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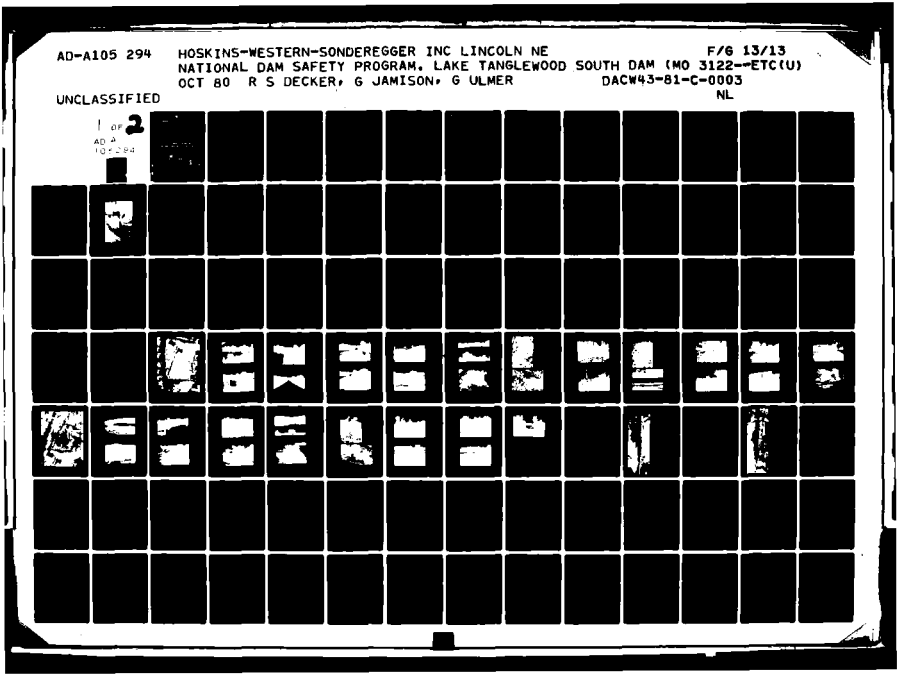

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LAKE TANGLEWOOD SOUTH DAM

LAKE TANGLEWOOD NORTH DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31224

MO 31225

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
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St. Louis District

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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake Tanglewood South (MO 31224) & North (MO 31225) Cape Girardeau County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report. / 6. PERFORMING ORG. REPORT NUMBER
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National Dam Safety Program. Lake Tanglewood South Dam (MO 31224), Lake Tanglewood North Dam (MO 31225), Mississippi - Kaskaskia - St. Louis Basin, Cape Girardeau County, Missouri. Phase I

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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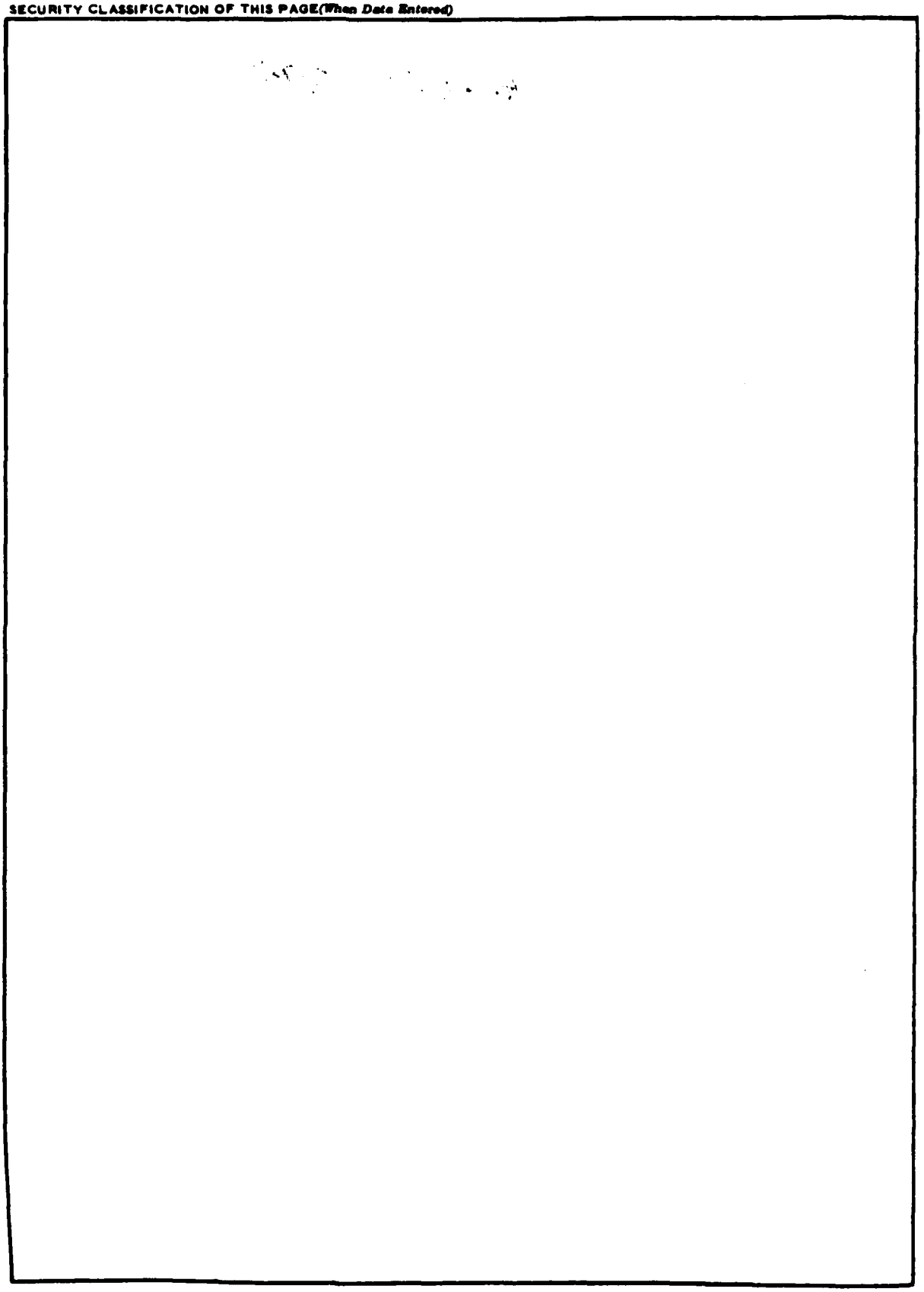

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LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
CAPE GIRARDEAU COUNTY, MISSOURI

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: Lake Tanglewood South Dam Phase I Inspection Report
Lake Tanglewood North Dam Phase I Inspection Report

This report presents the results of field inspections and evaluations of Lake Tanglewood South Dam (MO 31224) and Lake Tanglewood North Dam (MO 31225).

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

These dams have been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillways will not pass 50 percent of the Probable Maximum Flood without overtopping the dams.

b. Overtopping of the dams could result in failure of the dams.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 13 JUL 1981
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 14 JUL 1981
Colonel, CE, Commanding — Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Names of Dams	Lake Tanglewood South Dam Lake Tanglewood North Dam
State Located	Missouri
County Located	Cape Girardeau County
Stream	Tributary to Juden Creek
Date of Inspection	October 28, 1980

Lake Tanglewood South Dam and Lake Tanglewood North Dam were inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspections was to make an assessment of the general conditions of the dams with respect to safety, based upon available data and visual inspections, in order to determine if the dams pose 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.

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.

Lake Tanglewood South Dam has a height of thirty-one (31) feet, a maximum storage capacity at the minimum top elevation of the dam of thirty-two (32) acre-feet, and is classified as a small size dam.

Lake Tanglewood North Dam has a height of 22 feet and a maximum storage capacity at the minimum top elevation of the dam of 20 acre-feet. This dam is small considering program requirements. It was inspected and included in the program due to its proximity and hydrologic impact on Lake Tanglewood South Dam. The hydrologic impact is discussed in Section 5, Hydraulic/ Hydrologic Section.

In accordance with the guidelines and based on visual observation, Lake Tanglewood South Dam is in the high hazard potential classification. Due to Lake Tanglewood North Dams' proximity and hydrologic impact on Lake Tanglewood South Dam it is also classified as having a high hazard potential. The estimated damage zone extends approximately two miles downstream of the North Dam. Within the damage zone are Lake Tanglewood South Dam (MO 31224); six dwellings at 0.25 to 0.4 miles; a dwelling, building, and road at 0.6 miles; three dwellings at 0.7 miles; five dwellings and a road at 0.8 miles; three dwellings, a building and a road at 0.9 miles; four dwellings and a road at 1.0 mile; a dwelling, building and a road at 1.1 miles.

In consideration of the small volume of water impounded by the dams, the width of the downstream floodplain, and the criteria set forth in the recommended guidelines for small dams having high hazard potentials; 50% of the Probable Maximum Flood is the appropriate spillway design flood for each of the dams. 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.

Our inspections and evaluations indicate the following:

The spillways of Lake Tanglewood South Dam do not meet the criteria set forth in the recommended guidelines. The spillways will pass the 100-year flood (1% probability flood - flood having a one percent chance of being exceeded in any one year) without overtopping the dam. The spillways will pass 10% of the probable maximum flood without overtopping the dam.

Lake Tanglewood South Dam is in good structural condition. Deficiencies noted, other than inadequate spillway capacity, are the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential; tree growth on the embankment and in the emergency spillway, rodent holes in the embankment and erosion gullies along both sides of the outlet end of the principal spillway conduit.

The spillways of Lake Tanglewood North Dam do not meet the criteria set forth in the recommended guidelines. 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 9% of the Probable Maximum Flood without overtopping the dam.

Lake Tanglewood North Dam is in good structural condition, and the maintenance of the dam is good. The deficiencies noted, in addition to inadequate spillway capacity, are the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential; tree growth on the embankment and in the emergency spillway; and rodent holes in the embankment.

Design data were not available for these dams. Based on the field inspections and on the analyses made during and subsequent to the inspections, the following recommendations are made:

a. Alternatives.

(1) It is recommended that the height of dam and/or the spillway size be increased on both of the dams in order to pass 50% of the probable maximum flood without overtopping the dams. In either case, the spillways should be protected to prevent erosion and to prevent encroachment of spillway discharges upon the downstream section of the dams.

(2) Tree growth should be removed from both of the embankments and spillway channels and measures taken to prevent recurrent growth. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams.

(3) Rodent holes on both of the embankments should be repaired and measures taken to eliminate rodent activity.

(4) Both of the embankments should be mowed periodically.

(5) The gulleys entering the scour hole at the outlet end of the South Dam principal spillway conduit should be repaired and/or stabilized.

(6) The wave erosion on the upstream slope of the South Dam should be monitored on a periodic basis.

(7) The possibility of seepage occurring along the North Dam principal spillway conduit should be monitored on a periodic basis.

(8) A program of periodic inspection and maintenance designed to cover the above items should be initiated and copies of the inspection reports made a part of this project file.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-19246

H. P. Hoskins

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

MO 31225

MO 31224

PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
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 safety inspections of Lake Tanglewood South Dam and Lake Tanglewood North Dam be made.

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

c. Evaluation Criteria. Criteria used to evaluate the dams 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 Dams and Appurtenances.

(1) Embankments. The project consists of two earth fill dams located on a tributary to Juden Creek. Lake Tanglewood South Dam (MO 31224) is located approximately 650 feet south and downstream from Lake Tanglewood North Dam (MO 31225). The dams will be identified in the text of this report as the South Dam and the North Dam.

(a) South Dam. The embankment consists of an earth fill about 275 feet in length and 31 feet in height. The maximum storage capacity at the minimum top elevation of the dam is 32 acre-feet. A concrete paved road crosses on the crest of the dam.

(b) North Dam. The embankment consists of an earth fill approximately 290 feet in length and 22 feet in height with a maximum storage capacity at the minimum top of dam elevation of 20 acre-feet.

(2) Principal Spillway. The principal spillways of the two dams are uncontrolled and are identical in construction.

(a) Inlet Structure. The upstream end of the principal spillway conduit for each of the dams is equipped with a hooded inlet having an anti-vortex plate mounted on top of the hood. The hooded inlets and anti-vortex plates are bituminous coated. Trash racks protect the inlet ends of both spillways. Views of the South Dam inlet are shown in photos 10 and 11. The North Dam inlet is shown in photos 30 and 31.

(b) Conduit. The principal spillway conduit for each of the dams consists of 24-inch diameter bituminous coated corrugated metal pipe. It is not known whether seepage collars are located on either of the conduits. The South Dam principal spillway is 138 feet in length and is located at station 2+14 as shown on Plate C-1. Its profile is shown on Plate C-2. Photos 12 and 13 show views of the outlet end of the conduit. The North Dam principal spillway is 102 feet in length and is located at station 1+43 as shown on Plate C-3. Its profile is shown on Plate C-4. Photos 32 and 33 show views of the outlet end of this conduit.

(c) Stilling Basin. There is no structural stilling basin for the principal spillway of either of the dams.

(3) Emergency Spillway.

(a) South Dam. The emergency spillway is an uncontrolled, vegetated earth spillway located in the left abutment and a low area of the dam embankment. The control section of the spillway is the concrete surfaced road that crosses the dam which acts as a broad crested weir. The control section has a parabolic cross section with a top width of about 100 feet. The concrete road width is 20 feet. The spillway discharges onto the left abutment trough and downstream slope of the embankment on the left side. Details of the spillway are shown on Plate C-1. Photos 17 and 18 show views of the emergency spillway.

(b) North Dam. The emergency spillway is an uncontrolled, vegetated earth channel cut through the right abutment. The spillway control section has a 5-foot bottom width with side slopes of 1V on 5H. The entrance channel is about 28 feet in length on a negative grade of 11% to the control section at the centerline of the dam. From the centerline of the dam, the grade breaks downward to a positive grade of 8%. The plan view, profile, and cross sections are shown on Plates C-3, C-4, and C-5. Photos 34, 35 and 36 show views of the emergency spillway.

(4) Low-Level Outlet. There is no low-level outlet structure for either of these dams.

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

b. Location. The dams are located in the east central portion of Cape Girardeau County, Missouri, just north of the City of Cape Girardeau, as shown on Plate A-2. The dams are shown on Plate A-1 in the SW¼ of Section 17, T31N, R14E.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. 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.

(1) South Dam. Lake Tanglewood South Dam has a height of 31 feet and a maximum storage capacity at the minimum top elevation of the dam of 32 acre-feet. This dam is classified as a small size dam.

(2) North Dam. Lake Tanglewood North Dam has a height of 22 feet and a maximum storage capacity at the minimum top elevation of the dam of 20 acre-feet. This dam is small considering program requirements. It was inspected and included in the program due to its proximity and hydrologic impact on Lake Tanglewood South Dam. The hydrologic impact is discussed in Section 5, Hydraulic/Hydrologic Section.

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, Lake Tanglewood South Dam is in the High Hazard Potential Classification. Due to Lake Tanglewood North Dam's proximity and hydrologic impact on the South Dam it is also classified as having a High Hazard Potential. The estimated damage zone extends approximately two miles downstream of the North Dam. Within the damage zone are Lake Tanglewood South Dam (MO 31224); six dwellings at 0.25 to 0.4 miles; a dwelling, building, and road at 0.6 miles; three dwellings at 0.7 miles; five dwellings and a road at 0.8 miles; three dwellings, a building and a road at 0.9 miles; four dwellings and a road at 1.0 mile; a dwelling, building and a road at 1.1 miles.

e. Ownership. The dams are owned by the Tanglewood Homeowners' Association, c/o Mrs. Thomas Millburg, Secretary, Cape Girardeau, Missouri 63701.

f. Purpose of Dams. The dams were constructed as a part of a housing development. The South Dam forms a recreational lake covering 2+ acres and impounding 16+ acre-feet of water at normal pool elevation. The North Dam also forms a recreational lake covering 2+ acres. The impoundment behind the North Dam at normal pool elevation is 15+ acre-feet.

g. Design and Construction History. No design or construction data were available. The following information was supplied by Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area. The dams were built in 1970 by a road contractor with some design assistance from the Soil Conservation Service. There were, however, no plans for the dams. The dams were deeded to the Tanglewood Homeowners' Association in 1971.

h. Normal Operating Procedure. There are no operating facilities for these dams. The pool levels are controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

1.3 PERTINENT DATA

a. Drainage Area.

(1) South Dam. 59 acres (0.09 square miles).

(2) North Dam. 45 acres (0.07 square miles).

b. Discharge at Damsites.

(1) South Dam.

(a) All discharges at the damsite are through a 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet and through an uncontrolled, vegetated earth spillway located on the left side of the dam with a concrete surfaced road normal to the spillway acting as a weir control.

(b) Estimated maximum flood at damsite - *unknown.*

(c) The principal spillway capacity varies from 0 c.f.s. at elevation 468.0 feet to 23 c.f.s. at the crest of the emergency spillway (elevation 472.2 feet) to 26 c.f.s. at the minimum top of dam (elevation 472.9 feet).

(d) The emergency spillway capacity varies from 0 c.f.s. at its crest (elevation 472.2 feet) to 123 c.f.s. at the minimum top of dam (elevation 472.9 feet).

(2) North Dam.

(a) All discharges at the damsite are through a 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet and through an uncontrolled, vegetated earth emergency spillway. Discharges from this dam flow directly into the adjoining Lake Tanglewood South Reservoir (MO 31224).

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

(c) The principal spillway capacity varies from 0 c.f.s. at elevation 486.8 feet to 9 c.f.s. at the crest of the emergency spillway (elevation 488.1 feet) to 14 c.f.s. at the minimum top of dam (elevation 489.0 feet).

(d) The emergency spillway capacity varies from 0 c.f.s. at its crest (elevation 488.1 feet) to 18 c.f.s. at the minimum top of dam (elevation 489.0).

(e) Total spillway capacity at the minimum top of dam is 32 c.f.s. ±.

c. Elevations (feet above M.S.L.).	South Dam	North Dam
(1) Observed pool -	465.5	485.0
(2) Normal pool -	468.0	486.8
(3) Spillway crests		
Principal -	468.0	486.8
Emergency -	472.2	488.1
(4) Maximum experienced pool -	Unknown	Unknown
(5) Top of dam (minimum) -	472.9	489.0
(6) Streambed -	442±	467±
(7) Maximum tailwater -	Unknown	Unknown
d. Reservoir. (Length (feet) of pool).		
(1) At principal spillway crest -	525±	550±
(2) At emergency spillway crest -	580±	650±
(3) At top of dam (minimum) -	600±	750±

		South Dam	North Dam
e.	Storage (acre-feet).		
	(1) Observed pool -	12±	11±
	(2) Normal pool -	16±	15±
	(3) Spillway crests		
	Principal -	16±	15±
	Emergency -	32±	18±
	(4) Maximum experienced pool -	Unknown	Unknown
	(5) Top of dam (minimum) -	32±	20±
f.	Reservoir Surface (acres).		
	(1) Observed pool -	1.4±	1.7±
	(2) Normal pool -	2.3±	2.2±
	(3) Spillway crests		
	Principal -	2.3±	2.2±
	Emergency -	4.0±	2.5±
	(4) Maximum experienced pool -	Unknown	Unknown
	(5) Top of dam (minimum) -	4.0±	2.9±
g.	Dam.		
	(1) Type -	Earth fill	Earth fill
	(2) Length -	275 feet ±	290 feet ±
	(3) Height -	31 feet ±	22 feet ±
	(4) Top width -	36 feet (includes 20 feet of paved road)	10 feet
	(5) Side slopes		
	(a) Downstream -	IV on 3.1 H	IV on 3 H
	(b) Upstream -	(Measured on Exposed slope) IV on 3.1 H	IV on 3.8 H
	(6) Zoning -	Unknown	Unknown
	(7) Impervious core -	Unknown	Unknown
	(8) Cutoff -	Unknown	Unknown
	(9) Grout curtain -	Unknown	Unknown

g. Dam. (Continued)	South Dam	North Dam
(10) Wave protection -	Well vegetated	Well vegetated
(11) Drains -	Unknown	Unknown
h. Diversion Channel and Regulating Tunnel.	None	None

i. Spillways.

(1) Principal.

(a) Type - Uncontrolled, 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet, anti-vortex device and trash rack passing through each of the embankments.

(b) Crest (invert) elevation - 468.0 feet (South Dam)
- 486.8 feet (North Dam)

Outlet (invert) elevation - 442.7 feet (South Dam)
- 467.0 feet (North Dam)

(c) Length - 138 feet ± (South Dam)
- 102 feet ± (North Dam)

(2) Emergency.

(a) Type.

1. South Dam. Vegetated earth, uncontrolled, located in the left side of dam. Cross section is parabolic with a top width of approximately 100 feet.

2. North Dam. Uncontrolled, vegetated earth channel cut through the right abutment.

(b) Control section.

1. South Dam. Concrete surfaced road running normal to the spillway channel centerline, approximately 20 feet wide.

2. North Dam. A 5-foot bottom width with 1V on 5H side slopes located on the centerline of the dam.

(c) Crest elevation.

1. South Dam. 472.2 (minimum top of road).

2. North Dam. 488.1

(d) Upstream channel.

1. South Dam. Sparsely vegetated, many trees.

2. North Dam. Vegetated, small willows in entrance, and on an -11% grade.

(e) Downstream channel.

1. South Dam. Vegetated, many trees, consists of the left abutment trough and the downstream slope of the left embankment.

2. North Dam. Vegetated, choked with brush and weeds, and on an +8% grade.

j. Regulating Outlets. - No regulating outlets for either dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for these dams. Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area, reported that some design assistance was given by the Soil Conservation Service. The Jackson, Missouri field office of the Soil Conservation Service was contacted prior to the inspection. There were no plans or other data in the SCS files regarding these dams.

2.2 CONSTRUCTION

No construction data were available for these dams. Mr. Vernon Landgraf reported that the dams were constructed in 1970 by a road contractor. No other information was available.

2.3 OPERATION

It was reported by Mr. Landgraf that the emergency spillways of the two dams have never operated. Visual observation, however, indicated that the emergency spillway of the North Dam has had some flow through it. There was no evidence to indicate that either of the dams have been overtopped. No other information on operation was available.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observations presented herein 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. Visual inspections of Lake Tanglewood South Dam and Lake Tanglewood North Dam were made on October 28, 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

Mrs. Thomas Millburg, Secretary of the Tanglewood Homeowners' Association, was contacted prior to the inspection but was not present during the inspection. Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area, was also contacted prior to inspection and was interviewed concerning the construction and design of the dam. Mr. Landgraf did not accompany the inspection team during the inspection.

b. Dam.

(1) Geology and Soils (abutment and embankment). The two embankments are situated in the uplands of the loess mantled hills west of the Mississippi Valley. Within the Ozark physiographic province, the structure is controlled by earth movement associated with the Ozark uplift and local structural activity. The major structural features are the Jackson and Cape Girardeau faults and the Brooks Dome. The Seismic Zone is 3. The bedrock underlying the loess mantle is the Bailey information.

The embankment is composed of low plastic silty clays and clayey silts derived from the Memphis-Loring soils and underlying loess. The loess mantle is 5 to 20 feet thick and covers the eroded surface of the Bailey information. Locally this formation consists of very light gray to light grayish brown cherty limestone. Residual sandy silts and clays with chert gravel fractions occur in the alluvium. The formation has a low hydraulic conductivity acting as an aquitard to the underlying units. The seepage from the impoundment is perched on the bedrock with static water levels in local wells at over 150 feet (Robertson, Fuller & Knight, 1963). No evidence of solution cavitation was observed. Catastrophic collapse from leaky impoundments in this region was not observed. Aley, Williams and Massello, 1977, do not list such collapse as a high potential in this region

The denuded loess mantle is highly erosive. Rills and small gulleys are evident in the as yet unvegetated lots. The embankment is vegetated and shows no evidence of recent erosion. Gulleys in the alluvium up to 5 feet deep are evidence of predam erosion.

Stover, Reagor and Algermissen, 1979, list the following years in which earthquakes above V on the Modified Mercalli Scale were experienced: 1895, 1909, 1919, and 1977. These epicenters are within 25 radial miles.

Groundwater seepage from the impoundment is controlled by the alluvial-colluvial materials supporting the embankment. These materials consist of slightly plastic clayey silts and silty clays, residual clays and cherty gravels on the weathered surface of the underlying bedrock and limestone fragments. The thickness of the alluvium ranges from 5 to 10 feet.

(2) Upstream Slope.

(a) South Dam. The upstream slope is well vegetated with adapted grasses above the normal pool elevation. Wave erosion has caused a 6 to 8-inch scarp at normal pool elevation, but it did not appear to be serious. No cracks, bulges or other deformations were noted on the slope. Materials taken from hand auger samples were field identified as silty clays and clayey silts (CL-ML).

A number of small willow trees are growing along the normal reservoir level. Some rodent activity was noted at about normal pool level on the left side of the pipe spillway inlet. Photos 2, 3 and 4 show the upstream slope.

(b) North Dam. The upstream slope is well vegetated with adapted grasses from the crest down to the normal waterline. No significant erosion was evident on the slope. A few small willows are growing on the slope toward the right end of the dam. No cracks, bulges or abnormal deformations were observed. Some rodent (probably muskrat) activity was noted at the normal water line about 50 feet from the right end of the dam (about Station 2+50). Photos 24, 25 and 26 show the upstream slope.

(3) Crest.

(a) South Dam. The crest serves as a roadway with a 20-foot width of concrete pavement. The remainder of the crest is sparsely vegetated with grass and weeds. The crest is slightly higher (0.5 ft. ±) in the center of the dam than at the abutments. No cracks, slumps, or abnormal deformations were noted on the crest. Photo 5 shows the crest of the dam.

(b) North Dam. The crest is sparsely vegetated with adapted grasses. However, no significant erosion was noted. No cracks were observed. The profile at the crest shown on Plate C-3, Appendix C, indicates that the center section is 1 to 2 feet higher than the ends of the dam. (It was undoubtedly constructed this way.) A slight depression or swag in the crest was observed in the area of the principal spillway crossing. No other deformations were observed. Materials on the crest were sampled by hand auger and field classified as ML-CL. Photos 25 and 27 show the crest.

(4) Downstream Slope.

(a) South Dam. The downstream slope is well vegetated with adapted grasses which should be mowed. No cracks, bulges, slumps, or other deformations were observed. No seepage was observed on the slope, along the toe, or in the outlet channel below the pipe spillway outlet. Some rodent activity was noted at several locations on the slope. Photos 7 and 8 show the downstream slope.

(b) North Dam. The downstream slope is well vegetated. No tree growth or rodent activity were observed on the slope. Several trees (up to 8 or 10 inches in diameter) and brush are growing along the toe of the dam on the right end. It appears that these trees were left in place when the dam was constructed. There were no indications of seepage on the slope or along the toe of the dam. However, there was water standing in the channel at the outlet of the pipe spillway, and the reservoir level was about 3.5 feet below the inlet of the spillway. There was no flow observed in the channel downstream from this area. No cracks, bulges or other deformations were observed on the slope.

Hand auger borings made up from the toe of the slope showed dry ML soil to depths of 2.5 to 3 feet. Photos 27 and 28 show the downstream slope.

c. Appurtenant Structures.

(1) Principal Spillway.

(a) Inlet Structure. The inlet for each of the dams consists of a hooded 24-inch diameter corrugated metal pipe with anti-vortex device and trash rack.

1. South Dam. The inlet was not obstructed and appeared to be in good condition. Photos 10 and 11 show the inlet to the principal spillway.

2. North Dam. The inlet appeared to be in good condition. A few very small willows were growing in and around the trash rack. Photos 30 and 31 show the inlet structure.

(b) Conduit. The conduit for each of the dams consists of 24-inch diameter corrugated metal pipe passing through the embankment.

1. South Dam. The conduit appears to be in good condition. Photos 12 and 13 show the outlet end of the conduit. Erosional gulleys from surface runoff are head cutting upstream from the stilling basin on both sides of the outlet pipe. If left uncontrolled, these gulleys could ultimately cause damage to the outlet end of the spillway pipe. Photos 14, 15 and 16 show the gulleys.

2. North Dam. The outlet of the conduit appears to be in good condition, but the coating is missing in some areas and some rusting was observed. Photos 32 and 33 show the outlet of the conduit.

(c) Stilling Basin.

1. South Dam. The stilling basin consists of a small scour hole eroded into the natural valley alluvium. No abnormal nor detrimental erosion was noted in the scour hole. Surface runoff is cutting gulleys on each side of the pipe outlet. Photos 12 and 13 show the scour hole.

2. North Dam. There is no stilling basin (or scour hole) for the principal spillway. No significant erosion was observed at the outlet of the conduit. It should be noted that the normal pool level of the adjoining Tanglewood South Reservoir (MO 31224) is about 1 foot higher than the outlet invert elevation of this reservoir. This undoubtedly accounts for the lack of erosion at the outlet of this structure. Photo 33 shows the outlet of the pipe spillway conduit.

(2) Emergency Spillway.

(a) South Dam. The emergency spillway consists of a low swag in the crest on the left end of the dam. The control section of the spillway consists of the 20-foot wide concrete roadway that passes over the dam. A few small willows are growing on the right side of the inlet section. The discharge from the spillway flows down the left abutment trough and the left downstream slope of the dam. There was no indication that the spillway has operated. Photos 17 and 18 show the emergency spillway.

(b) North Dam. The emergency spillway consists of a narrow channel cut through the right abutment. Trees and brush are growing in both the inlet and outlet channels. The spillway channel is well vegetated with grass, and no significant erosion was observed. It appeared that small flows had passed through the spillway. The spillway discharges into the right abutment trough, and high flows would probably encroach upon the toe of the embankment. The profile of the crest indicates that the low area on the left abutment would also serve as an emergency spillway. Photos 34, 35 and 36 show the emergency spillway.

(3) Low-Level Outlet. There is no low-level or drawdown facility for either of the two dams.

d. Reservoir Area.

(1) South Dam. The area around the reservoir is well vegetated. No slumps or slides were evident around the reservoir. No significant erosion was observed along the shoreline and there was no evidence of siltation. Photo No. 10 shows a portion of the reservoir. Lake Tanglewood North Dam (MO 31225) shows in the background.

(2) North Dam. The area around the reservoir is well vegetated. No slumps or slides were evident around the reservoir. No significant erosion was observed along the shoreline. There was no evidence of siltation in the reservoir. Photo No. 30 shows a portion of the reservoir area.

e. Downstream Channel.

(1) South Dam. The channel downstream from the principal spillway is overgrown with brush and trees. However, this should not significantly affect the operation of the pipe spillway. There is no distinct channel for the emergency spillway. It discharges over the slope of the embankment and into the left abutment trough. Photos 1 and 9 show the downstream channel.

(2) North Dam. There is no downstream channel for the principal spillway. At normal pool levels, all discharges from this dam will pass directly into the Tanglewood South Reservoir (MO 31224).

3.2 EVALUATION

a. South Dam. This dam appears to be in relatively good condition. The embankment slopes of 1V on 3H, the lack of abnormal deformations and the lack of seepage on the downstream side would indicate that it is safe against seepage and piping and against static shear stresses. The effects of dynamic (earthquake) loadings on the embankment are not known. The effects of overtopping are not known, but it would appear that discharges through the emergency spillway on the left end and over the low crest area on the right end could cause considerable erosion in the abutment troughs and on the downstream slope of the dam. Gulley erosion from surface runoff into the principal spillway scour hole along both sides of the pipe outlet could ultimately result in damage to the pipe. Tree growth and rodent activity on the embankment could ultimately impair the stability of the dam and should be remedied and controlled. Mowing the downstream slope would facilitate rodent control and better observation of other potential deficiencies.

b. North Dam. This dam appears to be in good condition with no serious potential of failure. The 1V on 3+H slopes of the embankment should provide adequate safety against failures for a dam of this height. No seepage was evident on the downstream slope or along the toe of the dam. Tree growth and rodent activity on the upstream slope could ultimately impair the stability of the dam. Tree growth in the inlet section of the emergency spillway could affect spillway operation.

The effects of overtopping on the stability of this structure are not known. However, the silty nature (ML) of the material in the dam would indicate that overtopping would probably cause considerable damage to this dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for either of the two dams. The pool levels are controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillways. Discharges from Lake Tanglewood North (MO 31225) flow into the reservoir formed by Lake Tanglewood South Dam.

4.2 MAINTENANCE OF DAM

a. South Dam. Maintenance of the structure is fair. The trees on the upstream slope and in the emergency spillway channel should be removed. The rodents should be eliminated. The erosional gulleys around the outlet pipe should be repaired and the downstream slope mowed.

b. North Dam. Maintenance appears to be reasonably good. The downstream slope was mowed. Tree growth and rodent activity on the dam and in the spillway should be controlled.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at these dams.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for these dams.

4.5 EVALUATION

a. South Dam. The deficiencies observed during the inspection can be corrected with an improvement in the maintenance program.

b. North Dam. There are no operating facilities for this dam. Maintenance is reasonably good but should include control of tree growth and rodent activity on the structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF F ATURES

a. Design Data. No design data were found for these dams.

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

c. Visual Observations.

(1) South Dam.

(a) The principal spillway appeared to be in good condition. The trash rack is considered to be adequate, and no debris was observed around the inlet. There was some deterioration of the bituminous coating covering the pipe.

(b) The emergency spillway had trees located both in the entrance and exit channels. The crest had recently been paved. The upstream or entrance channel was sparsely vegetated. Flows through the spillway could endanger the integrity of the dam, if continued for an extended period of time, due to the nature of the material in the embankment and the fact that flows are released over the downstream slope of the dam embankment.

(c) Lake Tanglewood North Dam (MO 31225) is located immediately upstream of Lake Tanglewood South Dam on the same drainage channel. All releases from the upper reservoir flow into the Lake Tanglewood South reservoir.

(d) There are no drawdown facilities for this structure.

(2) North Dam.

(a) The principal spillway appeared to be in good condition. The trash rack is considered to be adequate, and no debris was noticed around the inlet. There was some deterioration of the bituminous coating covering the pipe with some appearance of rust in a few places.

(b) The emergency spillway appeared to have had some flow through it. The entrance had some willow trees growing along the normal pool waterline. The spillway channel just downstream of the centerline of the dam was choked with brush and weeds.

(c) All discharges, from both the principal and emergency spillways, would be released into Lake Tanglewood South Reservoir (MO 31224) immediately downstream of Lake Tanglewood North Dam.

(d) There are no drawdown facilities available for this dam.

d. Overtopping Potential.

(1) South Dam. The hydrologic routing of this structure consisted of a multiple dam analysis, taking into consideration Lake Tanglewood North Dam. Sufficient field data were collected for the upstream dam to route the probable maximum flood (PMF) through it. It was determined that the upstream dam's spillways would only pass 9% of the PMF without overtopping. The upstream flood was therefore routed through Lake Tanglewood South Dam, both without breaching and with breaching. The results of the routings did not give significant differences for the PMF or 50% of the PMF. However, there was a difference in the lower ratios as shown in the table below:

Frequency	*Maximum Depth Over Dam (Feet)	Duration Over Top (Hours)
0.15 PMF - No Breach	0	0
Breach	0.2	1-
0.25 PMF - No Breach	0	0
Breach	0.3	1±
0.50 PMF - No Breach	0.6	1±
Breach	0.5	2±
PMF - No Breach	1.0	5-
Breach	0.9	6-

The routings with breaching of Lake Tanglewood North Dam are more severe at the lower frequency ratios; therefore, the routings with breaching shall be used to determine the hydrologic capabilities of the Lake Tanglewood South Dam.

The spillways for Lake Tanglewood South Dam are too small to pass 50 percent of the probable maximum flood without overtopping the dam. The spillways will pass 10% of the probable maximum flood and the 1% probabilistic flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest could erode the face of the dam and, if continued long enough, could breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the 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% Flood	55	10	469.8	0	0
1/2 PMF	450	425	473.4	0.5	2-
PMF	925	920	473.8	0.9	6-
0.10 PMF	180	140	472.8	0	0

* Minimum top of dam elevation - 472.9

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 is the test for the adequacy of the dam and its spillways.

(2) North Dam. The spillways are too small to pass 50% of the probable maximum flood without overtopping the dam. The spillways will pass the 1% probability flood as well as 9% of the probable maximum flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest could erode the face of the dam and, if continued long enough, could breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the 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% Flood	120	20	488.7	0	0
1/2 PMF	430	410	490.2	1.2	6-
PMF	870	870	490.7	1.7	7±
0.09 PMF	80	30	488.9	0	0

*Minimum top of dam elevation - 489.0

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 potential rating based on downstream hazards. This dam, although not meeting the requirements of the recommended guidelines to qualify as a small size dam, is located immediately upstream from Lake Tanglewood South Dam (MO 31224) which is classified as a small size dam having a high hazard potential rating. Approximately 76% of the water impounded by Lake Tanglewood South Dam must flow through the spillways of this dam. Failure of this dam due to overtopping could cause failure of Lake Tanglewood South Dam with the combined volume of water impounded in both reservoirs being released onto the downstream floodplain. The test for the adequacy of this dam and its spillways is 50% of the probable maximum flood which is the same as the requirement for Lake Tanglewood South Dam (MO 31224).

The estimated damage zone for these dams is described in paragraph 1.2.d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation.

(1) South Dam. The embankment slopes of 1V on 3H and the lack of any deformation and seepage would indicate that this dam is structurally stable against normal shear and seepage stresses.

(2) North Dam. Based on visual observation, this dam is considered to be structurally stable. There is no sign of seepage, and the cross section should provide adequate safety against shear failures.

b. Design and Construction Data. No design or construction data were available for the two dams. 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 other than the recent construction of the concrete pavement on the crest of the South Dam.

e. Seismic Stability. These dams are located in Seismic Zone 3. An earthquake of the magnitude predicted in this area might be expected to cause some damage to these dams, but it is unlikely that it would cause failure of dams of this height and cross section.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety.

(1) South Dam. Based on visual operation, this dam is in generally good condition with no serious potential of failure. Tree growth and rodent activity on the embankment, if allowed to continue, would ultimately impair the stability of the structure. Approximate analyses indicate that the dam would be overtopped by 50% of the probable maximum flood and/or by breaching failure of Lake Tanglewood North Dam (MO 31225). The effects of overtopping are not known, but it would appear that overtopping could cause considerable damage and possible breaching of the dam. Tree growth and rodent activity on the embankment as well as wave erosion of the upstream slope could ultimately impair the integrity of the structure if left uncontrolled. Surface erosion around the outlet of the principal spillway should be repaired and controlled. 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.

(2) North Dam. Based on visual observation, this dam is in good structural condition with no serious potential of failure from the structural standpoint. However, heavy emergency spillway flows and/or overtopping might cause breaching of the dam in a relatively short time. Breaching of the reservoir could cause overtopping and possible failure of the Lake Tanglewood South Dam (MO 31224) immediately downstream from this structure. Tree growth and rodent activity on the embankment could ultimately impair the integrity of the structure if left uncontrolled. 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. No design or construction data were available. The performance history and information collected during the inspection of these dams are considered adequate to support the conclusions presented in 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.

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 7.2.b should be accomplished in the near future. The item recommended in paragraph 7.2.a should be pursued on a high priority basis.

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

e. Seismic Stability. These dams are located in Seismic Zone 3. An earthquake of this magnitude could be expected to cause some damage to these dams. It is recommended that the prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for these dams.

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) It is recommended that the height of dam and/or the spillway size be increased on both of the dams in order to pass 50% of the probable maximum flood without overtopping the dams. In either case, the spillways should be protected to prevent erosion and to prevent encroachment of spillway discharges upon the downstream section of the dams.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed for both dams by an engineer experienced in the design and construction of dams. These analyses should include the prescribed seismic loading for Seismic Zone 3.

(2) Tree growth should be removed from both of the embankments and spillway channels and measures taken to prevent recurrent growth. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams.

(3) Rodent holes on both of the embankments should be repaired and measures taken to eliminate rodent activity.

(4) Both of the embankments should be mowed periodically.

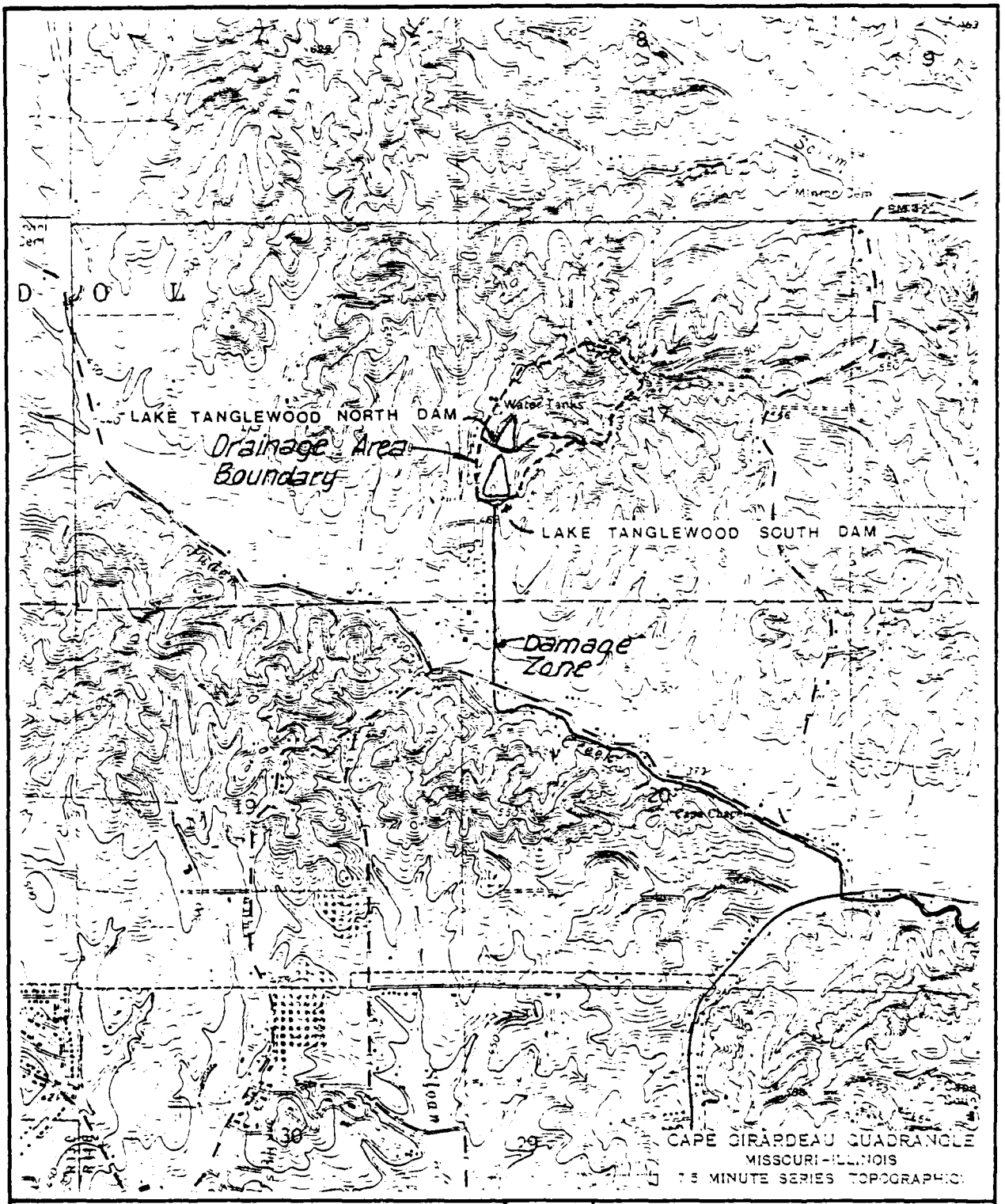
(5) The gulleys entering the scour hole at the outlet end of the South Dam principal spillway conduit should be repaired and/or stabilized.

(6) The wave erosion on the upstream slope of the South Dam should be monitored on a periodic basis.

(7) The possibility of seepage occurring along the North Dam principal spillway conduit should be monitored on a periodic basis.

(8) A program of periodic inspection and maintenance designed to cover the above items should be initiated and copies of the inspection reports made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval – 10'

N

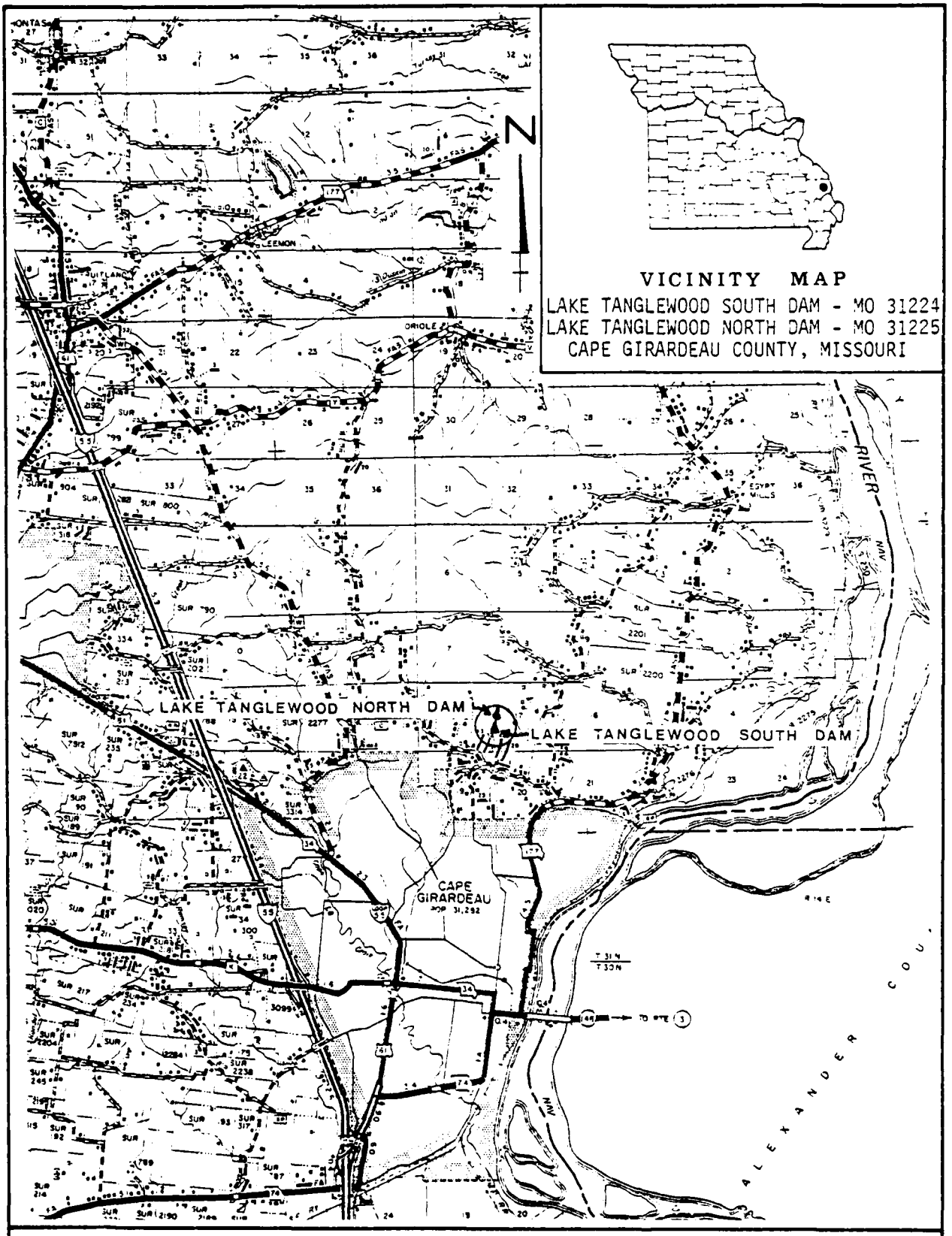
VICINITY TOPOGRAPHY

LAKE TANGLEWOOD SOUTH DAM MO 31224

LAKE TANGLEWOOD NORTH DAM MO 31225

CAPE GIRARDEAU COUNTY, MISSOURI

PLATE A-1



VICINITY MAP

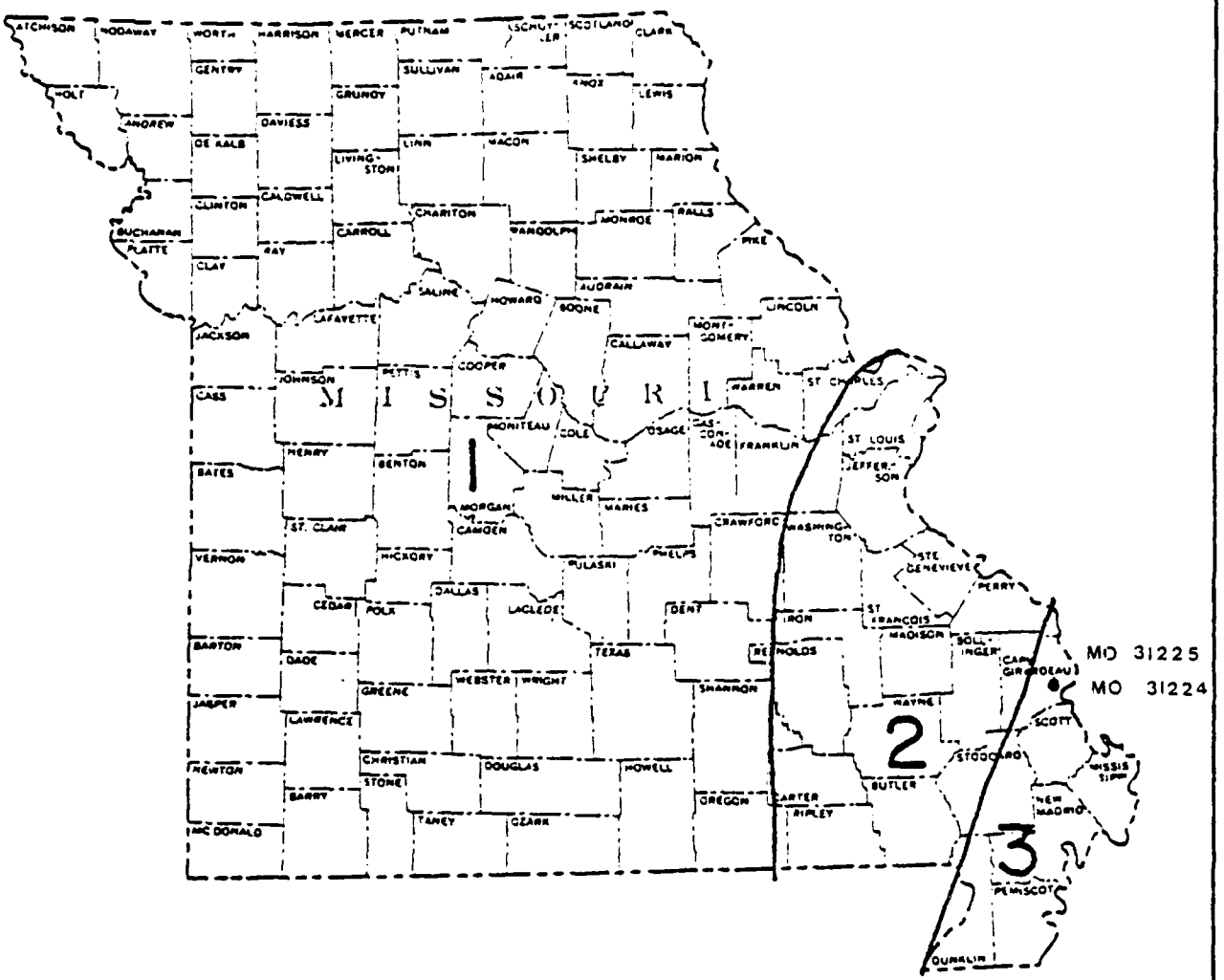
LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
CAPE GIRARDEAU COUNTY, MISSOURI

Scale in miles

0 1 2 3 4 5

LOCATION MAP

PLATE A-2



MISSOURI
SEISMIC ZONE MAP

PLATE A-3

APPENDIX B
PHOTOGRAPHS

LAKE TANGLEWOOD SOUTH DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31224

PHOTO INDEX

PLATE B-1

PHOTO NO. 2 - OVERVIEW TAKEN FROM THE RIGHT SIDE

PHOTO NO. 3 - UPSTREAM SLOPE TAKEN FROM THE RIGHT END

PHOTO NO. 4 - UPSTREAM SLOPE TAKEN FROM THE RIGHT END

PHOTO NO. 5 - CREST OF DAM TAKEN FROM RIGHT END

PHOTO NO. 6 - SPILLWAY CREST TAKEN FROM THE DOWNSTREAM SLOPE ON THE RIGHT SIDE OF THE DAM

PHOTO NO. 7 - DOWNSTREAM SLOPE TAKEN FROM THE RIGHT END

PHOTO NO. 8 - DOWNSTREAM SLOPE TAKEN FROM THE LEFT END

PHOTO NO. 9 - LOOKING DOWNSTREAM AT ABOUT THE PIPE SPILLWAY

PHOTO NO. 10 - LOOKING UPSTREAM OVER THE PIPE SPILLWAY. NOTE UPPER DAM IN THE BACKGROUND

PHOTO NO. 11 - INLET AND TRASH RACK FOR THE PIPE SPILLWAY

PHOTO NO. 12 - OUTLET OF THE PIPE SPILLWAY AND THE CHANNEL LOOKING DOWNSTREAM

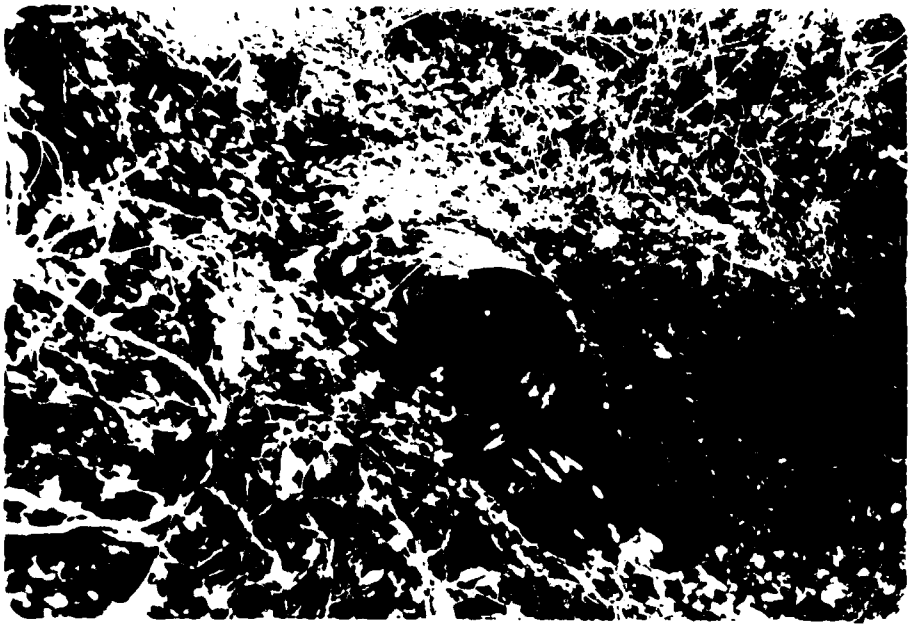


PHOTO NO. 13 - OUTLET OF THE PIPE SPILLWAY

PHOTO NO. 14 - GULLY COMING IN ON THE RIGHT SIDE OF THE OUTLET PIPE

PHOTO NO. 15 - GULLY COMING IN ON THE LEFT SIDE OF THE PIPE SPILLWAY

PHOTO NO. 16 - GULLY COMING IN ON THE LEFT SIDE OF THE PIPE SPILLWAY

PHOTO NO. 17 - LOOKING UPSTREAM INTO THE EMERGENCY SPILLWAY TAKEN FROM THE EXIT CHANNEL

PHOTO NO. 18 - LOOKING DOWNSTREAM INTO THE EMERGENCY SPILLWAY ON THE LEFT END OF THE DAM. TAKEN FROM THE ENTRANCE SECTION OF THE SPILLWAY

PHOTO NO. 19 - TWO OR THREE HOUSES ABOUT 0.5 MILES DOWNSTREAM OF DAM THAT ARE IN POTENTIAL DAMAGE ZONE

PHOTO NO. 20 - BACK OF THE 10TH HOUSE DOWNSTREAM OF THE DAM ON THE EAST SIDE OF THE ROAD

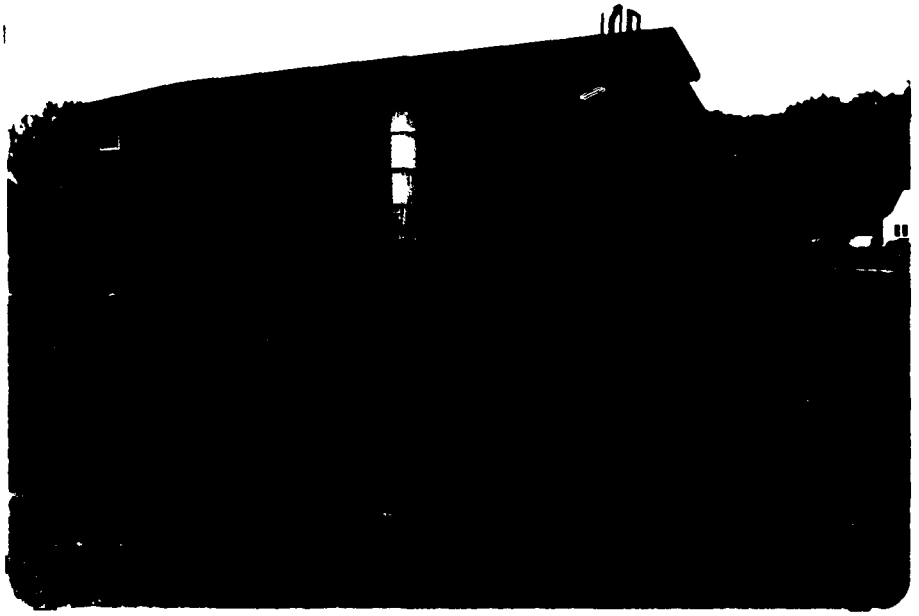
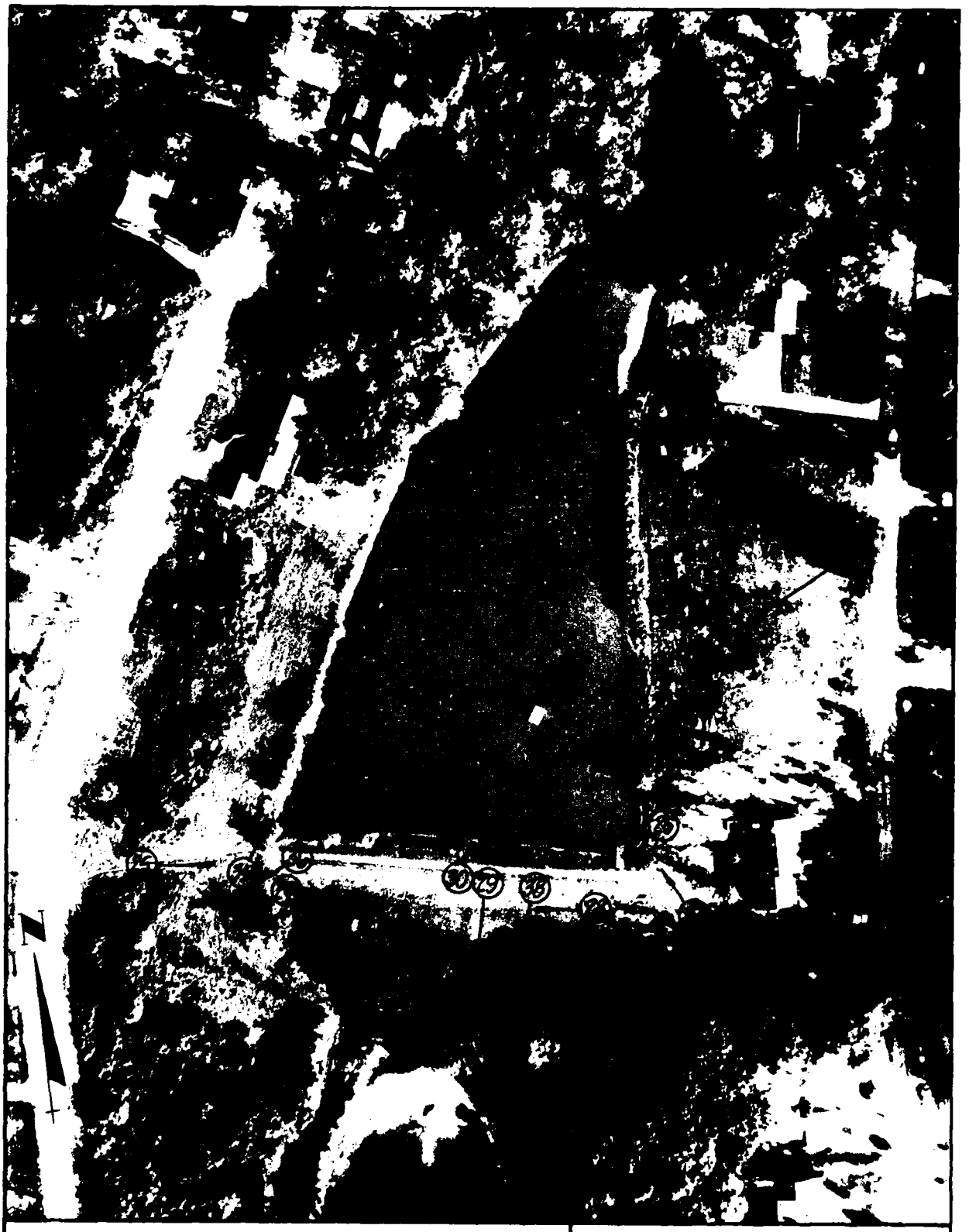


PHOTO NO. 21 - CHURCH AND HOUSE ABOUT 0.5 MILES DOWNSTREAM JUST BEFORE CHANNEL ENTERS INTO MAIN DRAINAGEWAY (JUDEN CREEK).

PHOTO NO. 22 - THREE HOUSES ON THE SOUTH SIDE OF THE ROAD ABOUT 0.5 MILES DOWNSTREAM OF DAM

PHOTO NO. 23 - SHALEY LIMESTONE EXPOSED IN CREEK BED OF JUDEN CREEK ABOUT 3/4 OF MILE DOWNSTREAM OF DAM



LAKE TANGLEWOOD NORTH DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31225

PHOTO INDEX

PLATE B-13

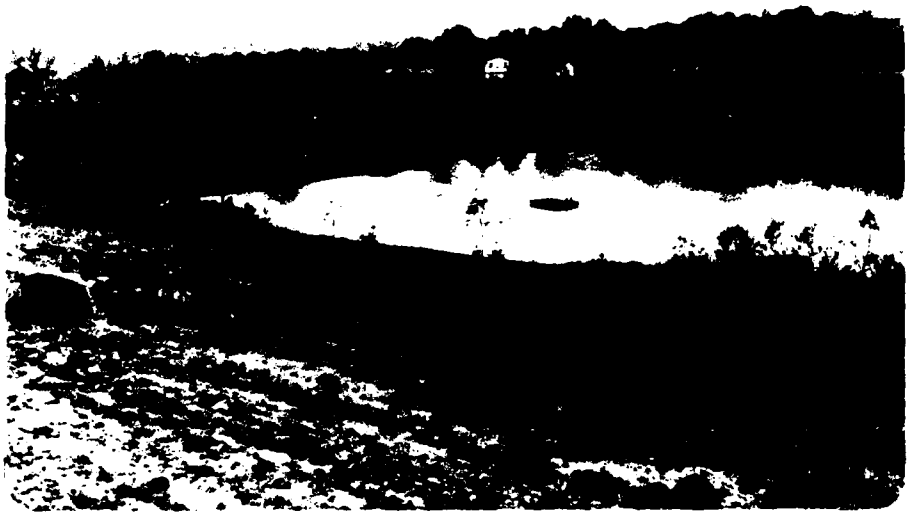


PHOTO NO. 24 - OVERVIEW TAKEN FROM THE LEFT SIDE

PHOTO NO. 25 - CREST TAKEN FROM THE RIGHT END

PHOTO NO. 26 - UPSTREAM SLOPE TAKEN FRUM LEFT END

PHOTO NO. 27 - DOWNSTREAM SLOPE TAKEN FROM THE RIGHT END

PHOTO NO. 28 - DOWNSTREAM SLOPE TAKEN FROM LEFT END

PHOTO NO. 29 - LOOKING DOWNSTREAM FROM CREST NEAR PRINCIPAL SPILLWAY. LOWER TANGLEWOOD LAKE IN THE BACKGROUND

PHOTO NO. 30 - LOOKING UPSTREAM OVER THE PIPE SPILLWAY

PHOTO NO. 31 - INLET OF THE PRINCIPAL SPILLWAY

PHOTO NO. 32 - OUTLET OF PRINCIPAL SPILLWAY

PHOTO NO. 33 - OUTLET OF PRINCIPAL SPILLWAY

PHOTO NO. 34 - EMERGENCY SPILLWAY ON RIGHT END TAKEN FROM UPSTREAM

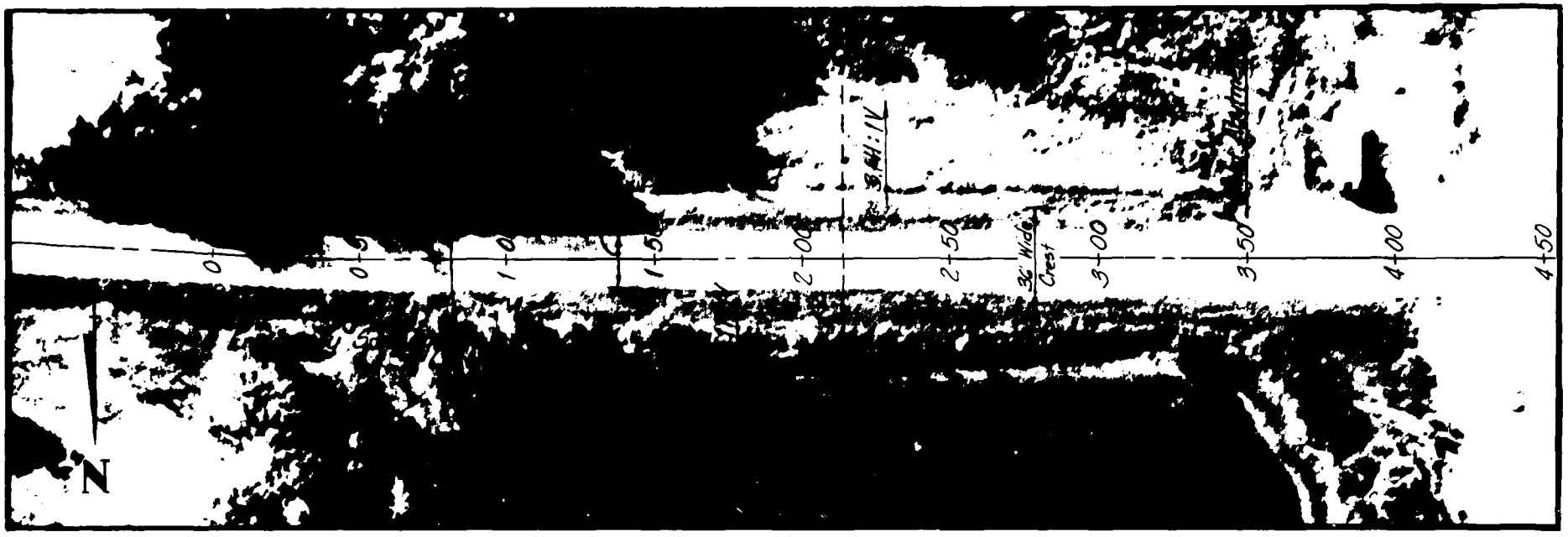
PHOTO NO. 35 - LOOKING UPSTREAM IN EMERGENCY SPILLWAY ON RIGHT END

PHOTO NO. 36 - LOOKING DOWNSTREAM IN EMERGENCY SPILLWAY ON RIGHT END

PHOTO NO. 37 - LEFT ABUTMENT LOOKING INTO RESERVOIR

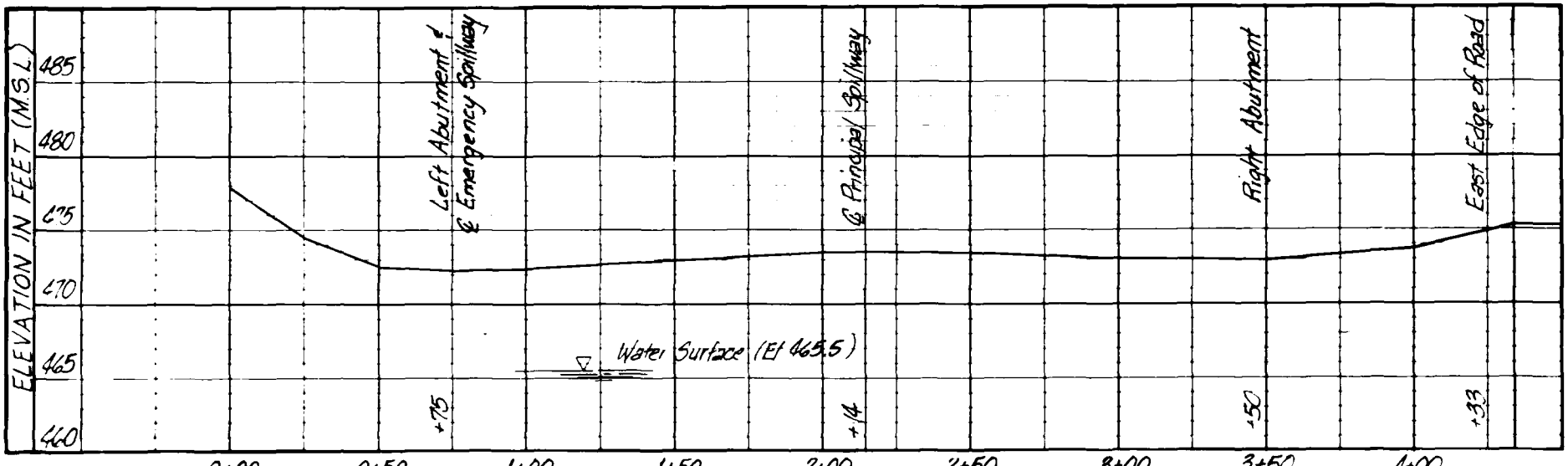
PHOTO NO. 38 - OVERVIEW OF LOWER LAKE TAKEN FROM THE CREST OF UPPER DAM

APPENDIX C
PROJECT PLATES



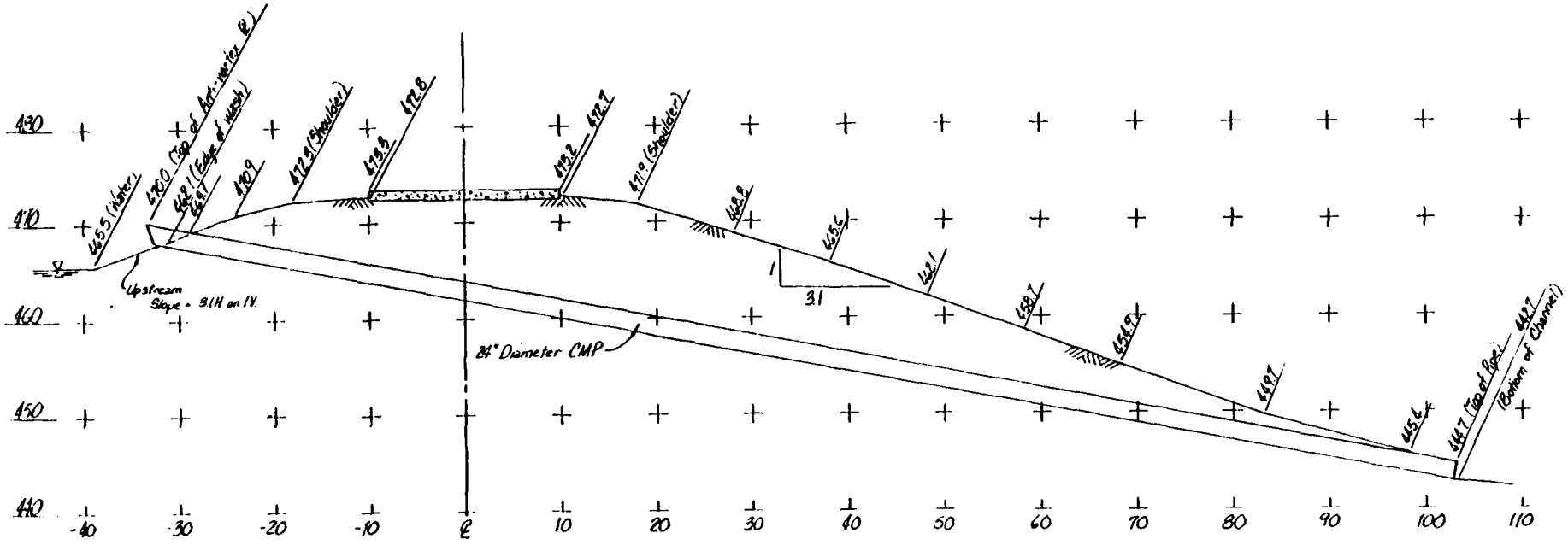
PLAN OF DAM
Scale: 1" = 50'

LAKE TANGLEWOOD SOUTH DAM



CENTERLINE PROFILE OF DAM
Scale As Shown

PLATE C-1

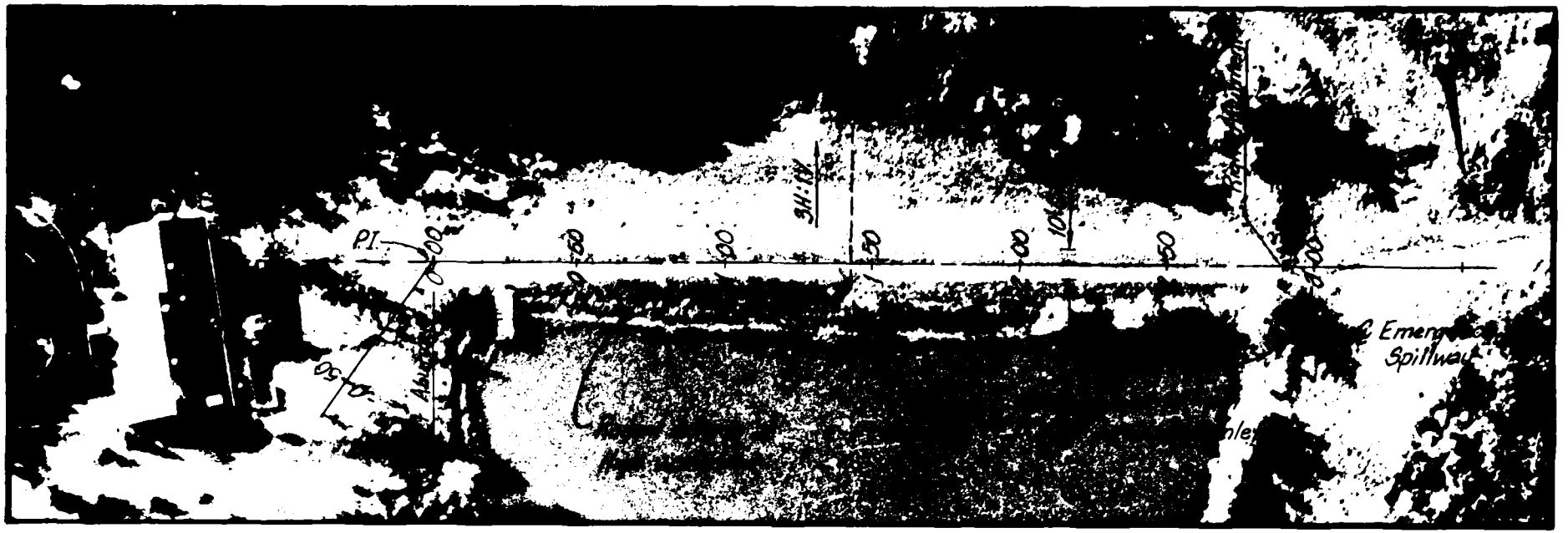


MAXIMUM CROSS-SECTION AT STATION 2+14

Scale: H. 1 V.

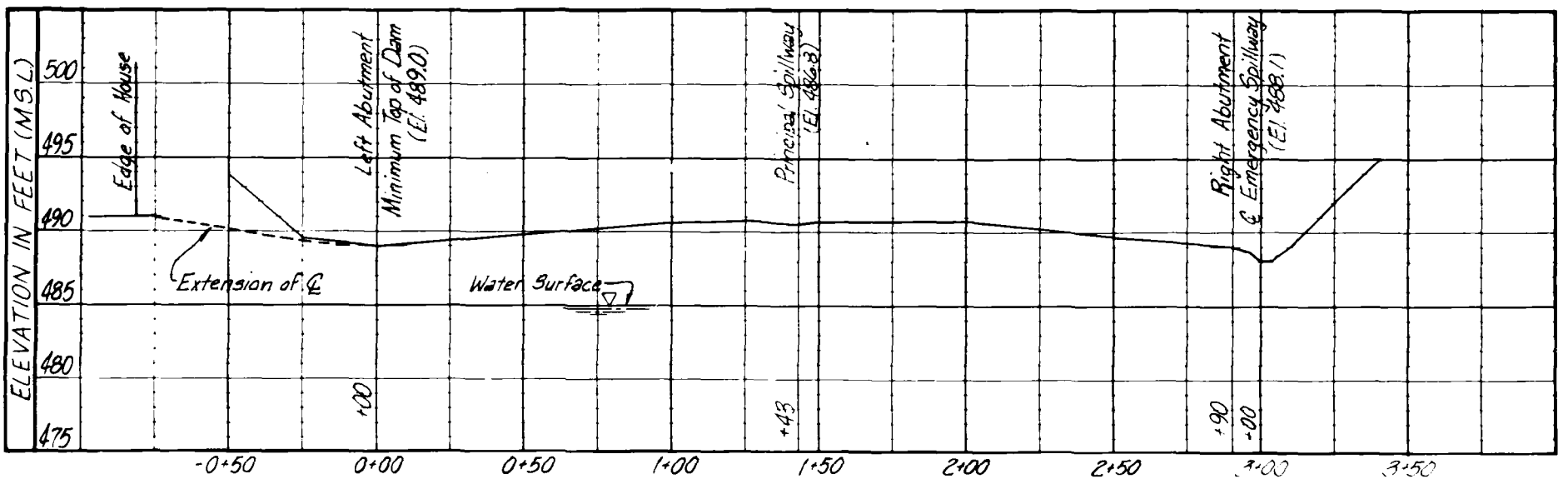
PLATE C-2

LAKE TANGLEWOOD SOUTH DAM



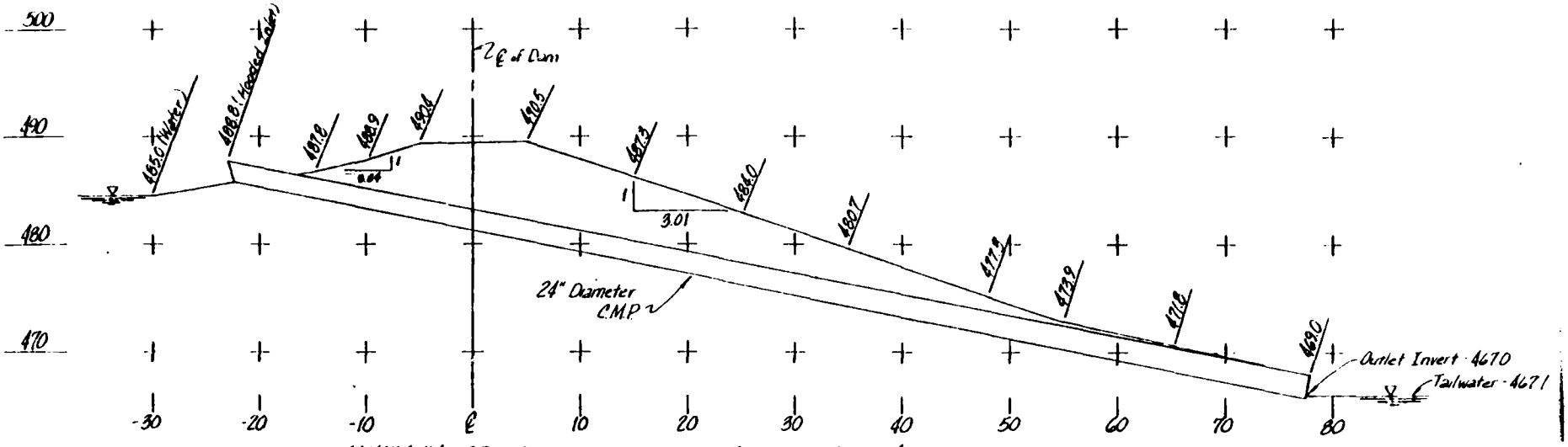
PLAN OF DAM
Scale: 1" = 50'

LAKE TANGLEWOOD NORTH DAM



CENTERLINE PROFILE OF DAM
Scale As Shown

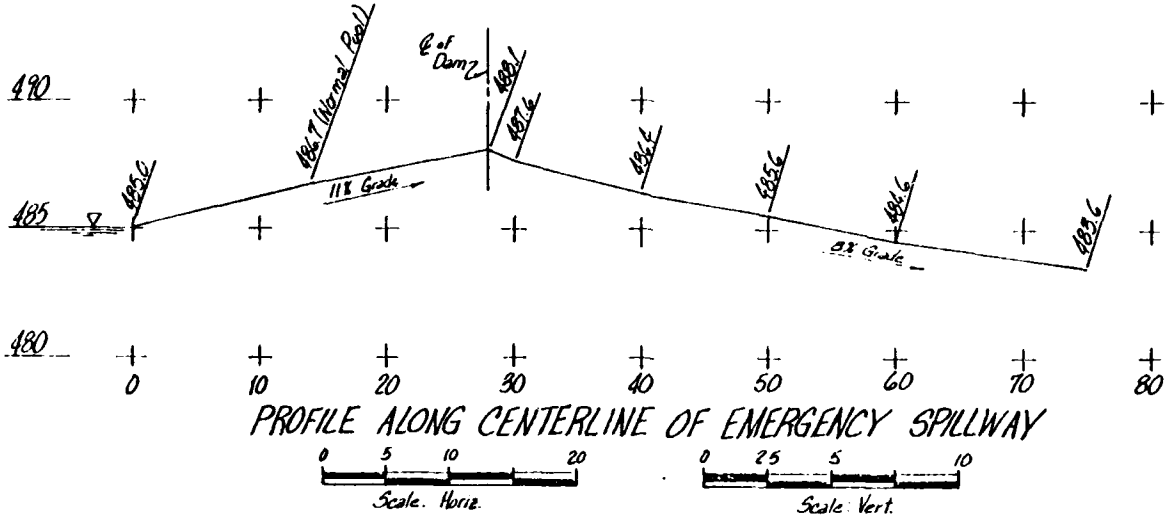
PLATE C-3



MAXIMUM CROSS-SECTION OF DAM AT STA 1+40

0 5 10 20

Scale: H&V.



PROFILE ALONG CENTERLINE OF EMERGENCY SPILLWAY

0 5 10 20

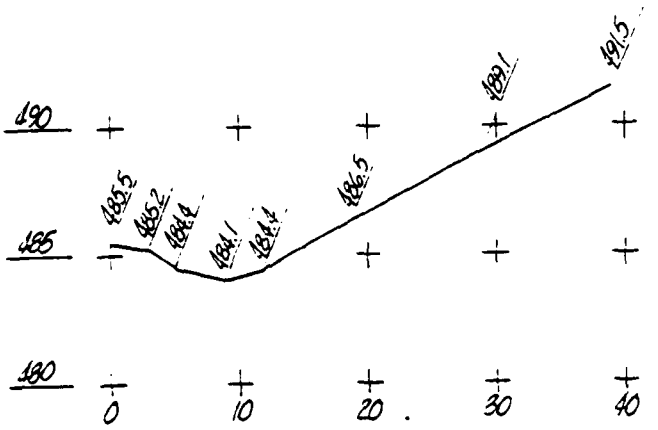
Scale. Horiz.

0 2.5 5 10

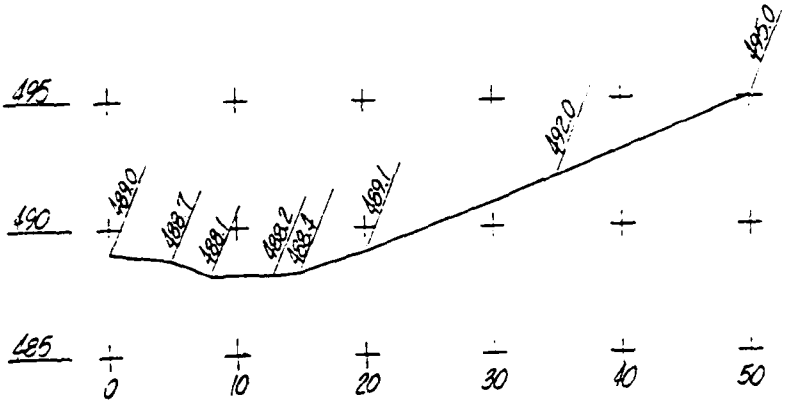
Scale: Vert.

PLATE C-4

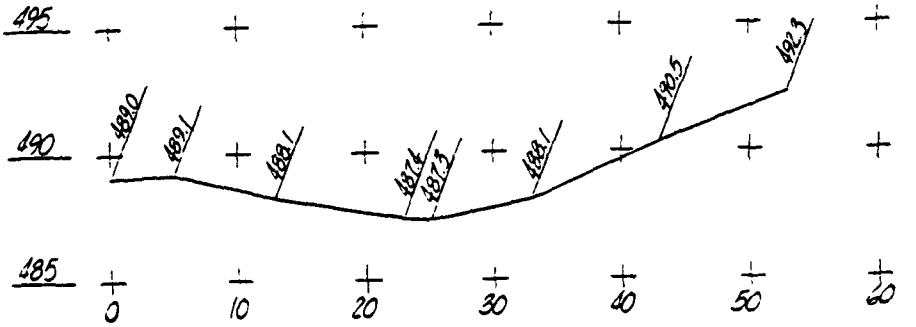
LAKE TANGLEWOOD NORTH DAM



Spillway Cross-Section 35' Downstream of ℄

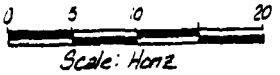


Spillway Cross-Section At ℄ of Dam

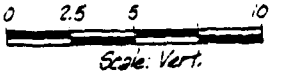


Spillway Cross-Section 8' Upstream of ℄

EMERGENCY SPILLWAY CROSS-SECTIONS



Scale: Horiz.



Scale: Vert.

PLATE C-5

LAKE TANGLEWOOD NORTH DAM

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 locations was taken from the data for the rainfall station at Cape Girardeau, Missouri, as supplied by the St. Louis District, Corps of Engineers, per their letter dated 5 December 1980. 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: Total drainage area = 59 acres (0.09 square miles) Lake Tanglewood North reservoir drainage area = 45 acres (0.07 square miles) Lake Tanglewood South reservoir drainage area = 14 acres (0.02 square miles)

   c. Time of concentration of runoff = 8 minutes (Lake Tanglewood North reservoir) and 5 minutes (Lake Tanglewood South reservoir). The time of concentration was computed from the "Kirpich" forula and verified using the equation from the California Culverts Practice, California Highways and Public Works Department. Time of concentration for the total area (assuming no upper dam or reservoir) = 11 minutes.

   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 spillways.

   e. Lake Tanglewood North Reservoir Losses: The total twenty-four hour storm duration losses for the one percent probabilistic storm were 4.42 inches. The total losses for the PMF storm were 3.17 inches. These data are based on SCS runoff curves No. 60 and No. 78 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups Menfro and Clarksville (hydrologic soil group "B"). Heavy, thick woods cover the majority of the watershed area with some residential development around the reservoir.

      Lake Tanglewood South Reservoir Losses: The total twenty-four hour storm duration losses for the one percent probabilistic storm were 3.61 inches. The total losses for the PMF storm were 2.34 inches. These data are based on SCS runoff curves No. 68 and No. 83 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups Menfro and Clarksville (hydrologic soil group "B"). Heavy, thick woods cover the majority of the watershed area with some residential development around the reservoir.

f. Average soil loss rates = 0.09 to 0.13 inch per hour approximately (for PMF storm, AMC III).

2. The combined discharge rating for both Lake Tanglewood Dams 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 for both dams was developed by using culvert flow tables for CMP culverts with inlet control as found in FHA-BPR HEC Circ. No. 5.

   b. The emergency spillway discharge rating for Lake Tanglewood South was developed using methods for flow over highway embankments in U.S.G.S. TWRI, Bk. 3, Ch. A-5 (coefficients based on h/L ratios and ranging in value from 2.09 to 3.04, paved road surface, and no submergence).

      The emergency spillway rating curve for Lake Tanglewood North was developed using the Corps of Engineers, Water Surface Profile HEC-2 computer program assuming critical depth just downstream of the centerline of the dam.

   c. The flows over the dams 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 reservoirs using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillways and dam embankment crests. A 24-hour PMF storm was first routed through the Lake Tanglewood North reservoir using data from the field inspection, The Lake Tanglewood North Dam's spillways did not pass 50% of the PMF; therefore, the Lake Tanglewood North Dam was breached in the routing of Lake Tanglewood South Dam according to current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology. The Lake Tanglewood North Dam was then routed in series with the Lake Tanglewood South Dam using a 24-hour storm to determine the hydrologic capabilities of Lake Tanglewood South Dam. The input, output, and plotted hydrographs are exhibited in this section.

GRAPH PAPER GRAPHIC CONTROLS CORPORATION Buffalo New York Printed in U.S.A. SQUARE 10 X 10 TO THE HALF INCH AS 0813 61

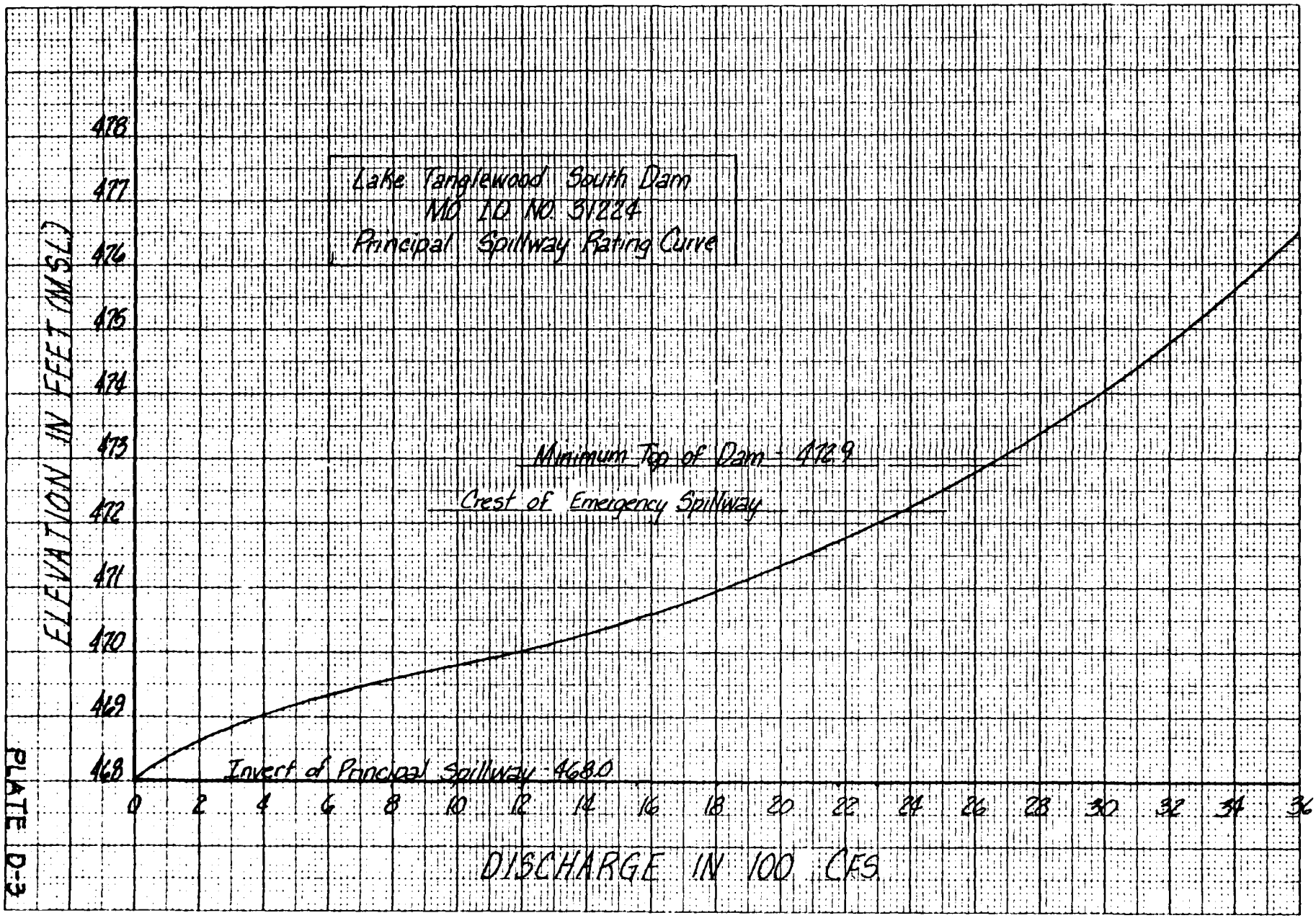


PLATE D-3

GRAPH PAPER GRAPHIC CONTROLS CORPORATION
Buffalo New York Printed in U.S.A.
SQUARE 10 X 10 TO THE HALF INCH AS 8013 61

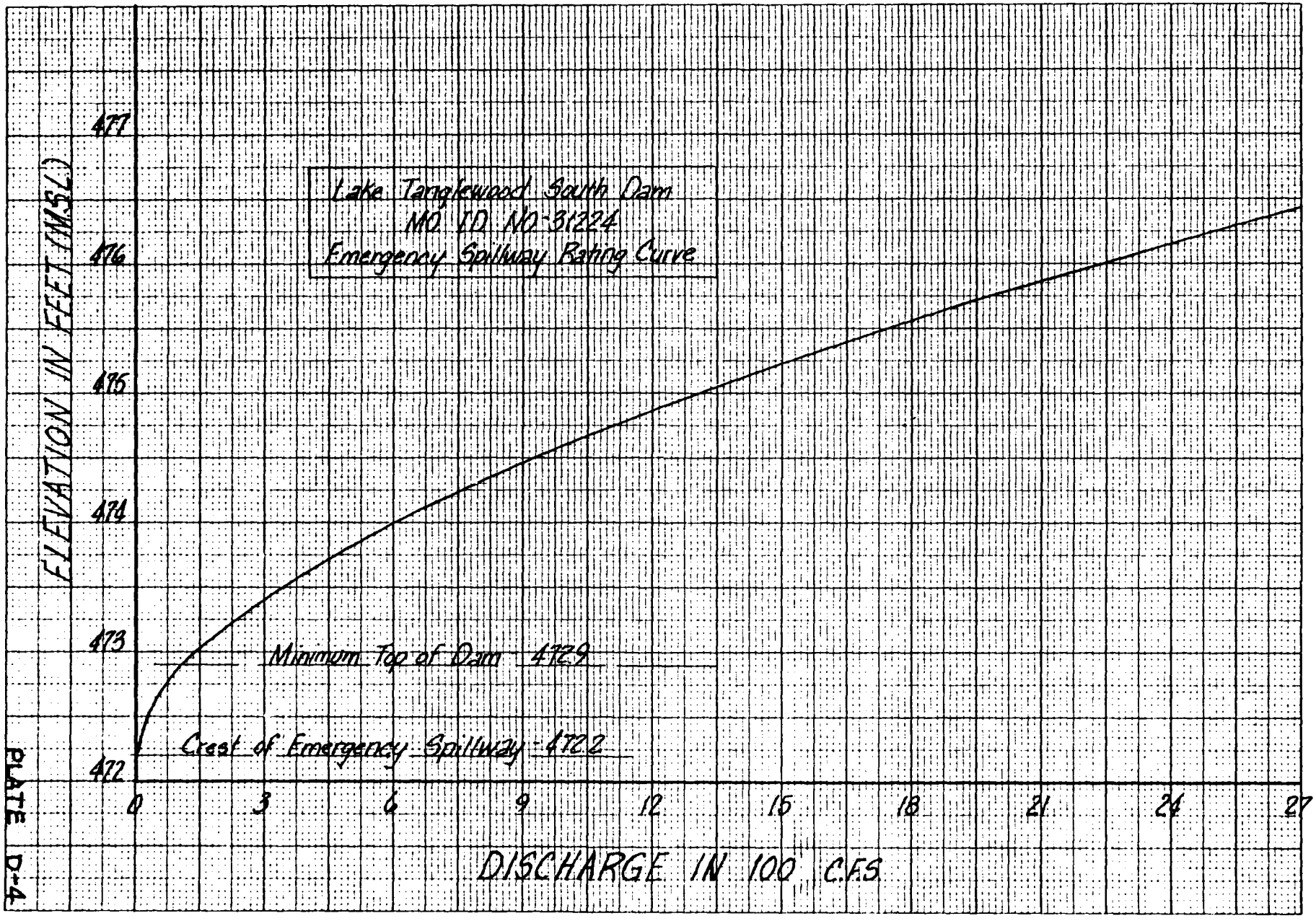


PLATE D-4

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

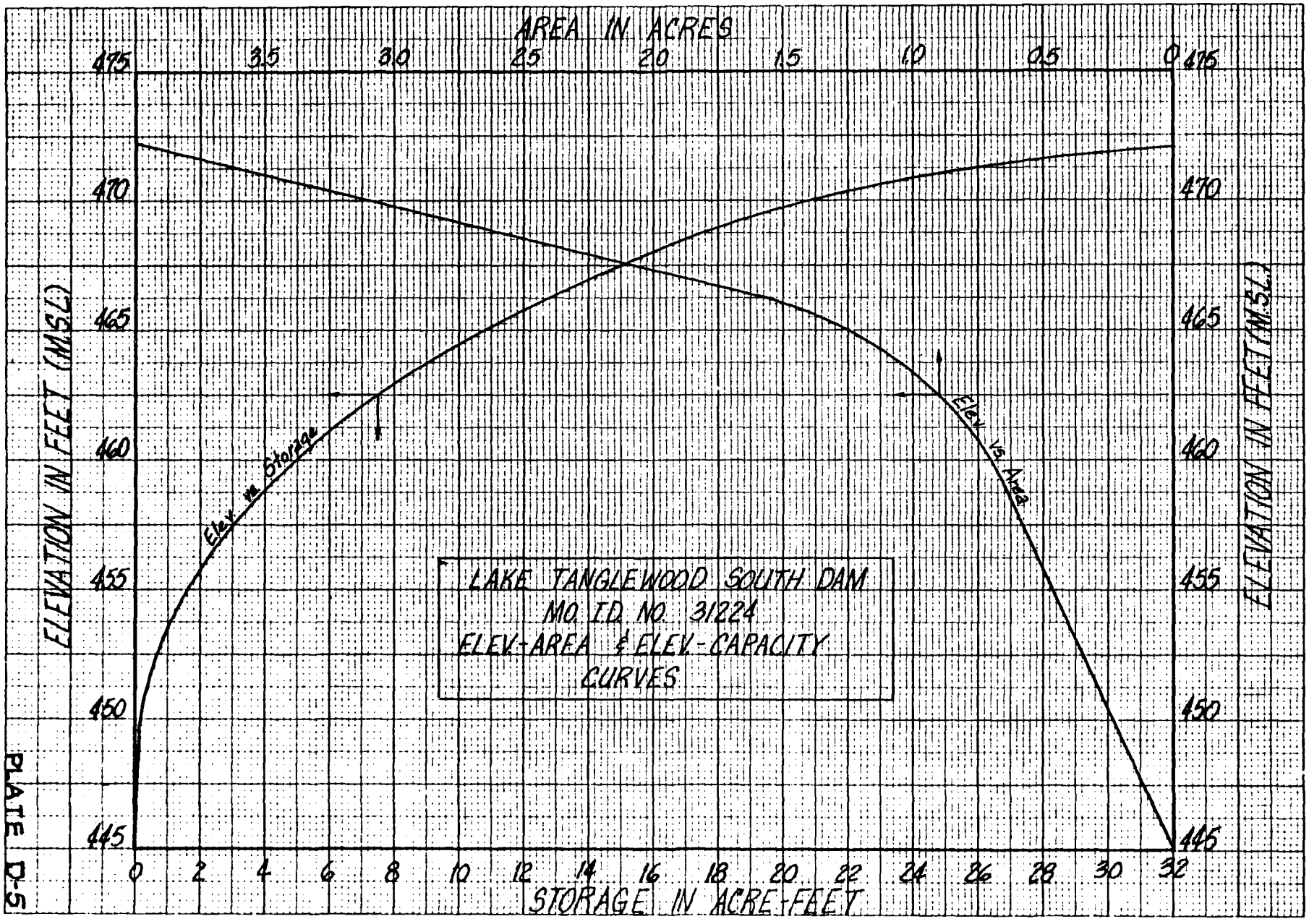


PLATE D-5

```
A1                ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2                H&H ANALYSIS OF SAFETY OF LAKE TANGLEWOOD SO DAM-MO ID NO 31224
A3                RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 0002880000000000000005                          000000000000000000000003
B1000006
J 000001000000090000001
J1000.050000.07500000.100000.12500000.1500000.2000000.2500000.5000001.00
K 00000000000001                  000000000000000000000001
K1                CALCULATION OF INFLOW HYDROGRAPH TO NORTH DAM
M 000001000000200000.07          00000.07000001.0                  00000001
P 000000000027.000000102000001210000130
T                                                    -1.0    -78.0
W2       00000.17
X 000000     -.0100000001
K 00000100000002                  000000020000000000000001
K1                ROUTED FLOWS THROUGH THE NORTH DAM
Y                          00000001000000001
Y1000001                                             -486.8       -1
Y40486.8000487.5000488.0000488.5000489.0000489.5000490.0000490.5000491.0000491.5
Y40492.0000492.5000493.0000493.5000494.0
Y5000000000000200000005000000120000003200000067000001150000017700000254000000336
Y5000427000005390000067100000812000000983
$A000000000001.1000002.2000003.2000004.8
$E00047000000480000486.80000490.0000500.
$$0486.8
$D0489.0000002.9000001.500000290
$L000000000004.7000000980000014600000183000002330000032500000330000003350000340
$V0489.0000489.3000489.6000490.0000490.3000490.6000491.0000492.0000493.0000494.0
$B000010000000.5000480.000000001000486.8000489.0
K 00000000000003                  000000000000000000000001
K1                CALCULATION OF INFLOW HYDROGRAPH TO LAKE TANGLEWOOD SOUTH DAM
M 000001000000020000.022          0000.022000001.0                  00000001
P 000000000027.000000102000001210000130
T                                                    -1.0    -83.0
W2       00000.17
X 000000     -.0100000001
K 000002SUM 2+3                   000000020000000000000001
K1                COMBINED INFLOW HYDROGRAPH TO LAKE TANGLEWOOD SOUTH DAM
K 00000100000004                  000000020000000000000001
K1                ROUTED FLOWS THROUGH LAKE TANGLEWOOD SOUTH DAM-MO 31224
Y                          00000001000000001
Y1000001                                             -468.0       -1
Y40468.0000469.0000470.0000471.0000472.0000473.0000473.5000474.0000475.0000476.0
Y40477.0
Y5000000000000040000001200000019000000230000016300000369000006300000133400002263
Y5003353
$A000000000000.2300000.69000002.3000003.1
$E00445.0000450.0000460.0000468.0000470.
$$0468.0
$D0472.9000002.9000001.500000275
$L000004000000380000024000000266000002860000032200000334
$V0472.9000473.0000473.4000474.0000475.0000476.0000477.0
K 000099
A
A
A
A
A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	000001
ROUTE HYDROGRAPH TO	000002
RUNOFF HYDROGRAPH AT	000003
COMBINE 2 HYDROGRAPHS AT	M 2+3
ROUTE HYDROGRAPH TO	000004
END OF NETWORK	

PLATE D-7

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

RUN DATE= 80/12/16.
TIME= 11.02.27.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HXH-ANALYSIS OF SAFETY OF LAKE TANGLEWOOD SO DAM-MO ID NO 51224
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	5	0
			JOPLN	NWT	LKOPT	TRACE			
			5	0	0	0			

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

RTIOS= .05 .08 .10 .13 .15 .20 .25 .50 1.00

****

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO NORTH DAM

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.07	0.00	.07	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

LKOPT	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 WETNESS = -1.00 EFFECT CN = 78.00

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

49. 147. 151. 95. 47. 25. 13. 7. 4. 2.
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	.20	.03	41.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.21	.02	82.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.21	.02	83.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.21	.02	97.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.21	.02	104.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.21	.02	108.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.21	.02	111.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.21	.02	112.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.21	.02	113.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.21	.02	114.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.21	.02	115.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.21	.02	115.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.26	.02	118.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.26	.02	124.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.26	.02	131.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.26	.02	136.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.26	.01	138.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.26	.01	140.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.28	.26	.01	141.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.28	.26	.01	141.

PLATE D-8

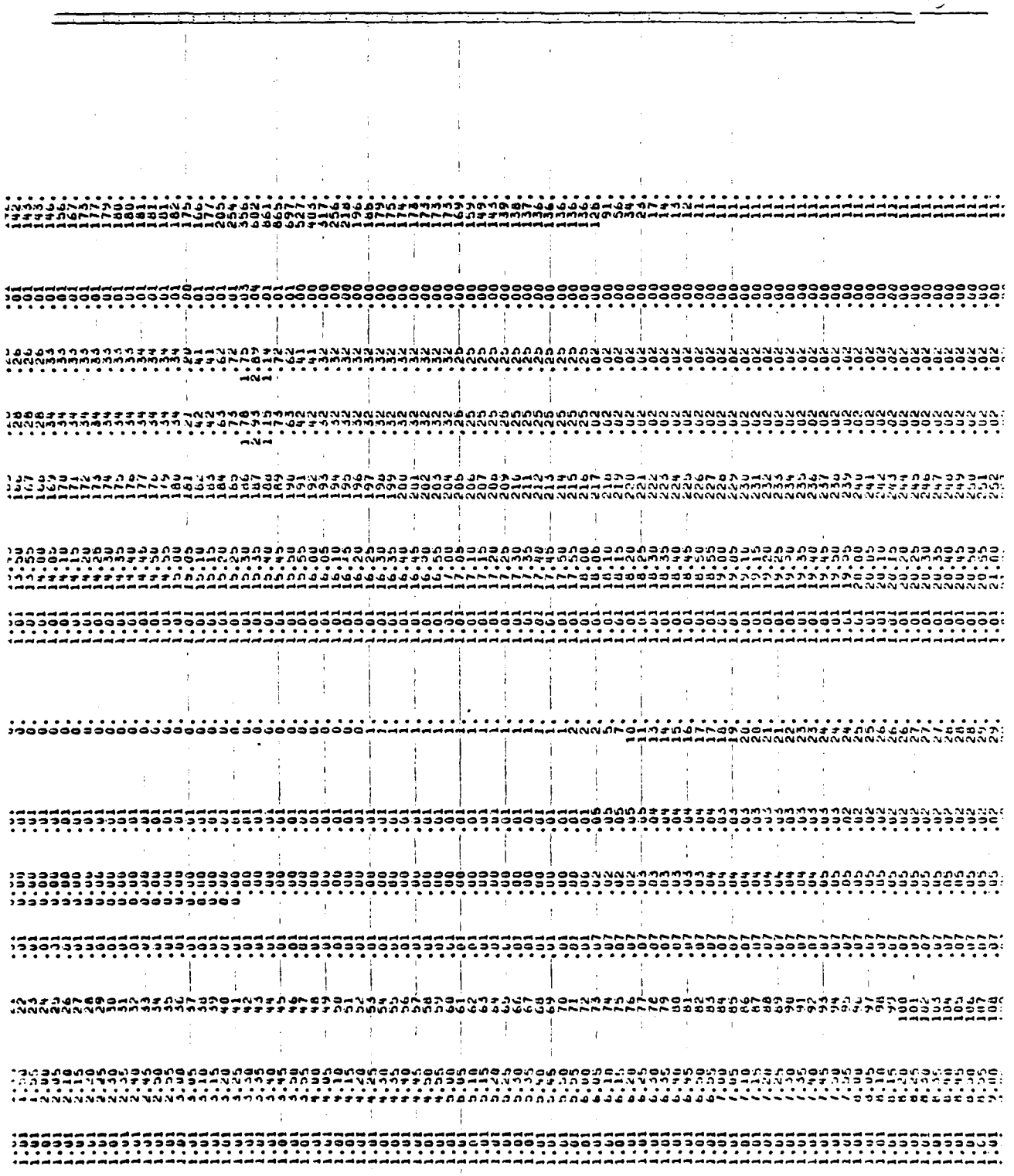


PLATE D-9

1.01	9.10	110	.07	.06	.02	29.	1.01	21.10	254	.02	.02	.00	11.
1.01	9.15	111	.07	.06	.02	29.	1.01	21.15	255	.02	.02	.00	11.
1.01	9.20	112	.07	.06	.02	30.	1.01	21.20	256	.02	.02	.00	11.
1.01	9.25	113	.07	.06	.02	30.	1.01	21.25	257	.02	.02	.00	11.
1.01	9.30	114	.07	.06	.01	30.	1.01	21.30	258	.02	.02	.00	11.
1.01	9.35	115	.07	.06	.01	30.	1.01	21.35	259	.02	.02	.00	11.
1.01	9.40	116	.07	.06	.01	31.	1.01	21.40	260	.02	.02	.00	11.
1.01	9.45	117	.07	.06	.01	31.	1.01	21.45	261	.02	.02	.00	11.
1.01	9.50	118	.07	.06	.01	31.	1.01	21.50	262	.02	.02	.00	11.
1.01	9.55	119	.07	.06	.01	31.	1.01	21.55	263	.02	.02	.00	11.
1.01	10.00	120	.07	.06	.01	31.	1.01	22.00	264	.02	.02	.00	11.
1.01	10.05	121	.07	.06	.01	31.	1.01	22.05	265	.02	.02	.00	11.
1.01	10.10	122	.07	.06	.01	32.	1.01	22.10	266	.02	.02	.00	11.
1.01	10.15	123	.07	.06	.01	32.	1.01	22.15	267	.02	.02	.00	11.
1.01	10.20	124	.07	.06	.01	32.	1.01	22.20	268	.02	.02	.00	11.
1.01	10.25	125	.07	.06	.01	32.	1.01	22.25	269	.02	.02	.00	11.
1.01	10.30	126	.07	.06	.01	32.	1.01	22.30	270	.02	.02	.00	11.
1.01	10.35	127	.07	.06	.01	32.	1.01	22.35	271	.02	.02	.00	11.
1.01	10.40	128	.07	.06	.01	32.	1.01	22.40	272	.02	.02	.00	11.
1.01	10.45	129	.07	.06	.01	32.	1.01	22.45	273	.02	.02	.00	11.
1.01	10.50	130	.07	.06	.01	33.	1.01	22.50	274	.02	.02	.00	11.
1.01	10.55	131	.07	.06	.01	33.	1.01	22.55	275	.02	.02	.00	11.
1.01	11.00	132	.07	.06	.01	33.	1.01	23.00	276	.02	.02	.00	11.
1.01	11.05	133	.07	.06	.01	33.	1.01	23.05	277	.02	.02	.00	11.
1.01	11.10	134	.07	.06	.01	33.	1.01	23.10	278	.02	.02	.00	11.
1.01	11.15	135	.07	.06	.01	33.	1.01	23.15	279	.02	.02	.00	11.
1.01	11.20	136	.07	.06	.01	33.	1.01	23.20	280	.02	.02	.00	11.
1.01	11.25	137	.07	.06	.01	33.	1.01	23.25	281	.02	.02	.00	11.
1.01	11.30	138	.07	.06	.01	33.	1.01	23.30	282	.02	.02	.00	11.
1.01	11.35	139	.07	.06	.01	34.	1.01	23.35	283	.02	.02	.00	11.
1.01	11.40	140	.07	.06	.01	34.	1.01	23.40	284	.02	.02	.00	11.
1.01	11.45	141	.07	.06	.01	34.	1.01	23.45	285	.02	.02	.00	11.
1.01	11.50	142	.07	.06	.01	34.	1.01	23.50	286	.02	.02	.00	11.
1.01	11.55	143	.07	.06	.01	34.	1.01	23.55	287	.02	.02	.00	11.
1.01	12.00	144	.07	.06	.01	34.	1.02	0.00	288	.02	.02	.00	11.
									SUM	35.10	31.93	3.17	17278.
										(892.)(	811.)(	81.)(	489.26)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	865.	200.	60.	60.	17268.
CMS	24.	6.	2.	2.	489.
INCHES		26.56	31.87	31.87	31.87
MM		674.66	809.55	809.55	809.55
AC-FT		99.	119.	119.	119.
THOUS CU M		122.	147.	147.	147.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	43.	10.	3.	3.	863.
CMS	1.	0.	0.	0.	24.
INCHES		1.33	1.59	1.59	1.59
MM		33.73	40.48	40.48	40.48
AC-FT		5.	6.	6.	6.
THOUS CU M		6.	7.	7.	7.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	65.	15.	4.	4.	1295.
CMS	2.	0.	0.	0.	37.
INCHES		1.99	2.39	2.39	2.39
MM		50.60	60.72	60.72	60.72
AC-FT		7.	9.	9.	9.
THOUS CU M		9.	11.	11.	11.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	86.	20.	6.	6.	1727.
CMS	2.	1.	0.	0.	49.
INCHES		2.66	3.19	3.19	3.19
MM		67.47	80.96	80.96	80.96
AC-FT		10.	12.	12.	12.
THOUS CU M		12.	15.	15.	15.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	108.	25.	7.	7.	2159.
CMS	3.	1.	0.	0.	61.
INCHES		3.32	1.98	1.98	1.98
MM		84.33	101.19	101.19	101.19
AC-FT		12.	15.	15.	15.
THOUS CU M		15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	130.	30.	9.	9.	2590.
CMS	4.	1.	0.	0.	73.
INCHES		3.98	4.78	4.78	4.78
MM		101.20	121.43	121.43	121.43
AC-FT		15.	18.	18.	18.
THOUS CU M		18.	22.	22.	22.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	173.	40.	12.	12.	3454.
CMS	5.	1.	0.	0.	98.
INCHES		5.31	6.37	6.37	6.37
MM		134.93	161.91	161.91	161.91
AC-FT		20.	24.	24.	24.
THOUS CU M		24.	29.	29.	29.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	216.	50.	15.	15.	4317.
CMS	6.	1.	0.	0.	122.
INCHES		6.64	7.97	7.97	7.97
MM		168.67	202.39	202.39	202.39
AC-FT		25.	30.	30.	30.
THOUS CU M		31.	37.	37.	37.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	432.	100.	30.	30.	8634.
CMS	12.	3.	1.	1.	244.
INCHES		13.28	15.94	15.94	15.94
MM		337.33	404.78	404.78	404.78
AC-FT		50.	59.	59.	59.
THOUS CU M		61.	73.	73.	73.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	865.	200.	60.	60.	17268.
CMS	24.	6.	2.	2.	489.
INCHES		26.56	31.87	31.87	31.87
MM		674.66	809.55	809.55	809.55
AC-FT		99.	119.	119.	119.
THOUS CU M		122.	147.	147.	147.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH THE NORTH DAM

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

ROUTING DATA

GLOSS	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	-487.	-1

STAGE	486.80	487.50	488.00	488.50	489.00	489.50	490.00	490.50	491.00	491.50

	492.00	492.50	493.00	493.50	494.00				
FLOW	0.00 427.00	2.00 539.00	5.00 671.00	12.00 812.00	32.00 983.00	67.00	115.00	177.00	254.00	336.00
SURFACE AREA=	0.	1.	2.	3.	5.					
CAPACITY=	0.	4.	15.	23.	63.					
ELEVATION=	470.	480.	487.	490.	500.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
486.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
489.0	2.9	1.5	290.

CREST LENGTH	0.	5.	98.	146.	183.	233.	325.	330.	335.	340.
AT OR BELOW ELEVATION	489.0	489.5	489.6	490.0	490.5	490.6	491.0	492.0	493.0	494.0

DAM BREACH DATA

BRWID	Z	ELBM	IFAIL	WSEL	FAILEL
10.	.50	480.00	1.00	486.80	489.00

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

OUTPUT

STATION 000002, PLAN 1, RATIO 5 [010 PMF]

BEGIN DAM FAILURE AT 15.92 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

487.2	487.2	487.2	487.3	487.3	487.3	487.3	487.3	487.3	487.4
487.4	487.4	487.4	487.5	487.5	487.5	487.5	487.6	487.6	487.6
487.7	487.7	487.7	487.8	487.8	487.8	487.8	487.9	487.9	487.9
488.0	488.0	488.0	488.1	488.1	488.1	488.1	488.2	488.2	488.2
488.3	488.3	488.3	488.3	488.4	488.4	488.5	488.6	488.6	488.9
489.0	489.0	488.9	488.8	488.5	488.1	487.7	487.1	486.5	485.8
485.0	484.2	483.4	482.6	482.1	481.8	481.5	481.3	481.1	481.0
480.9	480.8	480.8	480.7	480.7	480.7	480.7	480.6	480.6	480.6
480.5	480.4	480.4	480.4	480.3	480.3	480.3	480.3	480.2	480.2
480.2	480.2	480.2	480.2	480.2	480.2	480.2	480.2	480.2	480.1
480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1
480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1
480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1
480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1
480.1	480.1	480.1	480.1	480.1	480.1	480.1	480.1		

PEAK OUTFLOW IS 232. AT TIME 16.09 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	232.	44.	11.	11.	3300.
CMS	7.	1.	0.	0.	94.
INCHES		5.85	6.11	6.11	6.11
MM		148.10	155.07	155.07	155.07
AC-FT		22.	23.	23.	23.
THOUS CU M		27.	28.	28.	28.

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .083 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	- COMPUTED BREACH HYDROGRAPH (CFS)	= ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
15.917	0.000	32.	32.	0.	0.	0.
15.938	.021	38.	36.	2.	2.	0.
15.958	.042	45.	41.	2.	4.	0.
15.979	.063	49.	48.	1.	5.	0.
16.000	.083	54.	54.	0.	5.	0.
16.021	.104	62.	62.	1.	6.	0.
16.042	.125	70.	69.	1.	7.	0.
16.063	.146	78.	77.	0.	7.	0.
16.083	.167	85.	85.	0.	7.	0.
16.104	.188	93.	94.	-0.	7.	0.
16.125	.208	101.	102.	-0.	6.	0.
16.146	.229	109.	109.	-0.	6.	0.
16.167	.250	117.	117.	0.	6.	0.
16.188	.271	124.	124.	-0.	6.	0.
16.208	.292	131.	132.	-1.	5.	0.
16.229	.313	138.	138.	-0.	5.	0.
16.250	.333	145.	145.	-0.	5.	0.
16.271	.354	152.	153.	-1.	4.	0.
16.292	.375	160.	160.	-1.	3.	0.
16.313	.396	167.	168.	-1.	3.	0.
16.333	.417	174.	174.	0.	3.	0.
16.354	.437	180.	181.	-0.	3.	0.
16.375	.458	187.	187.	-0.	2.	0.
16.396	.479	193.	193.	-1.	2.	0.
16.417	.500	199.	199.	0.	2.	0.
16.438	.521	203.	204.	-1.	1.	0.
16.458	.542	208.	209.	-1.	0.	0.
16.479	.562	212.	213.	-1.	-0.	-0.
16.500	.583	217.	217.	0.	-0.	-0.
16.521	.604	219.	220.	-1.	-1.	-0.
16.542	.625	224.	225.	-1.	-2.	-0.
16.563	.646	225.	225.	-0.	-2.	-0.
16.583	.667	227.	227.	0.	-2.	-0.
16.604	.687	229.	229.	-1.	-3.	-0.
16.625	.708	230.	231.	-1.	-3.	-0.
16.646	.729	231.	232.	-1.	-4.	-0.
16.667	.750	232.	232.	0.	-4.	-0.
16.688	.771	232.	232.	-0.	-5.	-0.
16.708	.792	231.	232.	-1.	-5.	-0.
16.729	.812	231.	232.	-0.	-6.	-0.
16.750	.833	231.	231.	0.	-6.	-0.
16.771	.854	229.	230.	-0.	-6.	-0.
16.792	.875	228.	228.	-1.	-7.	-0.
16.813	.896	226.	227.	-0.	-7.	-0.
16.833	.917	225.	225.	0.	-7.	-0.
16.854	.937	223.	223.	-0.	-7.	-0.
16.875	.958	220.	221.	-0.	-8.	-0.
16.896	.979	218.	218.	-0.	-8.	-0.
16.917	1.000	216.	216.	0.	-8.	-0.

PLATE D-15

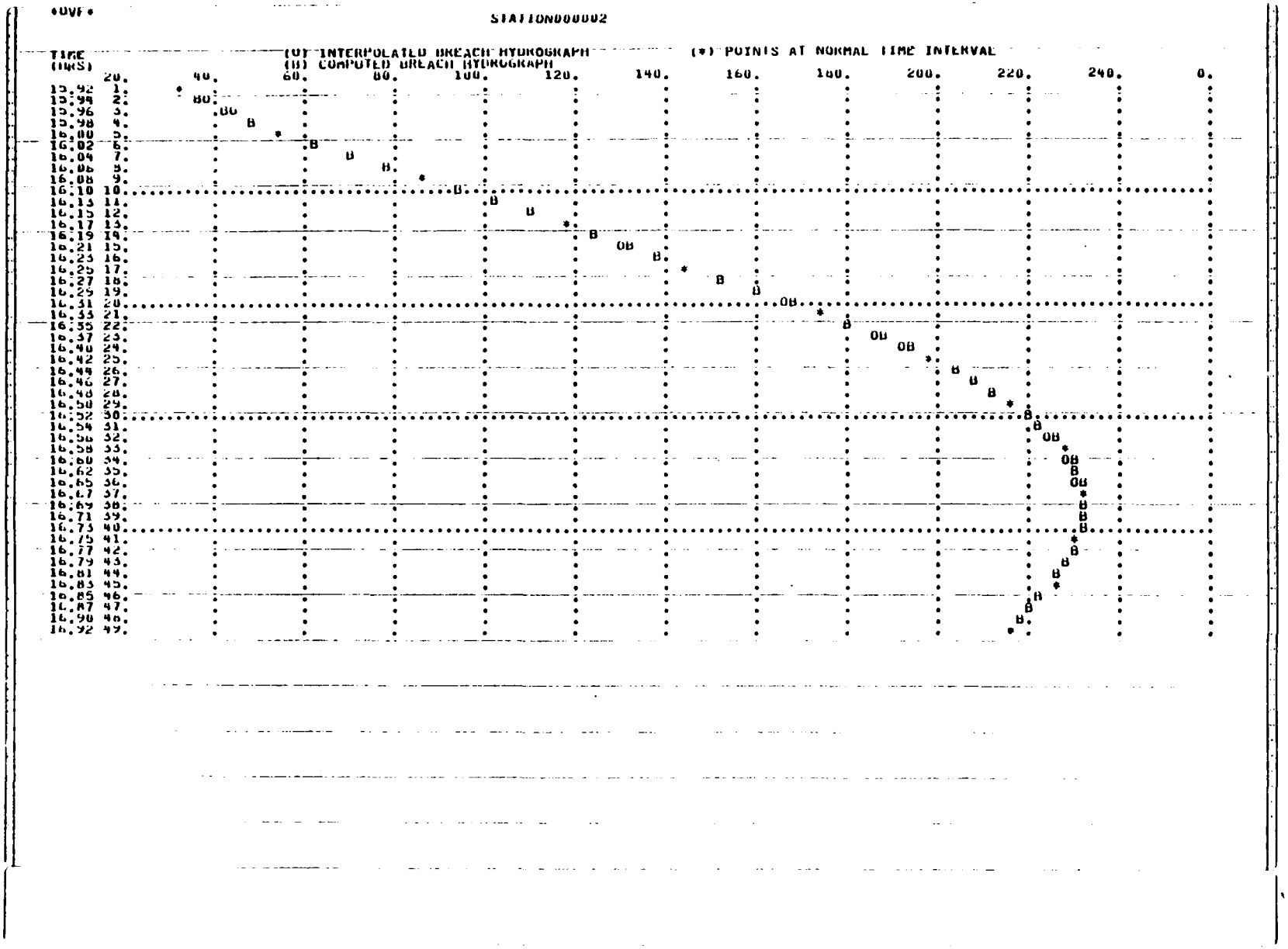

OVF
STATION000002
TIME (HRS)
(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL
20. 40. 60. 80. 100. 120. 140. 160. 180. 200. 220. 240. 0.

PLATE D-16

STATION00002 0.10 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 40. 80. 120. 160. 200. 240.

PLATE D-17

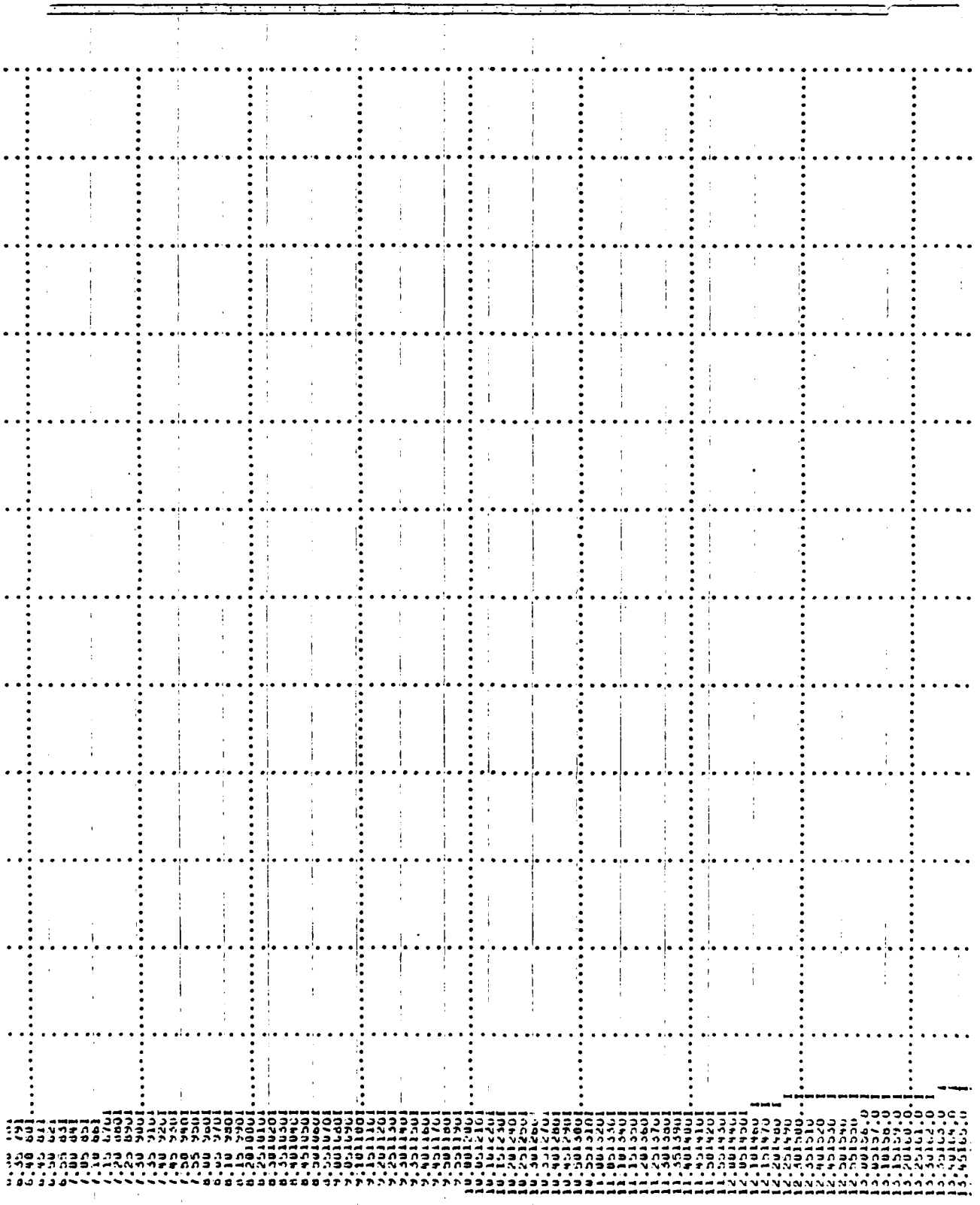


PLATE D-18

Data Documents, Inc.

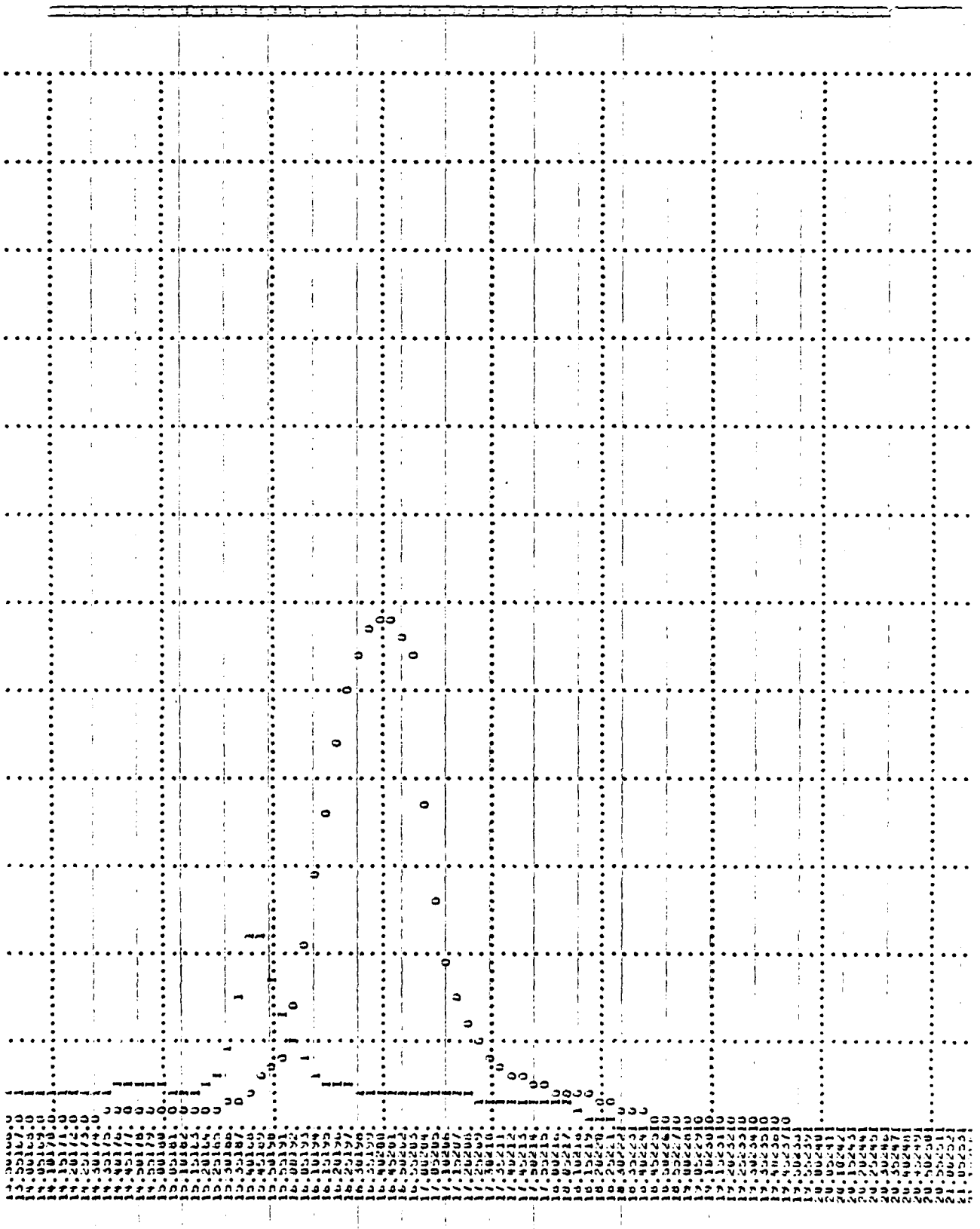


PLATE D-19

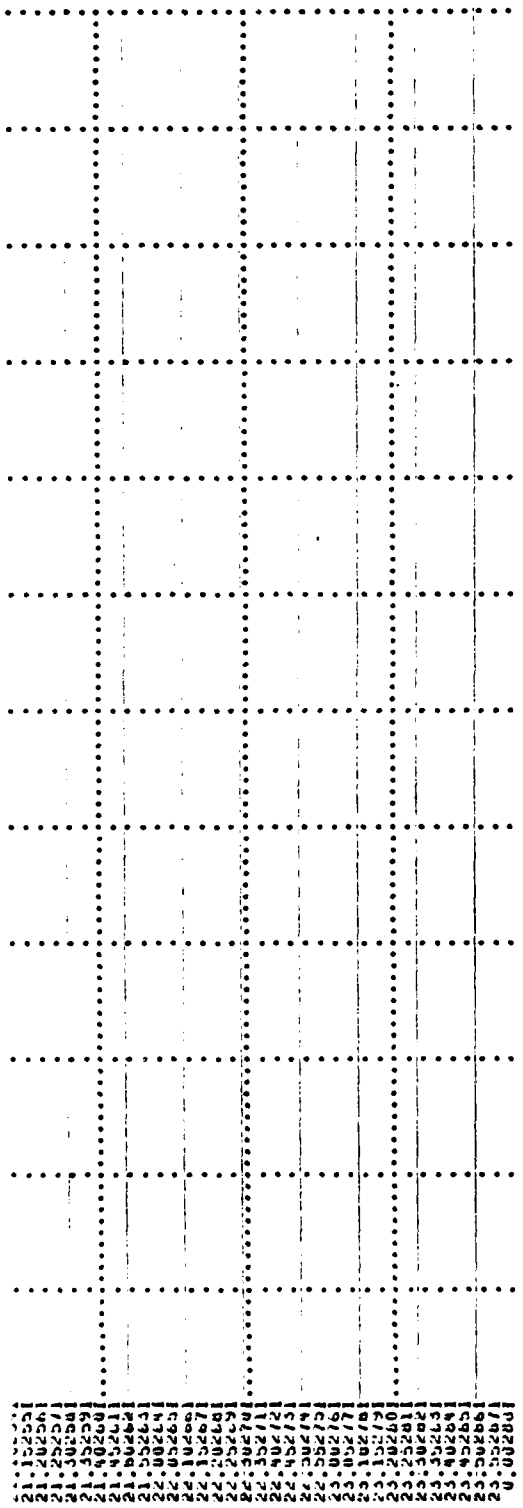


PLATE D-20

DVH

STATION 000002, PLAN 1, RATIO 8 [0.5 PMF]

BEGIN DAM FAILURE AT 12.75 HOURS

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.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	3.	4.	4.	4.	4.
4.	4.	5.	5.	5.	5.	6.	6.	6.	6.
7.	7.	8.	8.	8.	8.	9.	9.	9.	9.
10.	10.	10.	10.	11.	11.	11.	11.	11.	11.
12.	12.	12.	13.	14.	16.	19.	22.	25.	25.
48.	48.	55.	58.	93.	141.	165.	198.	229.	264.
271.	281.	284.	281.	274.	200.	154.	126.	109.	98.
93.	90.	89.	89.	89.	90.	90.	90.	90.	90.
90.	89.	88.	90.	98.	115.	157.	232.	307.	340.
324.	290.	248.	210.	177.	152.	134.	119.	109.	102.
97.	94.	92.	90.	89.	87.	84.	81.	78.	75.
73.	72.	71.	70.	69.	69.	68.	64.	56.	47.
32.	32.	26.	22.	18.	16.	14.	12.	11.	10.
9.	9.	8.	8.	7.	7.	7.	7.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.

STORAGE

15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	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.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	19.	19.	19.	19.	19.	19.	19.
19.	19.	19.	19.	19.	19.	19.	19.	20.	20.
20.	20.	20.	20.	20.	19.	18.	17.	16.	16.
15.	12.	10.	9.	8.	7.	7.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	7.	7.	8.	10.	10.	10.
9.	9.	8.	8.	7.	7.	7.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	5.	5.
5.	5.	5.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

STAGE

486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.9	486.9	486.9	486.9	486.9	486.9
487.0	487.0	487.0	487.0	487.1	487.1	487.1	487.1	487.2	487.2
487.2	487.3	487.3	487.3	487.4	487.4	487.4	487.4	487.5	487.5
487.5	487.6	487.6	487.6	487.7	487.7	487.7	487.8	487.8	487.8
487.8	487.9	487.9	487.9	488.0	488.0	488.0	488.0	488.1	488.1
488.1	488.1	488.2	488.2	488.2	488.2	488.2	488.3	488.3	488.3

PLATE D-21

Data Documents, Inc. 32

488.5	488.5	488.5	488.5	488.5	488.6	488.6	488.7	488.8	488.8
488.9	489.0	489.0	489.0	489.0	488.9	488.7	488.5	487.9	487.5
486.9	486.2	485.5	484.7	483.9	483.2	482.7	482.4	482.2	482.1
482.0	482.0	481.9	481.9	481.9	481.9	481.9	481.9	481.9	482.0
481.9	481.9	481.9	481.9	482.0	482.3	482.6	483.5	484.2	484.4
484.3	484.0	483.7	483.3	483.0	482.7	482.5	482.3	482.2	482.1
482.0	482.0	482.0	481.9	481.9	481.9	481.9	481.8	481.8	481.7
481.7	481.7	481.7	481.7	481.6	481.6	481.6	481.6	481.4	481.3
481.1	481.0	480.9	480.8	480.7	480.6	480.6	480.5	480.5	480.5
480.4	480.4	480.4	480.4	480.4	480.4	480.4	480.4	480.3	480.3
480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3
480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3
480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3
480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3
480.3	480.3	480.3	480.3	480.3	480.3	480.3	480.3		

PEAK OUTFLOW IS 340. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	340.	129.	35.	35.	10181.
CMS	10.	4.	1.	1.	288.
INCHES		17.10	18.79	18.79	18.79
MM		434.31	477.30	477.30	477.30
AC-FT		64.	70.	70.	70.
THOUS CU M		79.	86.	86.	86.

PLATE D-22

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .083 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
12.750	0.000	35.		35.		0.	0.	0.
12.771	.021	40.		37.		2.	2.	0.
12.792	.042	46.		43.		3.	5.	0.
12.813	.063	52.		50.		2.	6.	0.
12.833	.083	58.		58.		0.	6.	0.
12.854	.104	67.		66.		1.	7.	0.
12.875	.125	75.		75.		0.	7.	0.
12.896	.146	84.		84.		0.	7.	0.
12.917	.167	93.		93.		0.	7.	0.
12.938	.188	102.		102.		0.	7.	0.
12.958	.208	112.		112.		0.	7.	0.
12.979	.229	121.		121.		0.	7.	0.
13.000	.250	131.		131.		0.	7.	0.
13.021	.271	139.		140.		-1.	7.	0.
13.042	.292	148.		149.		-1.	6.	0.
13.063	.313	157.		157.		0.	6.	0.
13.083	.333	165.		165.		0.	6.	0.
13.104	.354	174.		173.		1.	7.	0.
13.125	.375	182.		181.		1.	7.	0.
13.146	.396	190.		190.		0.	8.	0.
13.167	.417	198.		198.		0.	8.	0.
13.188	.437	206.		207.		-1.	7.	0.
13.208	.458	214.		215.		-1.	6.	0.
13.229	.479	221.		222.		-1.	6.	0.
13.250	.500	229.		229.		0.	6.	0.
13.271	.521	235.		236.		-1.	5.	0.
13.292	.542	242.		243.		-1.	4.	0.
13.313	.562	248.		249.		-1.	3.	0.
13.333	.583	254.		254.		0.	3.	0.
13.354	.604	259.		259.		-1.	2.	0.
13.375	.625	265.		264.		-1.	1.	0.
13.396	.646	267.		268.		-1.	-0.	-0.
13.417	.667	271.		271.		0.	-0.	-0.
13.438	.687	274.		274.		-1.	-1.	-0.
13.458	.708	276.		277.		-1.	-2.	-0.
13.479	.729	279.		279.		-1.	-2.	-0.
13.500	.750	281.		281.		0.	-2.	-0.
13.521	.771	282.		283.		-1.	-3.	-0.
13.542	.792	283.		283.		-1.	-4.	-0.
13.563	.812	283.		284.		-1.	-4.	-0.
13.583	.833	284.		284.		0.	-4.	-0.
13.604	.854	283.		284.		-1.	-5.	-0.
13.625	.875	283.		285.		-1.	-6.	-0.
13.646	.896	282.		282.		0.	-6.	-0.
13.667	.917	281.		281.		0.	-6.	-0.
13.688	.937	279.		280.		-1.	-6.	-0.
13.708	.958	278.		278.		0.	-7.	-0.
13.729	.979	276.		276.		0.	-7.	-0.
13.750	1.000	274.		274.		0.	-7.	-0.

PLATE D-23

Data Documents, Inc.

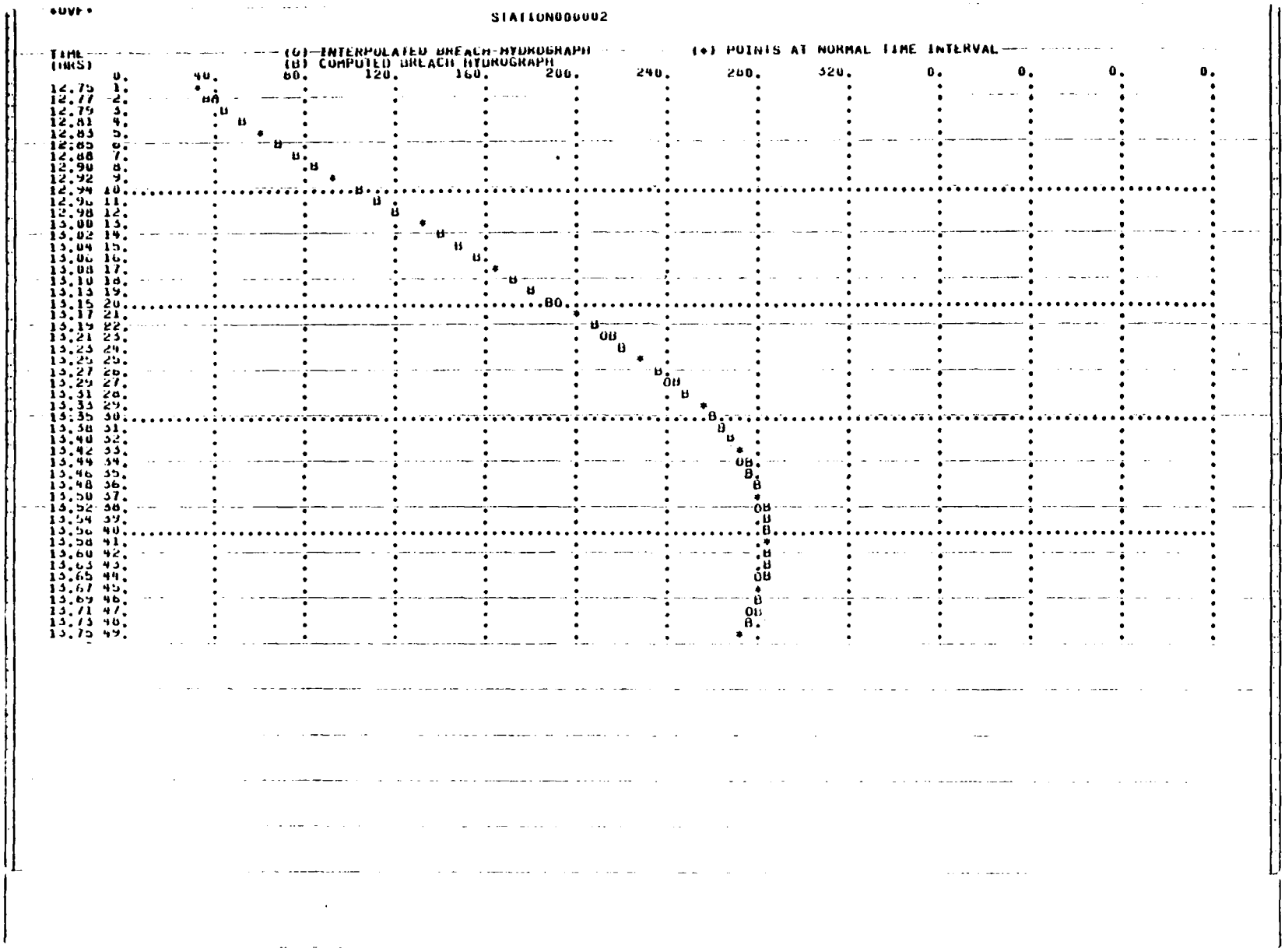

OVF
STATION000002
TIME (HRS)
(O)—INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(+) POINTS AT NORMAL TIME INTERVAL
0.
40.
80.
120.
160.
200.
240.
280.
320.
0.
0.
0.
0.

PLATE D-24

Data Documents, Inc. 12

PLATE D-25

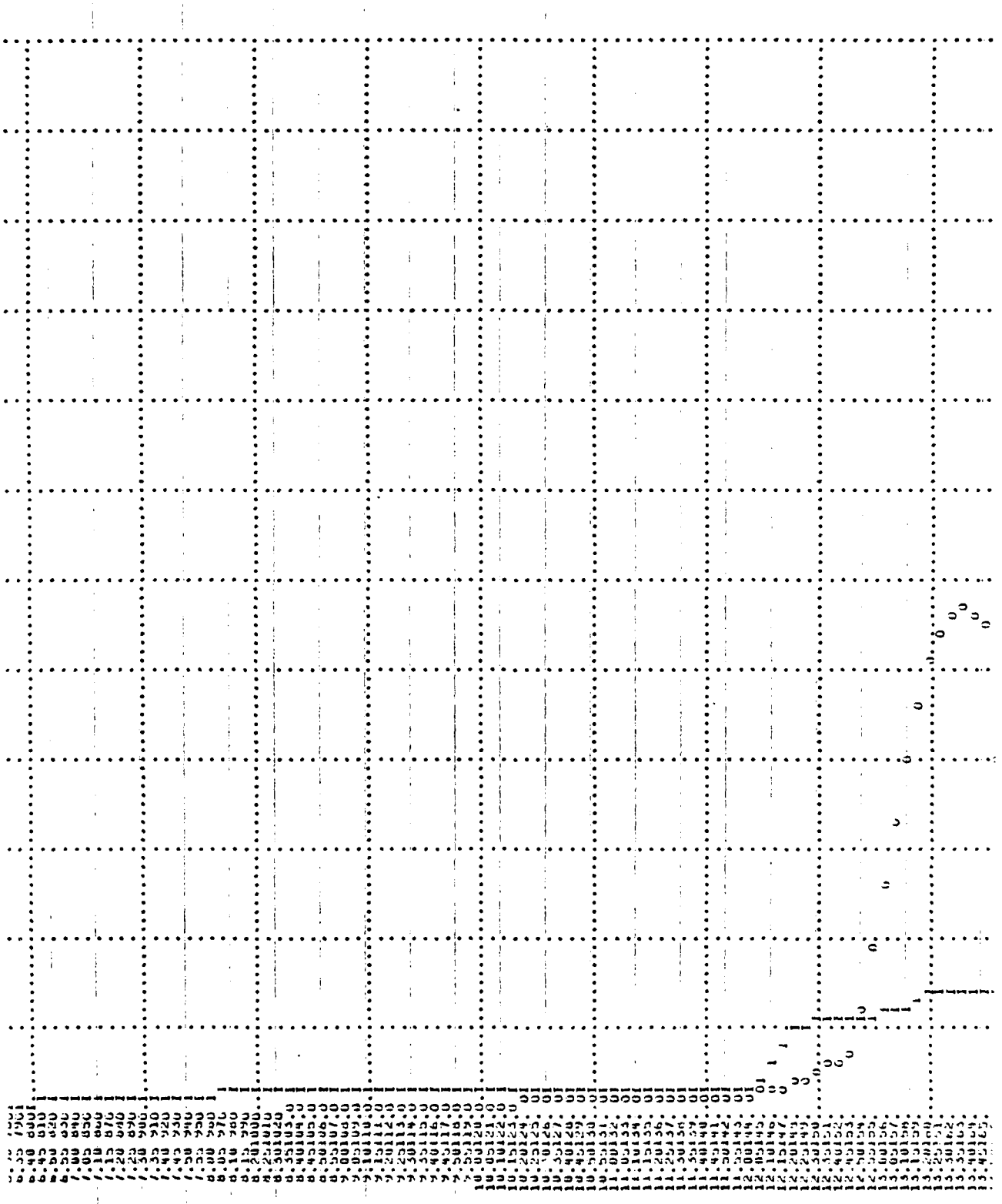
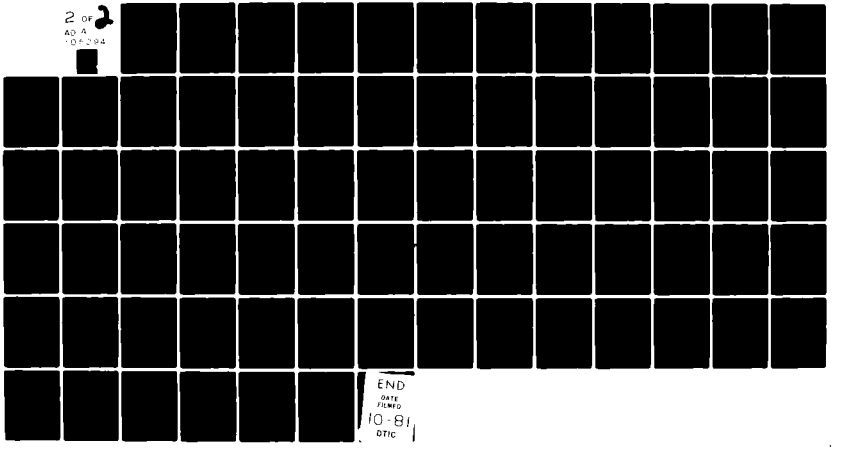


PLATE D-26

AD-A105 294 HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE TANGLEWOOD SOUTH DAM (MO 3122--ETC(U)
OCT 80 R S DECKER, G JAMISON, G ULMER DACW43-81-C-0003
UNCLASSIFIED NL



Data Documents, Inc. 72

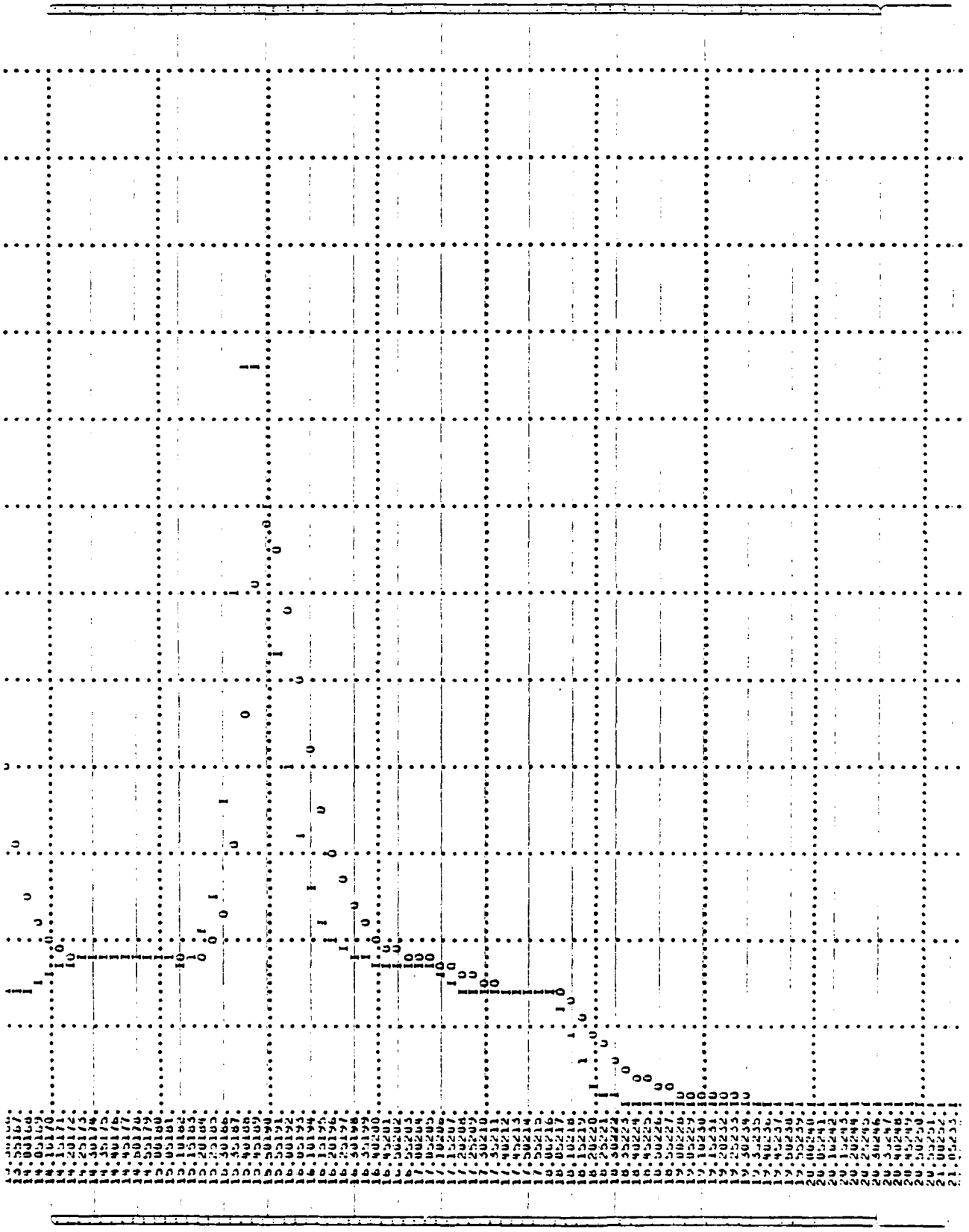


PLATE D-27

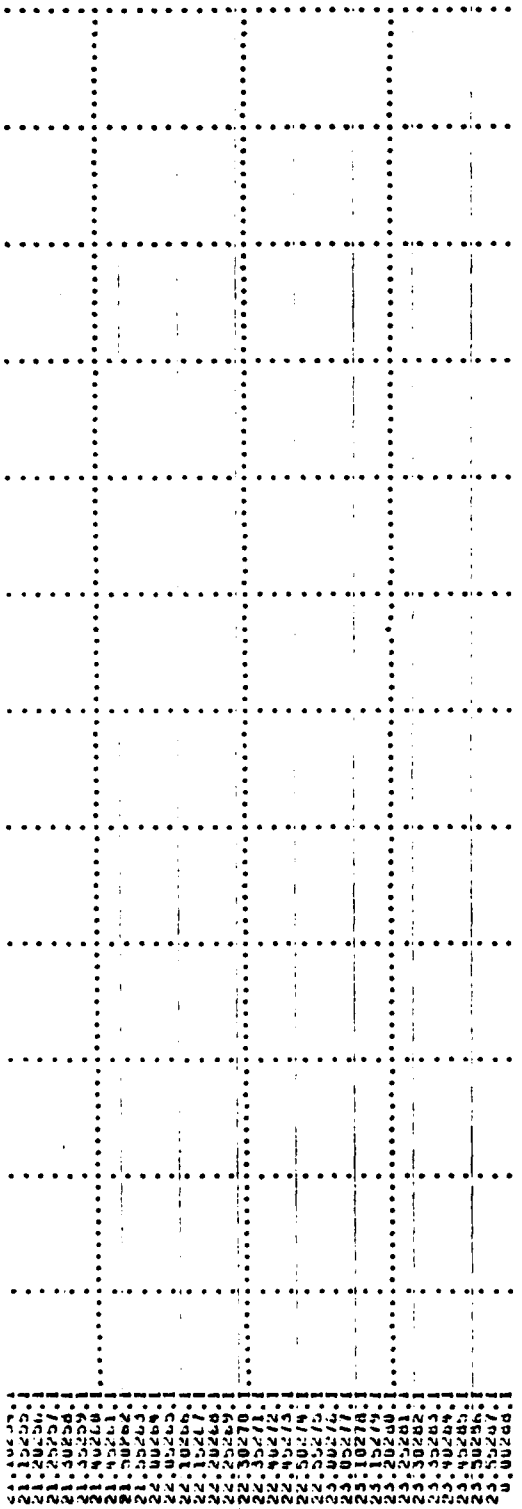


PLATE D-28

DVN

STATION 000002, PLAN 1, RATIO 9 PMF

BEGIN DAM FAILURE AT 11.92 HOURS

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.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
3.	3.	3.	4.	4.	4.	5.	5.	6.	7.
7.	8.	9.	10.	10.	11.	11.	12.	14.	15.
16.	18.	19.	20.	21.	22.	23.	24.	24.	25.
26.	26.	26.	27.	27.	28.	28.	28.	29.	29.
29.	30.	30.	30.	31.	31.	31.	31.	31.	32.
32.	32.	32.	52.	84.	121.	162.	203.	243.	276.
301.	316.	324.	620.	620.	243.	197.	170.	155.	148.
144.	142.	142.	141.	141.	142.	142.	142.	143.	146.
151.	158.	163.	168.	172.	175.	177.	178.	179.	180.
180.	177.	175.	180.	198.	237.	329.	491.	647.	705.
669.	580.	488.	406.	339.	288.	261.	226.	208.	196.
148.	182.	179.	177.	175.	171.	165.	159.	153.	148.
144.	142.	140.	139.	138.	137.	135.	126.	109.	89.
71.	56.	45.	37.	31.	26.	23.	20.	18.	17.
16.	15.	14.	13.	13.	13.	12.	12.	12.	12.
12.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.		

STORAGE

15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	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.
17.	17.	17.	17.	17.	17.	17.	18.	18.	18.
18.	18.	18.	18.	18.	19.	19.	19.	19.	19.
19.	19.	19.	19.	19.	20.	20.	20.	20.	20.
20.	20.	20.	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.	18.	17.
15.	14.	13.	11.	10.	9.	8.	7.	7.	7.
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.	9.	10.	12.	14.	15.
14.	13.	12.	11.	10.	9.	9.	8.	8.	8.
8.	8.	8.	8.	8.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	6.	6.
6.	5.	5.	5.	5.	5.	5.	5.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

STAGE

486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8	486.8
486.9	486.9	486.9	486.9	486.9	486.9	487.0	487.0	487.0	487.1
487.1	487.2	487.2	487.3	487.3	487.4	487.4	487.5	487.5	487.6
487.6	487.7	487.7	487.8	487.9	487.9	488.0	488.0	488.1	488.1
488.2	488.2	488.3	488.3	488.4	488.4	488.5	488.5	488.5	488.6
488.6	488.6	488.7	488.7	488.7	488.7	488.8	488.8	488.8	488.8
488.8	488.8	488.9	488.9	488.9	488.9	488.9	488.9	488.9	488.9

PLATE D-29

489.0	489.0	489.0	489.0	488.9	488.8	488.6	488.4	488.1	487.6
487.1	486.5	485.8	485.1	484.3	483.6	483.2	482.9	482.7	482.7
482.6	482.6	482.6	482.6	482.6	482.6	482.6	482.6	482.6	482.6
482.7	482.6	482.6	482.9	482.9	483.0	483.0	483.0	483.0	483.0
483.0	483.0	483.0	483.0	483.2	483.6	484.4	485.5	486.5	486.9
486.4	486.1	485.5	485.0	484.4	484.0	483.7	483.5	483.3	483.2
483.1	483.0	483.0	483.0	483.0	482.9	482.9	482.8	482.7	482.7
482.6	482.6	482.6	482.6	482.6	482.6	482.6	482.4	482.4	481.9
481.7	481.4	481.3	481.1	481.0	480.9	480.8	480.7	480.7	480.7
480.6	480.6	480.6	480.6	480.6	480.5	480.5	480.5	480.5	480.5
480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5
480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5
480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5
480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5
480.5	480.5	480.5	480.5	480.5	480.5	480.5	480.5		

PEAK OUTFLOW IS 705. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	705.	226.	65.	65.	18781.
CMS	20.	6.	2.	2.	532.
INCHES		30.83	34.66	34.66	34.66
MM		782.66	880.46	880.46	880.46
AC-FT		112.	129.	129.	129.
THOUS CU M		138.	160.	160.	160.

PLATE D-30

THE HOR BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .083 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
11.917	0.000	32.		32.		0.	0.	0.
11.938	.021	37.		35.		2.	2.	0.
11.958	.042	42.		39.		3.	5.	0.
11.979	.063	47.		45.		2.	7.	0.
12.000	.083	52.		52.		0.	7.	0.
12.021	.104	60.		59.		1.	7.	0.
12.042	.125	68.		67.		1.	8.	0.
12.063	.146	76.		75.		1.	9.	0.
12.083	.167	84.		84.		-0.	9.	0.
12.104	.188	93.		92.		0.	9.	0.
12.125	.208	102.		102.		1.	10.	0.
12.146	.229	112.		111.		0.	10.	0.
12.167	.250	121.		121.		0.	10.	0.
12.188	.271	131.		131.		0.	10.	0.
12.208	.292	141.		141.		0.	11.	0.
12.229	.313	151.		151.		0.	11.	0.
12.250	.333	162.		162.		-0.	11.	0.
12.271	.354	172.		172.		0.	11.	0.
12.292	.375	182.		182.		1.	12.	0.
12.313	.396	193.		192.		1.	12.	0.
12.333	.417	203.		203.		0.	12.	0.
12.354	.437	213.		214.		-1.	12.	0.
12.375	.458	223.		224.		-1.	11.	0.
12.396	.479	233.		234.		-1.	10.	0.
12.417	.500	243.		243.		0.	10.	0.
12.438	.521	251.		252.		-0.	9.	0.
12.458	.542	260.		261.		-1.	8.	0.
12.479	.562	268.		269.		-1.	8.	0.
12.500	.583	276.		276.		0.	8.	0.
12.521	.604	283.		283.		-1.	7.	0.
12.542	.625	289.		290.		-1.	6.	0.
12.563	.646	295.		296.		-1.	5.	0.
12.583	.667	301.		301.		0.	5.	0.
12.604	.687	305.		306.		-1.	4.	0.
12.625	.708	309.		310.		-1.	3.	0.
12.646	.729	313.		313.		-1.	3.	0.
12.667	.750	316.		316.		0.	3.	0.
12.688	.771	318.		319.		-1.	2.	0.
12.708	.792	320.		321.		-1.	1.	0.
12.729	.812	322.		323.		-1.	0.	0.
12.750	.833	324.		324.		0.	0.	0.
12.771	.854	324.		325.		-1.	-0.	-0.
12.792	.875	324.		326.		-1.	-1.	-0.
12.813	.896	325.		325.		-1.	-2.	-0.
12.833	.917	325.		325.		0.	-2.	-0.
12.854	.937	324.		324.		-0.	-2.	-0.
12.875	.958	322.		323.		-1.	-3.	-0.
12.896	.979	321.		322.		-0.	-3.	-0.
12.917	1.000	320.		320.		0.	-3.	-0.

PLATE D-31

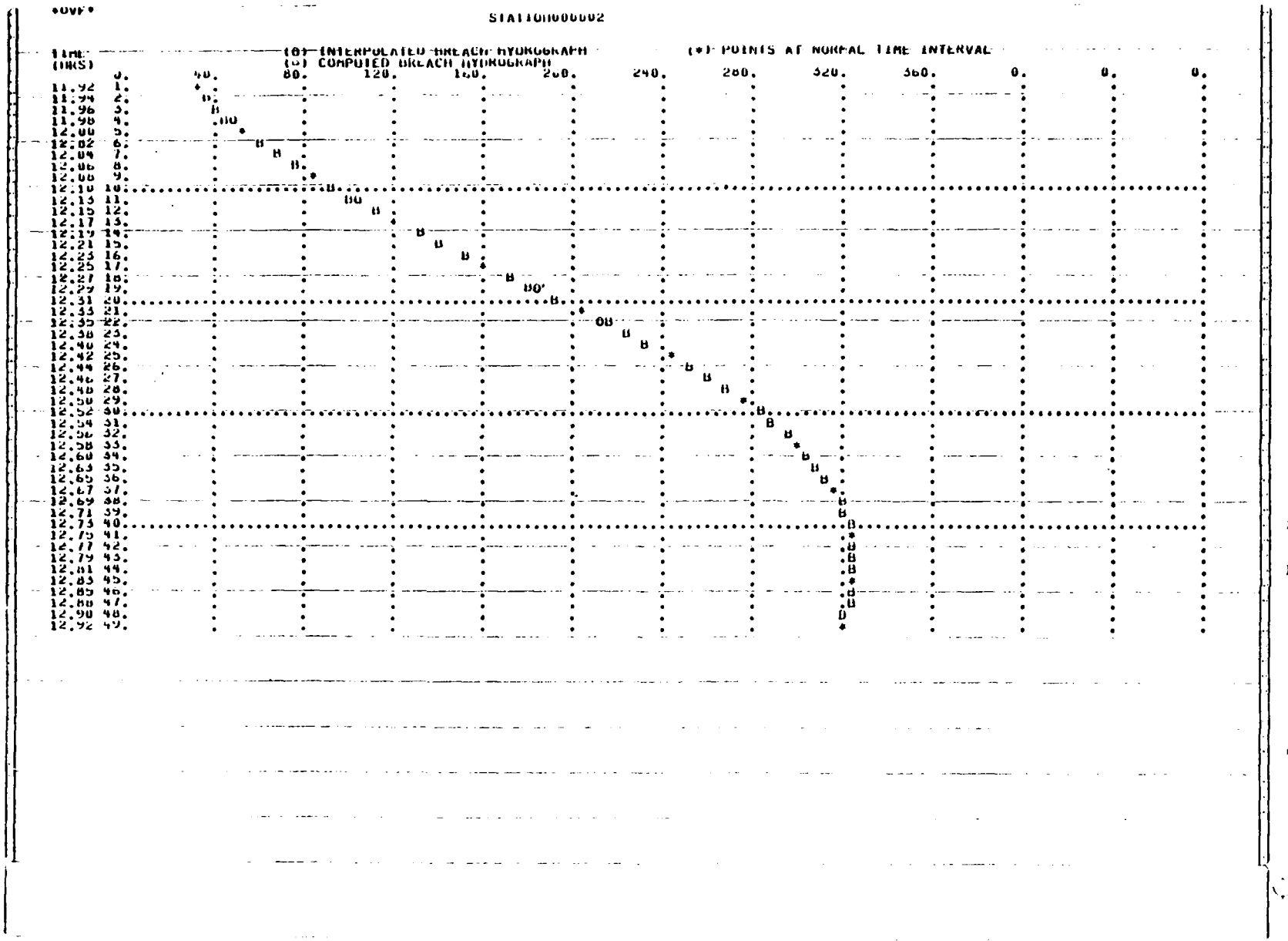

OVF
STATION000002
TIME (HRS)
(B) INTERPOLATED BREACH HYDROGRAPH
(O) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL
0. 40. 80. 120. 160. 200. 240. 280. 320. 360. 0. 0. 0.

PLATE D-32

Data Documents, Inc. 32

PLATE D-33

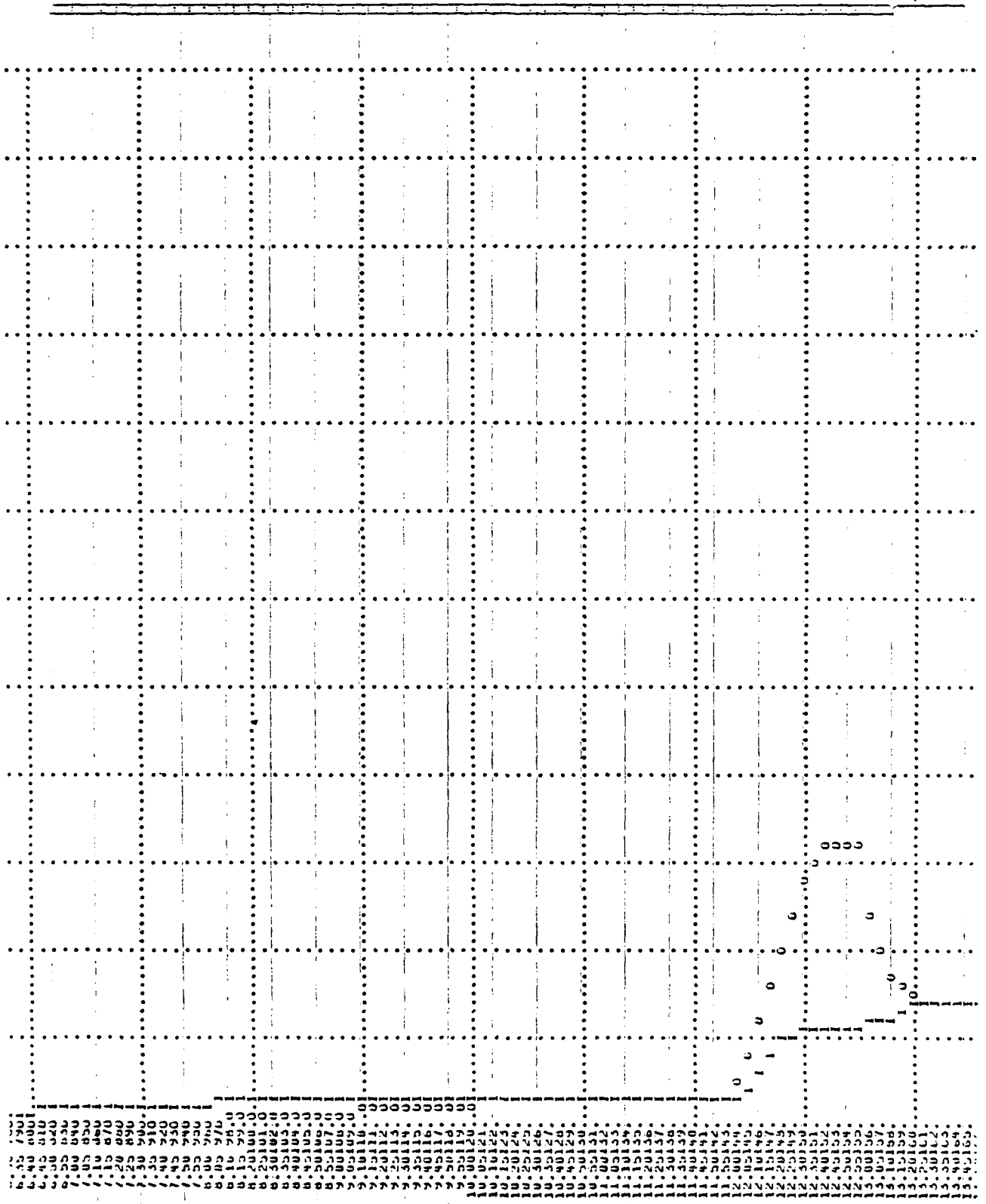


PLATE D-34

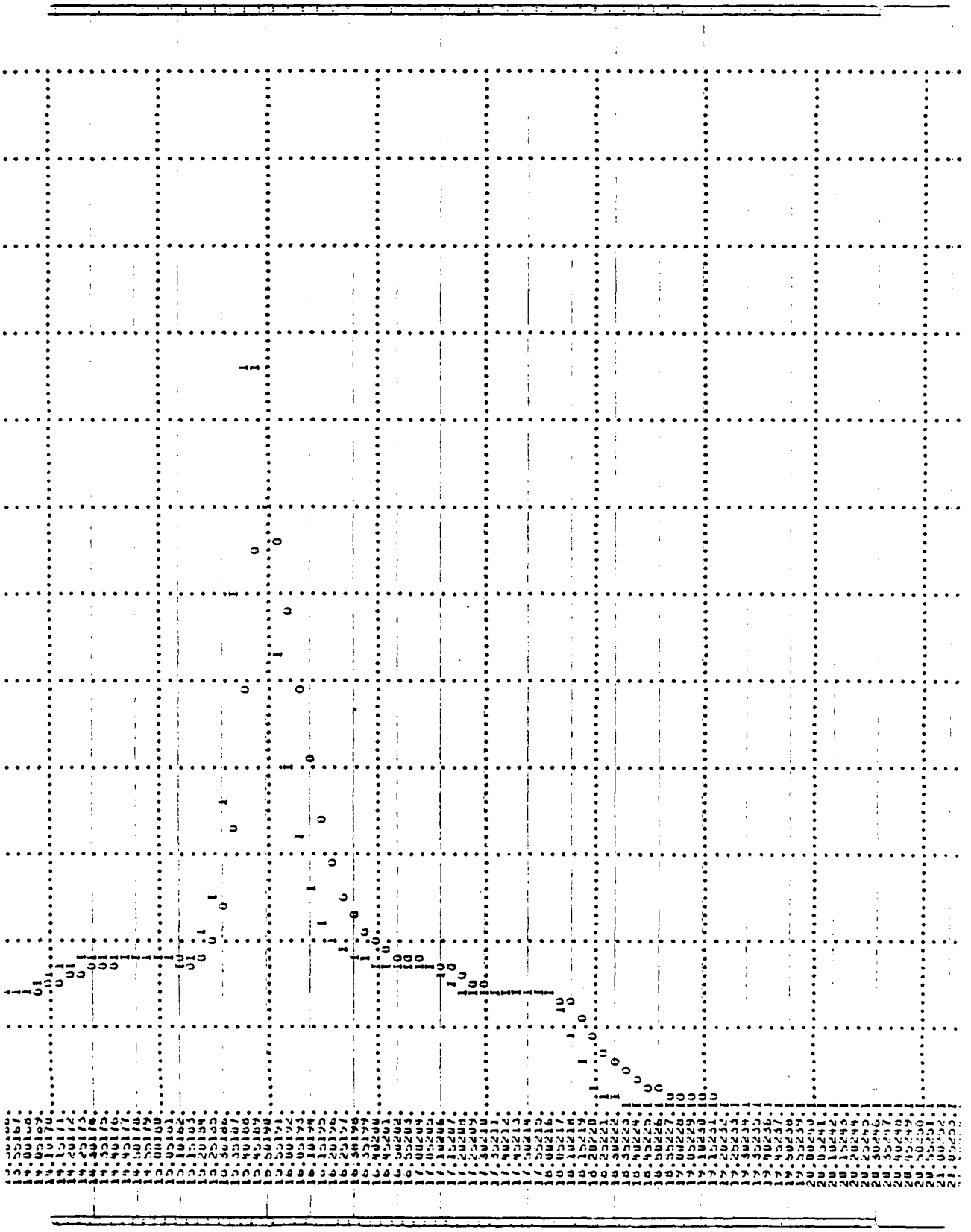


PLATE D-35

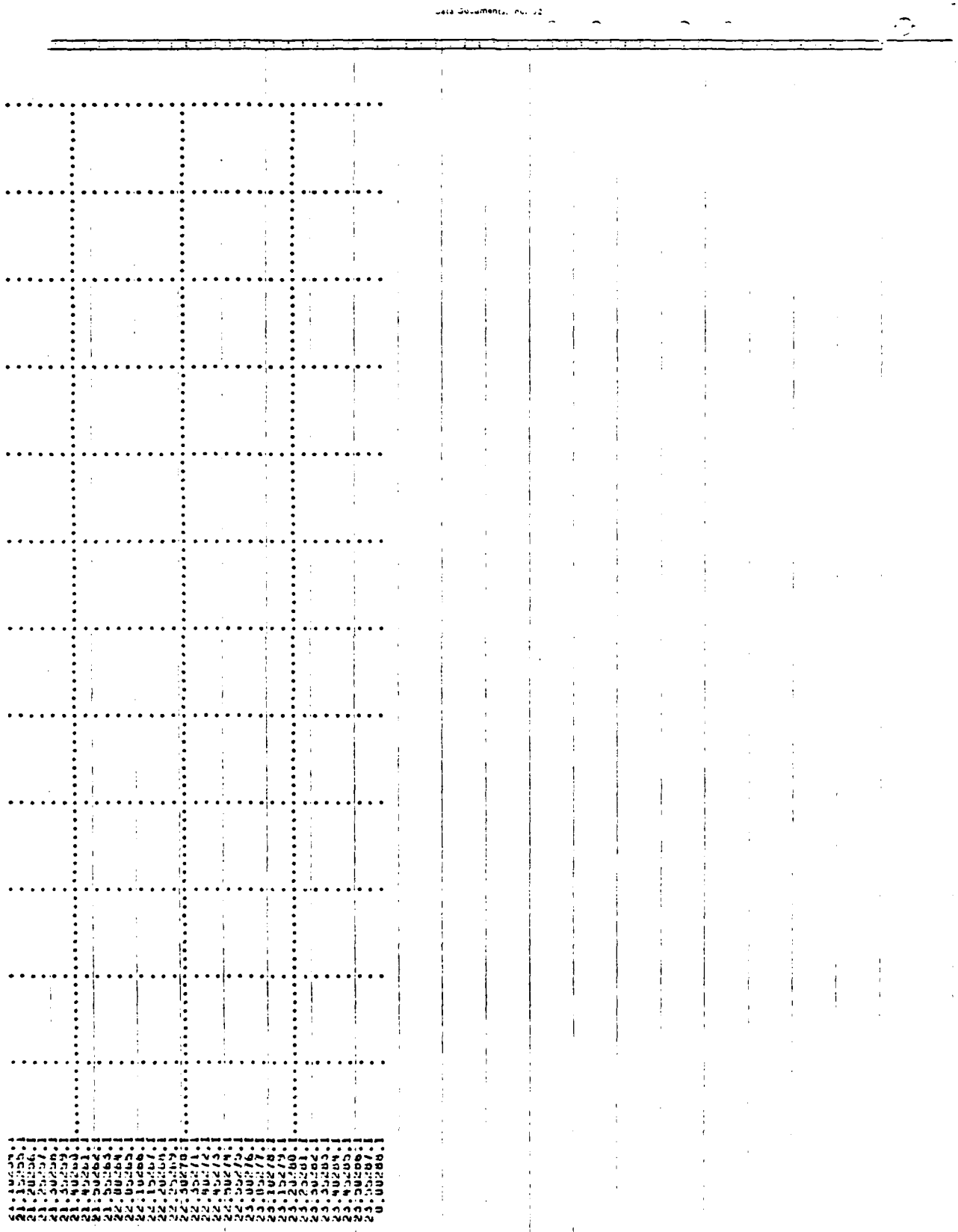


PLATE D-36

OVN

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO LAKE TANGLEWOOD SOUTH DAM

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	.02	0.00	.02	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

LKOPT	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	-85.00	0.00	0.00

CURVE NO = -85.00 WETNESS = -1.00 EFFECT CN = 85.00

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

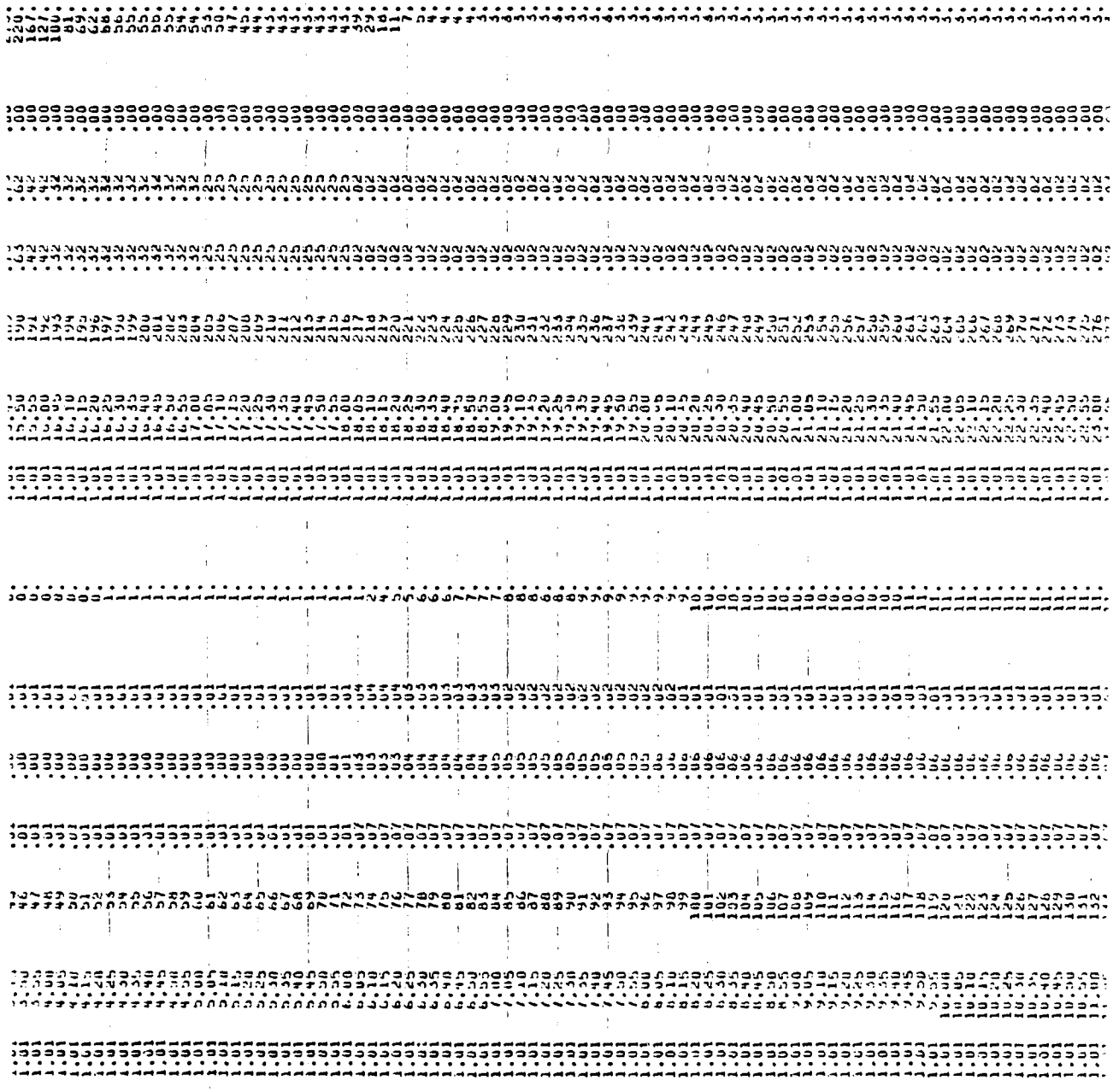
15. 46. 47. 30. 15. 8. 4. 2. 1. 1.
0. 0.

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	.21	.02	14.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.21	.01	20.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.22	.01	27.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.22	.01	32.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.22	.01	34.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.22	.01	36.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.22	.01	36.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.22	.01	37.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.22	.01	37.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.22	.01	37.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.22	.01	37.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.22	.01	37.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.27	.01	38.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.27	.01	40.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.27	.01	42.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.27	.01	44.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.27	.01	45.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.27	.01	45.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.28	.27	.01	45.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.28	.27	.01	45.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.28	.27	.01	46.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.28	.27	.01	46.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.28	.27	.01	46.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.28	.27	.01	46.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.34	.34	.01	47.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.34	.34	.01	50.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	.34	.34	.01	53.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.34	.34	.01	55.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.34	.34	.01	56.
1.01	2.30	30	.01	0.00	.01	0.	1.01	14.30	174	.34	.34	.01	57.
1.01	2.35	31	.01	.00	.01	0.	1.01	14.35	175	.34	.34	.01	57.
1.01	2.40	32	.01	.00	.01	0.	1.01	14.40	176	.34	.34	.01	57.
1.01	2.45	33	.01	.00	.01	0.	1.01	14.45	177	.34	.34	.01	58.
1.01	2.50	34	.01	.00	.01	0.	1.01	14.50	178	.34	.34	.00	58.
1.01	2.55	35	.01	.00	.01	0.	1.01	14.55	179	.34	.34	.00	58.
1.01	3.00	36	.01	.00	.01	0.	1.01	15.00	180	.34	.34	.00	58.
1.01	3.05	37	.01	.00	.01	0.	1.01	15.05	181	.21	.21	.00	56.
1.01	3.10	38	.01	.00	.01	0.	1.01	15.10	182	.42	.41	.01	53.
1.01	3.15	39	.01	.00	.01	0.	1.01	15.15	183	.42	.41	.00	56.
1.01	3.20	40	.01	.00	.01	0.	1.01	15.20	184	.63	.62	.01	65.
1.01	3.25	41	.01	.00	.01	0.	1.01	15.25	185	.73	.72	.01	80.
1.01	3.30	42	.01	.00	.01	0.	1.01	15.30	186	1.78	1.76	.02	113.
1.01	3.35	43	.01	.00	.01	0.	1.01	15.35	187	2.93	2.91	.02	191.
1.01	3.40	44	.01	.00	.01	0.	1.01	15.40	188	1.15	1.14	.01	273.

PLATE D-37

Data Documentation



1.01	11.10	134	.07	.07	.01	11.	1.01	23.10	278	.02	.02	.00	3.
1.01	11.15	135	.07	.07	.01	11.	1.01	23.15	279	.02	.02	.00	3.
1.01	11.20	136	.07	.07	.01	11.	1.01	23.20	280	.02	.02	.00	3.
1.01	11.25	137	.07	.07	.01	11.	1.01	23.25	281	.02	.02	.00	3.
1.01	11.30	138	.07	.07	.01	11.	1.01	23.30	282	.02	.02	.00	3.
1.01	11.35	139	.07	.07	.01	11.	1.01	23.35	283	.02	.02	.00	3.
1.01	11.40	140	.07	.07	.01	11.	1.01	23.40	284	.02	.02	.00	3.
1.01	11.45	141	.07	.07	.01	11.	1.01	23.45	285	.02	.02	.00	3.
1.01	11.50	142	.07	.07	.01	11.	1.01	23.50	286	.02	.02	.00	3.
1.01	11.55	143	.07	.07	.01	11.	1.01	23.55	287	.02	.02	.00	3.
1.01	12.00	144	.07	.07	.01	11.	1.02	0.00	288	.02	.02	.00	3.
									SUM	55.10	32.70	2.34	9545.
										(892.1)	(830.5)	(60.1)	(157.0)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	273.	64.	19.	19.	5563.
CMS	8.	2.	1.	1.	158.
INCHES		26.87	32.70	32.70	32.70
MM		682.42	830.58	830.58	830.58
AC-FT		32.	38.	38.	38.
THOUS CU M		39.	47.	47.	47.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	14.	3.	1.	1.	278.
CMS	0.	0.	0.	0.	8.
INCHES		1.34	1.63	1.63	1.63
MM		34.12	41.53	41.53	41.53
AC-FT		2.	2.	2.	2.
THOUS CU M		2.	2.	2.	2.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	21.	5.	1.	1.	418.
CMS	1.	0.	0.	0.	12.
INCHES		2.02	2.45	2.45	2.45
MM		51.18	62.29	62.29	62.29
AC-FT		2.	3.	3.	3.
THOUS CU M		3.	4.	4.	4.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	27.	6.	2.	2.	557.
CMS	1.	0.	0.	0.	16.
INCHES		2.69	3.27	3.27	3.27
MM		68.24	83.06	83.06	83.06
AC-FT		3.	4.	4.	4.
THOUS CU M		4.	5.	5.	5.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	34.	8.	2.	2.	696.
CMS	1.	0.	0.	0.	20.
INCHES		3.36	4.09	4.09	4.09
MM		85.30	103.82	103.82	103.82
AC-FT		4.	5.	5.	5.
THOUS CU M		5.	6.	6.	6.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	41.	10.	3.	3.	835.
CMS	1.	0.	0.	0.	24.
INCHES		4.03	4.90	4.90	4.90
MM		102.36	124.59	124.59	124.59
AC-FT		5.	6.	6.	6.
THOUS CU M		6.	7.	7.	7.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	55.	13.	4.	4.	1114.
CMS	2.	0.	0.	0.	32.
INCHES		5.57	6.54	6.54	6.54
MM		146.48	166.12	166.12	166.12
AC-FT		6.	8.	8.	8.
THOUS CU M		8.	9.	9.	9.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	68.	16.	5.	5.	1392.
CMS	2.	0.	0.	0.	39.
INCHES		6.72	8.17	8.17	8.17
MM		170.61	207.64	207.64	207.64
AC-FT		8.	10.	10.	10.
THOUS CU M		10.	12.	12.	12.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	137.	32.	10.	10.	2784.
CMS	4.	1.	0.	0.	79.
INCHES		13.43	16.35	16.35	16.35
MM		341.21	415.29	415.29	415.29
AC-FT		16.	19.	19.	19.
THOUS CU M		19.	24.	24.	24.

HYDROGRAPH AT STA0000003 FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	273.	64.	19.	19.	5568.
CMS	8.	2.	1.	1.	158.
INCHES		26.87	32.70	32.70	32.70
MM		682.42	830.58	830.58	830.58
AC-FT		32.	38.	38.	38.
THOUS CU M		39.	47.	47.	47.

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COMBINE HYDROGRAPHS

COMBINED INFLOW HYDROGRAPH TO LAKE TANGLEWOOD SOUTH DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
M 2+3	2	0	0	2	0	1	0	0

SUM OF 2 HYDROGRAPHS AT M 2+3 PLAN 1 RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18.	8.	3.	3.	890.
CMS	1.	0.	0.	0.	25.
INCHES		.84	1.25	1.25	1.25
MM		21.45	31.75	31.75	31.75
AC-FT		4.	6.	6.	6.
THOUS CU M		5.	8.	8.	8.

OVN

SUM OF 2 HYDROGRAPHS AT M 2+3 PLAN 1 RTIO 5 0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	238.	50.	13.	13.	3865.
CMS	7.	1.	0.	0.	109.
INCHES		5.04	5.43	5.43	5.43
MM		127.96	137.85	137.85	137.85
AC-FT		25.	27.	27.	27.
THOUS CU M		30.	33.	33.	33.

PLATE D-41

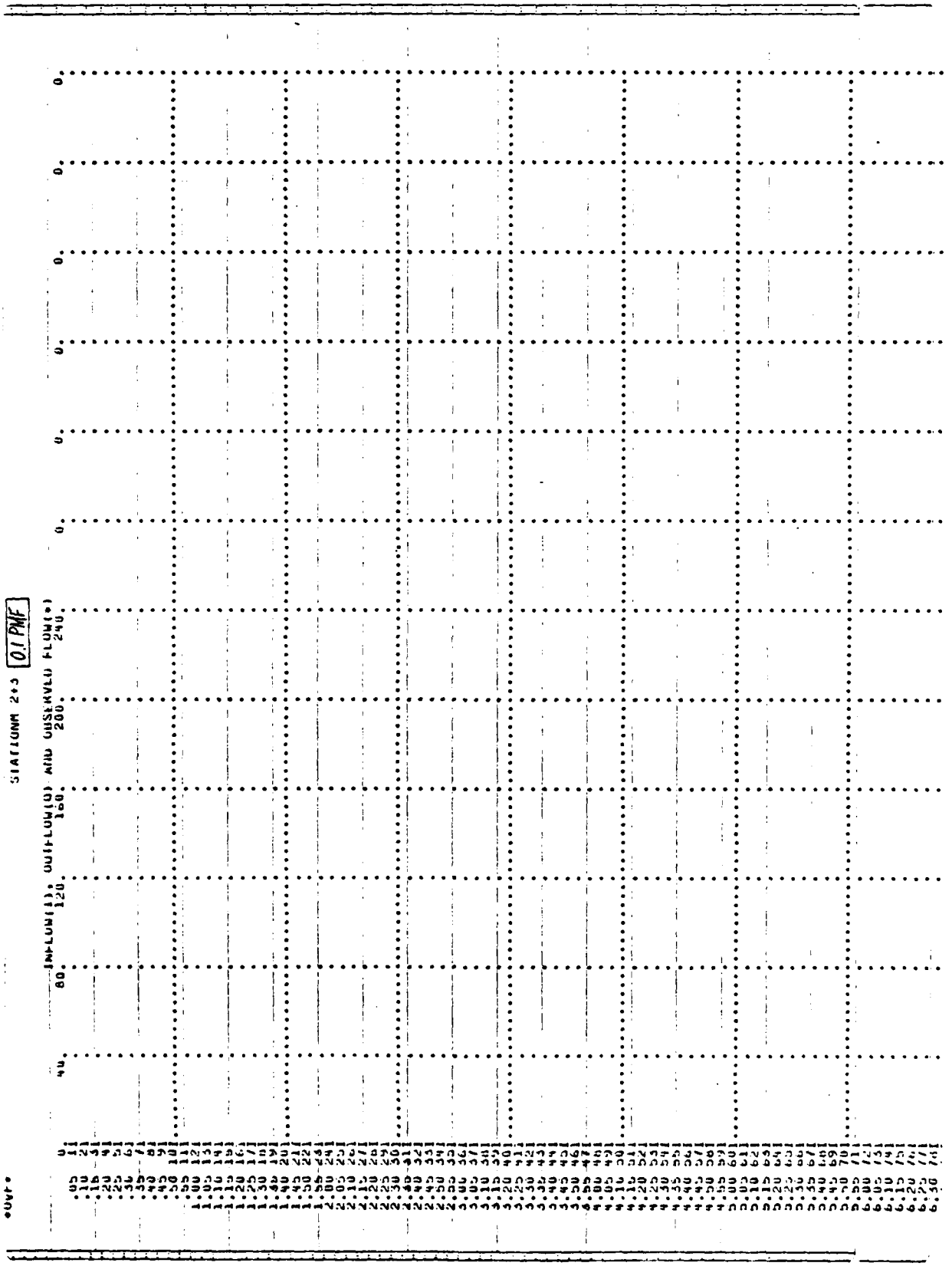

STATION 2+3 0.1 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(+)
0.
40.
80.
120.
160.
200.
240.

PLATE D-42

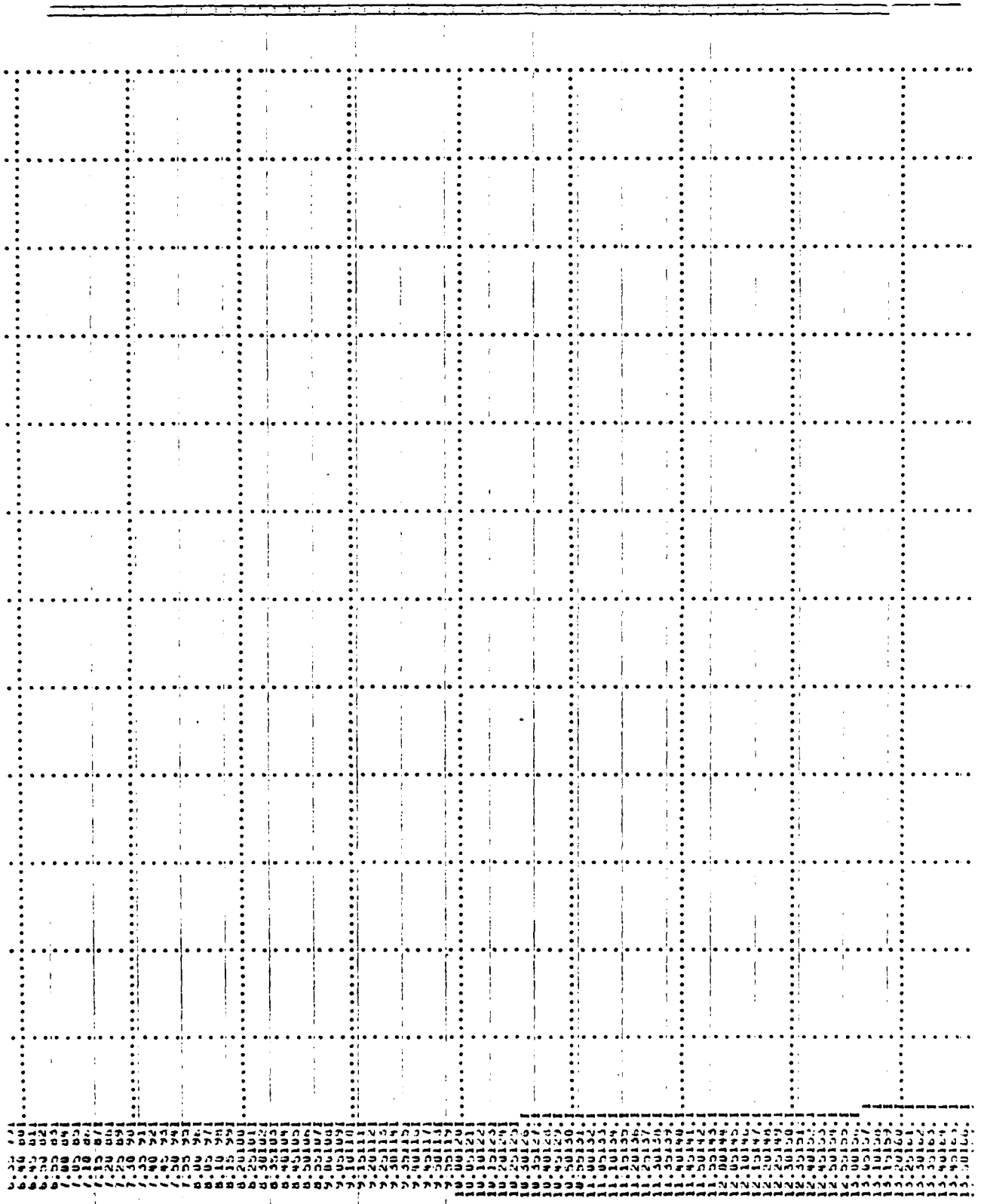


PLATE D-43

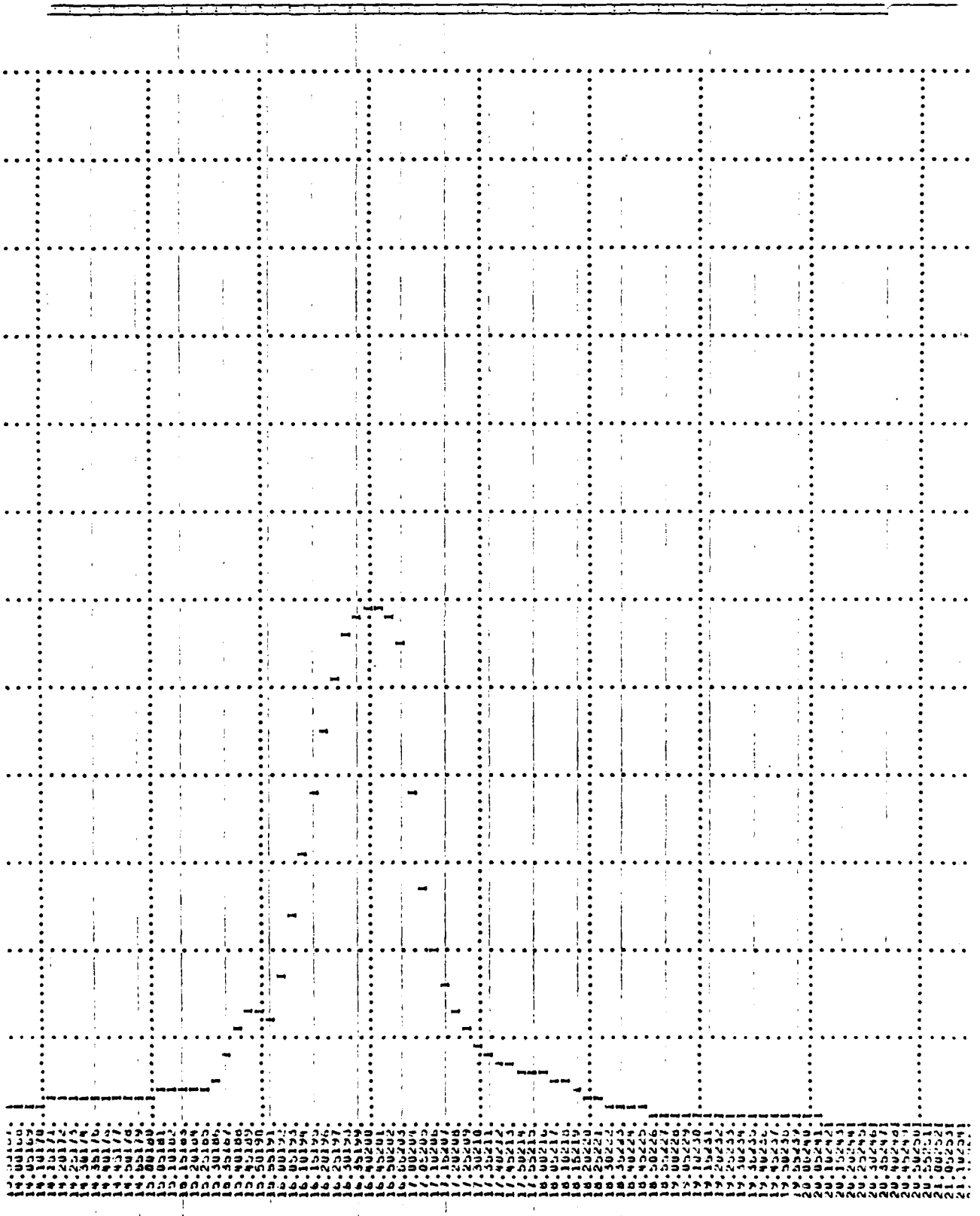
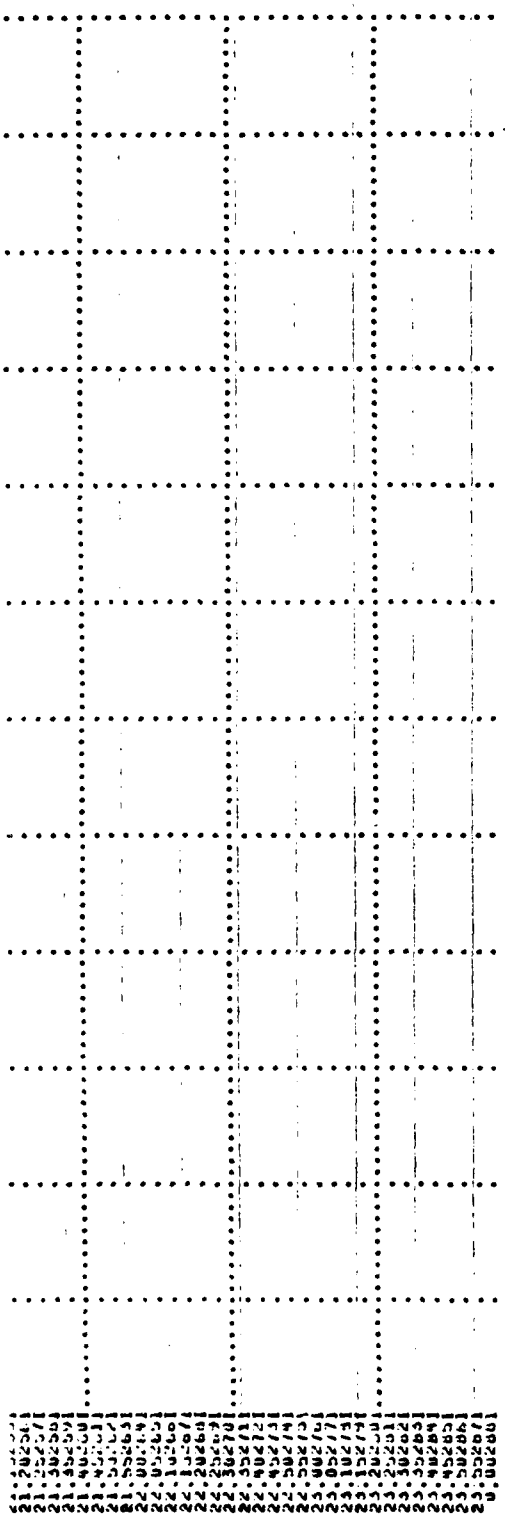


PLATE D-44



SUM OF 2 HYDROGRAPHS AT M 2+3 PLAN 1 RTIO 8 .05 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	450.	160.	45.	45.	12965.
CMS	13.	5.	1.	1.	367.
INCHES		16.17	18.21	18.21	18.21
MM		410.83	462.47	462.47	462.47
AC-FT		79.	89.	89.	89.
THOUS CU M		98.	110.	110.	110.

Data Documents, Inc. 12

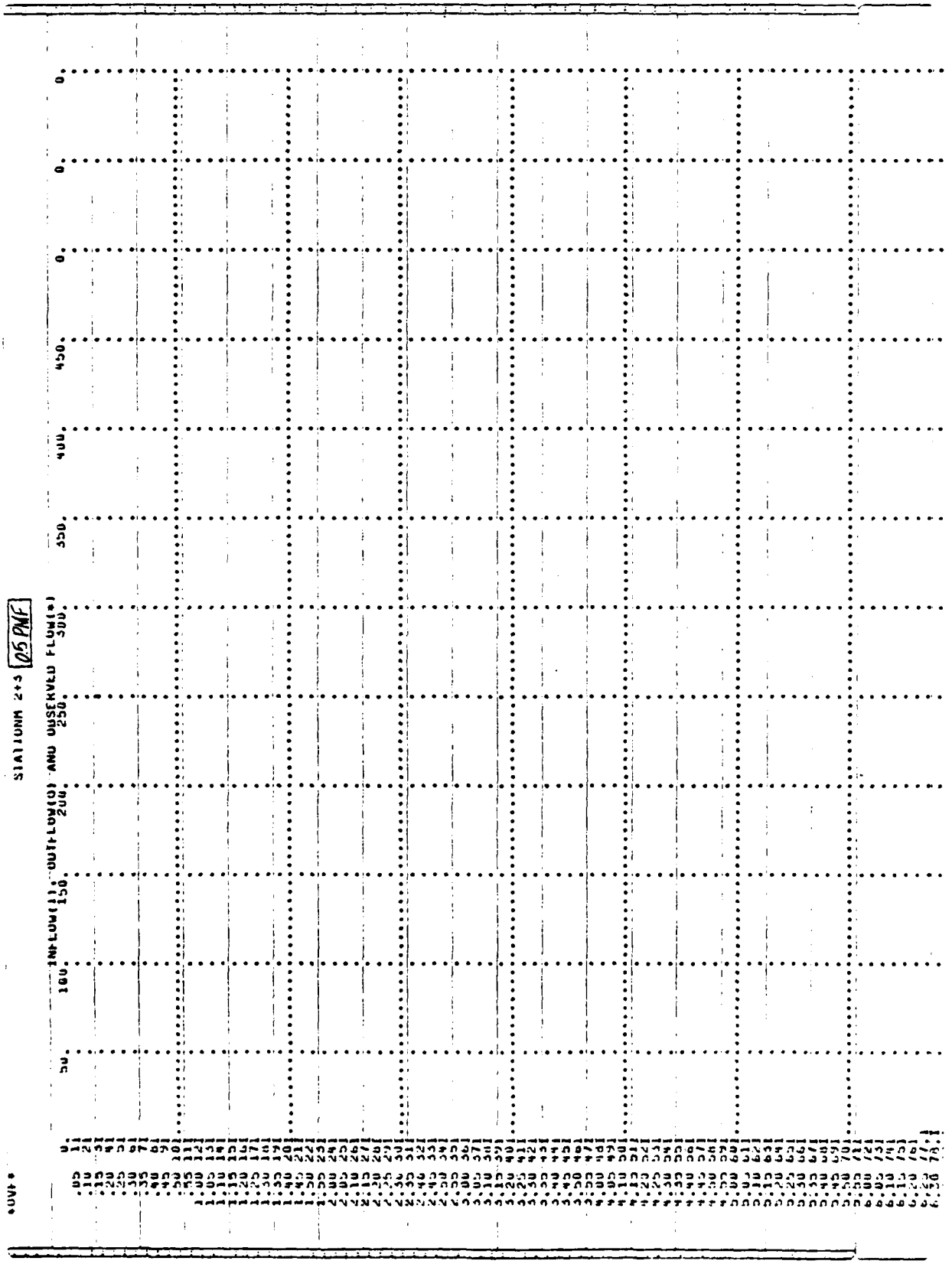

STATION 2+5 05 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
50.
100.
150.
200.
250.
300.
350.
400.
450.
0.
0.

PLATE D-47

Data Documents, Inc. 32

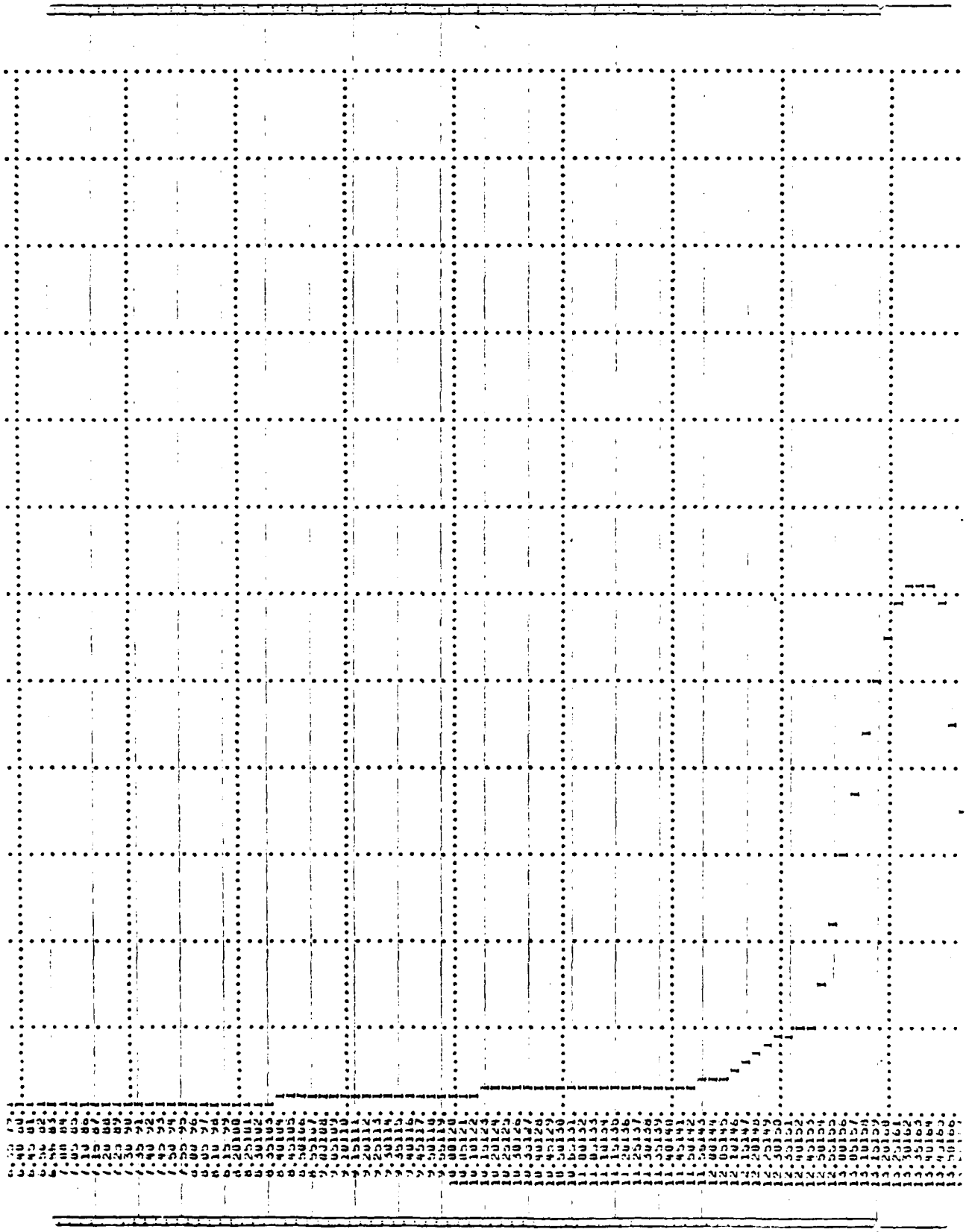


PLATE D-48

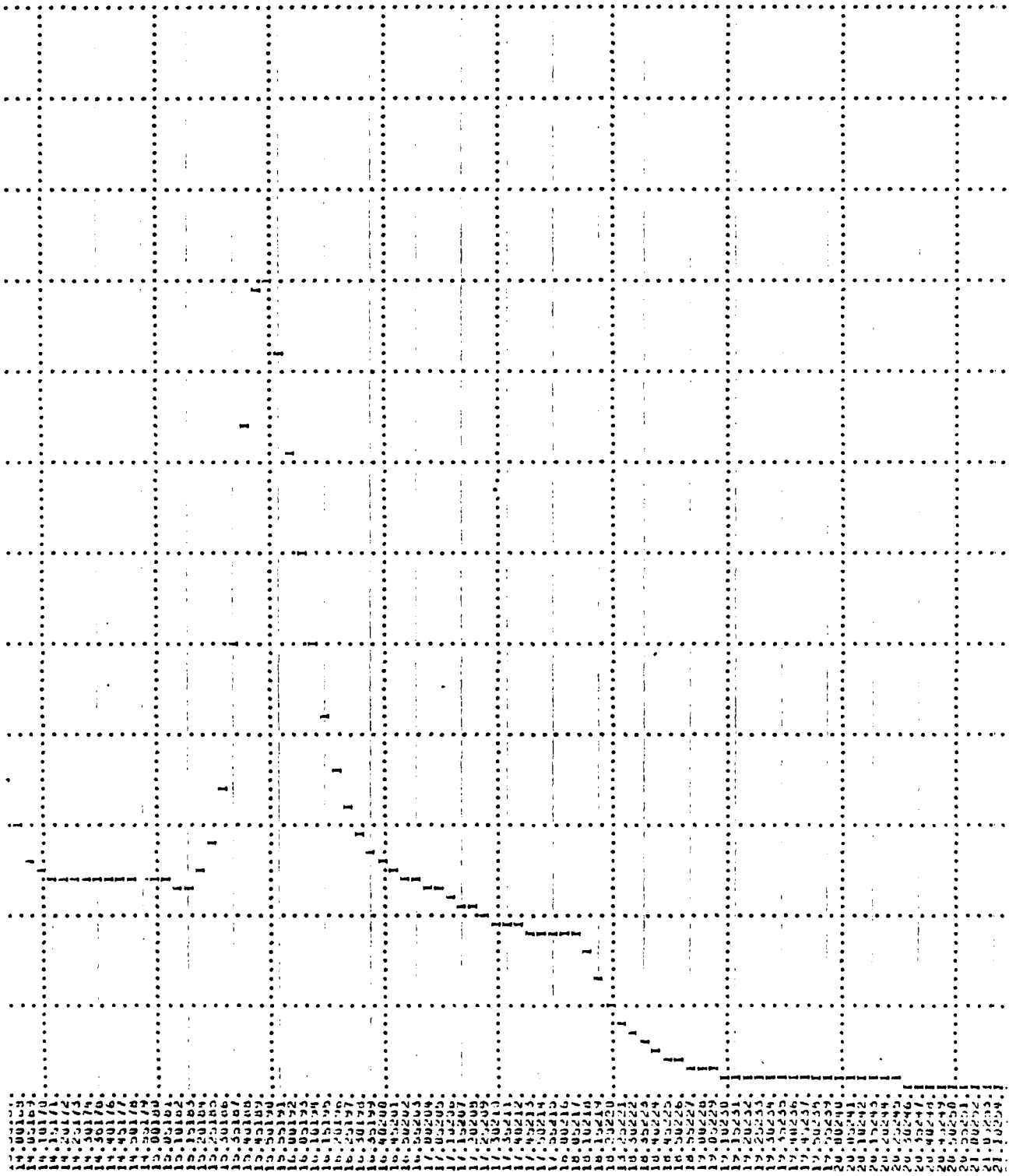


PLATE D-49

Data Documents, Inc.

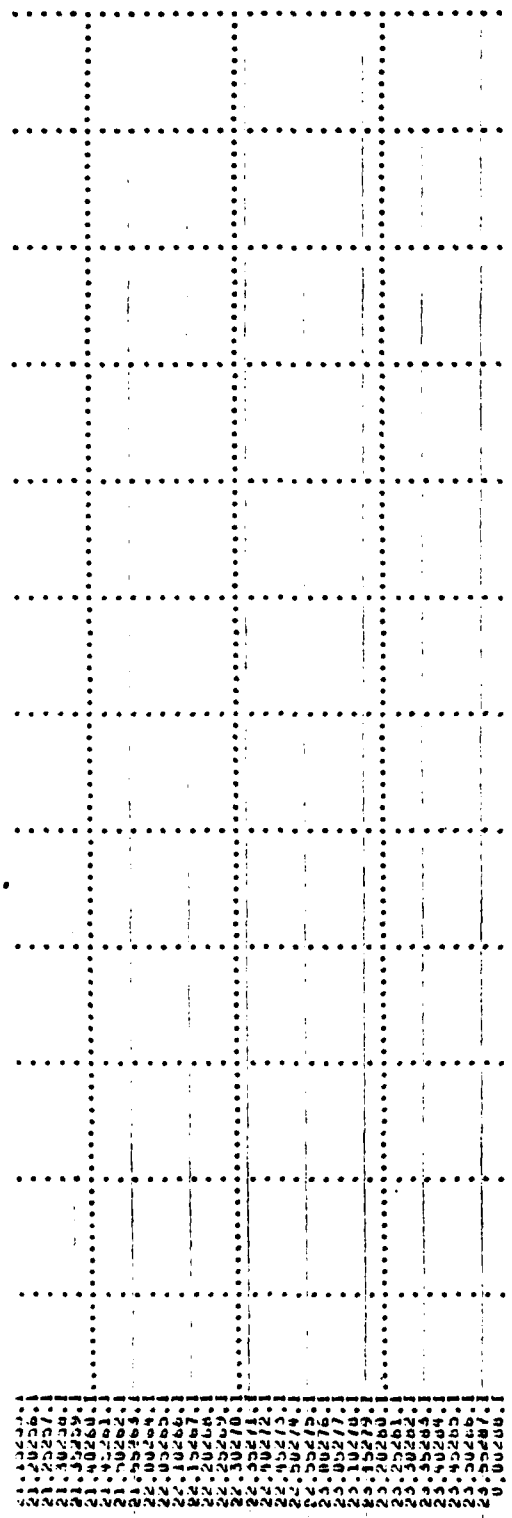


PLATE D-50

OUTPUT

SUM OF 2 HYDROGRAPHS AT A 2+3 PLAN 1 RTIO 9 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	925.	289.	85.	85.	24349.
CMS	26.	8.	2.	2.	689.
INCHES		29.27	34.19	34.19	34.19
MM		743.47	868.54	868.54	868.54
AC-FT		144.	168.	168.	168.
THOUS CU M		177.	207.	207.	207.

PLATE D-51

STATION 2+3
PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
0.
100.
200.
300.
400.
500.
600.
700.
800.
900.
1000.

PLATE D-52

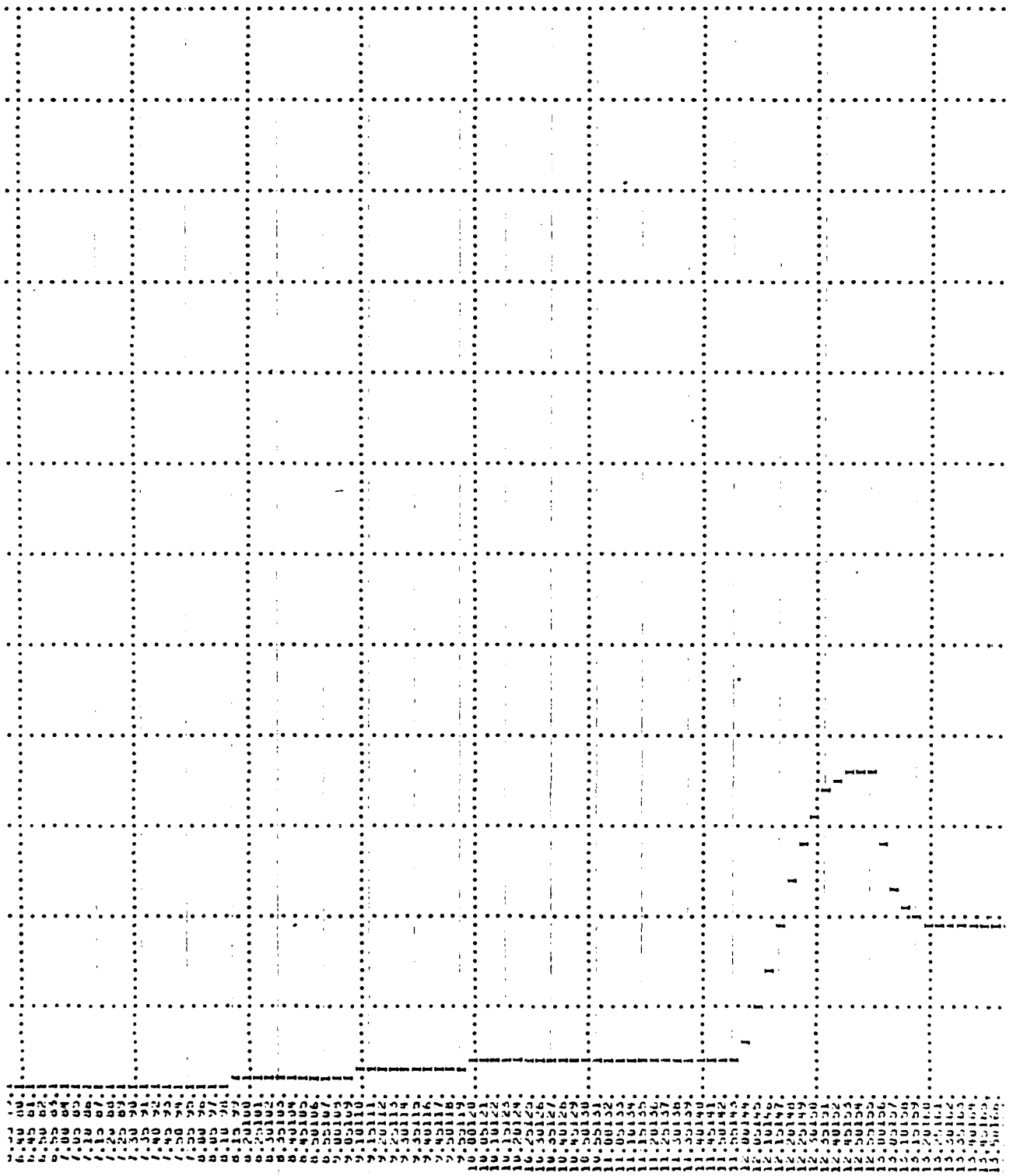


PLATE D-53

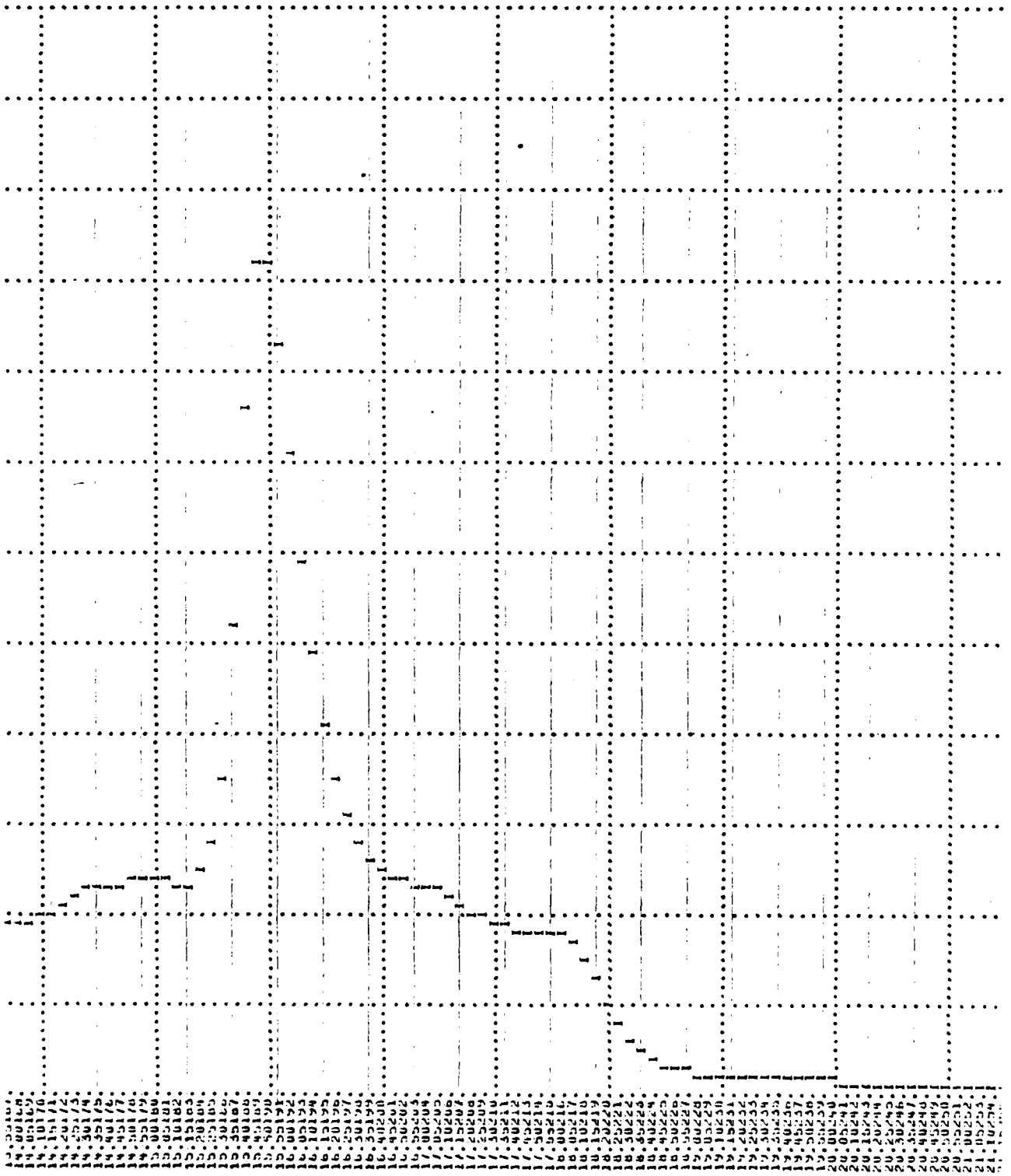


PLATE D-54

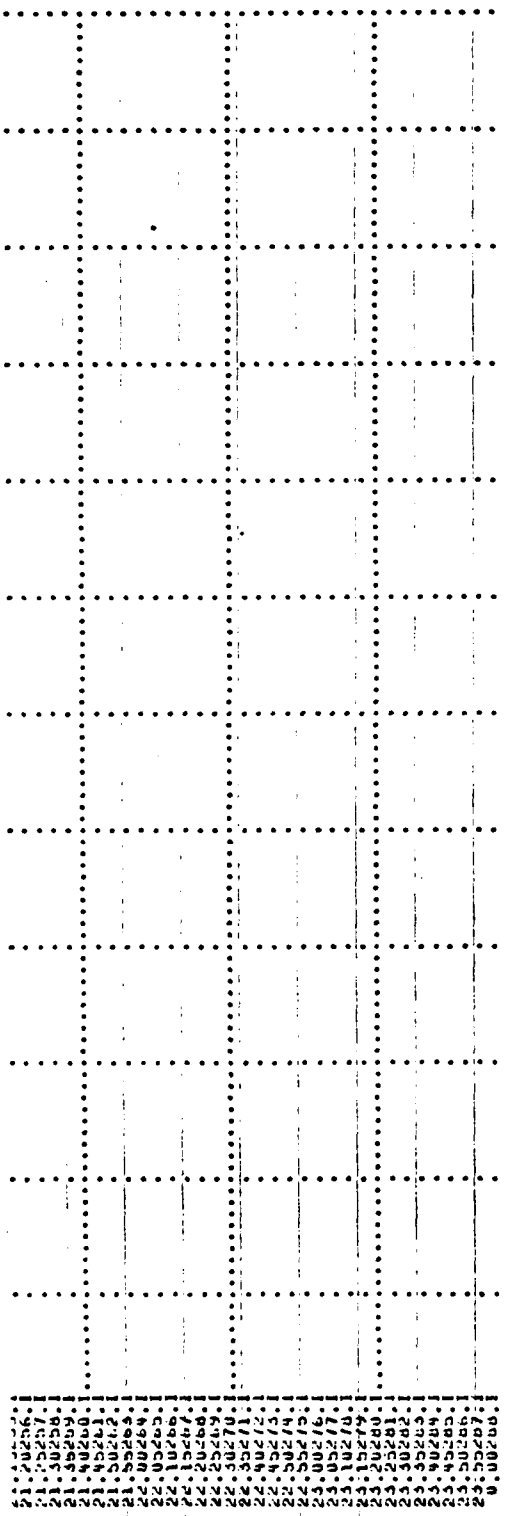


PLATE D-55

OVN

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

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH LAKE TANGLEWOOD SOUTH DAM-MO 31224

ISTAO	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	-468.	-1

STAGE	460.00	469.00	470.00	471.00	472.00	473.00	473.50	474.00	475.00	476.00
	477.00									
FLOW	0.00	4.00	12.00	19.00	23.00	163.00	369.00	630.00	1334.00	2263.00
	3353.00									
SURFACE AREA=	0.	0.	1.	2.	3.					
CAPACITY=	0.	0.	5.	16.	21.					
ELEVATION=	445.	450.	460.	468.	470.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
486.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
472.9	2.9	1.5	275.

CREST LENGTH	4.	38.	240.	266.	286.	322.	334.
AT OR BELOW ELEVATION	472.9	473.0	473.4	474.0	475.0	476.0	477.0

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 474.00

STATION 000004, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DAM

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

STATION 000004, PLAN 1, RATIO 5 [0.10 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

468.1	468.1	468.1	468.1	468.1	468.1	468.1	468.1	468.1	468.1
468.1	468.1	468.2	468.2	468.2	468.2	468.2	468.2	468.2	468.2
468.2	468.2	468.2	468.2	468.2	468.2	468.2	468.2	468.2	468.2
468.2	468.2	468.2	468.2	468.2	468.2	468.3	468.3	468.3	468.3
468.3	468.3	468.3	468.3	468.3	468.4	468.4	468.4	468.4	468.4
468.4	468.4	468.5	468.5	468.5	468.5	468.5	468.5	468.6	468.6
468.6	468.8	468.6	468.7	468.7	468.7	468.7	468.8	468.8	468.8
468.9	468.9	468.9	468.9	469.0	469.0	469.1	469.2	469.3	469.4
469.5	469.6	469.8	470.0	470.3	470.6	470.9	471.3	471.7	472.0
472.4	472.6	472.8	472.8	472.8	472.8	472.7	472.6	472.5	472.4
472.4	472.3	472.2	472.2	472.2	472.1	472.1	472.1	472.0	472.0
472.0	472.0	472.0	471.9	471.9	471.9	471.8	471.8	471.8	471.8
471.7	471.7	471.7	471.6	471.6	471.6	471.5	471.5	471.5	471.4
471.4	471.4	471.3	471.3	471.3	471.2	471.2	471.2	471.1	471.1
471.1	471.0	471.0	471.0	470.9	470.9	470.9	470.6	470.8	470.8
470.7	470.7	470.7	470.6	470.6	470.6	470.5	470.5	470.5	470.5
470.4	470.4	470.4	470.3	470.3	470.3	470.3	470.2	470.2	470.2
470.2	470.1	470.1	470.1	470.1	470.0	470.0	470.0		

PEAK OUTFLOW IS 141. AT TIME 17.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	141.	36.	11.	11.	5097.
CMS	4.	1.	0.	0.	88.
INCHES		3.68	4.35	4.35	4.35
MM		93.39	110.47	110.47	110.47
AC-FT		18.	21.	21.	21.
THOUS CU M		22.	26.	26.	26.

PLATE D-58

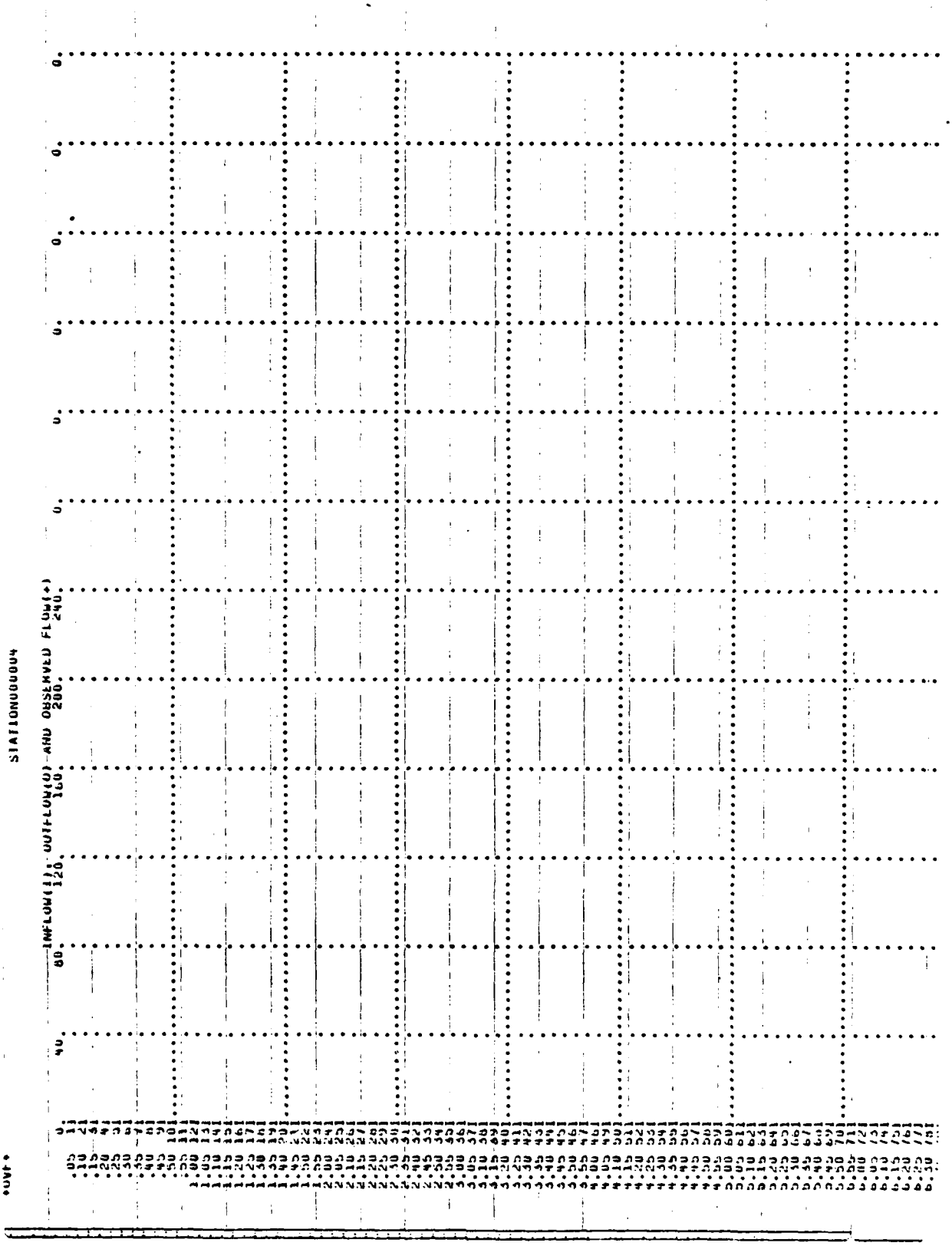

STATION00000004
INFLOW(I), OUTFLOW(O), AND OBSERVED FLOW(*)
0.
40.
80.
120.
160.
200.
240.

PLATE D-59

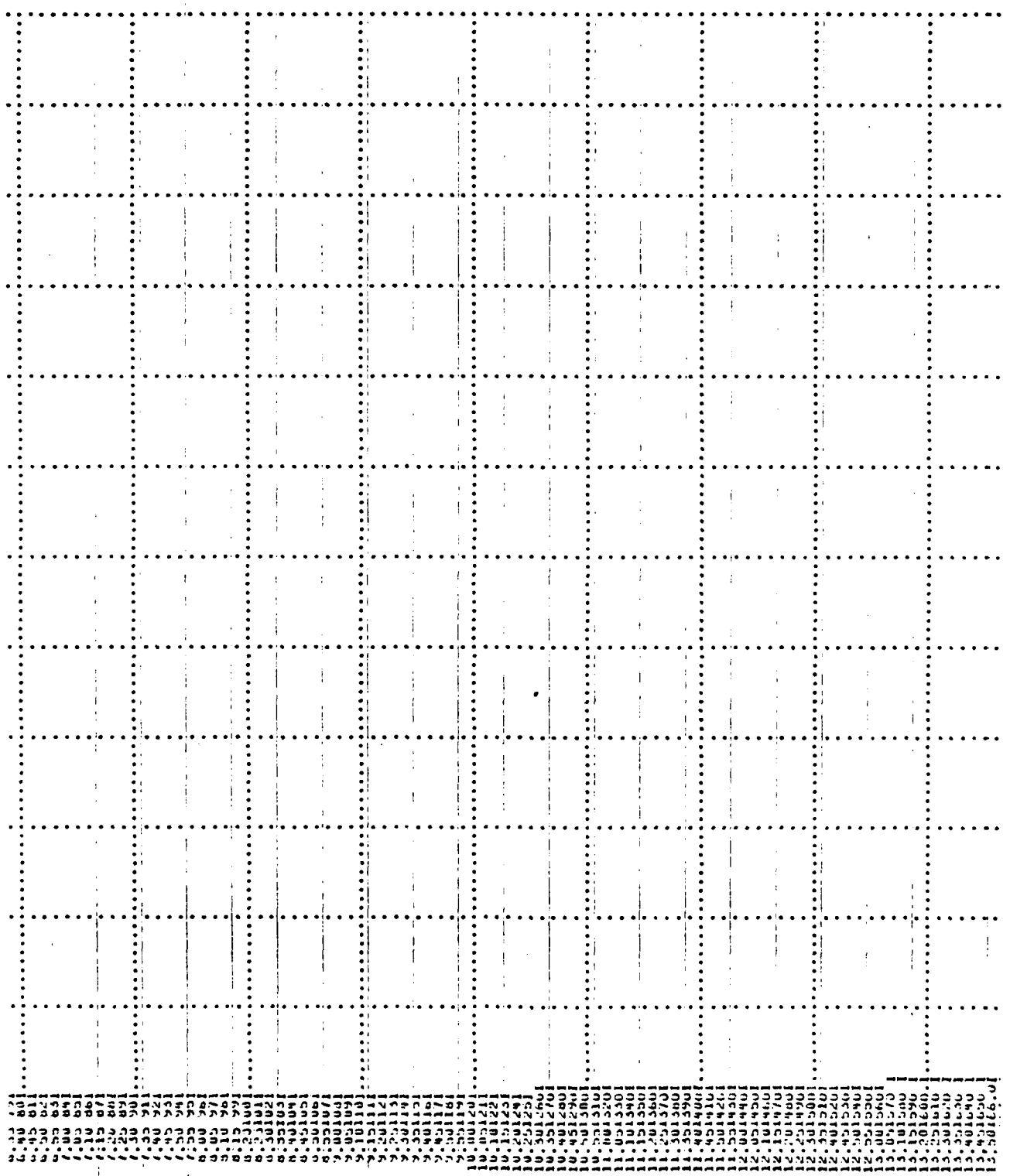


PLATE D-60

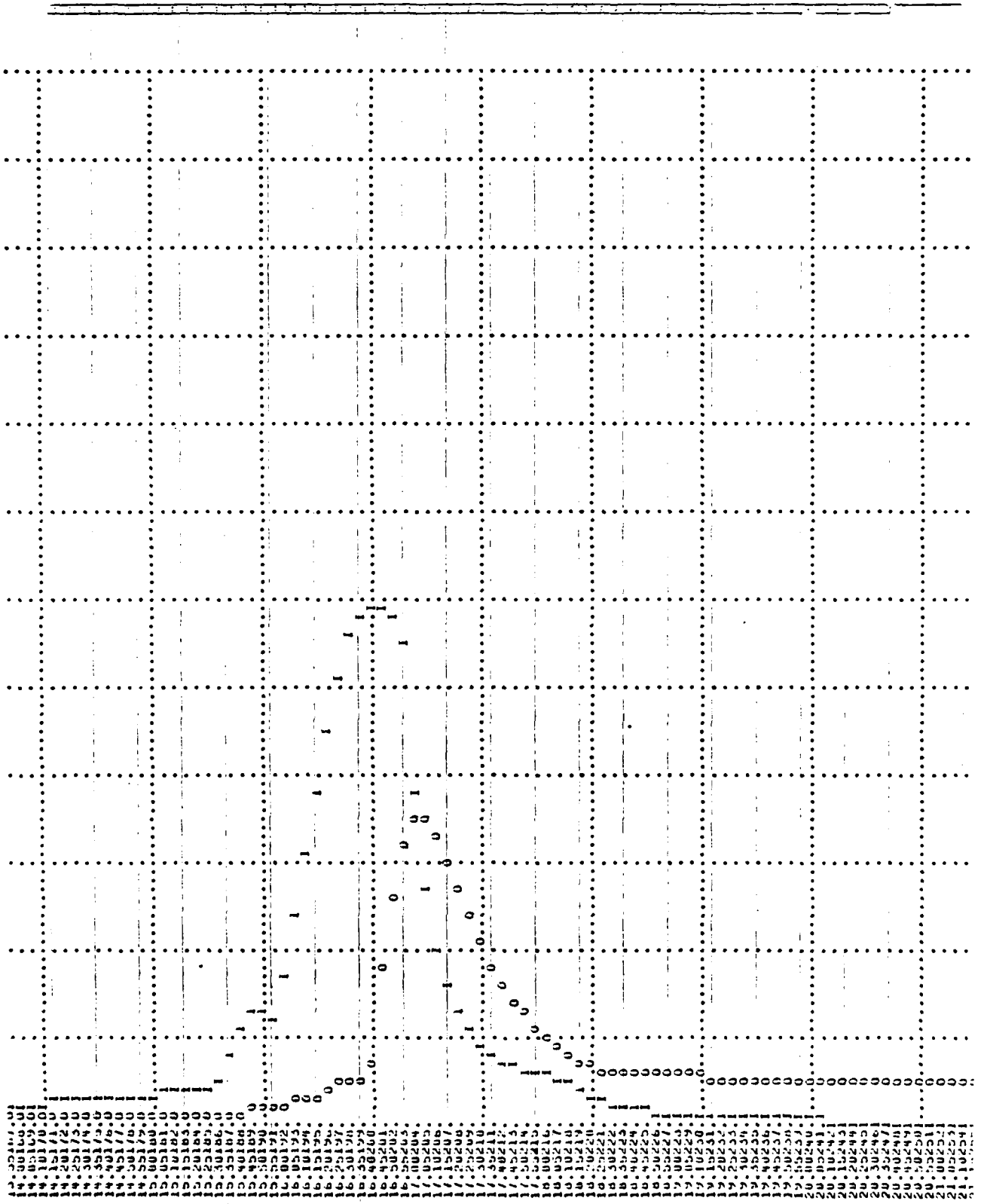


PLATE D-61

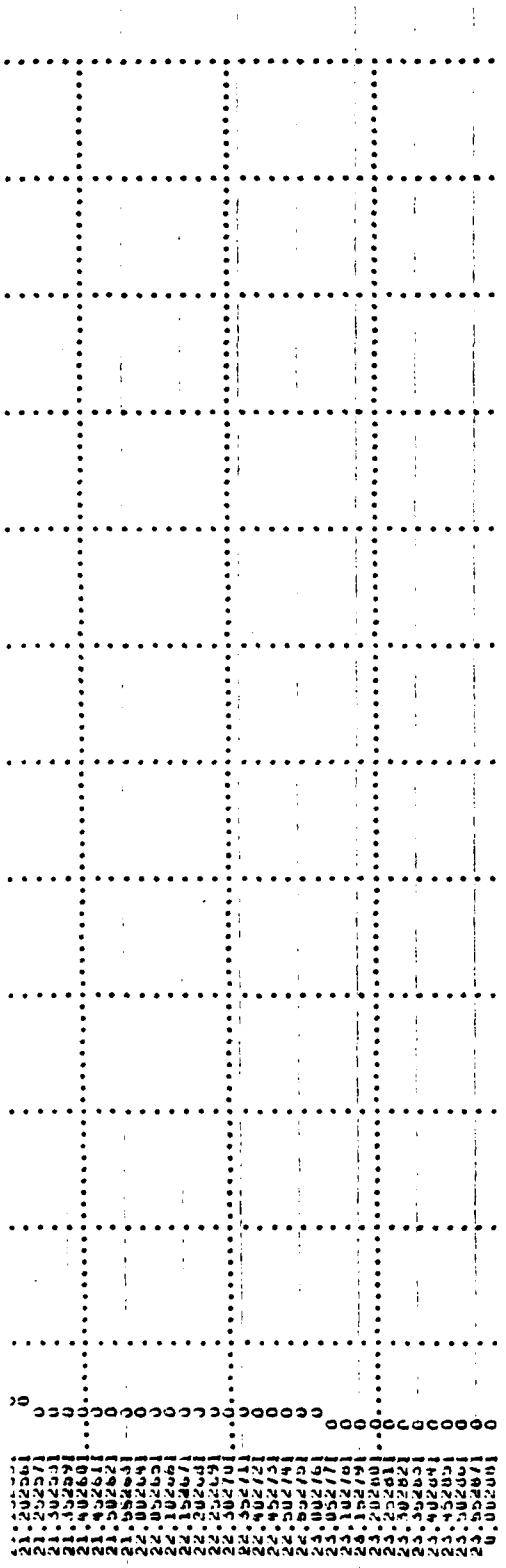


PLATE D-62

DVN

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

STATION 000004, PLAN 1, RATIO 3 [0.5 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.	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.	2.	2.	2.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	4.	4.	4.	4.	4.
4.	4.	4.	5.	5.	5.	5.	6.	6.	6.
6.	6.	7.	7.	7.	7.	8.	8.	9.	9.
10.	11.	11.	12.	14.	15.	17.	20.	21.	23.
72.	118.	155.	225.	270.	264.	225.	190.	165.	156.
149.	145.	138.	134.	131.	129.	127.	125.	124.	123.
122.	121.	120.	120.	122.	128.	146.	202.	330.	417.
427.	392.	343.	295.	254.	220.	193.	173.	161.	155.
149.	144.	139.	135.	131.	128.	124.	121.	117.	113.
110.	107.	104.	102.	100.	98.	96.	94.	89.	83.
76.	68.	60.	53.	47.	41.	36.	31.	28.	24.
23.	23.	23.	23.	23.	23.	22.	22.	22.	22.
22.	22.	22.	22.	22.	22.	21.	21.	21.	21.
21.	21.	21.	21.	21.	21.	20.	20.	20.	20.
20.	20.	20.	20.	20.	20.	19.	19.	19.	19.
19.	19.	19.	19.	19.	18.	18.	18.	18.	18.
18.	18.	17.	17.	17.	17.	17.	17.		

STORAGE

16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	19.
19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
19.	19.	20.	20.	20.	20.	20.	20.	20.	20.
21.	21.	21.	22.	22.	23.	24.	25.	27.	28.
30.	31.	33.	33.	34.	34.	33.	33.	33.	33.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	31.	32.	32.	32.	33.	34.	35.
35.	35.	34.	34.	34.	33.	33.	33.	33.	33.
32.	32.	32.	32.	32.	32.	32.	32.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	30.
30.	30.	30.	29.	29.	29.	29.	29.	29.	29.
29.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	27.	27.	27.	27.	27.	27.	27.	27.
27.	27.	26.	26.	26.	26.	26.	26.	26.	26.
26.	26.	26.	26.	25.	25.	25.	25.	25.	25.
25.	25.	25.	25.	25.	25.	24.	24.	24.	24.
24.	24.	24.	24.	24.	24.	24.	24.		

STAGE

468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0

468.5	468.5	468.6	468.6	468.6	468.6	468.6	468.6	468.7	468.7	468.7
468.7	468.8	468.8	468.8	468.8	468.9	468.9	468.9	468.9	468.9	469.0
469.0	469.0	469.1	469.1	469.1	469.1	469.2	469.2	469.2	469.2	469.2
469.4	469.4	469.5	469.4	469.4	469.4	469.5	469.5	469.6	469.6	469.7
469.7	469.8	469.9	470.0	470.2	470.5	470.8	471.1	471.5	471.5	472.0
472.4	472.7	472.9	473.1	473.2	473.2	473.1	473.1	473.0	473.0	472.9
472.9	472.9	472.8	472.8	472.8	472.8	472.7	472.7	472.7	472.7	472.7
472.7	472.7	472.7	472.7	472.7	472.8	472.9	473.1	473.4	473.4	473.4
473.4	473.4	473.3	473.2	473.2	473.1	473.1	473.0	473.0	473.0	472.9
472.9	472.9	472.8	472.8	472.8	472.7	472.7	472.7	472.7	472.7	472.6
472.6	472.6	472.6	472.6	472.5	472.5	472.5	472.5	472.5	472.5	472.4
472.4	472.3	472.3	472.2	472.2	472.1	472.1	472.1	472.0	472.0	472.0
472.0	472.0	471.9	471.9	471.9	471.9	471.9	471.8	471.8	471.8	471.8
471.8	471.7	471.7	471.7	471.7	471.6	471.6	471.6	471.6	471.6	471.5
471.5	471.5	471.5	471.4	471.4	471.4	471.4	471.3	471.3	471.3	471.3
471.3	471.2	471.2	471.2	471.2	471.1	471.1	471.1	471.1	471.1	471.1
471.0	471.0	471.0	471.0	470.9	470.9	470.9	470.9	470.9	470.9	470.8
470.8	470.8	470.8	470.7	470.7	470.7	470.7	470.7			

PEAK OUTFLOW IS 427. AT TIME 15.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	427.	149.	41.	41.	11885.
CMS	12.	4.	1.	1.	337.
INCHES		14.60	16.69	16.69	16.69
MM		370.95	423.92	423.92	423.92
AC-FT		72.	82.	82.	82.
THOUS CU M		88.	101.	101.	101.

PLATE D-64

STATION 00004 0.5 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(+)
0
0
0
450.
400.
350.
300.
250.
200.
150.
100.
50.

PLATE D-65

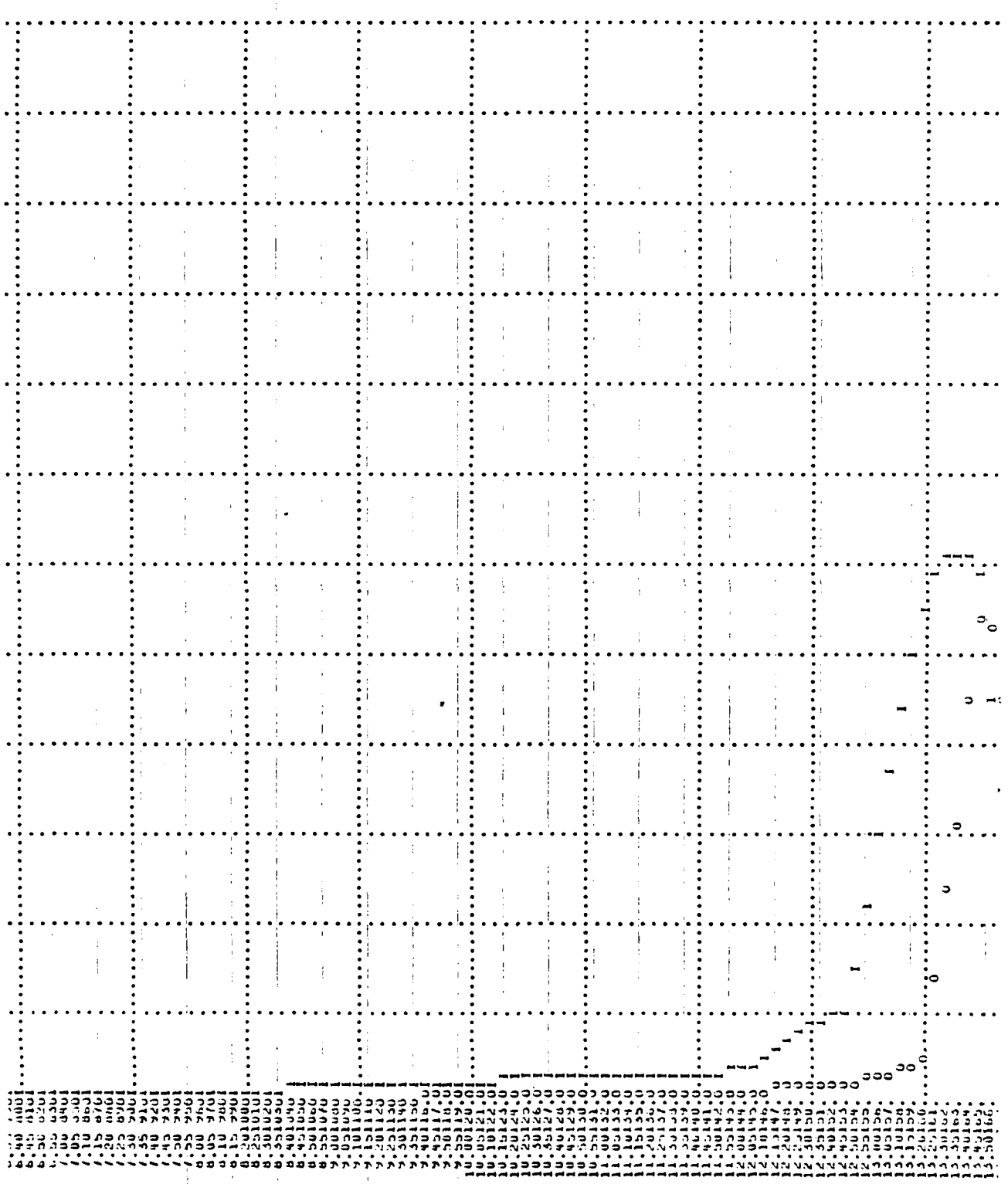


PLATE D-66

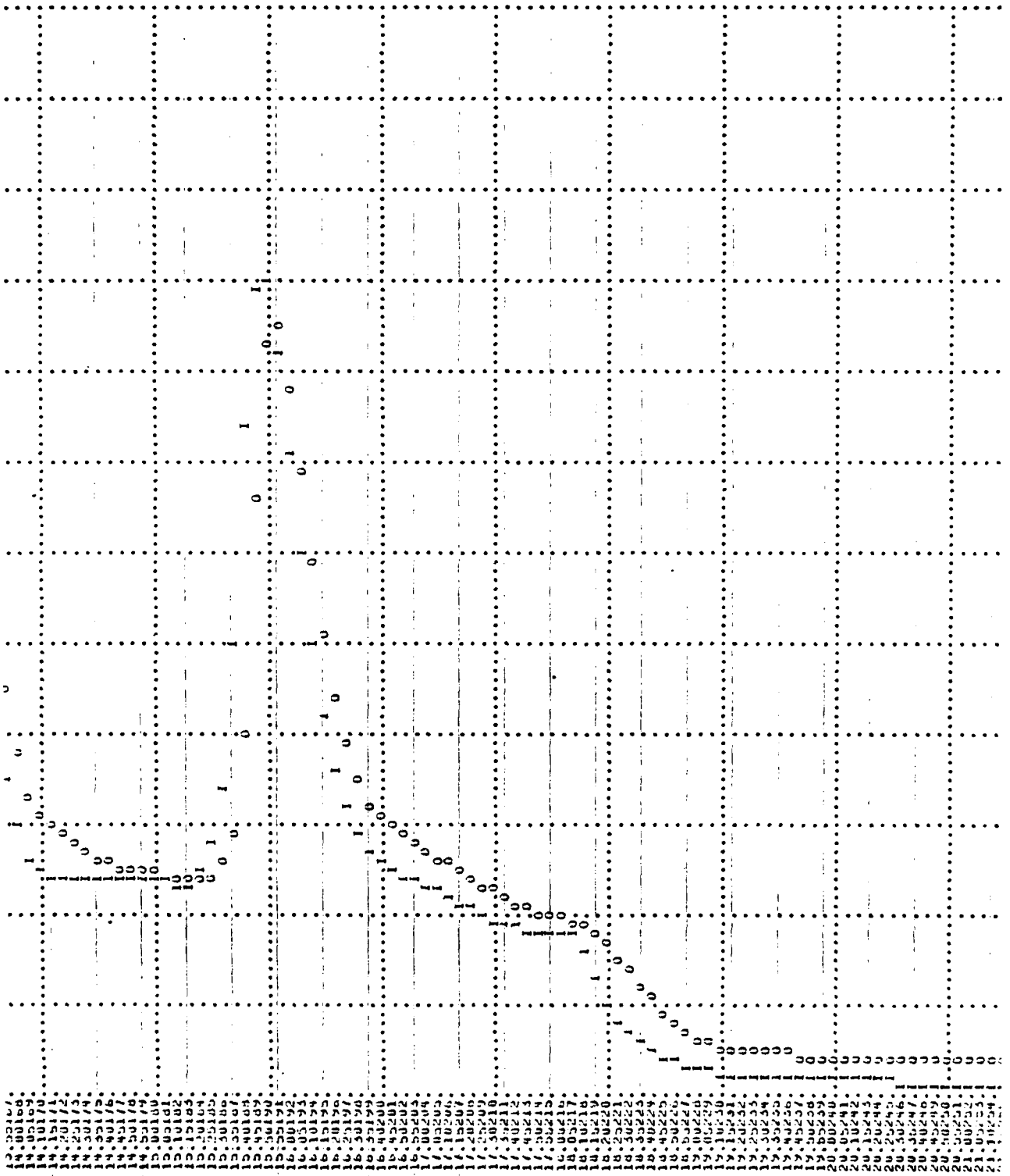


PLATE D-67

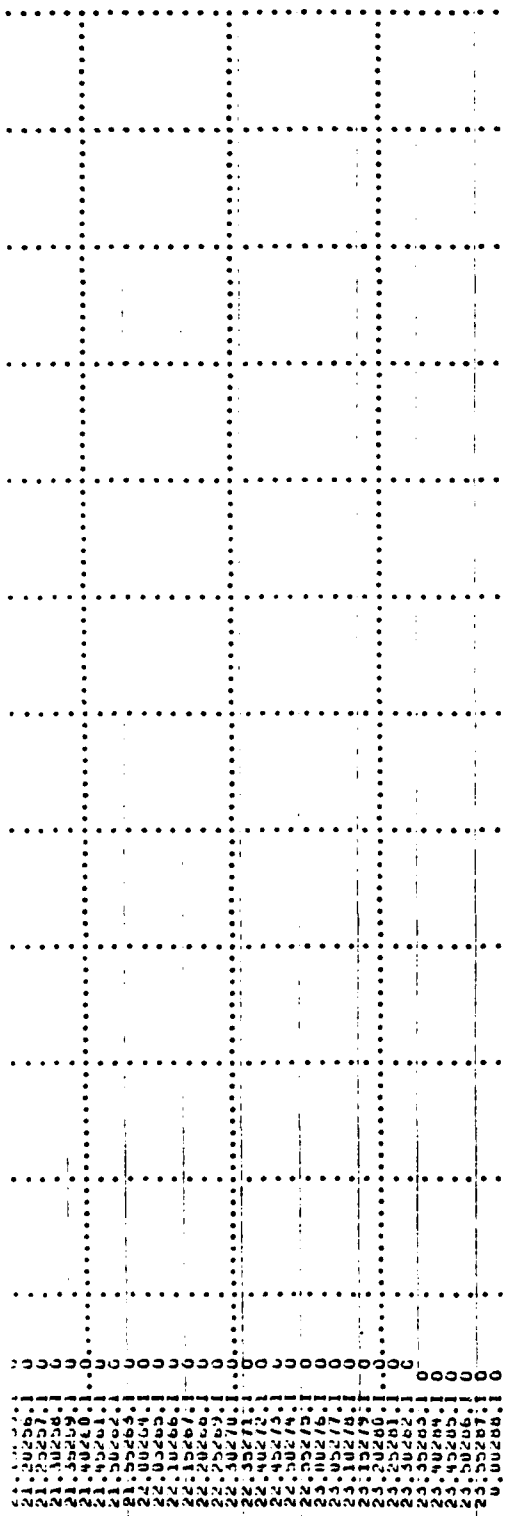


PLATE D-68

OVER

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

STATION 000004, PLAN 1, RATIO 9 [10 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.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	4.	4.	4.	4.	4.	4.	5.
5.	6.	6.	7.	7.	8.	8.	9.	9.	9.
10.	10.	11.	11.	12.	12.	13.	13.	13.	14.
14.	15.	15.	15.	16.	16.	16.	17.	17.	18.
18.	18.	19.	19.	20.	20.	21.	23.	62.	109.
152.	239.	315.	348.	356.	329.	281.	244.	220.	206.
196.	194.	190.	189.	188.	187.	187.	188.	188.	190.
195.	202.	209.	216.	222.	227.	230.	233.	235.	236.
237.	234.	232.	235.	251.	291.	394.	606.	854.	922.
879.	771.	652.	545.	461.	396.	347.	311.	285.	267.
255.	246.	240.	236.	233.	228.	222.	215.	207.	200.
195.	190.	187.	185.	183.	182.	179.	172.	161.	151.
139.	125.	111.	98.	86.	75.	65.	57.	50.	44.
37.	35.	31.	28.	26.	24.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	22.	22.	22.	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.	20.	20.	20.		

STORAGE

16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	19.	19.	19.	19.
19.	19.	20.	20.	20.	20.	20.	20.	20.	21.
21.	21.	21.	21.	21.	22.	22.	22.	22.	22.
23.	23.	23.	23.	23.	23.	24.	24.	24.	24.
24.	24.	25.	25.	25.	26.	27.	28.	30.	31.
33.	34.	34.	34.	34.	34.	34.	34.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	34.
34.	33.	33.	33.	34.	34.	35.	36.	36.	37.
37.	36.	36.	35.	35.	35.	34.	34.	34.	34.
34.	34.	34.	34.	33.	33.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	32.
32.	32.	31.	31.	30.	30.	30.	30.	29.	29.
29.	29.	29.	29.	29.	29.	29.	29.	28.	28.
28.	28.	28.	28.	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.	27.
27.	27.	27.	27.	27.	27.	27.	27.	26.	26.
26.	26.	26.	26.	26.	26.	26.	26.		

STAGE

468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
468.0	468.1	468.1	468.1	468.1	468.1	468.1	468.1	468.1	468.1
468.2	468.2	468.2	468.2	468.3	468.3	468.3	468.3	468.3	468.4
468.4	468.4	468.5	468.5	468.5	468.5	468.6	468.6	468.6	468.7

PLATE D-69

469.2	469.2	469.3	469.3	469.4	469.4	469.5	469.6	469.6	469.7
469.7	469.8	469.9	469.9	470.0	470.0	470.1	470.2	470.2	470.3
470.3	470.4	470.4	470.5	470.5	470.6	470.6	470.7	470.7	470.8
470.8	470.9	470.9	471.0	471.1	471.3	471.6	471.9	472.3	472.6
472.9	473.1	473.3	473.5	473.6	473.3	473.2	473.2	473.1	473.1
473.1	473.1	473.1	473.1	473.0	473.0	473.0	473.0	473.1	473.1
473.1	473.1	473.1	473.1	473.1	473.1	473.1	473.1	473.1	473.1
473.1	473.1	473.1	473.1	473.2	473.2	473.4	473.6	473.7	473.8
473.8	473.7	473.6	473.5	473.4	473.4	473.3	473.3	473.2	473.2
473.2	473.2	473.1	473.1	473.1	473.1	473.1	473.1	473.1	473.1
473.1	473.1	473.0	473.0	473.0	473.0	473.0	473.0	473.0	472.9
472.8	472.7	472.6	472.5	472.4	472.4	472.3	472.2	472.2	472.1
472.1	472.1	472.1	472.0	472.0	472.0	472.0	472.0	472.0	472.0
471.9	471.9	471.9	471.9	471.9	471.9	471.9	471.8	471.8	471.8
471.8	471.8	471.8	471.8	471.8	471.7	471.7	471.7	471.7	471.7
471.7	471.7	471.6	471.6	471.6	471.6	471.6	471.6	471.6	471.6
471.5	471.5	471.5	471.5	471.5	471.5	471.5	471.5	471.5	471.4
471.4	471.4	471.4	471.4	471.4	471.4	471.4	471.4		

PEAK OUTFLOW IS 922. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	922.	281.	80.	80.	22914.
CMS	26.	8.	2.	2.	649.
INCHES		28.46	32.18	32.18	32.18
MM		722.96	817.35	817.35	817.35
AC-FT		140.	158.	158.	158.
THOUS CU M		172.	195.	195.	195.

PLATE D-70

STATION00000 10 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
200.
400.
600.
800.
1000.

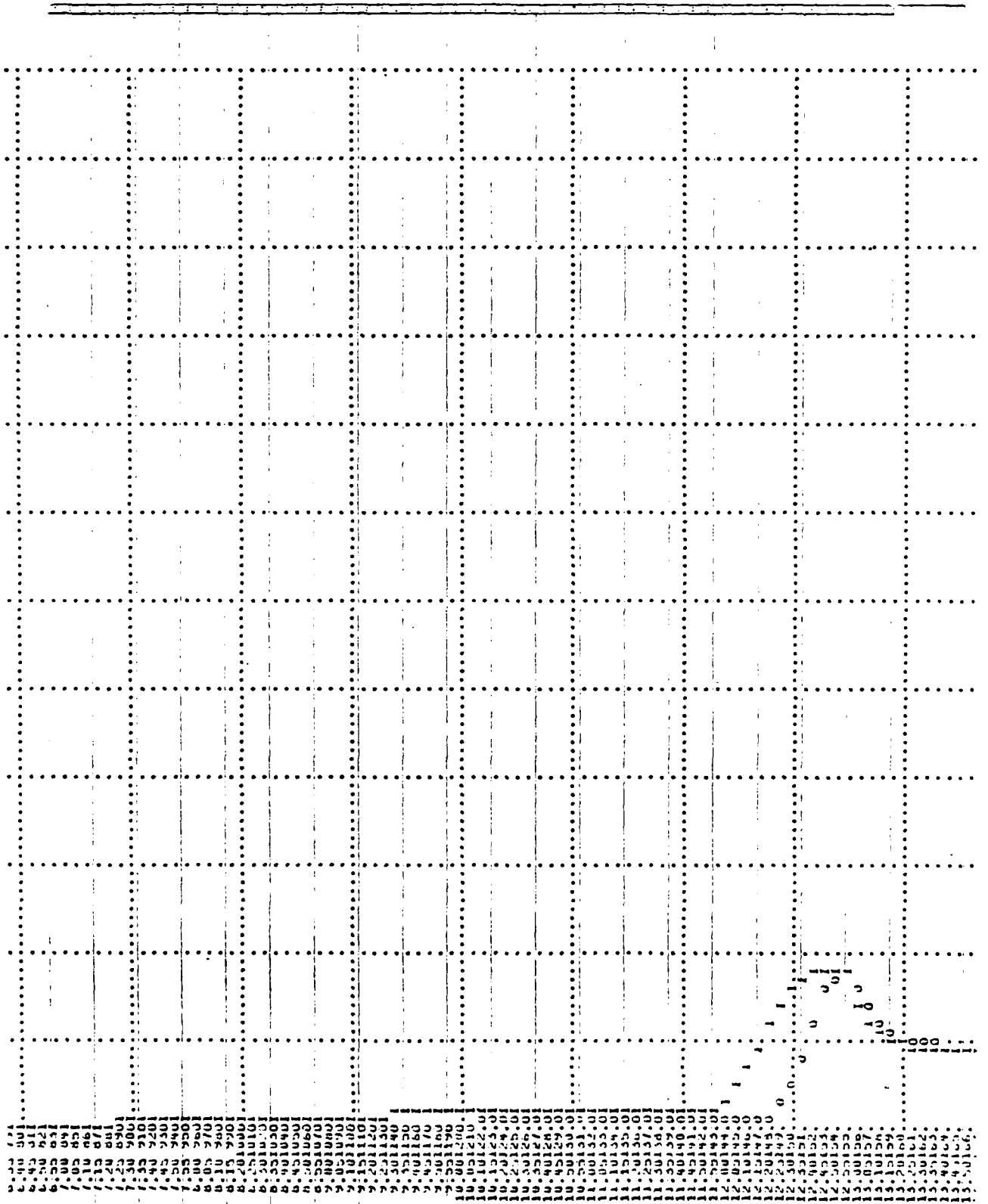


PLATE D-72

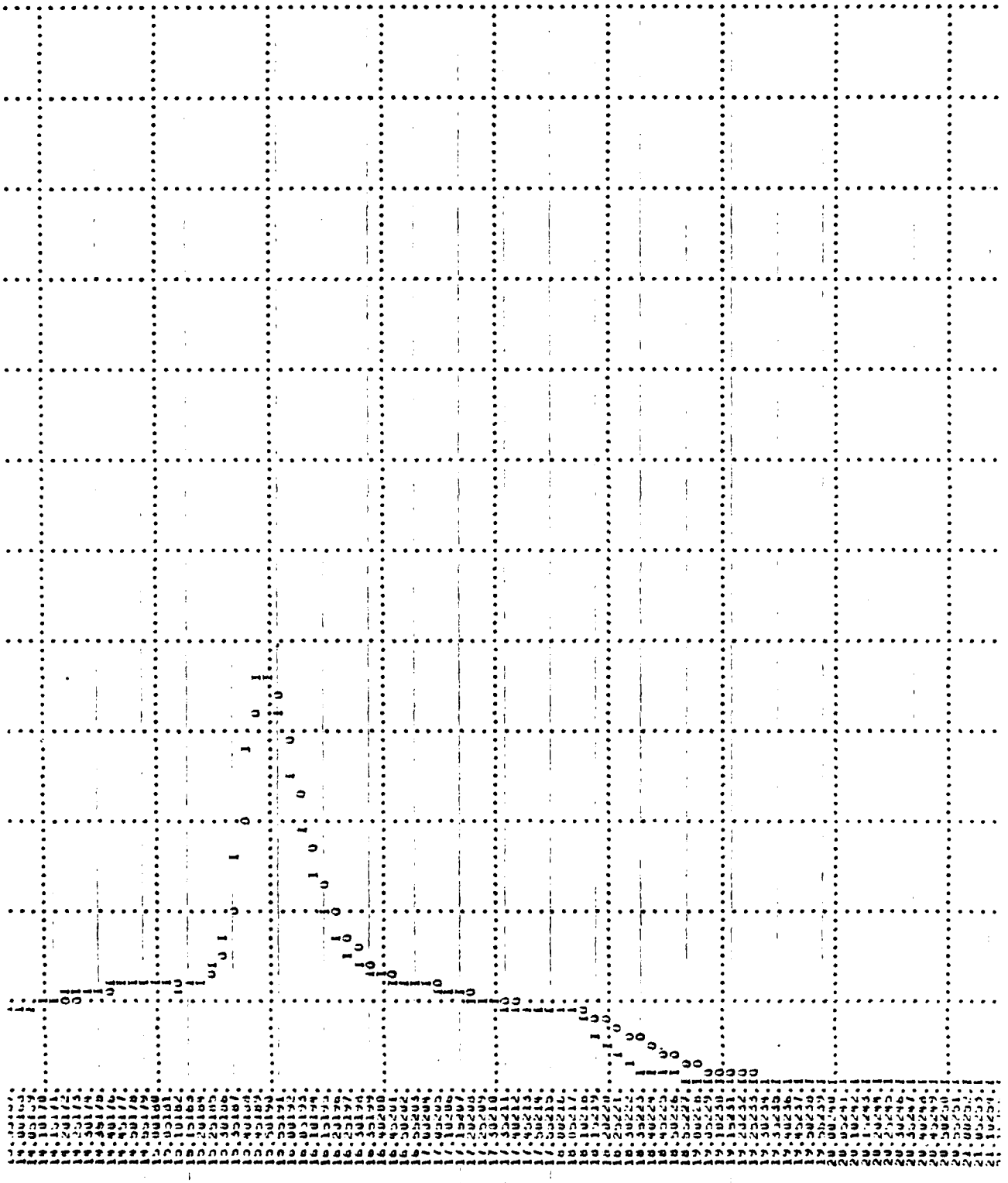


PLATE D-73

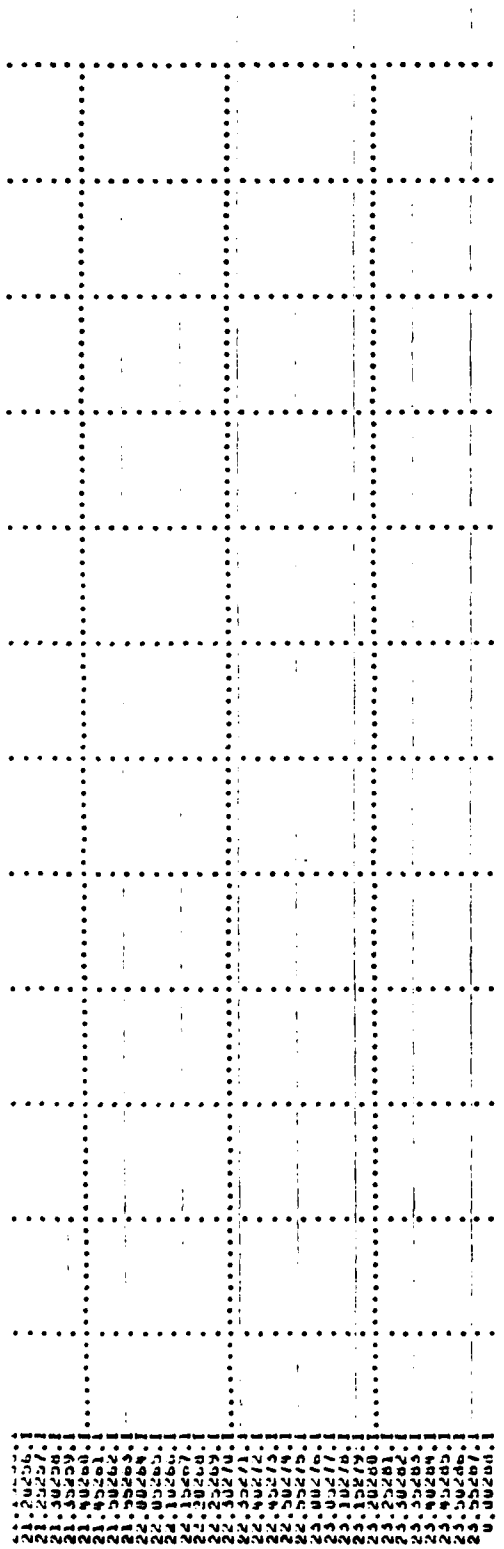


PLATE D-74

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 .08	RATIO 3 .10	RATIO 4 .13	RATIO 5 .15	RATIO 6 .20	RATIO 7 .25	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	000001	.07	1	43.	65.	86.	108.	130.	173.	216.	432.	865.
		(.18)		(1.22)(	1.84)(	2.45)(	3.06)(	3.67)(	4.90)(	6.12)(	12.24)(	24.48)
ROUTED TO	000002	.07	1	8.	20.	232.	245.	258.	314.	261.	340.	705.
		(.18)		(.24)(	.56)(	6.57)(	6.95)(	7.32)(	8.88)(	7.40)(	9.62)(	19.95)
HYDROGRAPH AT	000003	.02	1	14.	21.	27.	34.	41.	55.	68.	137.	273.
		(.06)		(.39)(	.58)(	.77)(	.97)(	1.16)(	1.55)(	1.94)(	3.87)(	7.74)
2 COMBINED	M 243	.09	1	18.	32.	238.	252.	267.	334.	290.	450.	925.
		(.24)		(.52)(	.90)(	6.73)(	7.15)(	7.57)(	9.46)(	8.20)(	12.74)(	26.19)
ROUTED TO	000004	.09	1	6.	11.	141.	180.	228.	298.	267.	427.	922.
		(.24)		(.16)(	.30)(	3.98)(	5.09)(	6.45)(	8.43)(	7.56)(	12.08)(	26.12)

PLATE D-75

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	486.80	486.80	489.00
STORAGE	15.	15.	20.
OUTFLOW	0.	0.	32.

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	488.24	0.00	18.	8.	0.00	17.08	0.00
.08	488.69	0.00	19.	20.	0.00	16.17	0.00
.10	489.02	.02	20.	232.	.19	16.69	15.92
.13	489.19	.19	21.	245.	.31	16.50	15.75
.15	489.30	.30	21.	259.	.38	16.38	15.67
.20	489.12	.12	21.	314.	.44	16.08	15.42
.25	489.02	.02	20.	261.	.19	15.50	14.50
.50	489.05	.05	20.	440.	.25	15.83	12.75
1.00	489.00	.00	20.	705.	.13	15.83	11.92

PLATE D-76

Data Documents, Inc. 12

SUMMARY OF DAM SAFETY ANALYSIS (With Breach)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	468.00	468.00	472.90
STORAGE	16.	16.	32.
OUTFLOW	0.	0.	149.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPT; OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	469.19	0.00	19.	6.	0.00	19.17	0.00
.08	469.82	0.00	21.	11.	0.00	18.58	0.00
.10	472.84	0.00	32.	141.	0.00	17.00	0.00
.13	473.03	.13	33.	180.	.33	16.83	0.00
.15	473.13	.23	33.	228.	.50	16.67	0.00
.20	473.24	.34	34.	298.	.75	16.33	0.00
.25	473.19	.29	34.	267.	.92	15.75	0.00
.50	473.40	.50	35.	427.	1.92	15.92	0.00
1.00	473.81	.91	37.	922.	5.83	15.83	0.00

PLATE D-77

GRAPH PAPER GRAPHIC CONTROLS CORPORATION
Buffalo New York Printed in U.S.A.
SQUARE 10 X 10 TO THE HALF INCH AS 0813 67

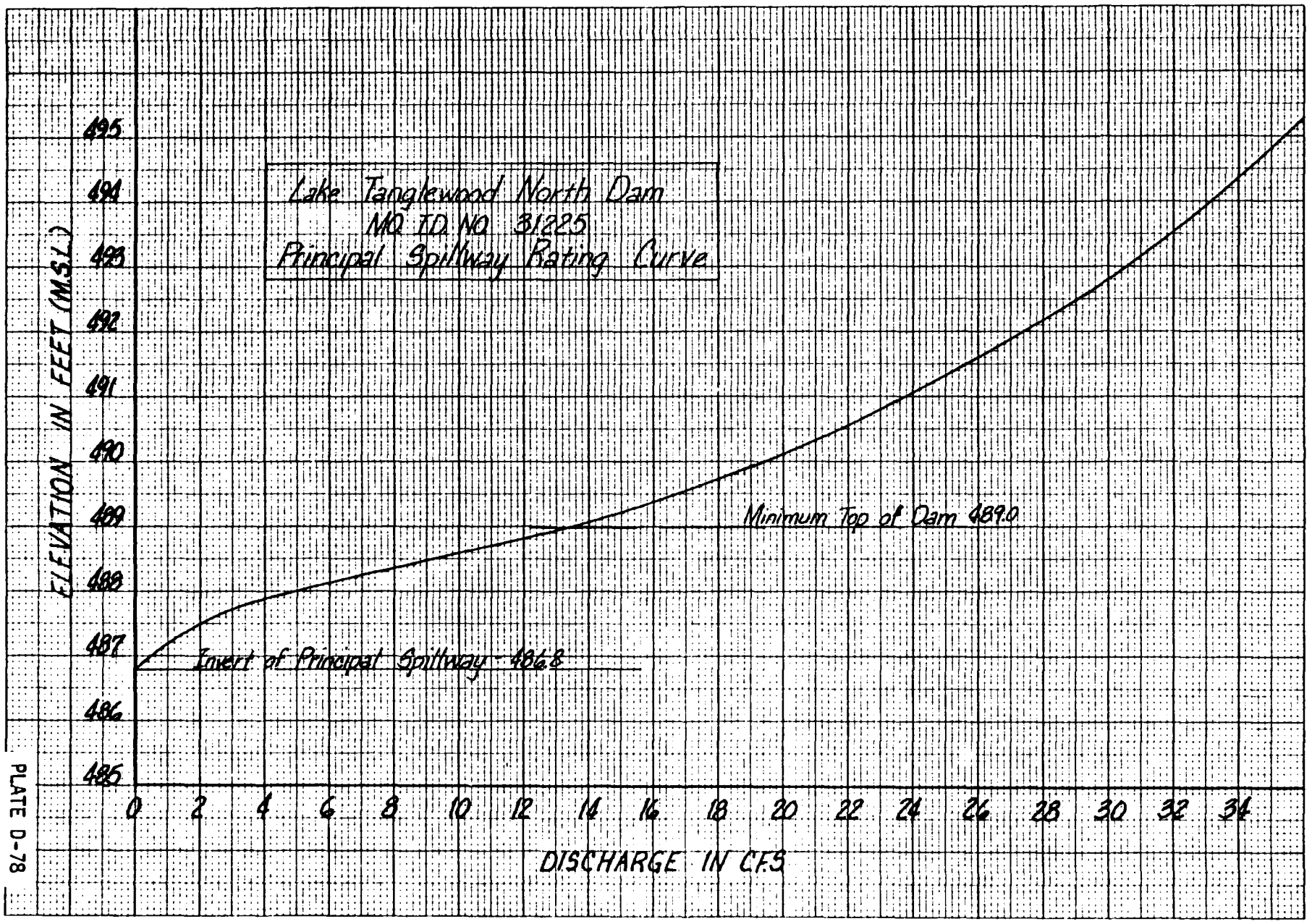


PLATE D-78

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

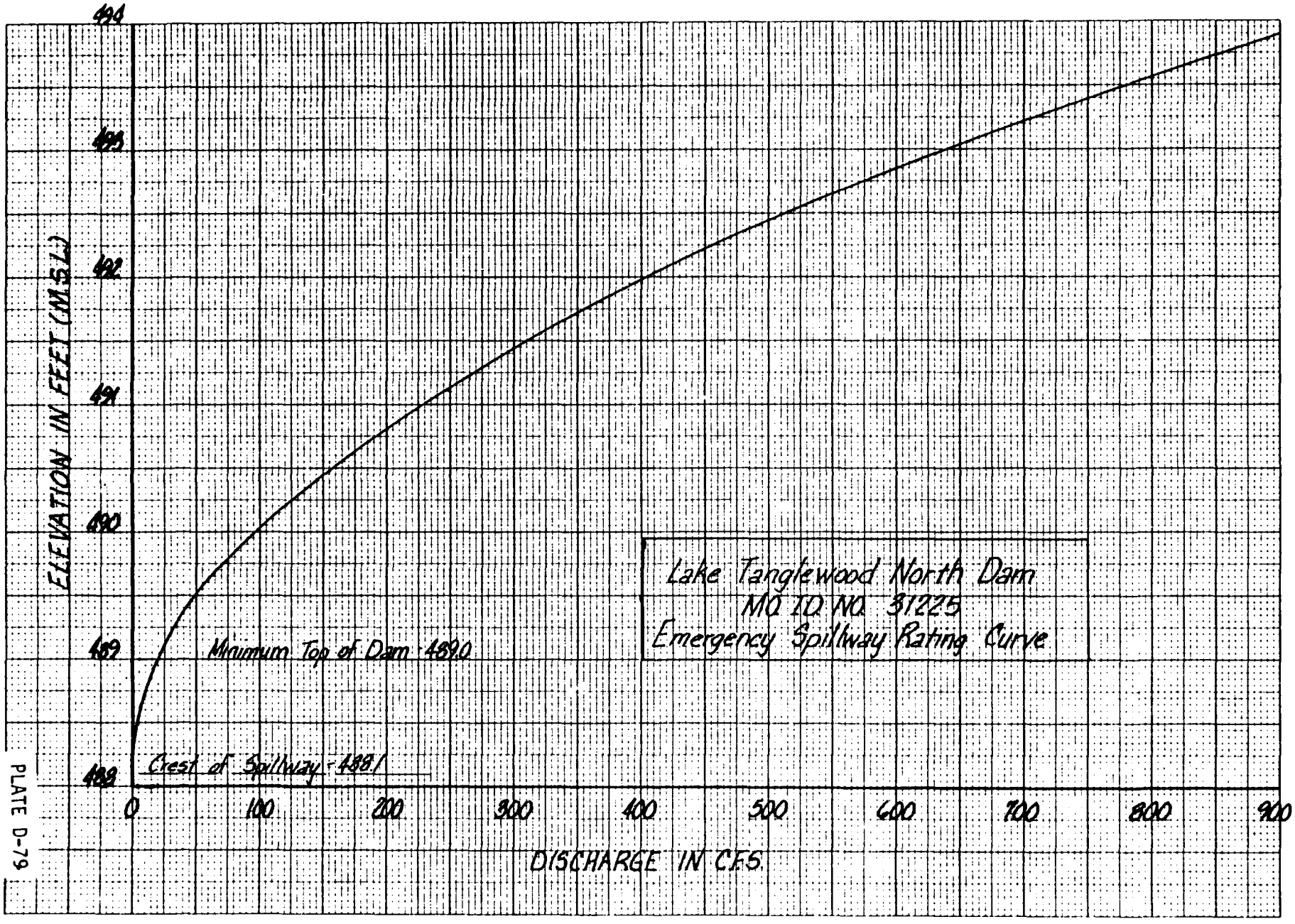


PLATE D-79

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

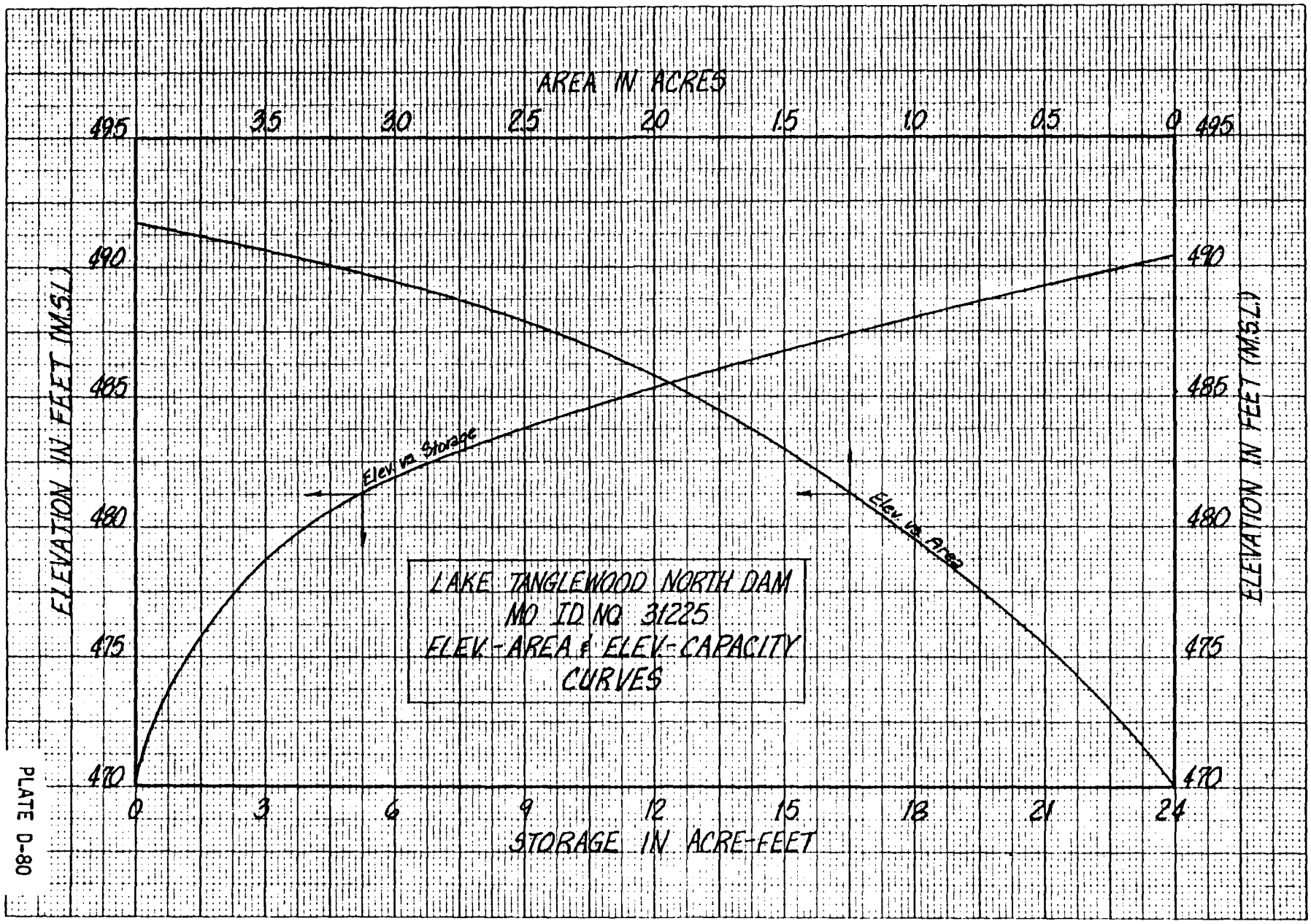


PLATE D-80

```
A1                ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2                H & H ANALYSIS OF SAFETY OF LAKE TANGLEWOOD NORTH DAM
A3                RATIOS OF PMF THROUGH RESERVOIR MO 31225
B 00028800000000000000005                          00000000000000000000003
B1000005
J 000001000000090000001
J1000.0500000.1000000.1500000.2000000.2500000.3000000.3500000.50000001.0
K 00000000000001                  00000000000000000000001
K1                CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 31225
M 000001000000020000 0.07         00000.07000001.0                 00000001
P 000000000027.000000102000001210000 0130
T                                                        -1.0   -78.0
W2       00000.17
X 000000     -.0100000001
K 00000100000002                  00000002000000000000001
K1                ROUTED FLOWS THROUGH RESERVOIR 31225
Y                         0000000100000001
Y1000001                                              -486.8       -1
Y40486.8000487.5000488.0000488.5000489.0000489.5000490.0000490.5000491.0000491.5
Y40492.0000492.5000493.0000493.5000494.0
Y500000000000002000000050000001200000032000000670000011500000177000002540000 0336
Y500042700000539000006710000081200000983
$A000000000001.1000002.2000003.2000004.8
$E000470000004800004 86.80000049000000500
$$0486.8
$D0489.0000002.9000001.500000290
$L000000000000470000009800000146000001830000023300000325000003300000033500000340
$V0489.0000489.3000489.6000490.0000490.3000490.6000491.0000492.0000493.0000494.0
K 000099
A
A
A
A
A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 000001
ROUTE HYDROGRAPH TO 000002
END OF NETWORK

PLATE D-82

Data Documents, Inc. 32

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

RUN  DATE= 80/12/10.
     TIME= 10.18.52.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
H & H ANALYSIS OF SAFETY OF LAKE TANGLEWOOD NORTH DAM
RATIOS OF PMF THROUGH RESERVOIR NO 31225

JOU SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	5	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

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

RTIOS= .05 .10 .15 .20 .25 .30 .35 .50 1.00

****

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 31225

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.07	0.00	.07	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	-78.00	0.00	0.00

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

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
49. 147. 151. 95. 47. 25. 13. 7. 4. 2.
1. 0.

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.23	.20	.03	41.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.23	.21	.02	62.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.23	.21	.02	83.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.23	.21	.02	97.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.23	.21	.02	104.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.23	.21	.02	108.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.23	.21	.02	111.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.23	.21	.02	112.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.23	.21	.02	113.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.23	.21	.02	114.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.23	.21	.02	115.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.23	.21	.02	115.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.28	.26	.02	118.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.28	.26	.02	124.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.28	.26	.02	131.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.28	.26	.02	136.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.28	.26	.01	138.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.28	.26	.01	140.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.28	.26	.01	141.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.28	.26	.01	141.

Data Documents, Inc. 32

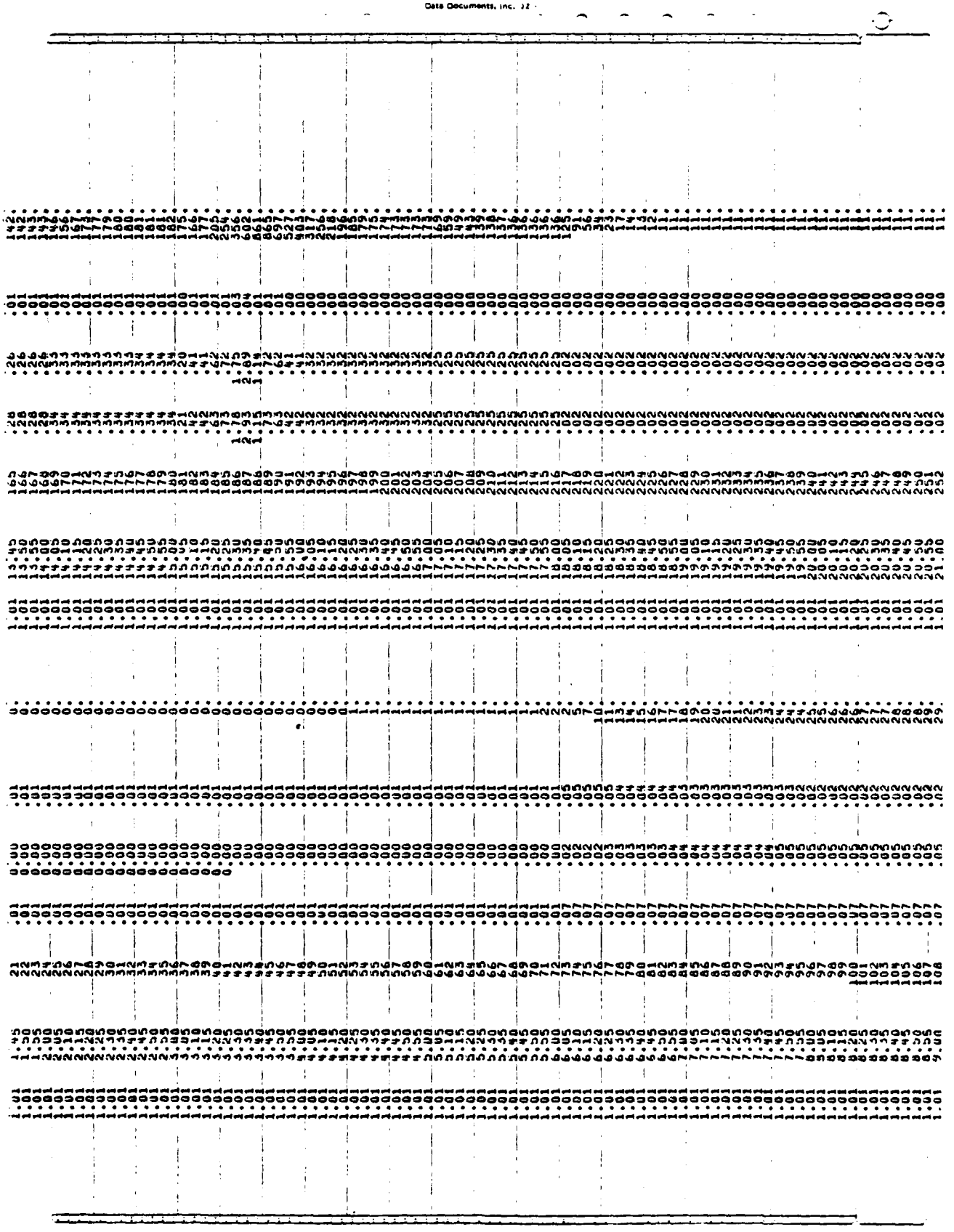


PLATE D-84

1.01	9.05	109	.07	.05	.02	29.	1.01	21.05	253	.02	.02	.00	11.
1.01	9.10	110	.07	.05	.02	29.	1.01	21.10	254	.02	.02	.00	11.
1.01	9.15	111	.07	.06	.02	29.	1.01	21.15	255	.02	.02	.00	11.
1.01	9.20	112	.07	.06	.02	30.	1.01	21.20	256	.02	.02	.00	11.
1.01	9.25	113	.07	.06	.02	30.	1.01	21.25	257	.02	.02	.00	11.
1.01	9.30	114	.07	.06	.01	30.	1.01	21.30	258	.02	.02	.00	11.
1.01	9.35	115	.07	.06	.01	30.	1.01	21.35	259	.02	.02	.00	11.
1.01	9.40	116	.07	.06	.01	31.	1.01	21.40	260	.02	.02	.00	11.
1.01	9.45	117	.07	.06	.01	31.	1.01	21.45	261	.02	.02	.00	11.
1.01	9.50	118	.07	.06	.01	31.	1.01	21.50	262	.02	.02	.00	11.
1.01	9.55	119	.07	.06	.01	31.	1.01	21.55	263	.02	.02	.00	11.
1.01	10.00	120	.07	.06	.01	31.	1.01	22.00	264	.02	.02	.00	11.
1.01	10.05	121	.07	.06	.01	31.	1.01	22.05	265	.02	.02	.00	11.
1.01	10.10	122	.07	.06	.01	32.	1.01	22.10	266	.02	.02	.00	11.
1.01	10.15	123	.07	.06	.01	32.	1.01	22.15	267	.02	.02	.00	11.
1.01	10.20	124	.07	.06	.01	32.	1.01	22.20	268	.02	.02	.00	11.
1.01	10.25	125	.07	.06	.01	32.	1.01	22.25	269	.02	.02	.00	11.
1.01	10.30	126	.07	.06	.01	32.	1.01	22.30	270	.02	.02	.00	11.
1.01	10.35	127	.07	.06	.01	32.	1.01	22.35	271	.02	.02	.00	11.
1.01	10.40	128	.07	.06	.01	32.	1.01	22.40	272	.02	.02	.00	11.
1.01	10.45	129	.07	.06	.01	32.	1.01	22.45	273	.02	.02	.00	11.
1.01	10.50	130	.07	.06	.01	33.	1.01	22.50	274	.02	.02	.00	11.
1.01	10.55	131	.07	.06	.01	33.	1.01	22.55	275	.02	.02	.00	11.
1.01	11.00	132	.07	.06	.01	33.	1.01	23.00	276	.02	.02	.00	11.
1.01	11.05	133	.07	.06	.01	33.	1.01	23.05	277	.02	.02	.00	11.
1.01	11.10	134	.07	.06	.01	33.	1.01	23.10	278	.02	.02	.00	11.
1.01	11.15	135	.07	.06	.01	33.	1.01	23.15	279	.02	.02	.00	11.
1.01	11.20	136	.07	.06	.01	33.	1.01	23.20	280	.02	.02	.00	11.
1.01	11.25	137	.07	.06	.01	33.	1.01	23.25	281	.02	.02	.00	11.
1.01	11.30	138	.07	.06	.01	33.	1.01	23.30	282	.02	.02	.00	11.
1.01	11.35	139	.07	.06	.01	34.	1.01	23.35	283	.02	.02	.00	11.
1.01	11.40	140	.07	.06	.01	34.	1.01	23.40	284	.02	.02	.00	11.
1.01	11.45	141	.07	.06	.01	34.	1.01	23.45	285	.02	.02	.00	11.
1.01	11.50	142	.07	.06	.01	34.	1.01	23.50	286	.02	.02	.00	11.
1.01	11.55	143	.07	.06	.01	34.	1.01	23.55	287	.02	.02	.00	11.
1.01	12.00	144	.07	.06	.01	34.	1.02	0.00	288	.02	.02	.00	11.
									SUM	35.10	31.93	3.17	17278.
										(892.)	(811.)	(81.)	(489.26)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	865.	200.	60.	60.	17268.
CMS	24.	6.	2.	2.	489.
INCHES		26.56	31.87	31.87	31.87
MM		674.66	809.55	809.55	809.55
AC-FT		99.	119.	119.	119.
THOUS CU M		122.	147.	147.	147.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	43.	10.	3.	3.	863.
CMS	1.	0.	0.	0.	24.
INCHES		1.33	1.59	1.59	1.59
MM		33.73	40.48	40.48	40.48
AC-FT		5.	6.	6.	6.
THOUS CU M		6.	7.	7.	7.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	86.	20.	6.	6.	1727.
CMS	2.	1.	0.	0.	49.
INCHES		2.66	3.19	3.19	3.19
MM		67.47	80.96	80.96	80.96
AC-FT		10.	12.	12.	12.
THOUS CU M		12.	15.	15.	15.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	130.	30.	9.	9.	2590.
CMS	4.	1.	0.	0.	73.
INCHES		3.98	4.78	4.78	4.78
MM		101.20	121.43	121.43	121.43
AC-FT		15.	18.	18.	18.
THOUS CU M		18.	22.	22.	22.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	173.	40.	12.	12.	3454.
CMS	5.	1.	0.	0.	98.
INCHES		3.31	6.37	6.37	6.37
MM		134.93	161.91	161.91	161.91
AC-FT		20.	24.	24.	24.
THOUS CU M		24.	29.	29.	29.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	216.	50.	15.	15.	4317.
CMS	6.	1.	0.	0.	122.
INCHES		6.64	7.97	7.97	7.97
MM		168.67	202.39	202.39	202.39
AC-FT		25.	30.	30.	30.
THOUS CU M		31.	37.	37.	37.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	259.	60.	18.	18.	5180.
CMS	7.	2.	1.	1.	147.
INCHES		7.97	9.56	9.56	9.56
MM		202.40	242.87	242.87	242.87
AC-FT		30.	36.	36.	36.
THOUS CU M		37.	44.	44.	44.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	303.	70.	21.	21.	6044.
CMS	9.	2.	1.	1.	171.
INCHES		9.30	11.16	11.16	11.16
MM		236.13	283.34	283.34	283.34
AC-FT		35.	42.	42.	42.
THOUS CU M		43.	51.	51.	51.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	432.	100.	30.	30.	8634.
CMS	12.	3.	1.	1.	244.
INCHES		13.28	15.94	15.94	15.94
MM		337.33	404.78	404.78	404.78
AC-FT		50.	59.	59.	59.
THOUS CU M		61.	73.	73.	73.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	865.	200.	60.	60.	17268.
CMS	24.	6.	2.	2.	489.
INCHES		26.56	31.87	31.87	31.87
MM		674.66	809.55	809.55	809.55
AC-FT		99.	119.	119.	119.
THOUS CU M		122.	147.	147.	147.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR 31225

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	-487.	-1

STAGE	486.80	487.50	488.00	488.50	489.00	489.50	490.00	490.50	491.00	491.50

Data Documents, no. 12

DVN

STATION 000002, PLAN 1, RATIO 8 [0.5 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

488.9	489.0	489.0	489.1	489.1	489.1	489.2	489.2	489.2	489.3
489.3	489.3	489.3	489.3	489.3	489.3	489.3	489.4	489.4	489.4
489.4	489.4	489.4	489.4	489.4	489.4	489.4	489.5	489.5	489.5
489.5	489.4	489.4	489.5	489.5	489.6	489.6	490.0	490.2	490.1
490.0	489.9	489.8	489.7	489.6	489.6	489.5	489.5	489.5	489.5
489.5	489.4	489.4	489.4	489.4	489.4	489.4	489.4	489.4	489.4
489.4	489.4	489.4	489.3	489.3	489.3	489.3	489.3	489.3	489.2
489.1	489.0	489.0	488.9	488.9	488.8	488.8	488.7	488.7	488.7
488.6	488.6	488.6	488.6	488.5	488.5	488.5	488.5	488.5	488.5
488.4	488.4	488.4	488.4	488.4	488.4	488.4	488.3	488.3	488.3
488.3	488.3	488.3	488.3	488.3	488.3	488.3	488.2	488.2	488.2
488.2	488.2	488.2	488.2	488.2	488.2	488.2	488.2	488.2	488.2
488.2	488.2	488.2	488.2	488.2	488.1	488.1	488.1	488.1	488.1
488.1	488.1	488.1	488.1	488.1	488.1	488.1	488.1		

PEAK OUTFLOW IS 410. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	410.	97.	28.	28.	8180.
CMS	12.	3.	1.	1.	232.
INCHES		12.94	15.10	15.10	15.10
MM		328.61	383.51	383.51	383.51
AC-FT		98.	56.	56.	56.
THOUS CU M		60.	69.	69.	69.

Data Documents, Inc. 77

PLATE D-89

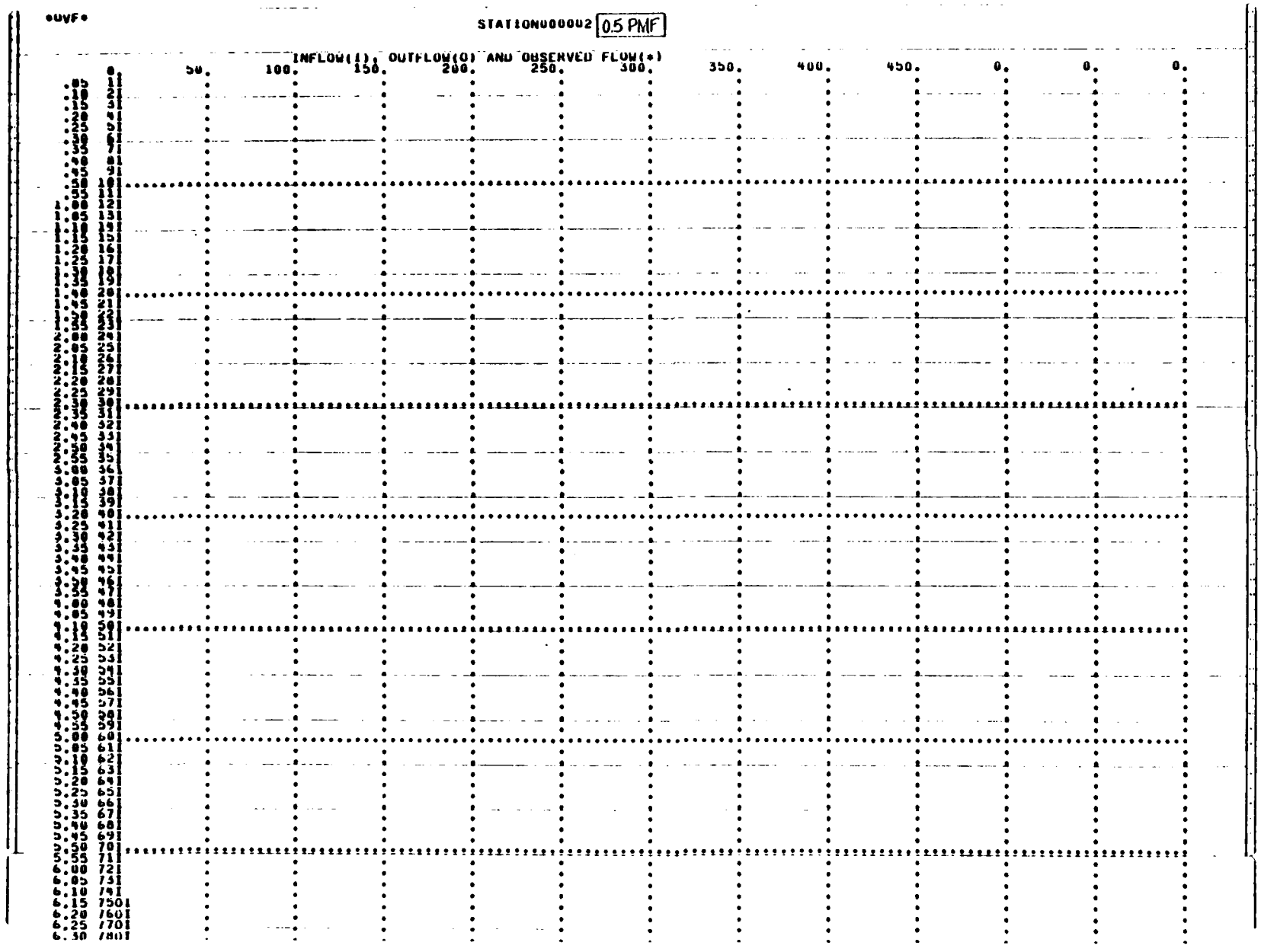


PLATE D-90

Data Documents, Inc. 32

Data Documents, Inc. 32 -

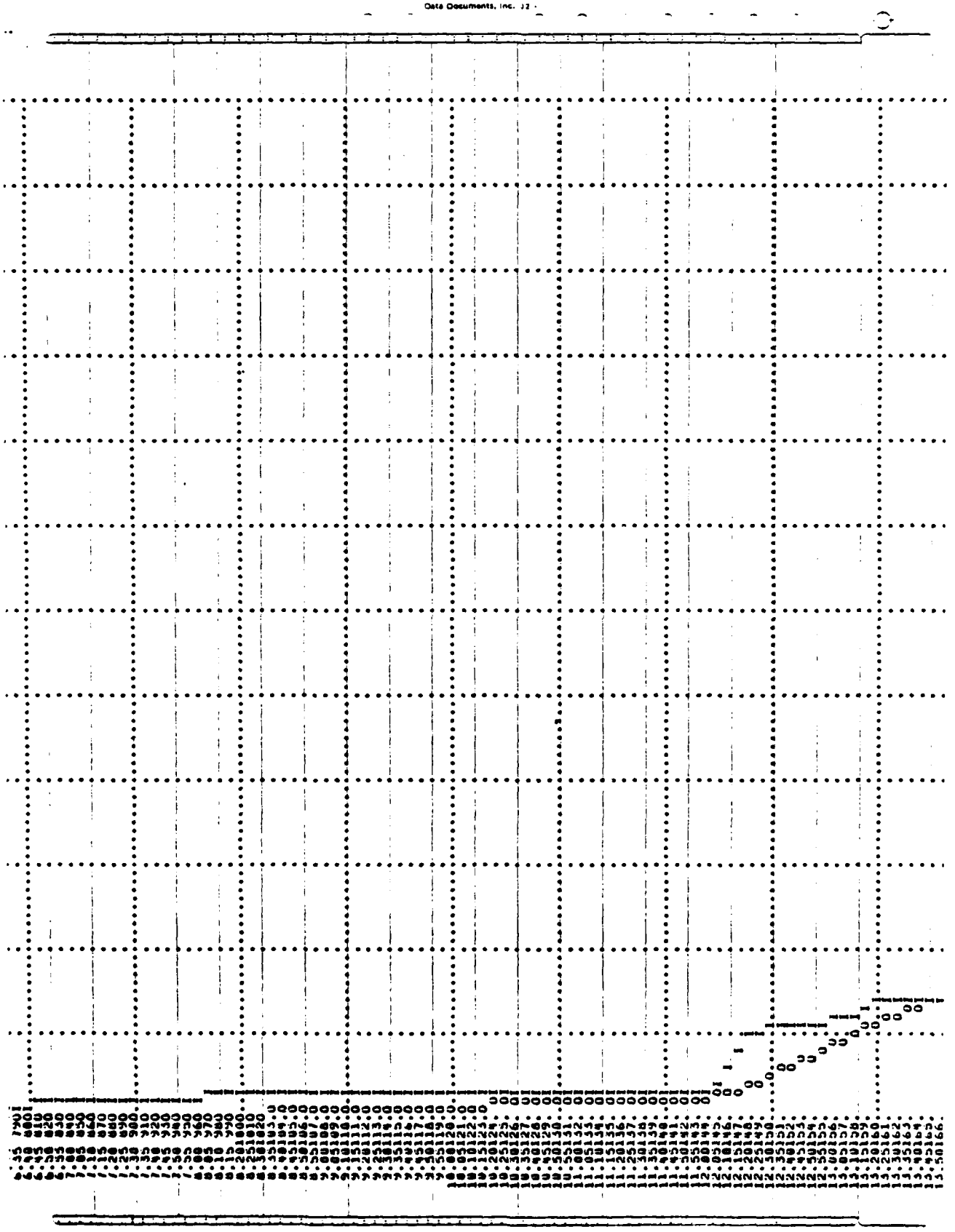


PLATE D-91

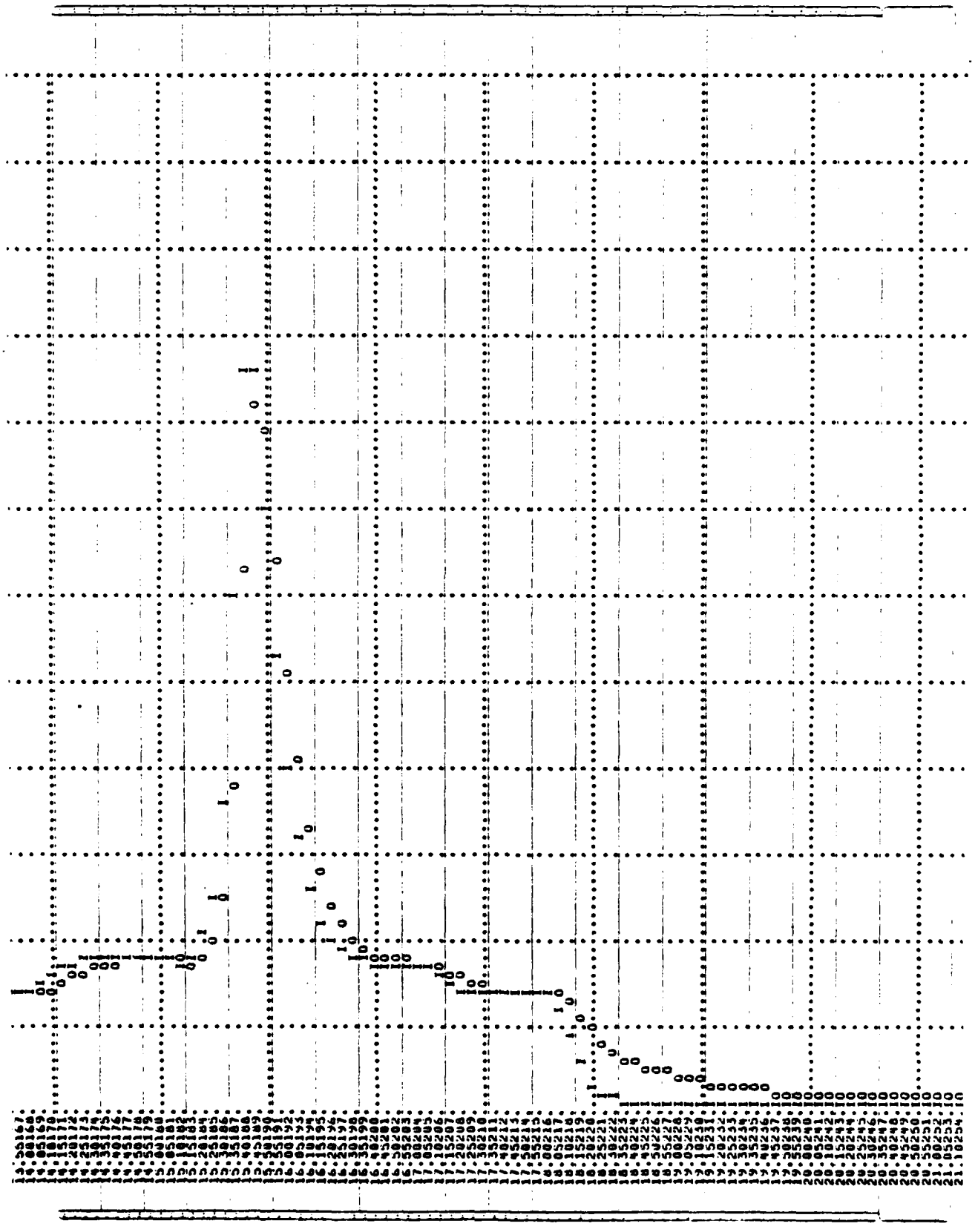


PLATE D-92

Data Documents, Inc. 32

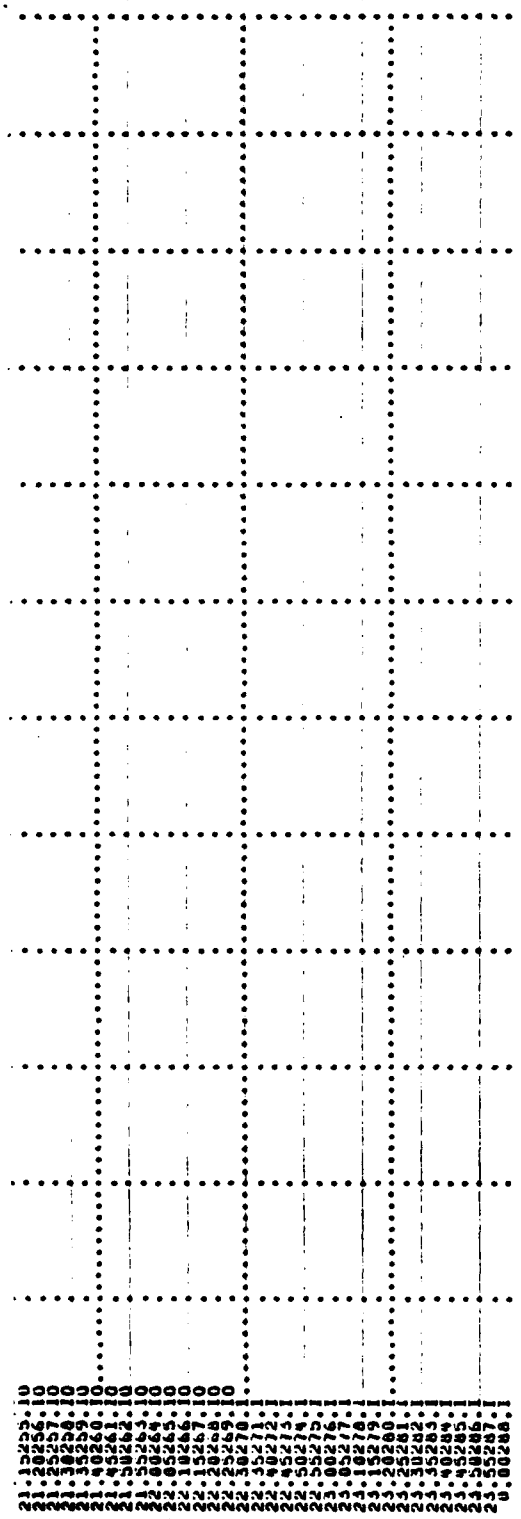


PLATE D-93

DVN

STATION 000002, PLAN 1, RATIO 9 [PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

489.5	489.5	489.5	489.5	489.5	489.5	489.6	489.6	489.6	489.6
489.6	489.6	489.6	489.6	489.6	489.6	489.6	489.6	489.6	489.7
489.7	489.7	489.7	489.7	489.7	489.7	489.7	489.7	489.7	489.7
489.7	489.7	489.7	489.7	489.8	489.9	490.2	490.5	490.7	490.6
490.4	490.3	490.1	490.0	489.9	489.8	489.8	489.8	489.7	489.7
489.7	489.7	489.7	489.7	489.7	489.7	489.7	489.7	489.6	489.6
489.6	489.6	489.6	489.6	489.6	489.6	489.6	489.6	489.5	489.4
489.3	489.2	489.1	489.1	489.0	489.0	488.9	488.9	488.8	488.8
488.8	488.8	488.7	488.7	488.7	488.7	488.6	488.6	488.6	488.6
488.6	488.6	488.6	488.6	488.6	488.5	488.5	488.5	488.5	488.5
488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5
488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5
488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5	488.5
488.5	488.5	488.5	488.5	488.4	488.4	488.4	488.4		

PEAK OUTFLOW IS 871. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	871.	198.	58.	58.	16674.
CMS	25.	6.	2.	2.	472.
INCHES		26.37	30.78	30.78	30.78
MM		669.69	781.71	781.71	781.71
AC-FT		98.	115.	115.	115.
THOUS CU M		121.	142.	142.	142.

Data Document No. 12

PLATE D-95

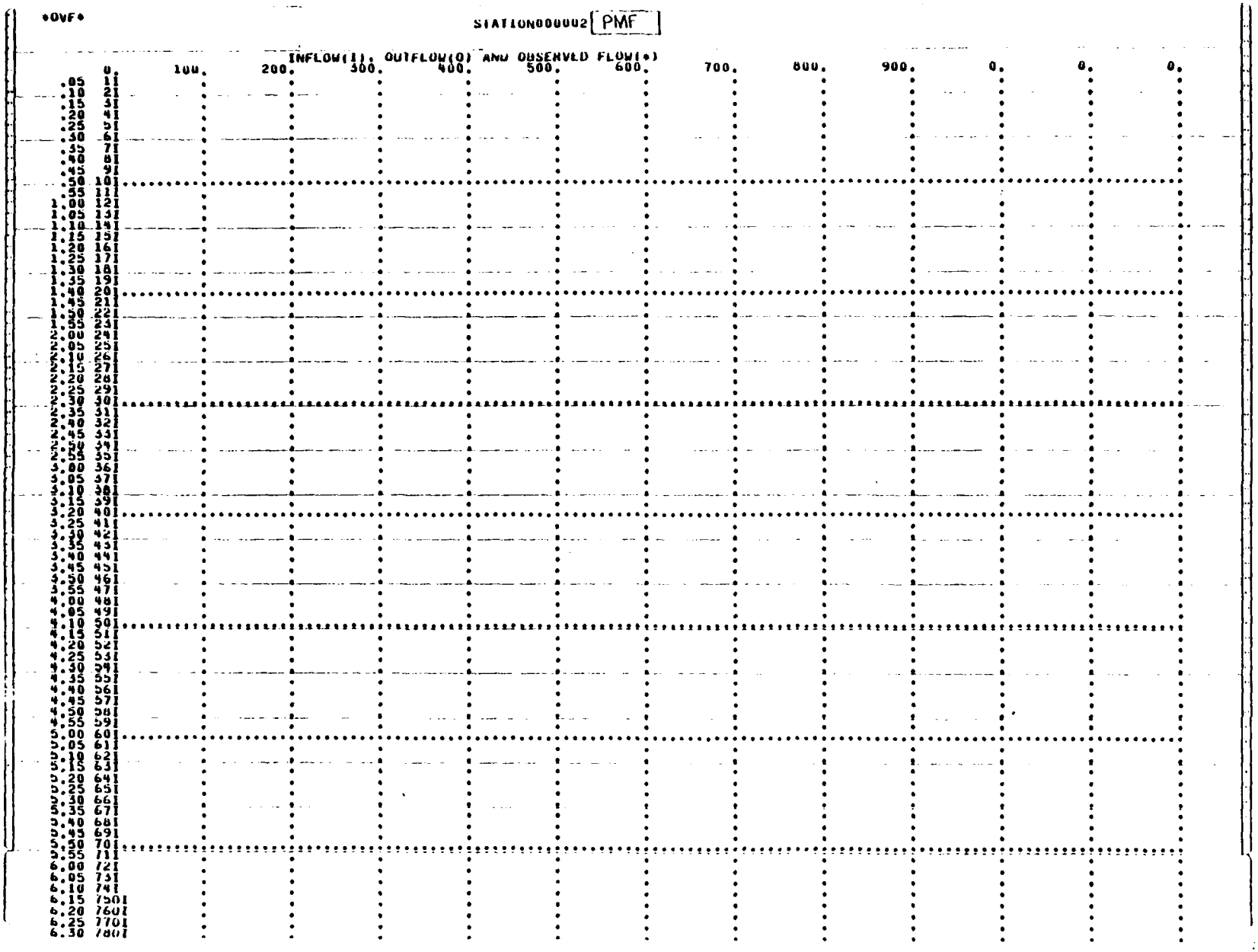
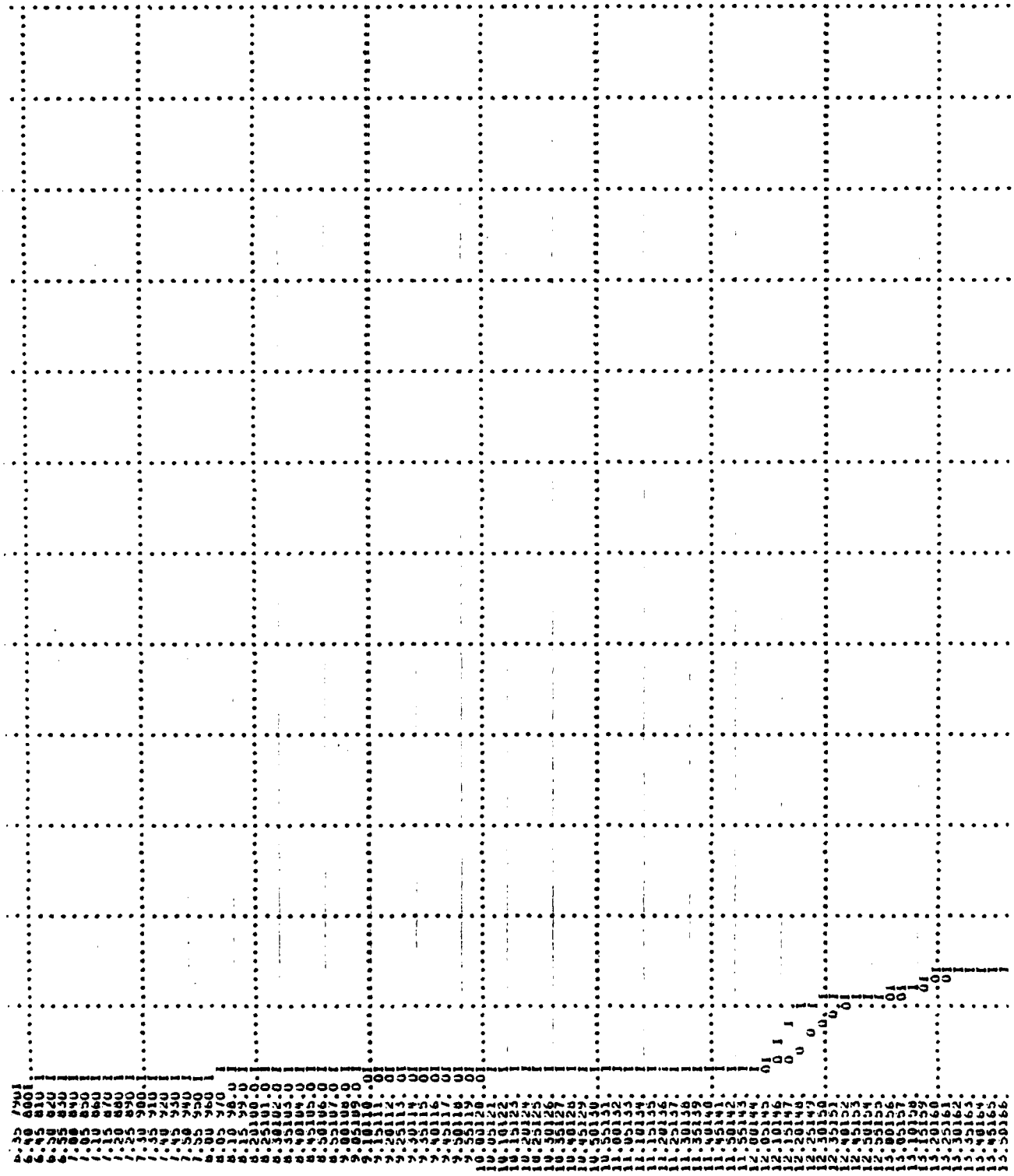

OVF
STATION000002 PMF
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 100. 200. 300. 400. 500. 600. 700. 800. 900. 0. 0. 0.

PLATE D-96



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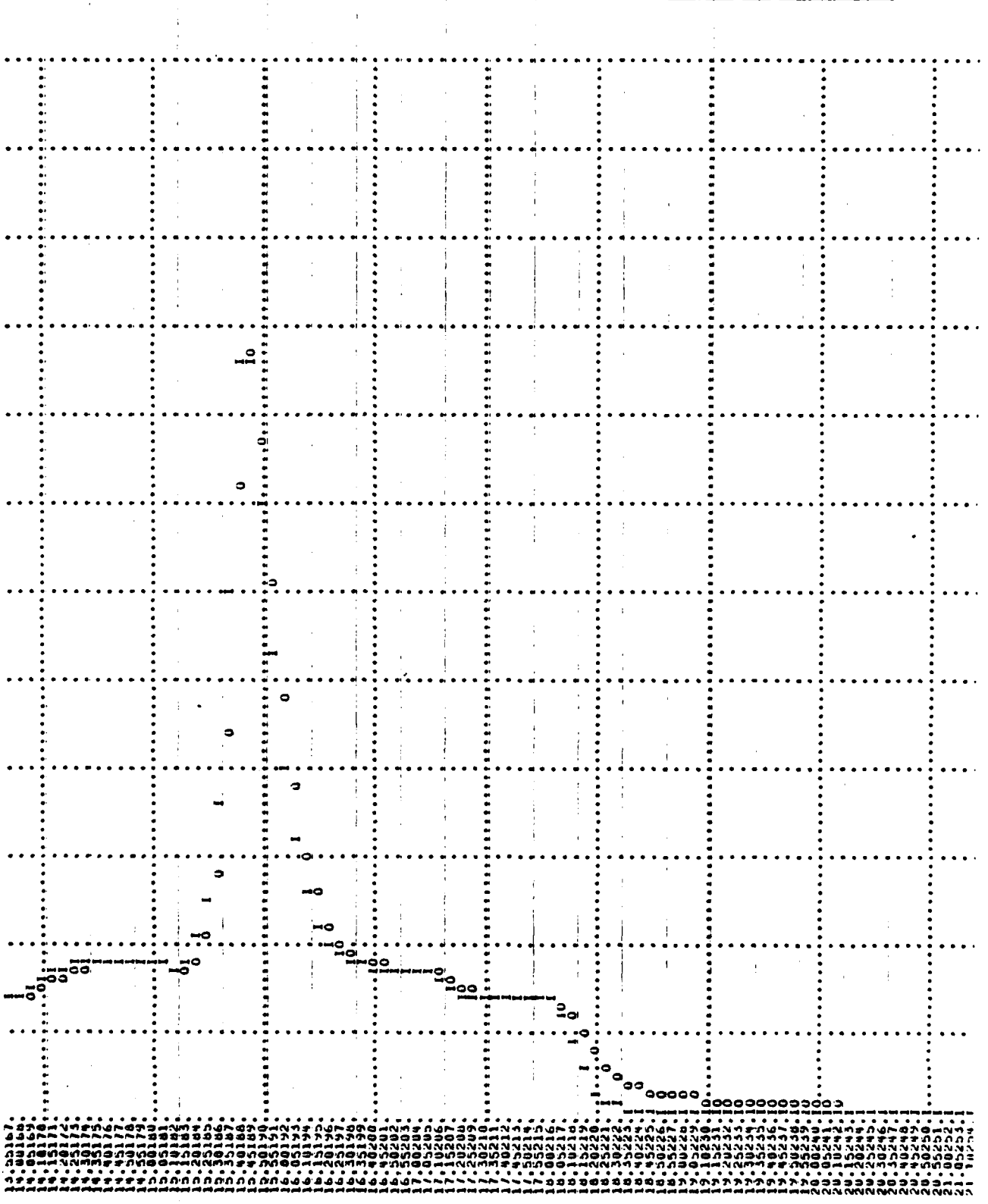

PLATE D-98

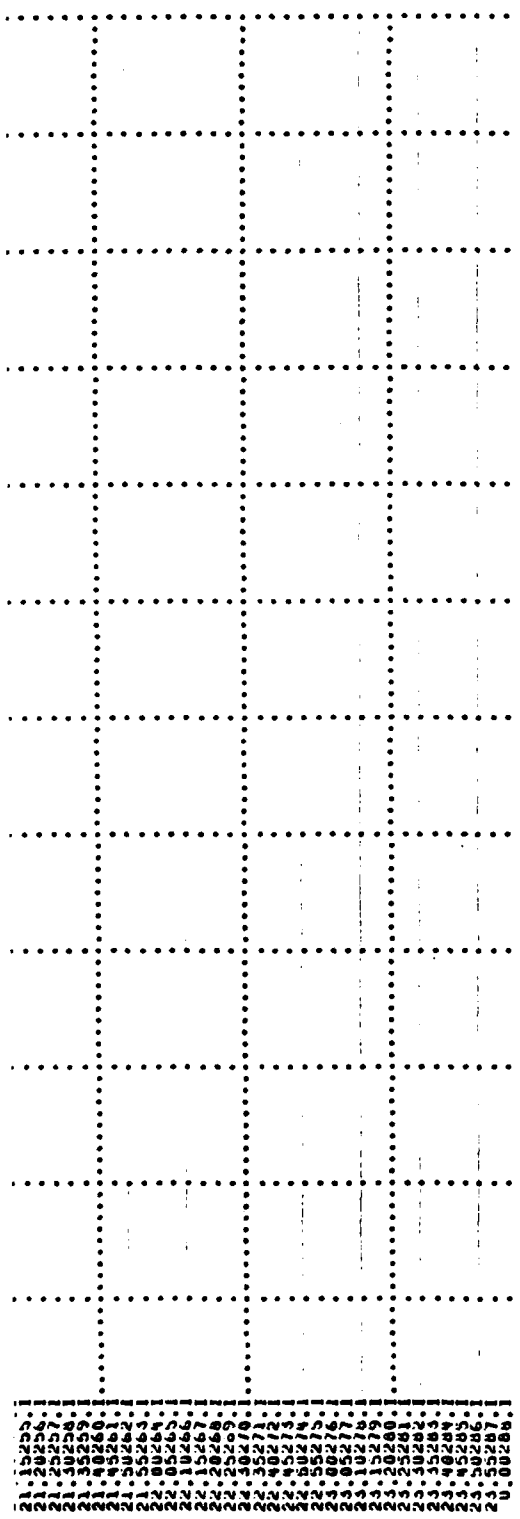

PLATE D-99

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 .25	RATIO 6 .30	RATIO 7 .35	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	000001	.07 (.18)	1	43 (1.22)	86 (2.45)	130 (3.67)	173 (4.90)	216 (6.12)	259 (7.35)	303 (8.57)	432 (12.24)	865 (24.48)
ROUTED TO	000002	.07 (.18)	1	8 (.24)	35 (.99)	84 (2.37)	138 (3.92)	187 (5.29)	230 (6.51)	272 (7.70)	410 (11.62)	871 (24.67)

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	486.80	486.80	489.00
STORAGE	15.	15.	20.
OUTFLOW	0.	0.	32.

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	488.24	0.00	18.	8.	0.00	17.08	0.00
.10	489.04	.04	20.	35.	.42	16.08	0.00
.15	489.42	.42	21.	84.	1.33	15.92	0.00
.20	489.63	.63	22.	138.	2.25	15.83	0.00
.25	489.75	.75	22.	187.	3.75	15.83	0.00
.30	489.85	.85	23.	230.	4.50	15.83	0.00
.35	489.94	.94	23.	272.	5.00	15.83	0.00
.40	490.16	1.16	24.	410.	5.83	15.75	0.00
1.00	490.67	1.67	25.	871.	8.92	15.75	0.00

PLATE D-101

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