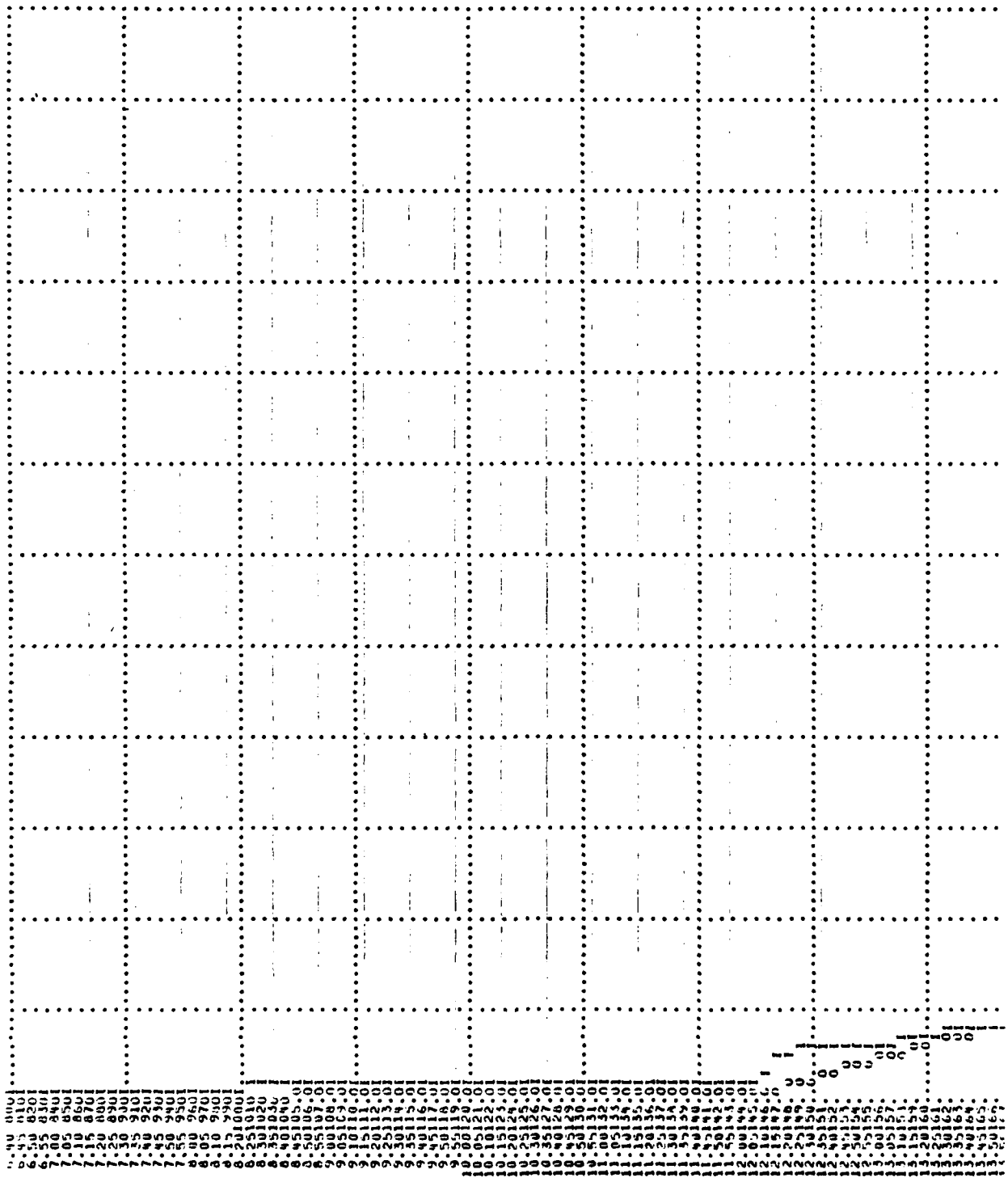


PLATE D-21

PLATE D-22

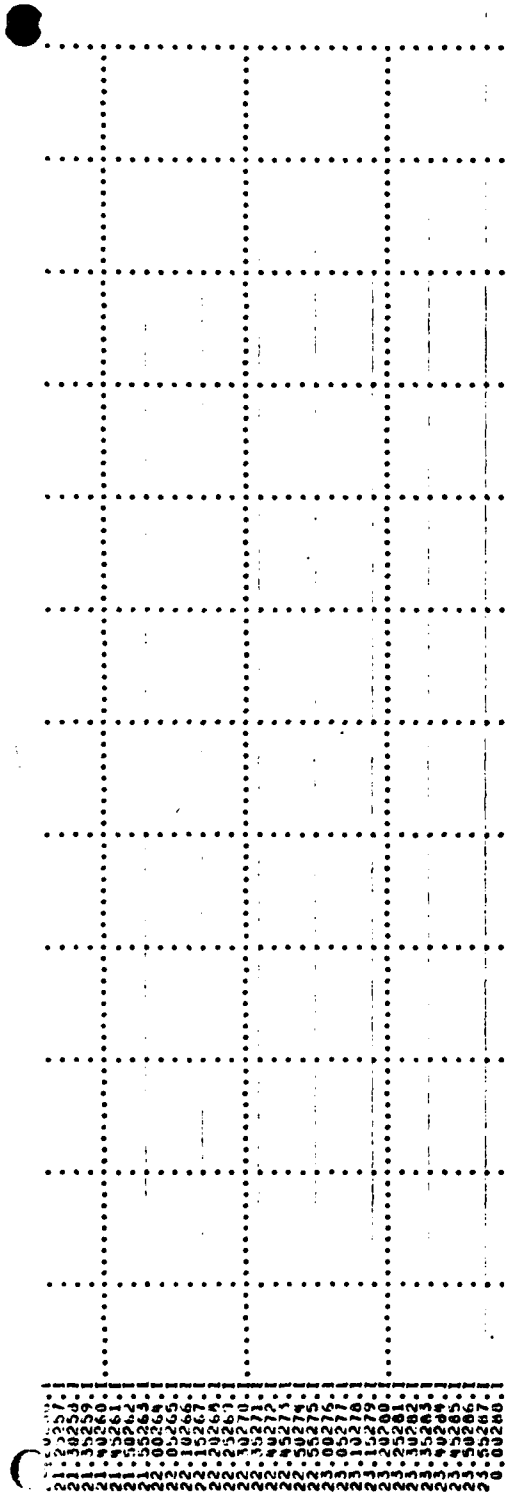


PLATE D-23

OVH

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLO HYDRO TO NO TWIN LAKES RES-NO. 31216

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000003	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.03	0.00	.03	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	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	-89.00	0.00	0.00

CURVE NO = -89.00 WETNESS = -1.00 EFFECT CN = 89.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .17

RECESSION DATA

STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00

24. 71. 73. 46. 23. 12. 7. 3. 2. 1.
1. 0.

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	.23	.22	.01	22.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.22	.01	33.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.22	.01	44.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.22	.01	51.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.22	.01	55.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.22	.01	57.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.22	.00	58.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.23	.00	59.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.23	.00	59.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.23	.00	59.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.23	.00	59.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.23	.00	59.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.27	.00	60.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.27	.00	64.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.27	.00	67.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.27	.00	69.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.27	.00	70.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.27	.00	71.
1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.28	.27	.00	71.
1.01	1.40	20	.01	.00	.01	0.	1.01	13.40	164	.28	.27	.00	71.
1.01	1.45	21	.01	.00	.01	0.	1.01	13.45	165	.28	.27	.00	72.
1.01	1.50	22	.01	.00	.01	0.	1.01	13.50	166	.28	.27	.00	72.
1.01	1.55	23	.01	.00	.01	0.	1.01	13.55	167	.28	.27	.00	72.
1.01	2.00	24	.01	.00	.01	0.	1.01	14.00	168	.28	.27	.00	72.
1.01	2.05	25	.01	.00	.01	0.	1.01	14.05	169	.34	.34	.00	73.
1.01	2.10	26	.01	.00	.01	0.	1.01	14.10	170	.34	.34	.00	78.
1.01	2.15	27	.01	.00	.01	0.	1.01	14.15	171	.34	.34	.00	83.
1.01	2.20	28	.01	.00	.01	0.	1.01	14.20	172	.34	.34	.00	87.
1.01	2.25	29	.01	.00	.01	1.	1.01	14.25	173	.34	.34	.00	88.
1.01	2.30	30	.01	.00	.01	1.	1.01	14.30	174	.34	.34	.00	89.
1.01	2.35	31	.01	.00	.01	1.	1.01	14.35	175	.34	.34	.00	89.
1.01	2.40	32	.01	.00	.01	1.	1.01	14.40	176	.34	.34	.00	90.
1.01	2.45	33	.01	.00	.01	1.	1.01	14.45	177	.34	.34	.00	90.
1.01	2.50	34	.01	.00	.01	1.	1.01	14.50	178	.34	.34	.00	90.
1.01	2.55	35	.01	.00	.01	1.	1.01	14.55	179	.34	.34	.00	90.
1.01	3.00	36	.01	.00	.01	1.	1.01	15.00	180	.34	.34	.00	90.
1.01	3.05	37	.01	.00	.01	1.	1.01	15.05	181	.21	.21	.00	87.
1.01	3.10	38	.01	.00	.01	1.	1.01	15.10	182	.42	.42	.00	82.
1.01	3.15	39	.01	.00	.01	1.	1.01	15.15	183	.42	.42	.00	87.
1.01	3.20	40	.01	.00	.01	1.	1.01	15.20	184	.63	.63	.00	101.
1.01	3.25	41	.01	.00	.01	1.	1.01	15.25	185	.73	.73	.00	125.
1.01	3.30	42	.01	.00	.01	1.	1.01	15.30	186	1.78	1.77	.01	176.
1.01	3.35	43	.01	.01	.01	1.	1.01	15.35	187	2.93	2.92	.01	296.
1.01	3.40	44	.01	.01	.01	1.	1.01	15.40	188	1.15	1.15	.00	423.
1.01	3.45	45	.01	.01	.01	1.	1.01	15.45	189	.73	.74	.00	435.

PLATE D-24

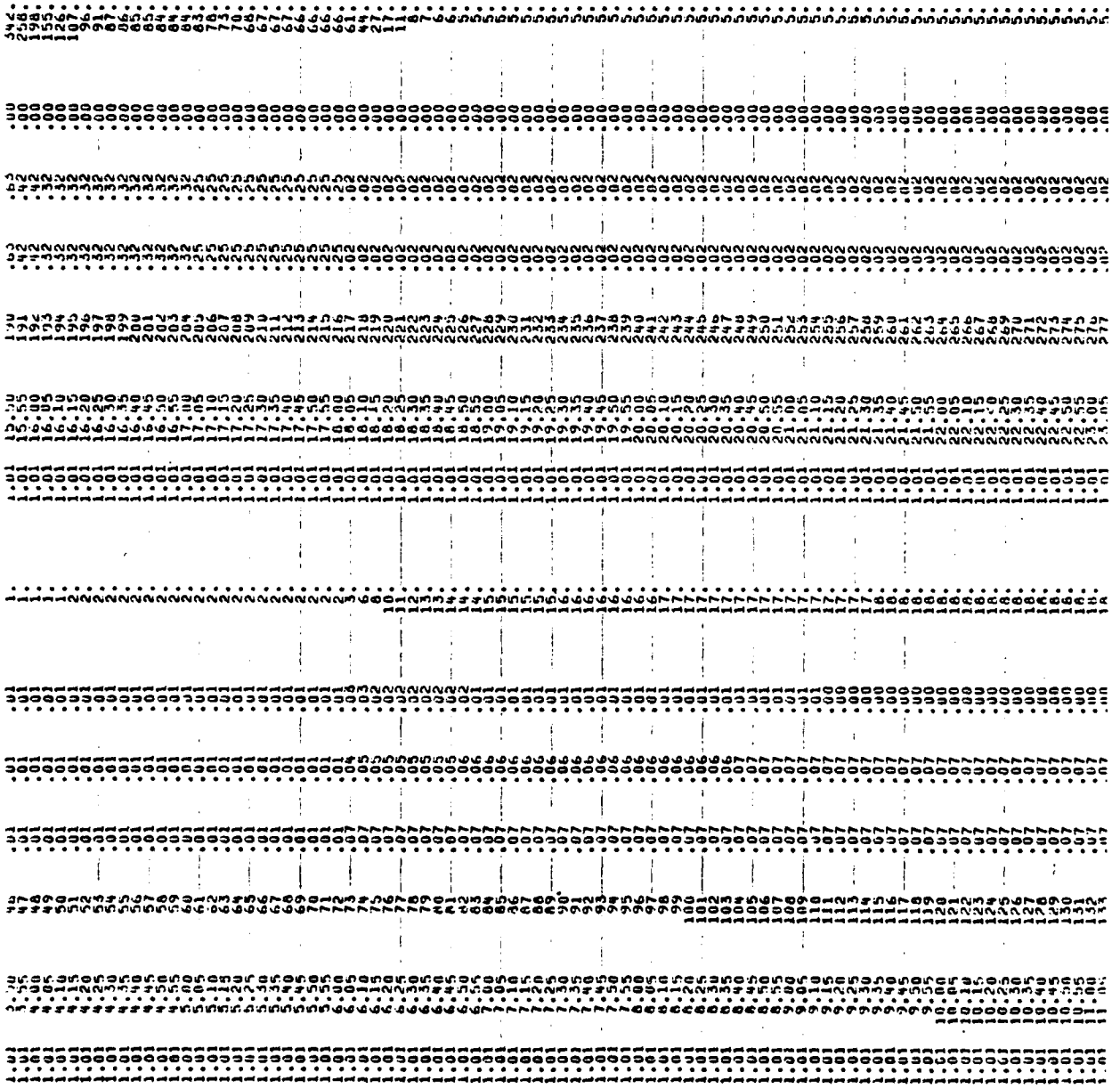


PLATE D-25

1.01	11.10	134	.07	.07	.00	18.	1.01	23.10	278	.02	.02	.00	
1.01	11.15	135	.07	.07	.00	18.	1.01	23.15	279	.02	.02	.00	
1.01	11.20	136	.07	.07	.00	18.	1.01	23.20	280	.02	.02	.00	
1.01	11.25	137	.07	.07	.00	18.	1.01	23.25	281	.02	.02	.00	
1.01	11.30	138	.07	.07	.00	18.	1.01	23.30	282	.02	.02	.00	
1.01	11.35	139	.07	.07	.00	18.	1.01	23.35	283	.02	.02	.00	
1.01	11.40	140	.07	.07	.00	18.	1.01	23.40	284	.02	.02	.00	
1.01	11.45	141	.07	.07	.00	18.	1.01	23.45	285	.02	.02	.00	
1.01	11.50	142	.07	.07	.00	18.	1.01	23.50	286	.02	.02	.00	
1.01	11.55	143	.07	.07	.00	18.	1.01	23.55	287	.02	.02	.00	
1.01	12.00	144	.07	.07	.00	18.	1.02	0.00	288	.02	.02	.00	
									SUM	35.10	33.66	1.44	8823.
										(892.)	(855.)	(37.)	(249.84)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	425.	99.	31.	31.	8843.
CMS	12.	3.	1.	1.	250.
INCHES		27.12	33.60	33.60	33.60
MM		688.82	853.51	853.51	853.51
AC-FT		49.	61.	61.	61.
THOUS CU M		61.	75.	75.	75.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	21.	5.	2.	2.	442.
CMS	1.	0.	0.	0.	13.
INCHES		1.36	1.68	1.68	1.68
MM		34.44	42.68	42.68	42.68
AC-FT		2.	3.	3.	3.
THOUS CU M		3.	4.	4.	4.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	42.	10.	3.	3.	884.
CMS	1.	0.	0.	0.	25.
INCHES		2.71	3.36	3.36	3.36
MM		68.88	85.35	85.35	85.35
AC-FT		5.	6.	6.	6.
THOUS CU M		6.	8.	8.	8.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	64.	15.	5.	5.	1326.
CMS	2.	0.	0.	0.	38.
INCHES		4.07	5.04	5.04	5.04
MM		103.32	128.03	128.03	128.03
AC-FT		7.	9.	9.	9.
THOUS CU M		9.	11.	11.	11.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	85.	20.	6.	6.	1769.
CMS	2.	1.	0.	0.	50.
INCHES		5.42	6.72	6.72	6.72
MM		137.76	170.70	170.70	170.70
AC-FT		10.	12.	12.	12.
THOUS CU M		12.	15.	15.	15.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	149.	35.	11.	11.	3095.
CMS	4.	1.	0.	0.	88.
INCHES		9.49	11.76	11.76	11.76
MM		241.09	298.73	298.73	298.73
AC-FT		17.	21.	21.	21.
THOUS CU M		21.	26.	26.	26.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 6 — ½ PMF

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

PLATE D-26

CFS	212.	50.	15.	15.	4424.
CMS	6.	1.	0.	0.	125.
INCHES		13.56	16.80	16.80	16.80
MM		344.41	426.75	426.75	426.75
AC-FT		25.	30.	30.	30.
THOUS CU M		30.	38.	38.	38.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	319.	74.	23.	23.	6632.
CMS	9.	2.	1.	1.	188.
INCHES		20.34	25.20	25.20	25.20
MM		516.62	640.13	640.13	640.13
AC-FT		37.	46.	46.	46.
THOUS CU M		45.	56.	56.	56.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 8 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	425.	99.	31.	31.	8843.
CMS	12.	3.	1.	1.	250.
INCHES		27.12	33.60	33.60	33.60
MM		688.82	853.51	853.51	853.51
AC-FT		49.	61.	61.	61.
THOUS CU M		61.	75.	75.	75.

****

COMBINE HYDROGRAPHS

COMBINED INFLO HYDRO TO NO TWIN LAKES RES NO 31216

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UM 2+3	2	0	0	2	0	1	0	0

~~SUM OF 2 HYDROGRAPHS AT UM 2+3 PLAN 1 RTIO 1~~

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	29.	12.	4.	4.	1284.
CMS	1.	0.	0.	0.	36.
INCHES		.99	1.52	1.52	1.52
MM		25.23	38.66	38.66	38.66
AC-FT		6.	9.	9.	9.
~~THOUS CU M~~		7.	11.	11.	11.

PLATE D-27

OVN

SUM OF 2 HYDROGRAPHS AT UM 2+3 PLAN 1 RTIO 6 ½ PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	643.	141.	44.	44.	12736.
CMS	18.	4.	1.	1.	361.
. INCHES		12.05	15.10	15.10	15.10
MM		306.00	383.43	383.43	383.43
AC-FT		70.	88.	88.	88.
THOUS CU M		86.	108.	108.	108.

PLATE D-28

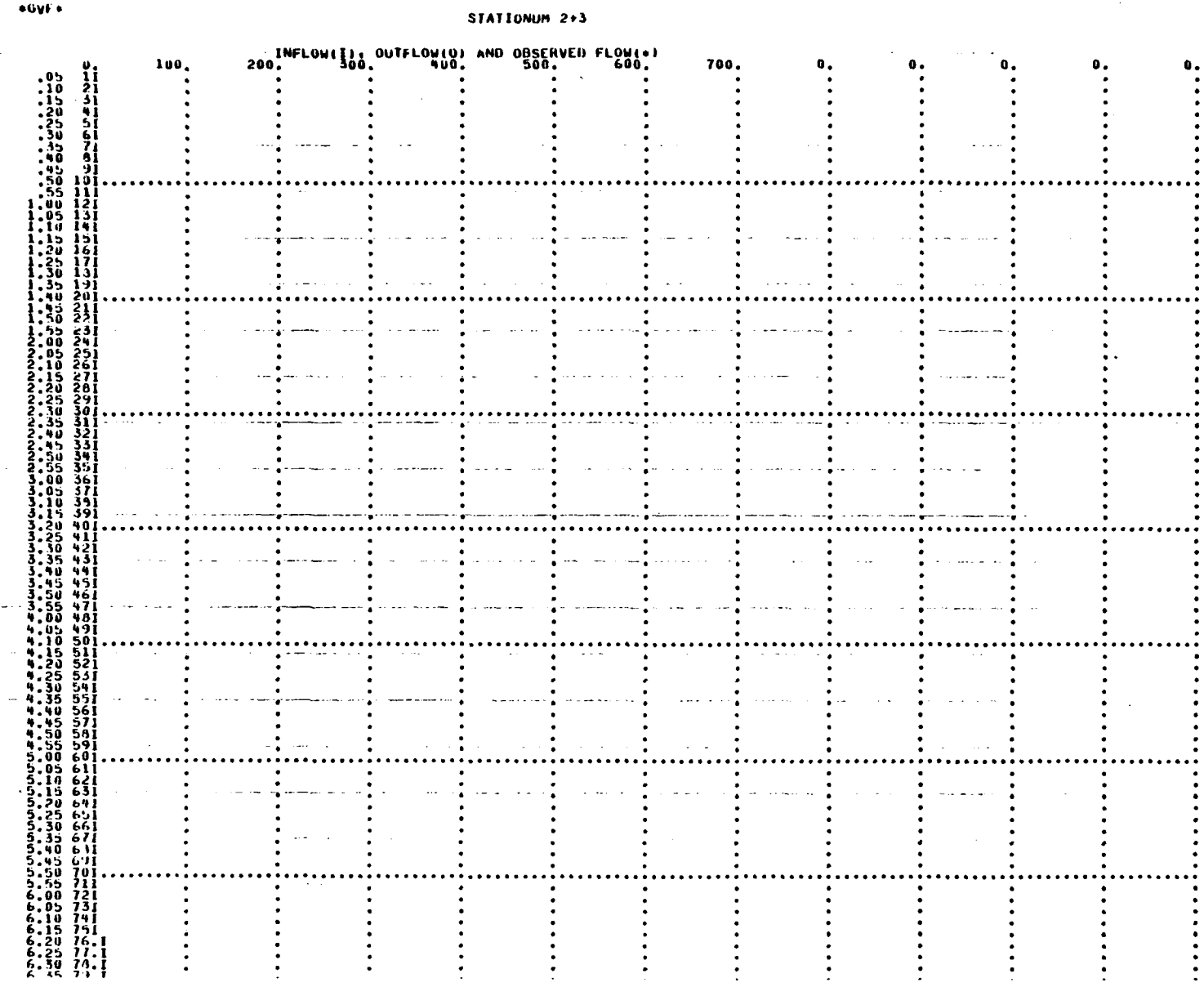

GVF
STATIONUM 2+3
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 100. 200. 300. 400. 500. 600. 700. 0. 0. 0. 0. 0.

PLATE D-29

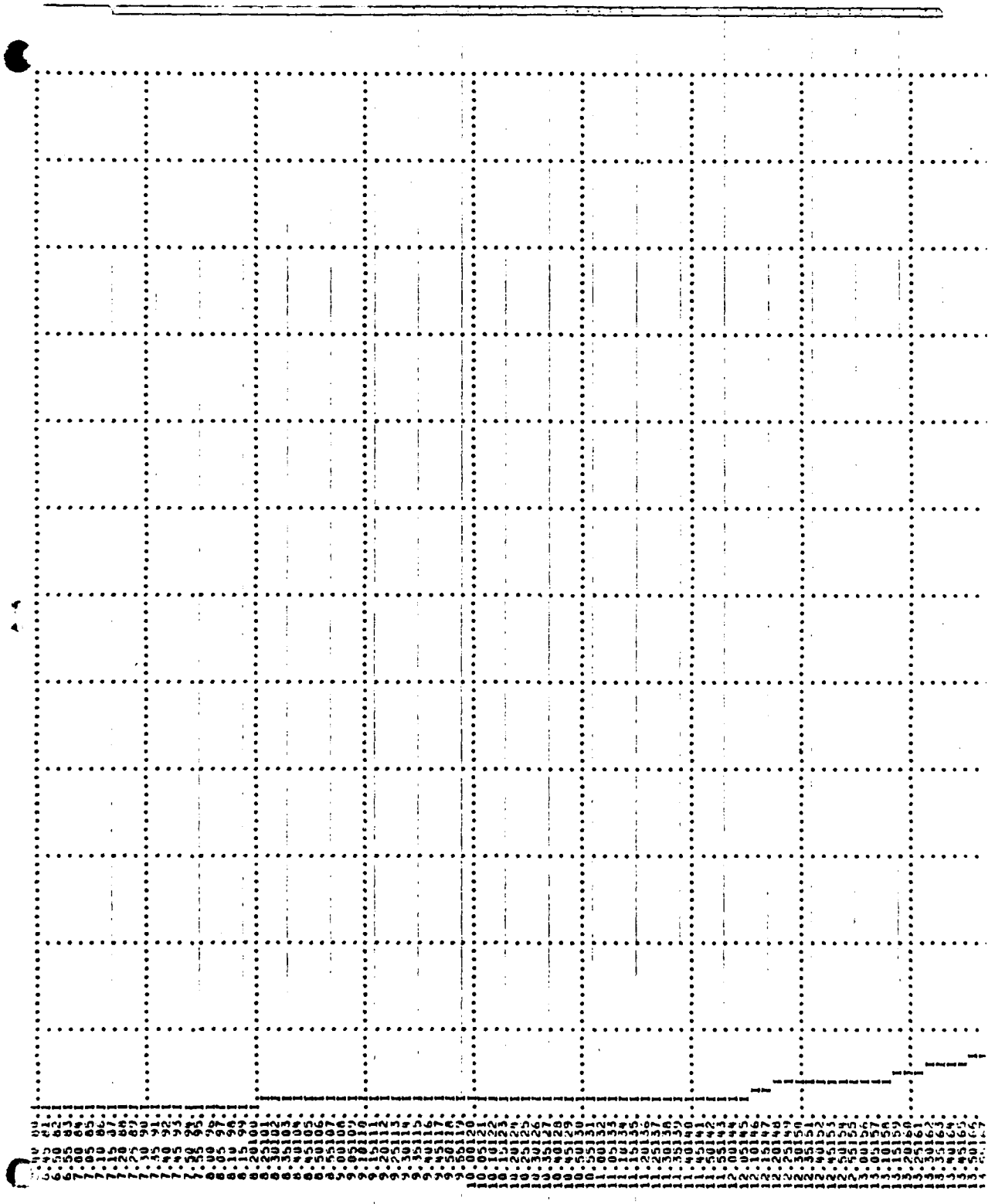


PLATE D-30

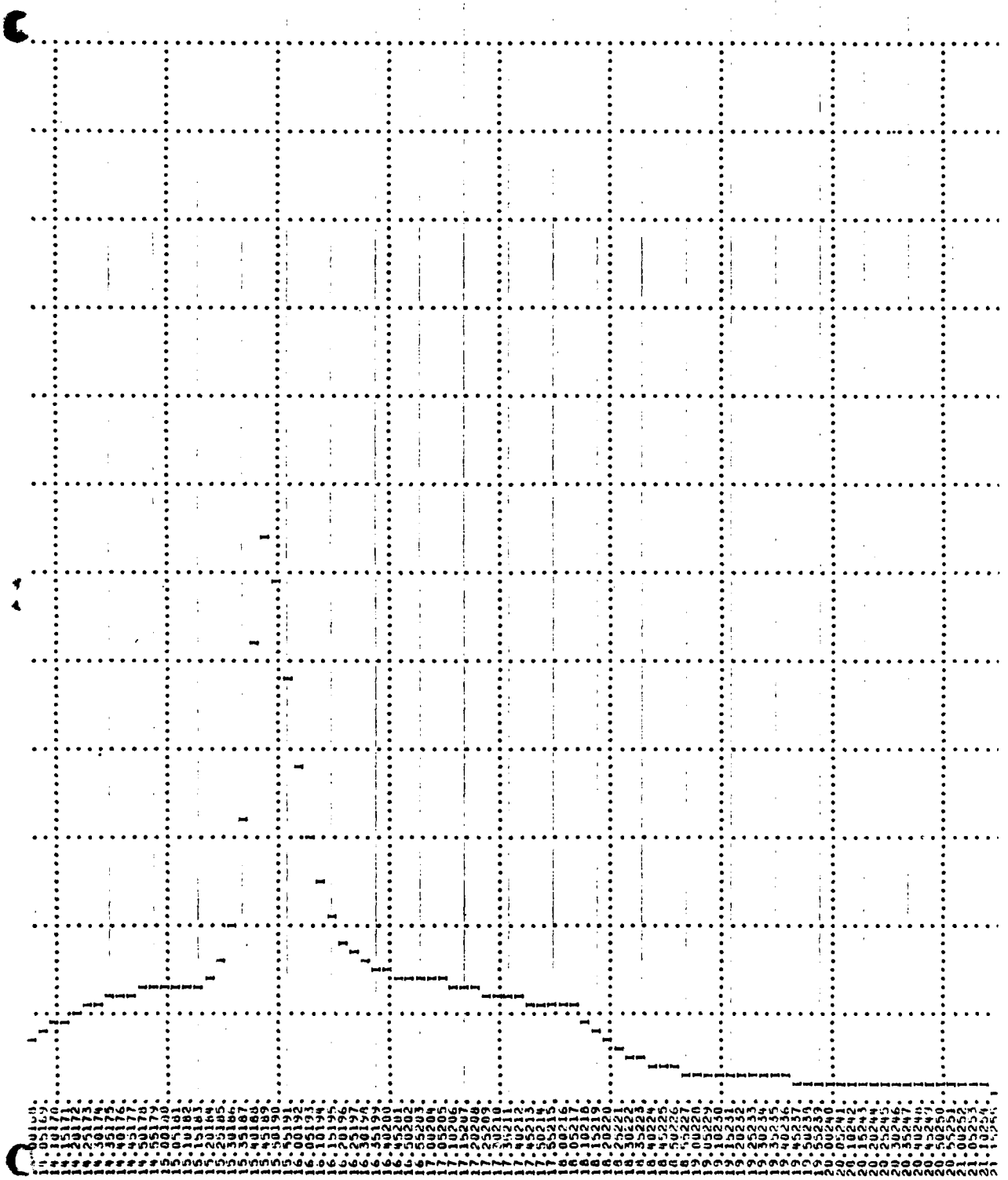


PLATE D-31

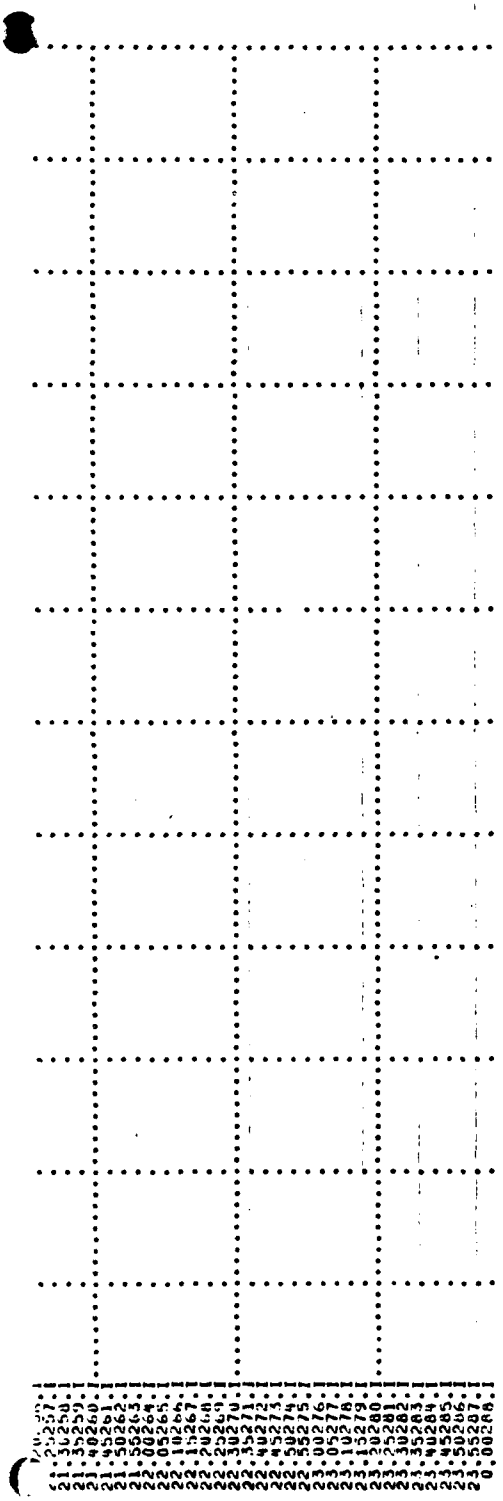


PLATE D-32

DVN

SUM OF 2 HYDROGRAPHS AT UM 2+3 PLAN 1 RTIO 8 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1357.	307.	91.	91.	26272.
CMS	38.	9.	3.	3.	744.
INCHES		26.20	31.14	31.14	31.14
MM		665.37	790.98	790.98	790.98
AC-FT		152.	181.	181.	181.
THOUS CU M		188.	223.	223.	223.

PLATE D-33

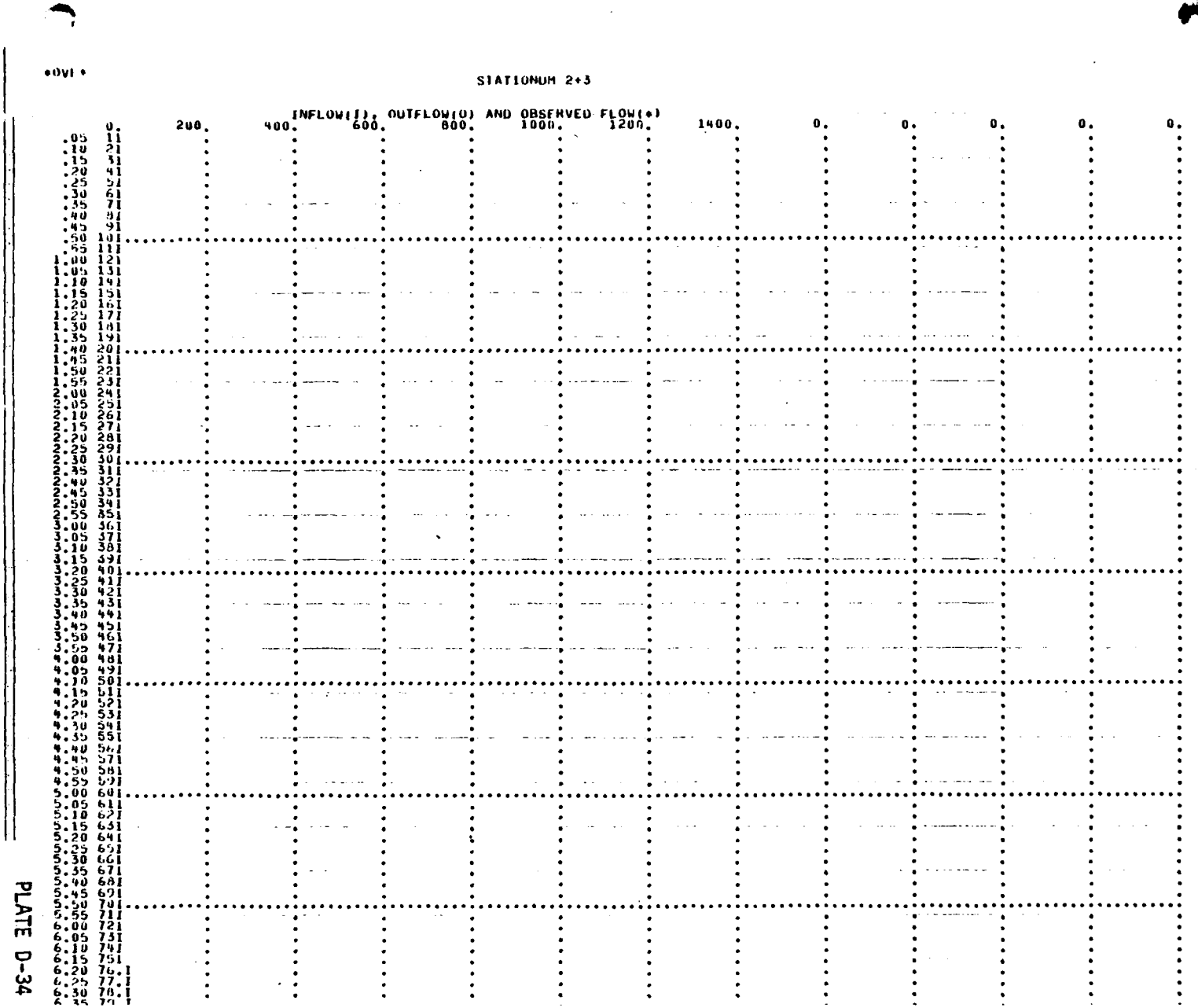

OVI
STATIONUM 2+3
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 200. 400. 600. 800. 1000. 1200. 1400. 0. 0. 0. 0. 0.

PLATE D-34

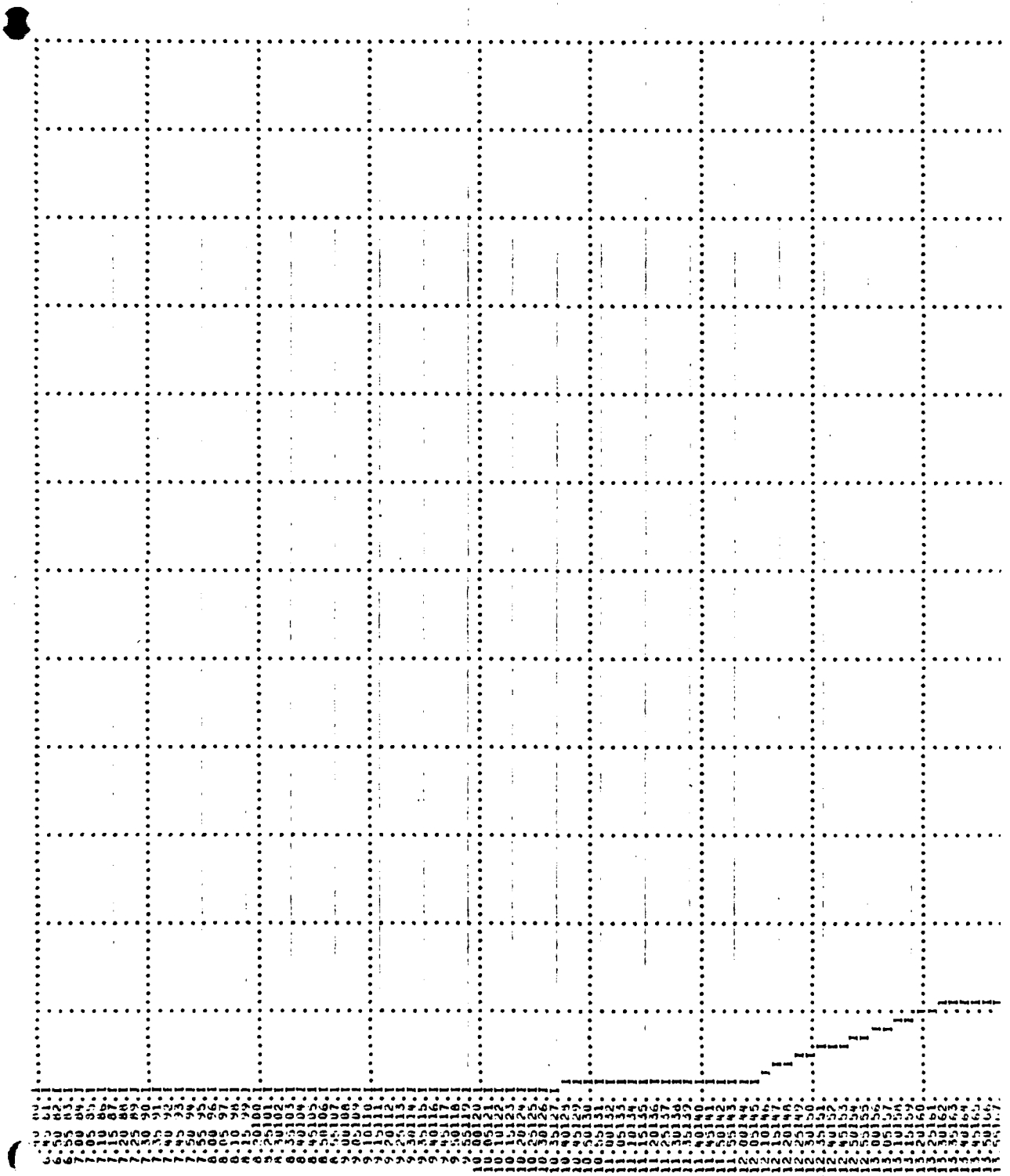


PLATE D-35

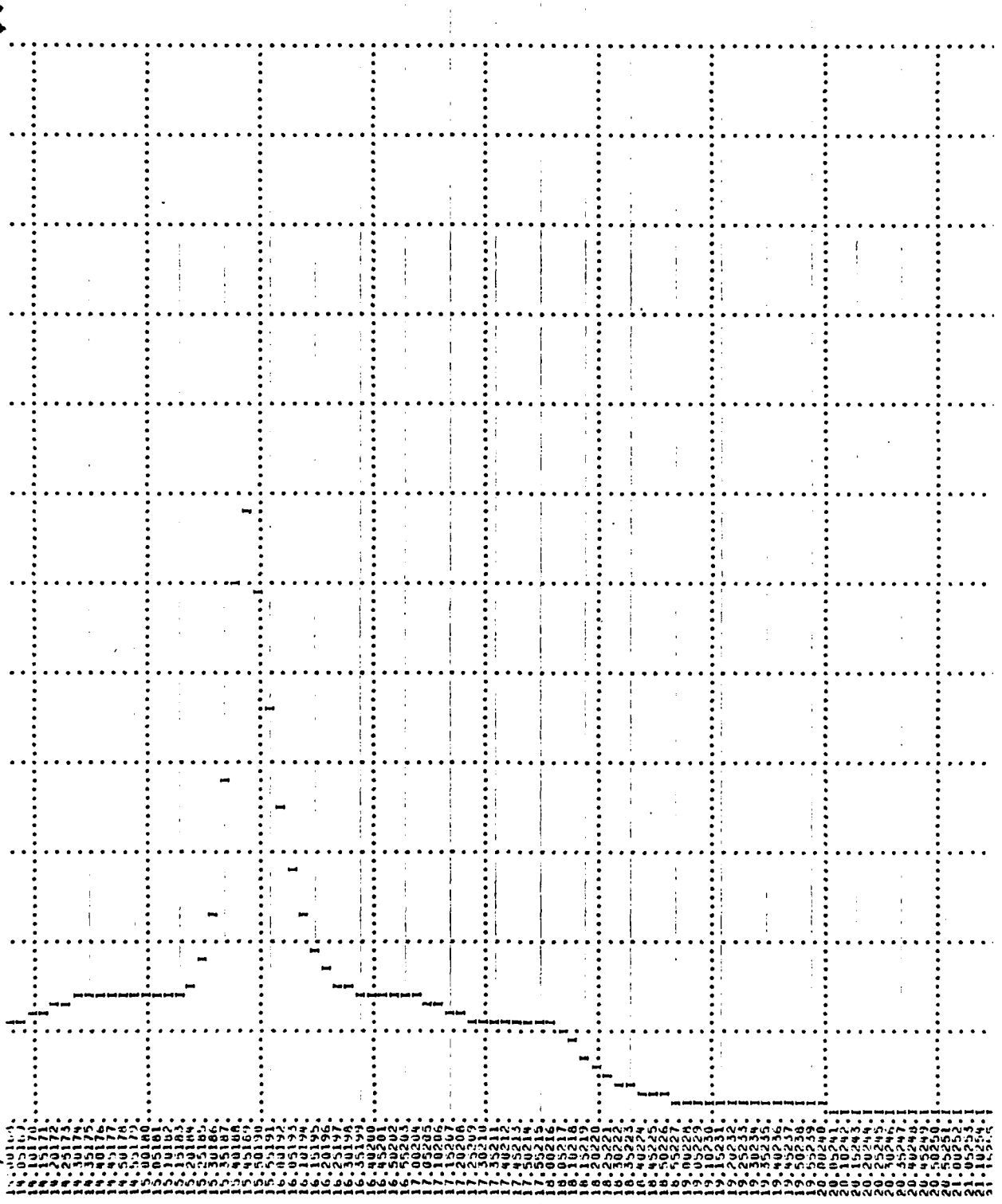


PLATE D-36

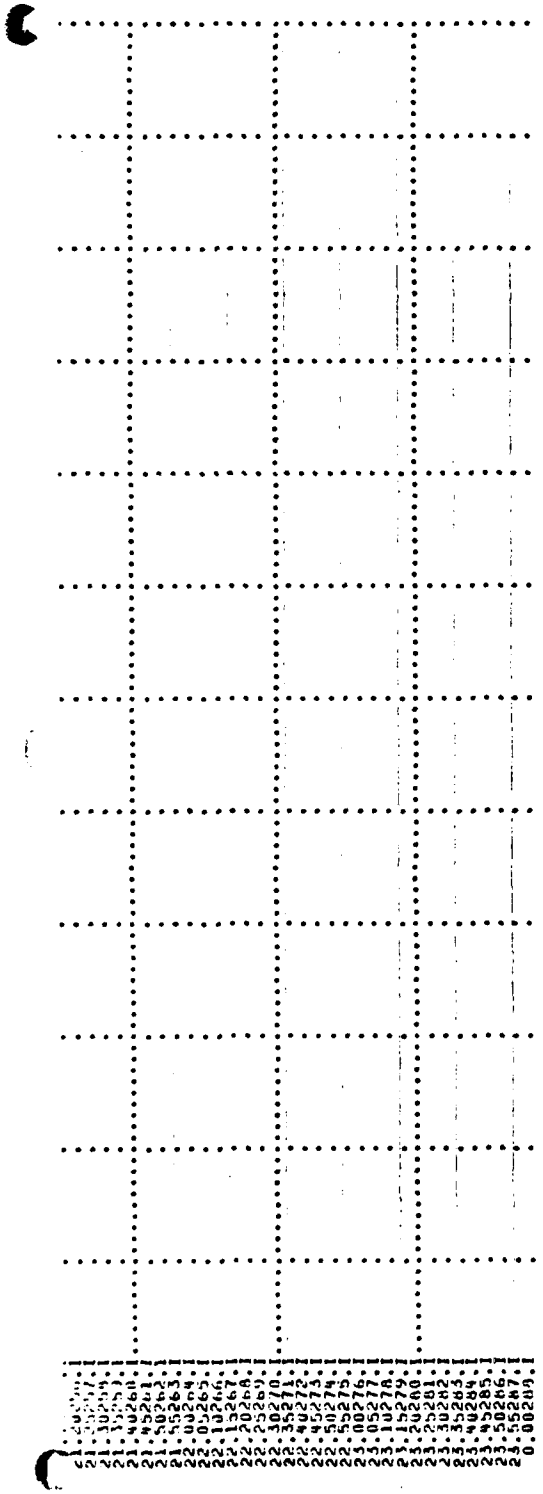


PLATE D-37

•OVN•

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU NO TWIN LAKES DAM NO. 31216

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000004	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	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-445.	-1

STAGE	444.80	445.00	445.20	445.40	445.50	446.00	446.50	447.00	447.30	447.40
	448.00	449.20	450.00	451.00	452.00	453.00				
FLOW	0.00	1.40	4.10	6.50	7.10	9.30	11.10	12.60	13.50	13.80
	14.00	14.30	14.50	14.80	15.10	15.30				

SURFACE AREA=	0.	2.	3.	5.	6.	7.	7.	8.	8.
CAPACITY=	0.	1.	13.	33.	58.	74.	87.	100.	132.
ELEVATION=	428.	430.	435.	440.	445.	447.	449.	451.	455.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
444.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
449.2	2.8	1.5	300.

CREST LENGTH AT OR BELOW	0.	45.	107.	134.	166.	312.	425.	453.	507.	547.
ELEVATION	447.3	447.7	448.7	449.2	449.3	449.6	449.8	450.2	451.8	453.0

~~STATION 000004, PLAN 1, RATIO 1~~

~~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.	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.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	3.	3.	3.	3.
3.	3.	3.	3.	3.	4.	4.	4.	5.	5.
5.	5.	5.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	6.	6.	6.	6.	6.		

STORAGE

58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.

•OVN•

STATION 000004, PLAN 1, RATIO 6 1/2 PME

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.	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.	1.
1.	1.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	4.	4.	4.	4.	4.	4.	5.
5.	5.	5.	5.	5.	6.	6.	6.	6.	6.
6.	6.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	8.	8.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	9.
9.	9.	9.	9.	9.	9.	10.	10.	10.	10.
10.	10.	11.	11.	11.	11.	11.	11.	12.	12.
12.	12.	13.	13.	13.	14.	15.	19.	26.	37.
49.	61.	72.	84.	97.	115.	150.	226.	350.	460.
493.	464.	410.	355.	307.	269.	239.	215.	198.	184.
173.	166.	160.	155.	151.	147.	144.	140.	136.	132.
129.	126.	123.	121.	119.	117.	115.	112.	107.	100.
94.	87.	80.	74.	69.	64.	59.	55.	52.	49.
47.	44.	42.	40.	39.	37.	36.	34.	33.	32.
31.	30.	29.	28.	28.	27.	26.	26.	25.	24.
24.	23.	23.	22.	22.	21.	21.	21.	20.	20.
20.	20.	19.	19.	19.	19.	19.	18.	18.	18.
18.	18.	18.	18.	18.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.		

STORAGE

58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	59.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	59.	59.	59.	59.	59.
59.	59.	59.	59.	59.	59.	59.	59.	59.	59.
59.	59.	60.	60.	60.	60.	60.	60.	60.	60.
60.	60.	60.	60.	60.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	62.	62.	62.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
63.	63.	63.	63.	63.	63.	63.	63.	63.	63.
63.	63.	63.	64.	64.	64.	64.	64.	64.	65.
65.	65.	65.	65.	66.	66.	66.	66.	67.	67.
67.	67.	68.	68.	68.	69.	69.	70.	70.	71.
71.	72.	72.	73.	74.	74.	75.	76.	77.	77.
78.	78.	79.	79.	80.	80.	81.	83.	85.	86.
87.	86.	86.	85.	84.	83.	83.	83.	82.	82.
82.	81.	81.	81.	81.	81.	81.	81.	61.	61.
81.	81.	80.	80.	80.	80.	80.	80.	80.	80.
80.	79.	79.	79.	79.	79.	78.	78.	78.	78.
78.	78.	78.	77.	77.	77.	77.	77.	77.	77.
77.	77.	77.	77.	77.	77.	77.	77.	76.	76.
76.	76.	76.	76.	76.	76.	76.	76.	76.	76.
76.	76.	76.	76.	76.	76.	76.	76.	76.	76.
76.	76.	76.	76.	76.	76.	76.	76.	75.	75.
75.	75.	75.	75.	75.	75.	75.	75.		

STAGE

444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.9	444.9	444.9	444.9
444.9	444.9	444.9	444.9	444.9	444.9	444.9	445.0	445.0	445.0
445.0	445.0	445.0	445.0	445.0	445.1	445.1	445.1	445.1	445.1
445.1	445.1	445.1	445.2	445.2	445.2	445.2	445.2	445.2	445.2
445.3	445.3	445.3	445.3	445.3	445.3	445.3	445.3	445.4	445.4
445.4	445.4	445.4	445.4	445.4	445.4	445.5	445.5	445.5	445.5
445.5	445.5	445.5	445.5	445.6	445.6	445.6	445.6	445.6	445.6
445.6	445.6	445.7	445.7	445.7	445.7	445.7	445.8	445.8	445.8
445.9	445.9	445.9	446.0	446.0	446.0	446.1	446.1	446.1	446.2

446.2	446.3	446.3	446.4	446.4	446.5	446.6	446.6	446.7	446.8
446.9	447.0	447.0	447.1	447.3	447.4	447.5	447.6	447.7	447.8
447.9	448.0	448.0	448.1	448.2	448.2	448.4	448.6	448.9	449.1
449.1	449.1	449.0	448.9	448.8	448.7	448.6	448.6	448.5	448.5
448.4	448.4	448.4	448.4	448.4	448.4	448.3	448.3	448.3	448.3
448.3	448.3	448.3	448.3	448.2	448.2	448.2	448.2	448.2	448.2
448.1	448.1	448.1	448.0	448.0	448.0	448.0	447.9	447.9	447.9
447.9	447.9	447.8	447.8	447.8	447.8	447.8	447.8	447.8	447.8
447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7
447.7	447.7	447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6
447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6
447.6	447.5	447.5	447.5	447.5	447.5	447.5	447.5	447.5	447.5
447.5	447.5	447.5	447.5	447.5	447.5	447.5	447.5		

PEAK OUTFLOW IS 493. AT TIME 15.32 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	493.	123.	36.	36.	10253.
CMS	14.	3.	1.	1.	290.
INCHES		10.52	12.15	12.15	12.15
MM		267.24	308.68	308.68	308.68
AC-FT		61.	71.	71.	71.
THOUS-CU M		76.	87.	87.	87.

PLATE D-40

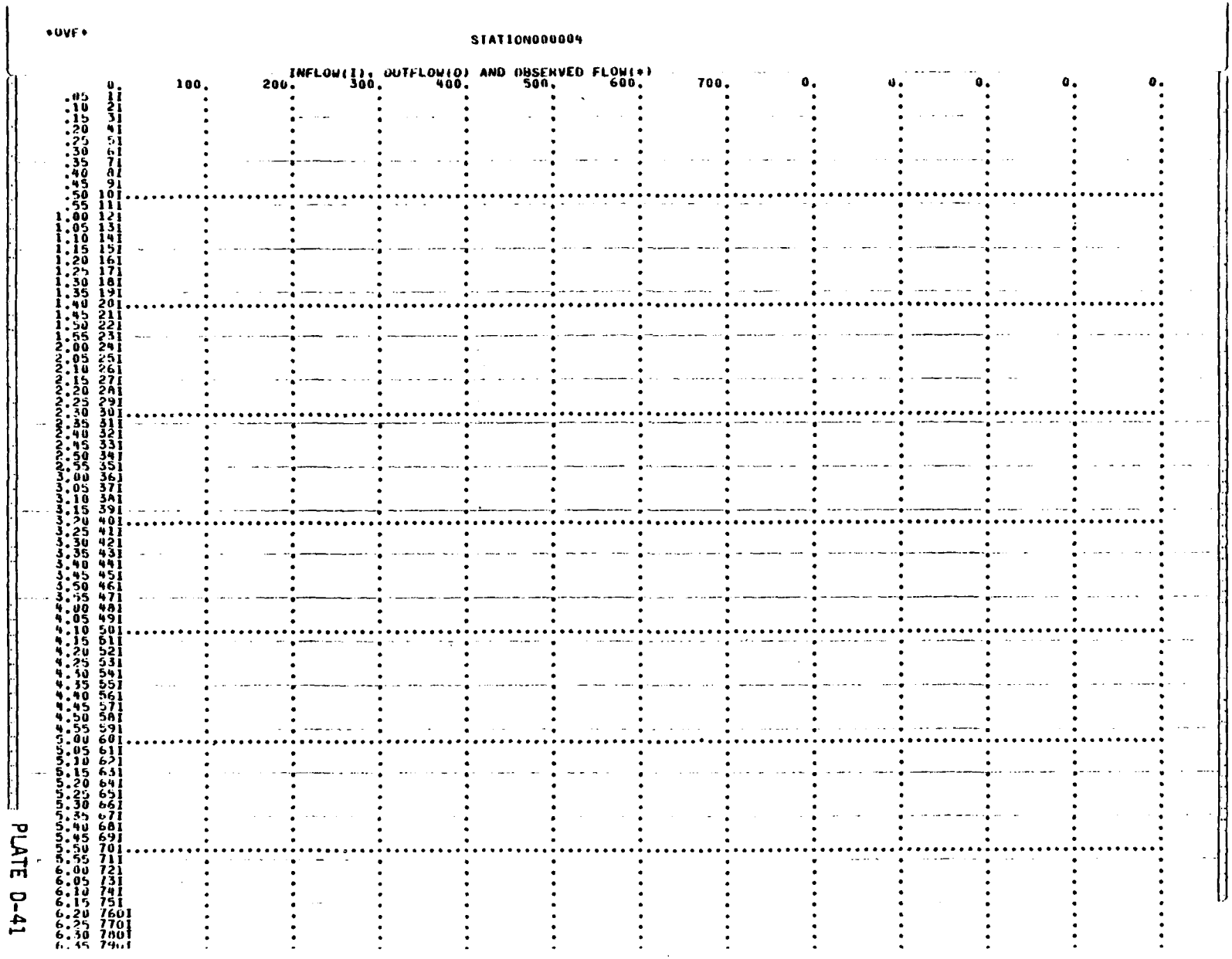

OVF
STATION000004
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 100. 200. 300. 400. 500. 600. 700. 0. 0. 0. 0. 0.

PLATE D-41

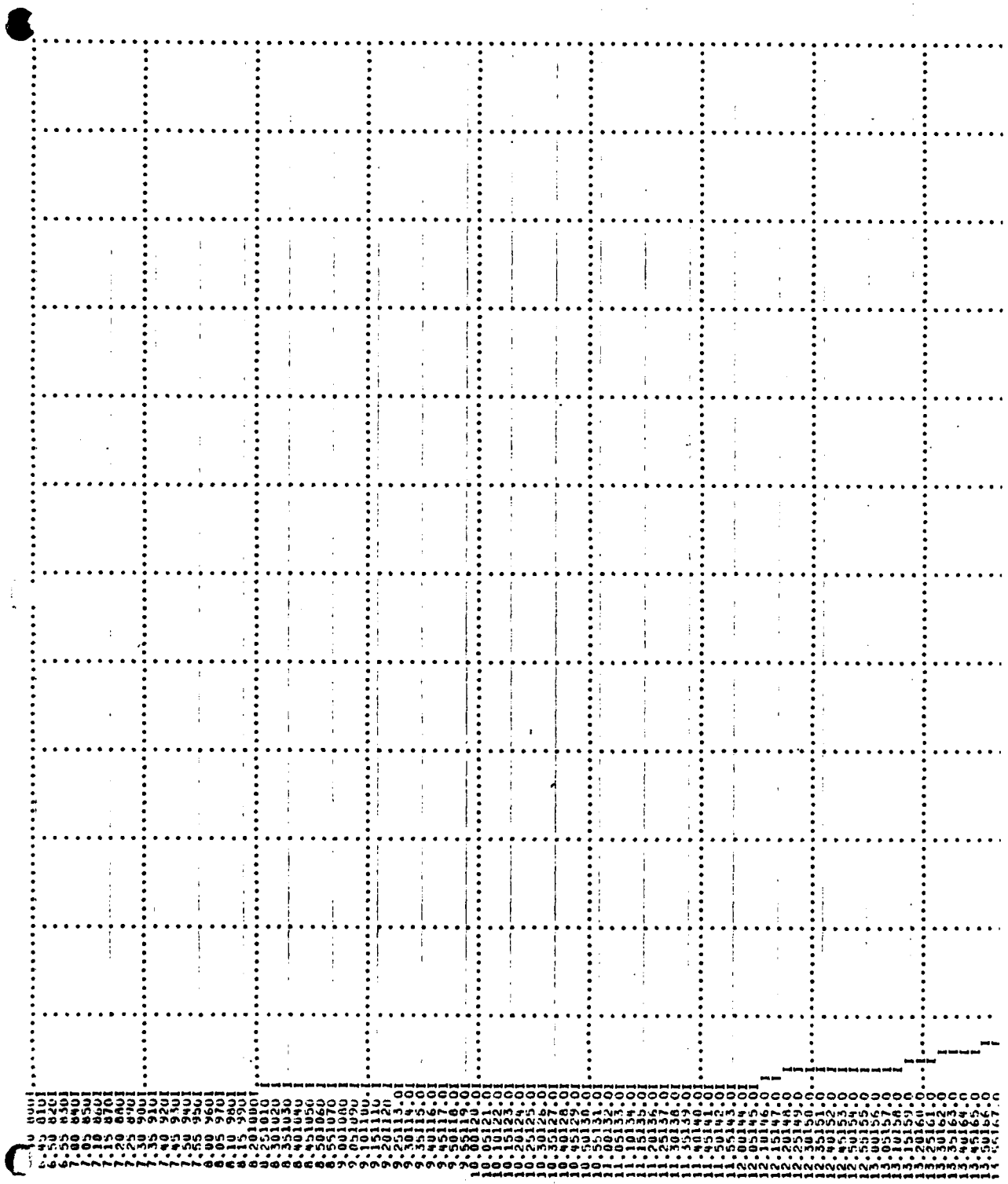


PLATE D-42

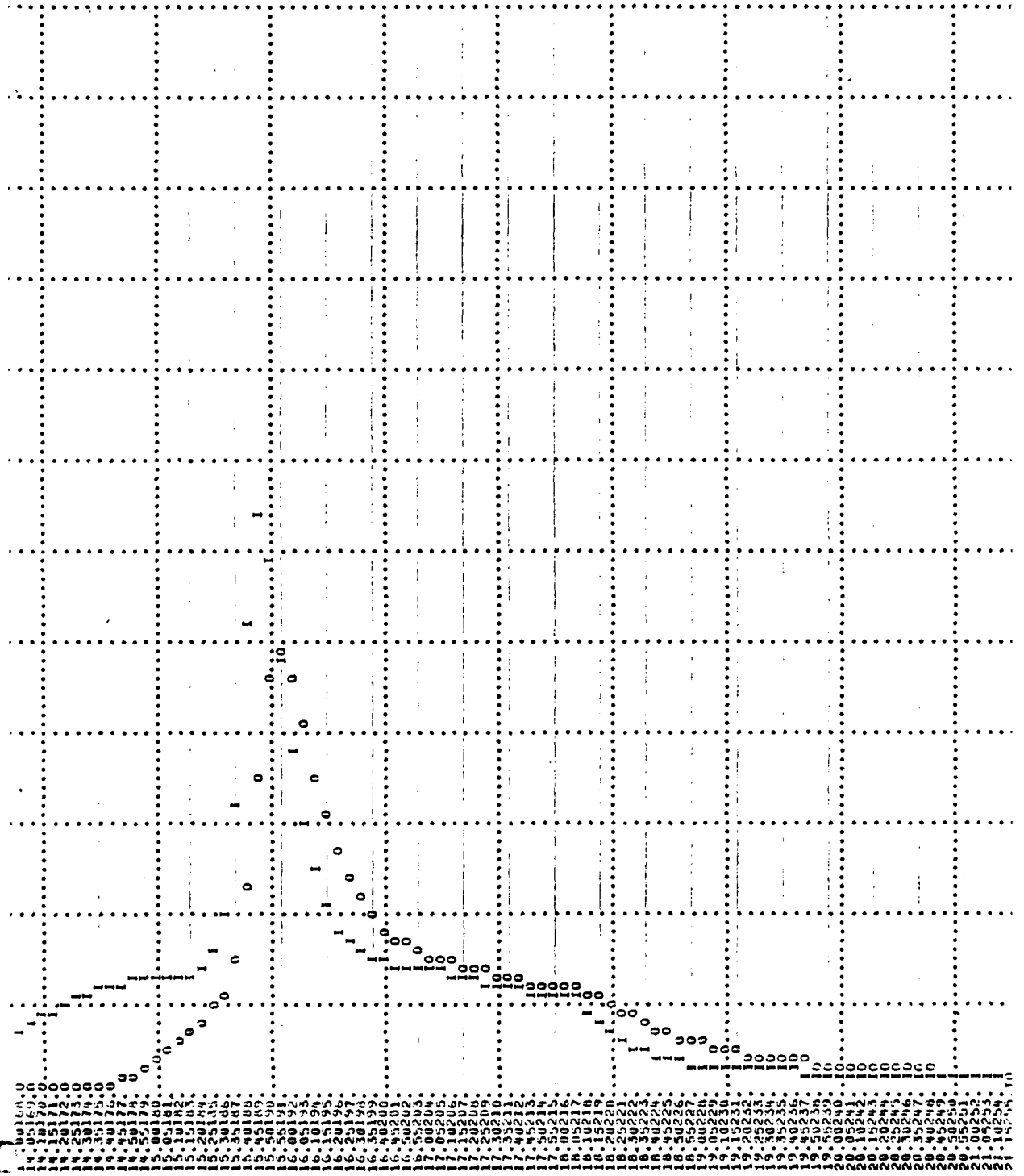


PLATE D-43

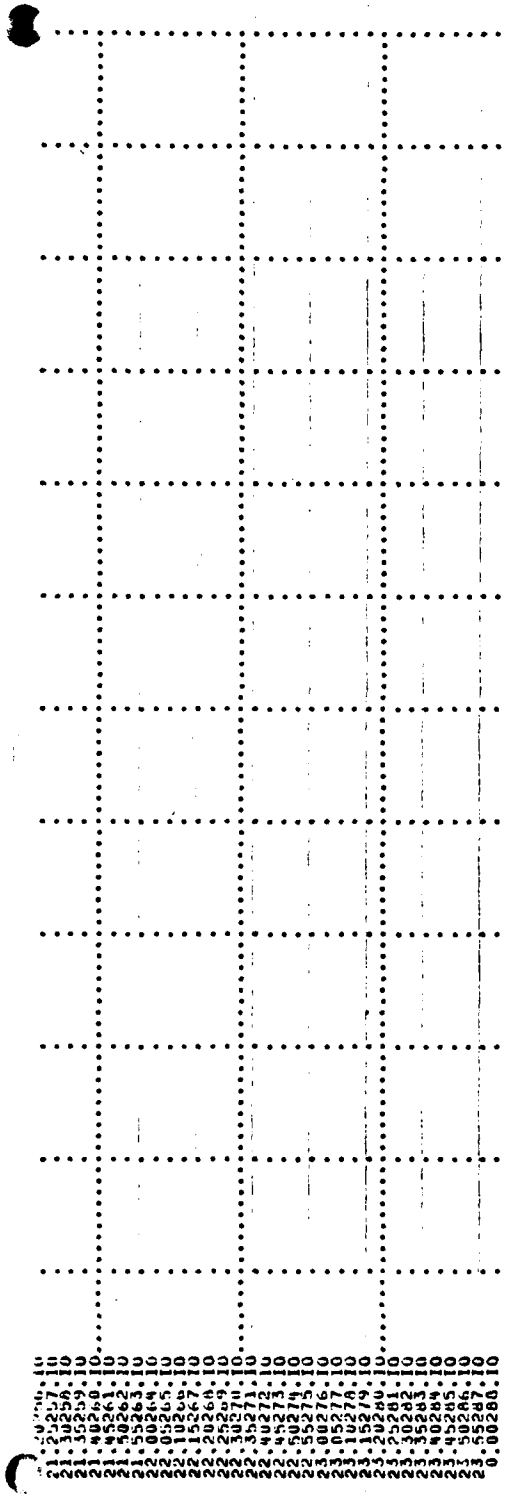


PLATE D-44

STATION 000004, PLAN 1, RATIO 8 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.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	3.	3.	3.	4.
4.	4.	4.	5.	5.	5.	5.	6.	6.	6.
7.	7.	7.	7.	7.	7.	7.	7.	7.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	11.	11.	11.	11.	11.	11.	11.	12.	12.
12.	13.	13.	13.	14.	17.	24.	38.	57.	79.
103.	126.	147.	166.	180.	192.	201.	208.	213.	219.
226.	235.	244.	253.	261.	267.	272.	276.	279.	281.
202.	280.	277.	280.	295.	337.	451.	714.	1114.	1244.
1077.	875.	718.	602.	514.	446.	394.	357.	330.	312.
299.	290.	284.	279.	276.	272.	265.	257.	249.	241.
235.	229.	225.	222.	219.	217.	215.	208.	193.	175.
156.	140.	125.	112.	102.	93.	85.	78.	72.	67.
62.	58.	55.	52.	49.	47.	45.	44.	42.	41.
39.	38.	37.	36.	35.	34.	33.	33.	32.	31.
31.	30.	30.	29.	29.	28.	28.	27.	27.	26.
26.	26.	25.	25.	25.	24.	24.	24.	24.	23.
23.	23.	23.	22.	22.	22.	22.	22.	22.	21.
21.	21.	21.	21.	21.	21.	20.	20.		

STORAGE

58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
59.	59.	59.	59.	59.	59.	59.	59.	59.	59.
59.	59.	59.	59.	59.	59.	59.	59.	59.	59.
59.	59.	59.	60.	60.	60.	60.	60.	60.	60.
61.	61.	61.	61.	61.	61.	61.	61.	62.	62.
62.	62.	62.	62.	62.	63.	63.	63.	63.	63.
63.	63.	64.	64.	64.	64.	64.	64.	64.	65.
65.	65.	65.	65.	65.	65.	66.	66.	66.	66.
66.	66.	66.	67.	67.	67.	67.	67.	67.	68.
68.	68.	68.	68.	68.	69.	69.	70.	70.	71.
71.	72.	73.	74.	75.	75.	76.	77.	78.	79.
80.	81.	81.	81.	82.	82.	82.	82.	82.	83.
83.	83.	83.	83.	83.	83.	84.	84.	84.	84.
84.	84.	84.	84.	84.	85.	86.	89.	91.	92.
91.	90.	89.	88.	87.	86.	85.	85.	84.	84.
84.	84.	84.	84.	84.	84.	83.	83.	83.	83.
83.	83.	83.	83.	83.	83.	82.	82.	82.	82.
81.	81.	80.	80.	80.	80.	79.	79.	79.	79.
78.	78.	78.	78.	78.	78.	78.	78.	78.	77.
77.	77.	77.	77.	77.	77.	77.	77.	77.	77.
77.	77.	77.	77.	77.	77.	77.	77.	77.	77.
77.	77.	76.	76.	76.	76.	76.	76.	76.	76.
76.	76.	76.	76.	76.	76.	76.	76.	76.	76.
76.	76.	76.	76.	76.	76.	76.	76.		

STAGE

444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8	444.8
444.8	444.8	444.9	444.9	444.9	444.9	444.9	444.9	444.9	444.9
444.9	444.9	444.9	444.9	444.9	444.9	444.9	444.9	444.9	445.0
445.0	445.0	445.0	445.0	445.1	445.1	445.1	445.1	445.1	445.2
445.2	445.2	445.2	445.2	445.3	445.3	445.3	445.3	445.4	445.4
445.4	445.4	445.4	445.5	445.5	445.5	445.5	445.6	445.6	445.6
445.6	445.7	445.7	445.7	445.7	445.7	445.8	445.8	445.8	445.8
445.9	445.9	445.9	445.9	446.0	446.0	446.0	446.0	446.0	446.1
446.1	446.1	446.1	446.2	446.2	446.2	446.2	446.2	446.3	446.3
446.3	446.4	446.4	446.4	446.5	446.5	446.6	446.6	446.7	446.8
446.9	447.0	447.1	447.2	447.4	447.5	447.7	447.8	447.9	448.1

448.2	448.3	448.4	448.4	448.5	.5	448.5	448.5	448.6	448.6
448.6	448.6	448.6	448.7	448.7	.7	448.7	448.7	448.7	448.7
448.7	448.7	448.7	448.7	448.8	448.9	449.1	449.5	449.8	449.9
449.8	449.6	449.5	449.3	449.2	449.1	449.0	448.9	448.8	448.8
448.8	448.8	448.7	448.7	448.7	448.7	448.7	448.7	448.7	448.6
448.6	448.6	448.6	448.6	448.6	448.6	448.6	448.5	448.5	448.4
448.4	448.3	448.3	448.2	448.2	448.1	448.1	448.1	448.0	448.0
448.0	447.9	447.9	447.9	447.9	447.9	447.9	447.9	447.8	447.8
447.8	447.8	447.8	447.8	447.8	447.8	447.8	447.8	447.8	447.7
447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7
447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7	447.7
447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6
447.6	447.6	447.6	447.6	447.6	447.6	447.6	447.6		

PEAK OUTFLOW IS 1244. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1244.	295.	82.	82.	23702.
CMS	35.	8.	2.	2.	671.
INCHES		25.21	28.09	28.09	28.09
MM		640.26	713.61	713.61	713.61
AC-FT		146.	163.	163.	163.
THOUS CU M		181.	201.	201.	201.

PLATE C-4

AD-A106 644 HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM. NORTH TWIN LAKES DAM (MO 31216), M--ETC(U)
OCT 80 R S DECKER, G G JAMISON, G ULMER DACW43-81-C-0003
UNCLASSIFIED NL

OVF

STATIONOOOOO4

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

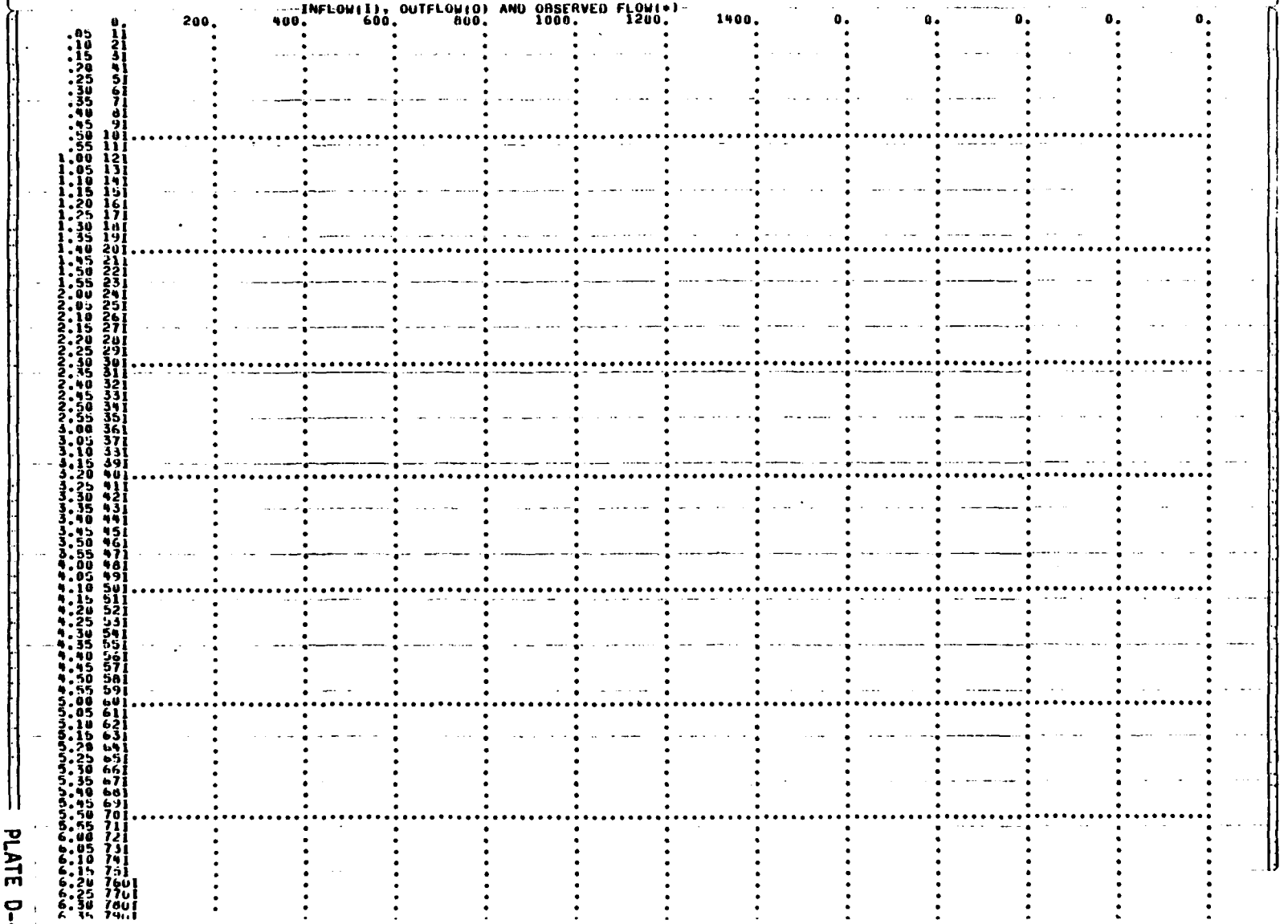


PLATE D-47

PLATE D-48

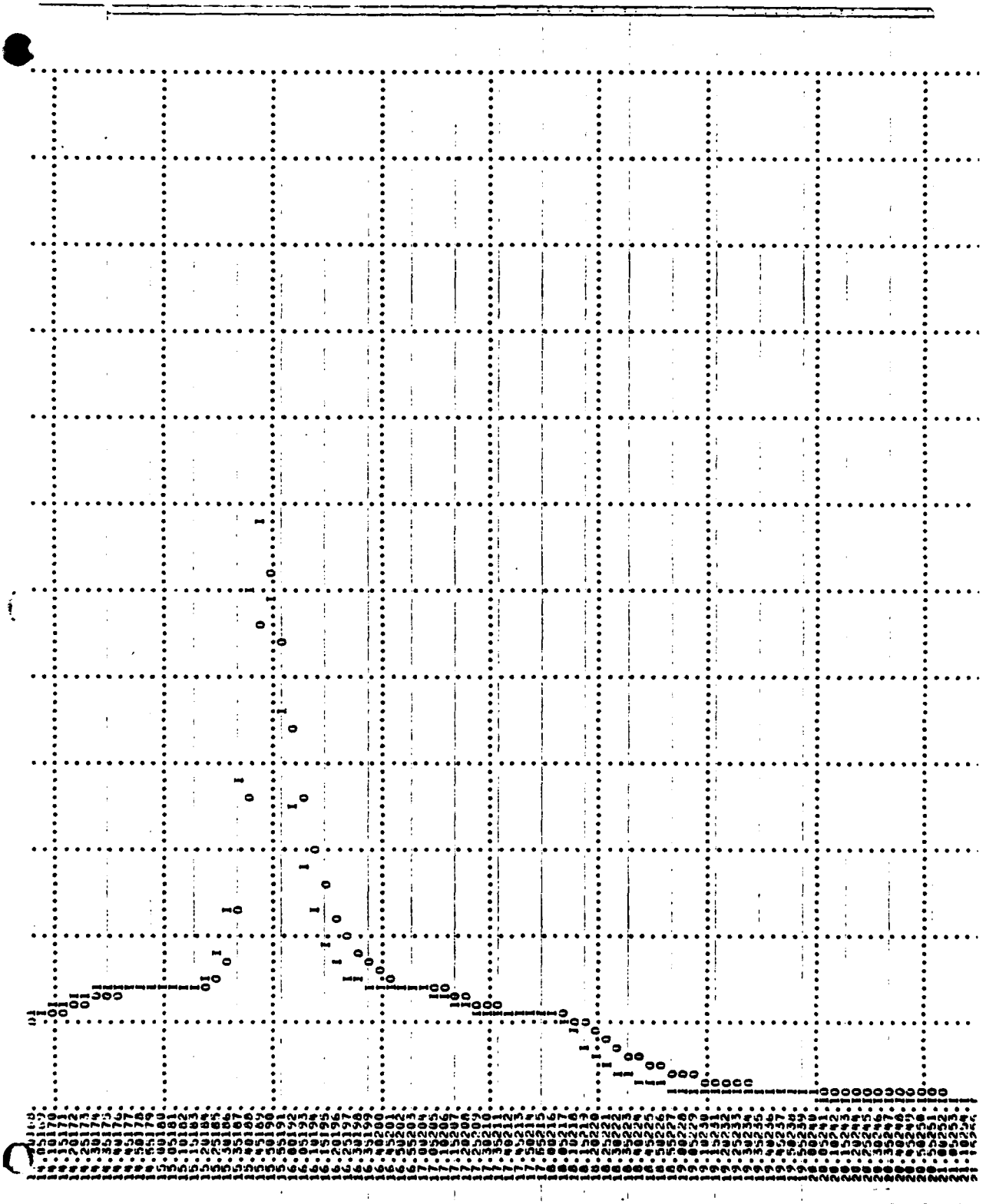


PLATE D-49

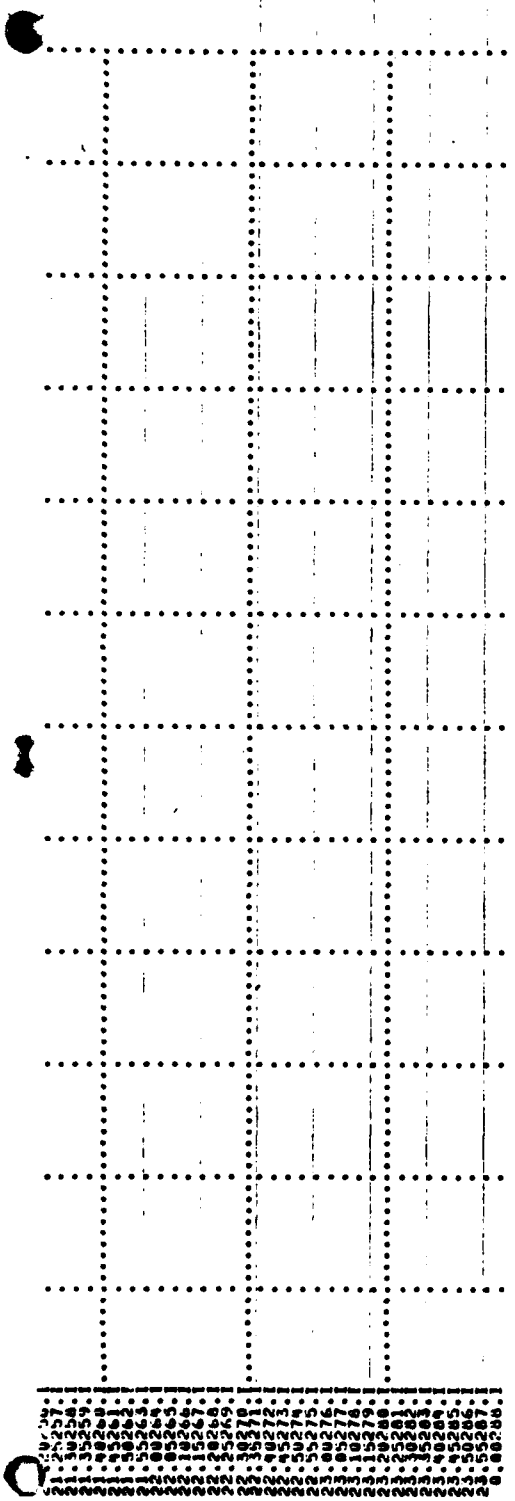


PLATE D-50

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 .75	RATIO 8 1.00
HYDROGRAPH AT	000001	.08	1	46.	93.	139.	186.	325.	465.	697.	929.
		(.19)		(1.32)	(2.63)	(3.95)	(5.26)	(9.21)	(13.15)	(19.73)	(26.31)
ROUTED TO	000002	.08	1	9.	12.	24.	54.	267.	430.	692.	933.
		(.19)		(.25)	(.34)	(.69)	(1.54)	(7.57)	(12.19)	(19.59)	(26.41)
HYDROGRAPH AT	000003	.03	1	21.	42.	64.	85.	149.	212.	319.	425.
		(.09)		(.60)	(1.20)	(1.80)	(2.41)	(4.21)	(6.01)	(9.02)	(12.03)
2 COMBINED	UM 2+3	.11	1	29.	54.	76.	110.	387.	643.	1010.	1357.
		(.28)		(.82)	(1.52)	(2.15)	(3.12)	(10.96)	(18.20)	(28.61)	(38.44)
ROUTED TO	000004	.11	1	7.	10.	12.	30.	200.	493.	858.	1244.
		(.28)		(.20)	(.28)	(.35)	(.86)	(5.66)	(13.97)	(24.30)	(35.23)

PLATE D-51

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 Sta. (3).....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	455.30	455.30	459.80
STORAGE	12.	12.	27.
OUTFLOW	0.	0.	103.

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	456.39	0.00	15.	9.	0.00	17.17	0.00
.10	457.71	0.00	19.	12.	0.00	16.08	0.00
.15	458.67	0.00	22.	24.	0.00	17.25	0.00
.20	459.38	0.00	25.	54.	0.00	16.17	0.00
.35	460.29	.49	28.	267.	.75	15.83	0.00
.50	460.46	.66	29.	430.	1.25	15.75	0.00
.75	460.71	.91	30.	692.	4.25	15.75	0.00
1.00	460.89	1.09	31.	933.	5.17	15.75	0.00

PLATE D-52

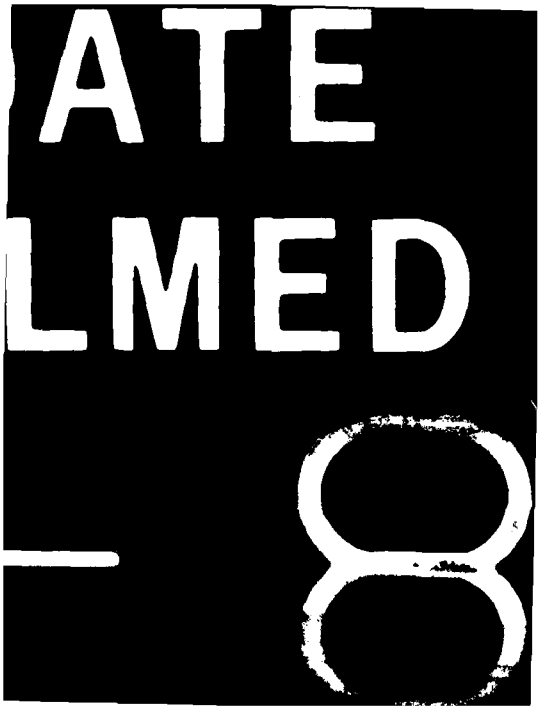
SUMMARY OF DAM SAFETY ANALYSIS

PLAN Sta. (4)

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	444.80	444.80	449.20
STORAGE	58.	58.	87.
OUTFLOW	0.	0.	525.

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	445.51	0.00	65.	7.	0.00	20.08	0.00
.10	446.16	0.00	67.	10.	0.00	22.83	0.00
.15	446.92	0.00	71.	12.	0.00	23.42	0.00
.20	447.74	0.00	77.	30.	0.00	18.50	0.00
.35	448.52	0.00	82.	200.	0.00	16.17	0.00
.50	449.15	0.00	87.	493.	0.00	15.92	0.00
.75	449.61	.41	90.	858.	.42	15.83	0.00
1.00	449.90	.70	92.	1244.	.58	15.83	0.00

PLATE D-53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