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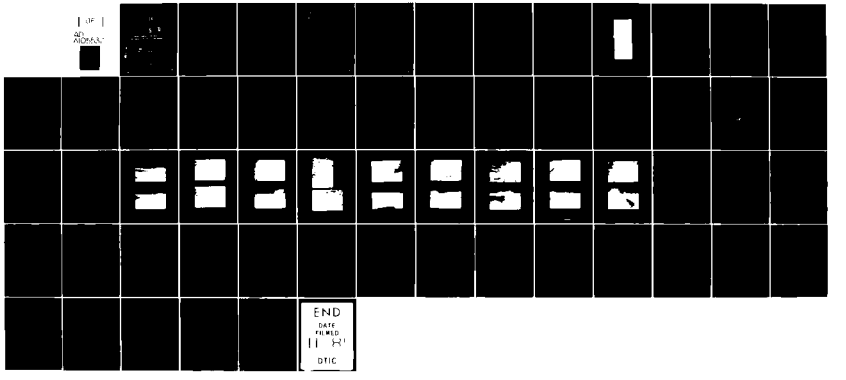

MISSOURI-NEMAHA-NODAWAY BASIN

AD A105537

LEVEL II

EARL LIMPP DAM

HOLT COUNTY, MISSOURI

MO. 10508

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

St. Louis District

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

FOR: STATE OF MISSOURI

MAY, 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Dam Safety, Lake, Dam Inspection, Private Dams

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

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

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

EARL LIMPP DAM

HOLT COUNTY, MISSOURI

MO. 10508

(15) DACW43-79-C-0046

(9) Final rept.,

(10) Rey S. /Decker Gordon G. /Jamison Garold
Garold /Ulmer Harold P. /Hoskins

PHASE I INSPECTION REPORT

(6) NATIONAL DAM SAFETY PROGRAM.

Earl Limpp Dam (MO 10508),
Missouri - Nemaha - Nodaway Basin,
Holt County, Missouri. Phase I Inspection
Report.

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

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Earl Limpp Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Earl Limpp Dam:

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

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

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

SUBMITTED BY: SIGNED
Chief, Engineering Division

18 SEP 1979
Date

APPROVED: SIGNED
Colonel, CE, District Engineer

18 SEP 1979
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Earl Limpp Dam
State Located	Missouri
County Located	Holt County
Stream	Tributary Davis Creek
Date of Inspection	May 16, 1979

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

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three and one-half miles downstream of the dam. Within the damage zone are a county road, a railroad, State Highway 275 and 5 to 10 buildings in Mound City.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the small volume of water impounded and the large floodplain downstream of the dam, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will not pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 12% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meterologic and hydrologic conditions that are reasonably possible in the region.

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

Other deficiencies observed during the inspection are a large rodent hole, drying cracks in the crest, minor surface and gully erosion of the downstream slope and in the left abutment trough, seepage emerging near the stilling basin of the principal spillway, a boil on the right side of the stilling basin, an accumulation of trash and logs around the riser of the principal spillway, erosion of the stilling basin, lack of a trash rack on the riser of the principal spillway and a steel mesh fence crossing the emergency spillway.

Maintenance and repair items needed to be done by the owner are described in detail in the report.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-4777

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

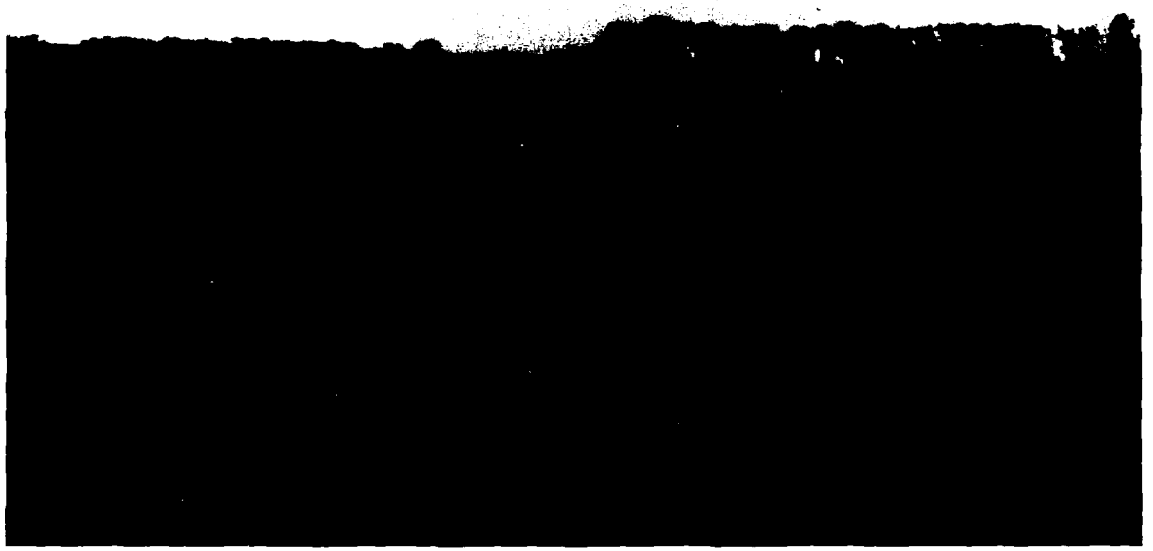


PHOTO NO. 1 - OVERVIEW FROM HIGH ON LEFT ABUTMENT

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
EARL LIMPP DAM - MO 10508
HOLT COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

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

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

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

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is a small earth fill located in the loess hills of northwestern Missouri just east of Mound City. The dam is approximately 580 feet in length and 26 feet in height.

(2) The principal spillway consists of a 48 inch diameter corrugated metal pipe (CMP) riser connected with a 30 inch diameter CMP outlet conduit passing through the embankment.

(3) A vegetated earth emergency spillway with bottom width of 25 feet ± is cut into the left abutment.

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

b. Location. The dam is located in the east central part of Holt County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SW¼ of Section 35, T62N, R38W. The lake formed behind the dam is shown in the SW¼ of Section 35, T62N, R38W.

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

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately three and one-half miles downstream of the dam. Within the damage zone are a county road just downstream from the dam, railroad and Highway 275 and 5 to 10 buildings in Mound City.

e. Ownership. The dam is owned by Earl Limpp, Mound City, Missouri 64470.

f. Purpose of Dam. The dam is a flood retardation structure. It is one of 21 small dams constructed in the Davis Creek Watershed for flood protection in Mound City.

g. Design and Construction History. This dam was constructed in 1972 as part of a group flood control project sponsored by the Agricultural Stabilization and Conservation Service (ASCS). It was reported that it was staked out by a technician from the ASCS. The Owner reported that a cutoff trench was not excavated for the dam but that standard corrugated metal antiseep collars were installed on the CMP spillway conduit.

h. Normal Operating Procedure. There are no operating procedures for this dam. All spillways are uncontrolled.

1.3 PERTINENT DATA

a. Drainage Area. 733 acres (1.145 square miles).

b. Discharge At Damsite.

(1) All discharges at the damsite are through a principal spillway consisting of a 48 inch diameter corrugated metal riser connected with a 30 inch diameter corru-

gated metal outlet pipe and a grassed earth channel ungated emergency spillway.

(2) Estimated maximum flood - unknown.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 979.7 to 64 c.f.s. at elevation 983.1 (crest of the emergency spillway) to 69 c.f.s. at elevation 985.4 (minimum top of dam).

(4) The emergency spillway capacity varies from 0 c.f.s at its crest elevation 983.1 feet to 194 c.f.s at elevation 985.4 (minimum top of dam) to 1070 c.f.s at elevation 987.8 (maximum top of dam).

(5) Total spillway capacity at the minimum top of dam is 263 c.f.s ±.

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

(1) Top of dam - 986 to 988 ±
(2) Principal spillway crest - 980
(3) Emergency spillway crest - 983
(4) Streambed at centerline - 961 ±
(5) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 2000 ±.

e. Storage (Acre-feet).

(1) Top of dam - 283 ±.
(2) Principal spillway crest - 146 ±.

f. Reservoir Surface (Acres).

(1) Top of dam - 24 ±.
(2) Principal spillway crest - 14 ±.

g. Dam.

(1) Type - Earth fill.
(2) Length - 580 feet ±.
(3) Height - 26 feet ±.
(4) Top width - 17 feet
(5) Side slopes.
    (a) Downstream - 3H on 1V (measured)
    (b) Upstream - Exposed=3.8H on 1V (measured)
(6) Zoning - unknown

(7) Impervious core - unknown
(8) Cutoff - unknown - owner reported none
(9) Grout curtain - unknown
(10) Wave protection - none

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal
  (a) Type - Corrugated metal pipe. 48 inch diameter riser approximately 6 feet high connected with 30 inch diameter CMP conduit outlet.
  (b) Crest (invert) elevation - Riser crest=980 feet, Conduit inlet=974 feet ±. Outlet - 965.7 feet ±
  (c) Length - 112 feet ±
(2) Emergency
  (a) Type - vegetated earth, trapezoidal section
  (b) Control section approximately 40 feet in length with 25 feet ± bottom width.
  (c) Crest elevation - 983 feet ±
  (d) Upstream Channel - vegetated, clear, approximately 35 feet in length on 7% ± slope.
  (e) Downstream Channel - vegetated and clear to the creek. Few large trees in the old creek channel.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Earl Limpp, the Owner, that the dam was constructed in 1972.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

a. Availability. No data were available.

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

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Limpp Dam was made on May 16, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison, Hydrology; Garold Ulmer, Civil Engineer. Mr. Earl Limpp, the owner, was present during the inspection.

b. Dam.

(1) Geology and Soils (Abutment and embankment). The dam is located in the deep loess rolling hills of northwestern Missouri adjacent to the Missouri River. Upland soils are deep silty clay loam (CL-ML) loess. Abutment soils consist of a thin mantle of CL loess underlain by clay (CL-CH) glacial till. Valley alluvium is CL-ML material. Drying cracks in the embankment indicate that the material is moderately plastic CL, probably borrowed from the side slopes around the reservoir.

(2) Upstream Slope. The upstream slope is well vegetated with adapted grasses. No abnormal deformation nor significant erosion was observed on the upstream slope.

(3) Crest. The crest of the dam is well vegetated with adapted grasses. The embankment and reservoir area is used for cattle grazing and cattle trails across the dam are well worn. A large rodent hole was observed near ℄ Station 2+50 (see Photo 4). Longitudinal drying cracks were observed on the crest. A series of transverse (normal to the ℄) cracks was observed at about ℄ Station 2+70 just left of the principal spillway location. The cracks were approximately 1/4 inch wide. Depth of cracks is not known. The transverse cracks were approximately 10 feet in length. The longitudinal cracks extended from Station 3+50 to Station 3+75+. The crest line profile is quite irregular with a low spot on the right end and high spot near ℄ Station 4+50.

(4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. It is used for grazing and has a number of erosional rills and washes due probably, in part, to grazing when wet. Surface erosion is significant in the area downstream from stations 2+00 to about 3+00. A small seepy area was noted at the toe of the dam opposite about

℄ Station 3+20. Several seeps were observed around the scour hole or stilling basin of the principal spillway. These seeps outcrop at or near the water line of the plunge pool. One small boil was observed on the right side of the plunge pool. It emerges through well aggregated, erosion resistant CH till. Flow from the boil was estimated at 0.1 gal./min. Total seepage effluent around the plunge pool probably amounts to 0.2 to 0.25 gals./min. All seepage was clear. No abnormal deformations were noted on the downstream slope.

The scour hole or plunge pool appeared to be eroded into fine grained glacial till.

(5) Miscellaneous. The gully erosion noted on the downstream slope and in the left abutment trough and the transverse cracks across the top of the dam near the crossing of the principal spillway indicate that prolonged overtopping of this dam could cause potential of failure. Minor overtopping as caused by the 100-year flood would probably not cause significant damage to the structure.

c. Appurtenant Structures.

(1) The Principal Spillway. The principal spillway consists of a 48 inch CMP riser with 30 inch CMP conduit outletting into a scour hole or plunge pool eroded into the valley bottom materials or into till. No corrosion or deterioration was noted in the metal pipe. The riser inlet does not have an effective trash rack and a considerable amount of trash and logs has accumulated around the riser (see Photo 14). The plunge pool and outlet channel appear to be stable.

(2) The Emergency Spillway. The emergency spillway is cut into glacial till in the left abutment of the dam. It is well vegetated and appears to be stable. A steel mesh fence crosses the spillway downstream from ℄ of dam. Under high flows this fence could become clogged with debris and reduce the effectiveness of the spillway. No debris was noted in the spillway at the time of the inspection thus indicating very little or no flow through the emergency spillway. The inlet section is clear and well vegetated.

(3) Drawdown Facilities. There are no drawdown facilities for this dam.

d. Reservoir Area. A few trees were observed in the upper end of the reservoir. No significant shore line erosion was observed.

e. Downstream Channel. The channel downstream from the principal spillway has a number of trees growing along the bank. It appears to be stable and adequate to handle principal spillway discharges. Discharges from this structure will be temporarily impounded behind a road structure located about 300 feet downstream as described in Section 5 of this report.

3.2 EVALUATION

The dam appears to be in good condition except for the rodent hole on the crest and minor surface erosion noted on the downstream slope and along the central toe area. The 3H on 1V side slopes should provide adequate safety against shear failure. Foundation seepage at the toe and into the plunge pool does not appear to seriously impair the integrity of the structure. The transverse cracks adjacent to the principal spillway crossing probably indicate some differential settlement in the area of the old channel. However, none of these cracks were evident on the upstream or downstream slopes and there is a good chance that they have healed themselves on the interior of the dam. Spillway operations would be improved with removal and prevention of trash accumulations around the principal spillway riser and removal or replacement of the barrier fence across the emergency spillway.

Additional studies would be required to assess potential damage to the structure from overtopping.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

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

4.2 MAINTENANCE OF DAM

Vegetation cover is well maintained by grazing activities. Some maintenance measures are needed to eliminate rodent holes, and reduce surface erosion on the downstream slope, and keep spillway inlets free of trash and debris.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Upon checking with the owner, we are not aware of any emergency warning system for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure. However, the minor surface erosion, foundation seepage, and transverse cracks discussed in Section 3.2 could lead to potential of failure if left unrepaired.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

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

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Maitland, Missouri 15 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) The spillway pipe appeared to be in good condition. There was no effective trash rack to speak of. Debris was accumulated around the riser, but the riser was open and operating.

(2) The emergency spillway and exit channel are located in the left abutment of the dam. Spillway releases should not endanger the integrity of the dam.

(3) The downstream channel appeared fairly open with some trees on the edge of the channel.

(4) A road embankment with a drainage structure through it is located a short distance downstream of the dam. The drainage structure is a 48 inch diameter corrugated metal pipe riser inclined approximately 60% from ground level. The culvert has no effect on the hydraulic operation of the principal spillway. The road is about 9 feet above the present water surface.

(5) No drawdown facilities are available to evacuate the pool.

d. Overtopping Potential. The spillways are too small to pass 50% of the probable maximum flood and the 100-year frequency flood without overtopping. The spillways will pass 12% of the PMF without overtopping. Prolonged overtopping could cause failure of this dam. 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	Freeboard Top of Dam Min. Elev. 985.4	Time Dam Overtopping Hr.
10 Yr.	1300	80	983.9	+1.5	0
100 Yr.	2400	480	986.0	-0.6	2±
1/2 PMF	4700	4500	988.1	-2.7	6+
PMF	9300	9000	989.0	-3.6	9+
0.12 PMF	1075	263	985.4	0	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 rating and a small size. Therefore, the 1/2 PMF to the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. This dam appears to be structurally stable. The 3H on 1V side slopes would provide adequate safety against shear failures for a dam of this height. Seepage effluent is discharging at a rate of approximately 0.1 to 0.2 gallons per minute through erosion resistant materials and is all clear. Additional studies would be required to determine the affects of seepage pressures on structural stability under full loading conditions.

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

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

d. Post Construction Changes. The inspection team is not aware of any post construction changes for this structure.

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

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The spillways will not pass 50% of the probable maximum flood. Additional studies would be required to determine the affect of overtopping on the safety of the dam. It would appear that prolonged overtopping could cause potential of failure. It appears that the structure is structurally stable but additional studies would be required to determine the affects of full reservoir loadings on seepage pressures and slope stability. The lack of some minor maintenance measures discussed in paragraph 7.2, do not pose a serious potential of failure but would enhance spillway operations and safety of the downstream slope.

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

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

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

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

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass one half the probable maximum flood without overtopping the dam. The services of an engineer experienced in the design of dams should be obtained to evaluate the present reservoir storage capacity, to

provide seepage and stability analyses of the present dam, and to design protective measures, if required.

b. O & M Procedures.

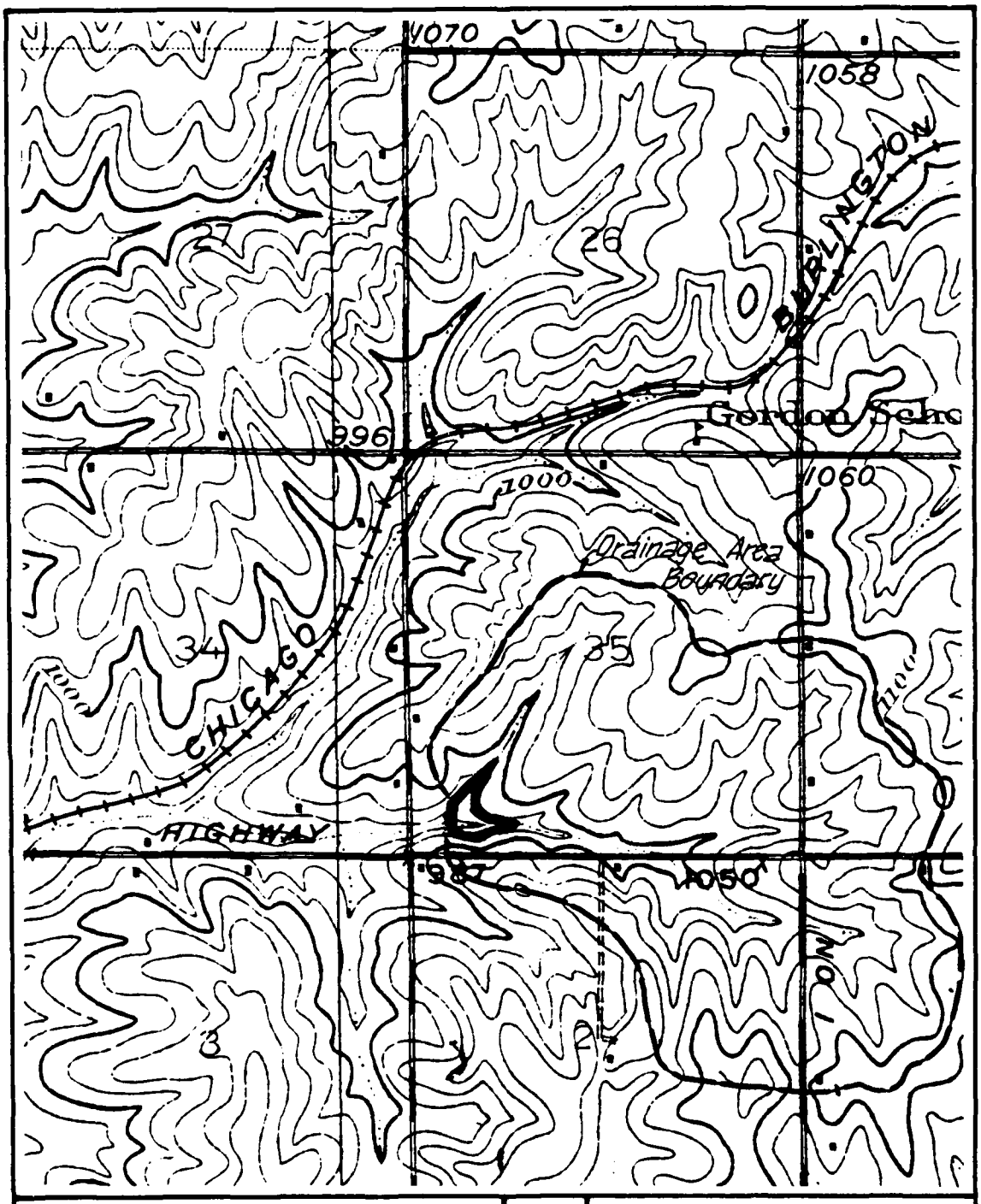
(1) Rodent holes should be eliminated and surface erosion in the left abutment trough and on the downstream slope should be repaired and measures initiated to minimize their recurrence. Elimination of the rodent holes should be done under the guidance of a qualified engineer.

(2) Debris should be removed from the principal spillway riser and a trash rack and anti-vortex device should be installed on the riser.

(3) The barrier across the emergency spillway should be removed or replaced with something that will not collect and accumulate trash and debris.

(4) A program of regular inspection and maintenance should be initiated. The program should include observations and related maintenance measures connected with rodent activity, surface erosion on the downstream slopes of the dam and enlargement or development of transverse cracks on the crest of the dam near the location of the principal spillway.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval 20 Feet

N

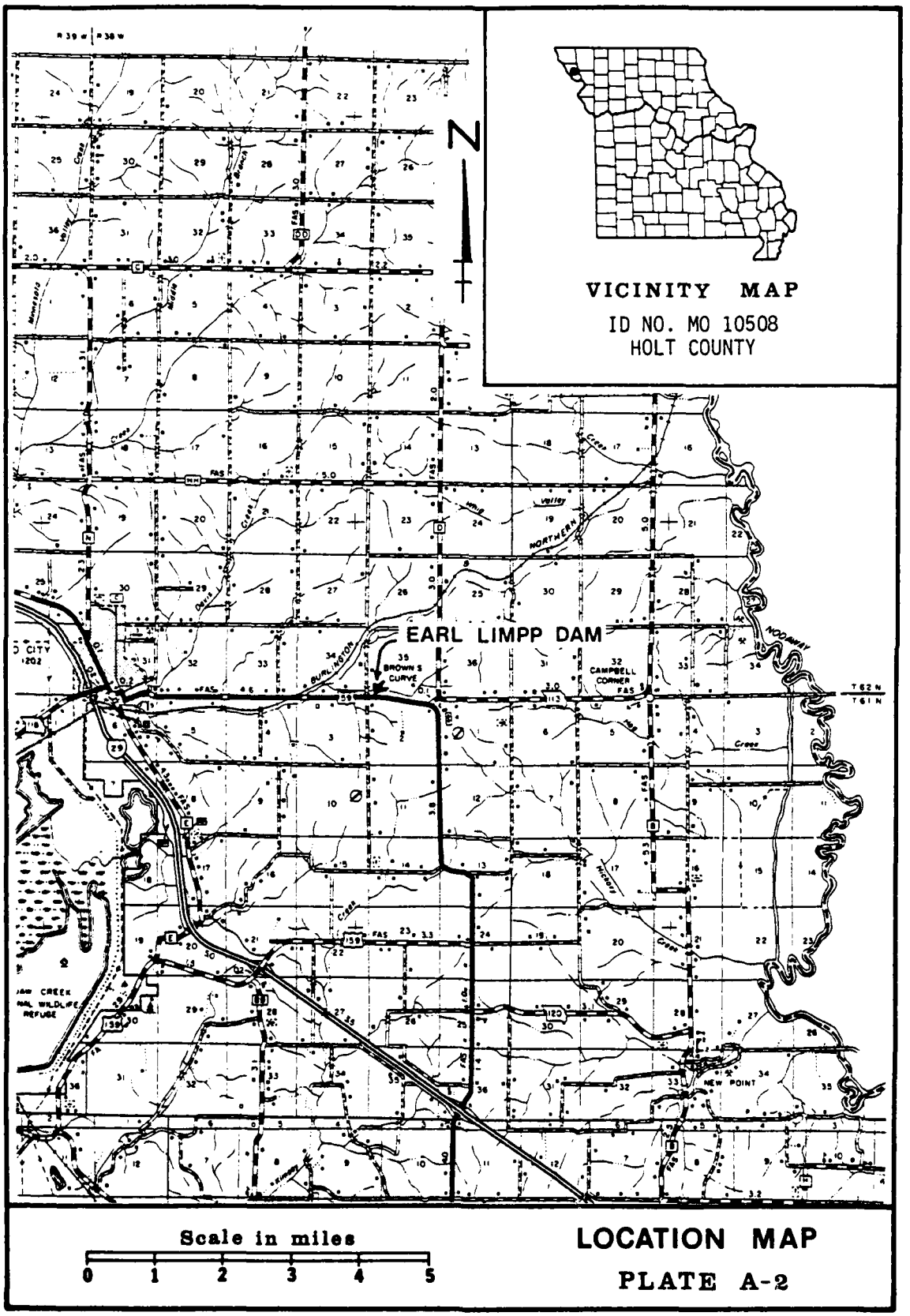
VICINITY TOPOGRAPHY

EARL LIMPP DAM

HOLT COUNTY, MISSOURI

MO. 10508

PLATE A-1


VICINITY MAP
ID NO. MO 10508
HOLT COUNTY
N
EARL LIMPP DAM
BROWN'S CURVE
CAMPBELL CORNER
NEW POINT
T62N
T61N
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

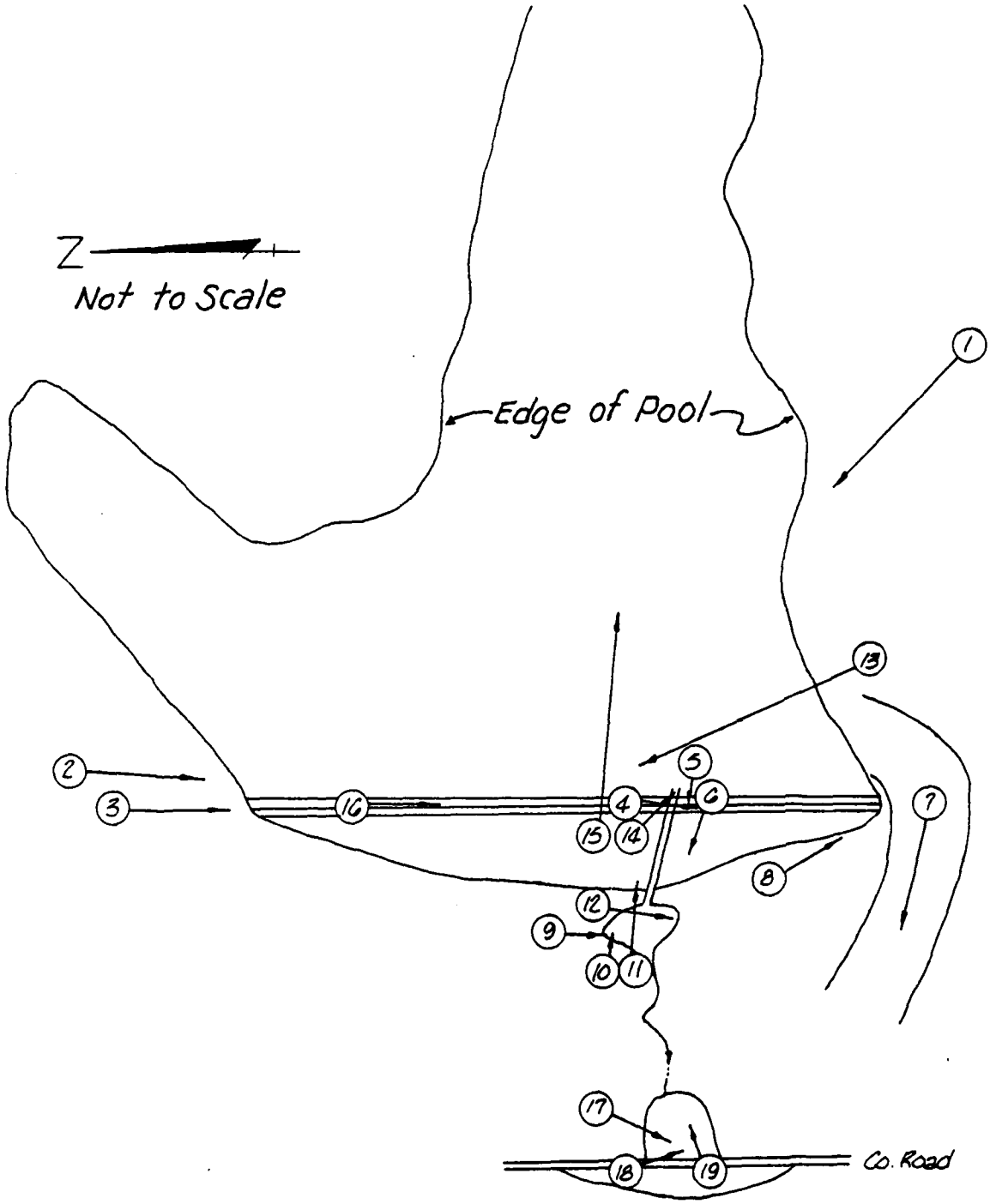


PHOTO INDEX

EARL LIMPP DAM

HOLT COUNTY, MISSOURI

MO. 10508

PLATE B-1

PHOTO NO. 2 - UPSTREAM SLOPE FROM RIGHT ABUTMENT

PHOTO NO. 3 - CREST FROM RIGHT END

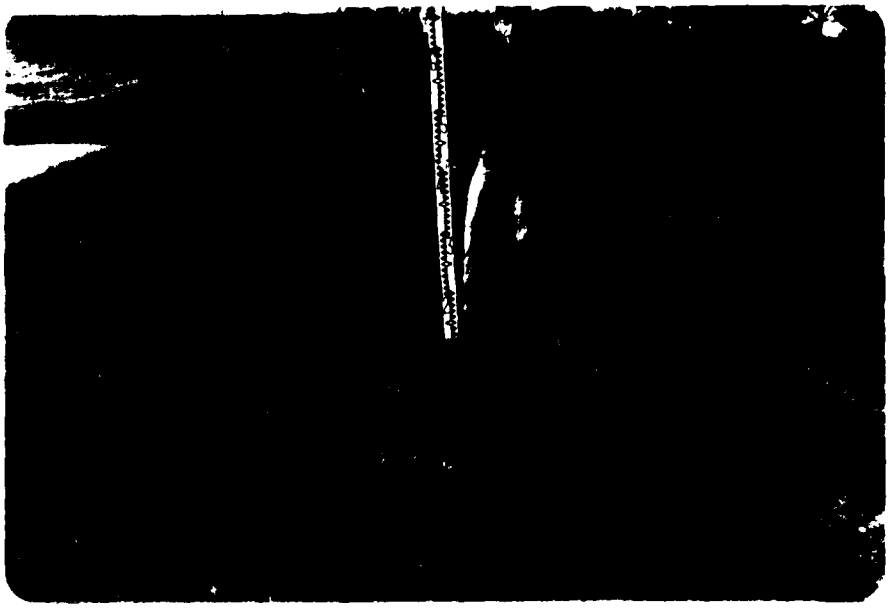


PHOTO NO. 4 - GOPHER HOLE NEAR ℄ STA. 2 + 50. SURVEY ROD SETTING IN HOLE.

PHOTO NO. 5 - TRANSVERSE CRACK ACROSS CREST LEFT OF PIPE SPILLWAY CROSSING

PHOTO NO. 6 - DOWNSTREAM FROM ℄ STA. 3 + 50

PHOTO NO. 7 - LOOKING DOWNSTREAM IN EMERGENCY SPILLWAY

PHOTO NO. 8 -
GULLY EROSION IN LEFT
ABUTMENT TROUGH

PHOTO NO. 9 - BOIL AND SEEPAGE ON RIGHT SIDE OF SPILLWAY
SCOUR HOLE

PHOTO NO. 10 - DISCHARGE FROM BOIL ON LEFT SIDE OF SCOUR HOLE

PHOTO NO. 11 - DOWNSTREAM SLOPE FROM DOWNSTREAM SHOWING GULLY EROSION

PHOTO NO. 12 - SEEPAGE ON LEFT SIDE OF SCOUR HOLE

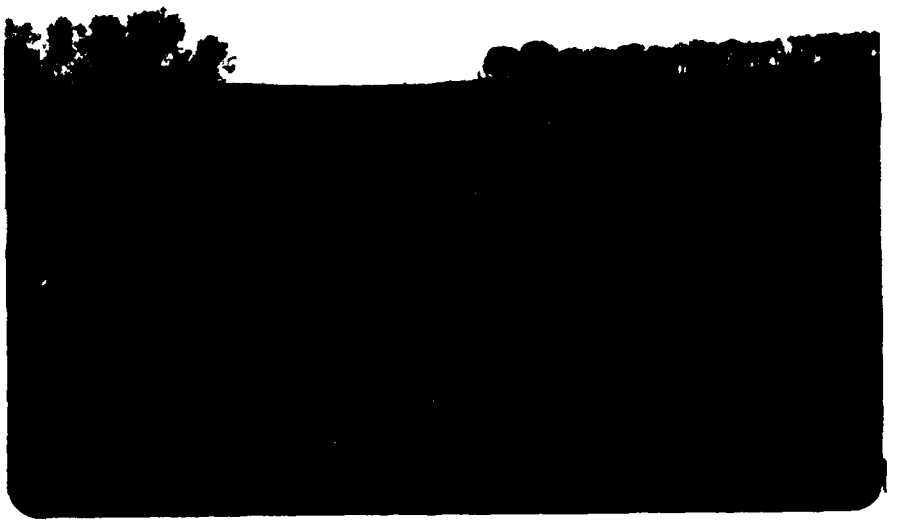


PHOTO NO. 13 - UPSTREAM FROM LEFT SIDE

PHOTO NO. 14 - PRINCIPAL SPILLWAY INLET

PHOTO NO. 15 - LOOKING UPSTREAM FROM ABOUT ℄ STA. 3 + 00

PHOTO NO. 16 - LONGITUDINAL CRACKS - ℄ STA. 3 + 50 to 3 + 74.

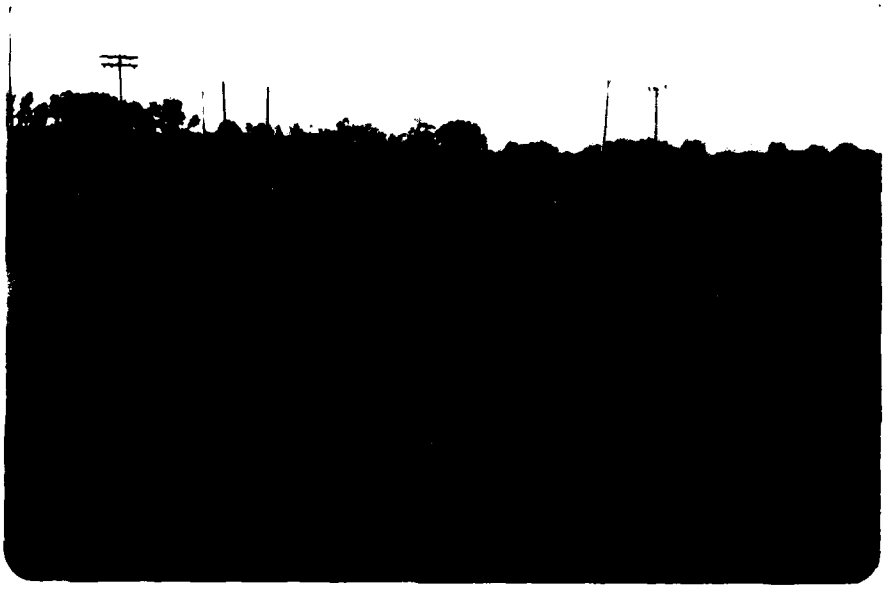


PHOTO NO. 17 - ROAD STRUCTURE DOWNSTREAM FROM DAM

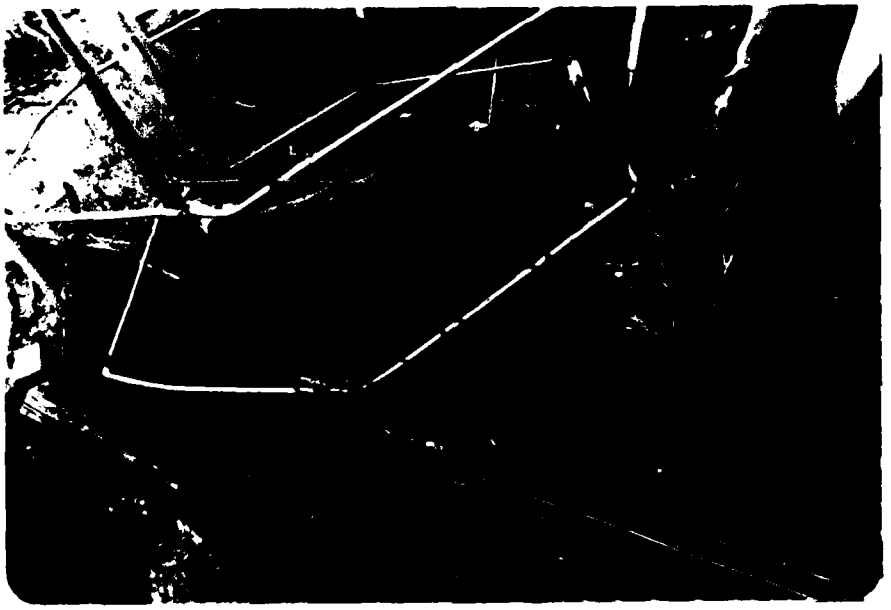
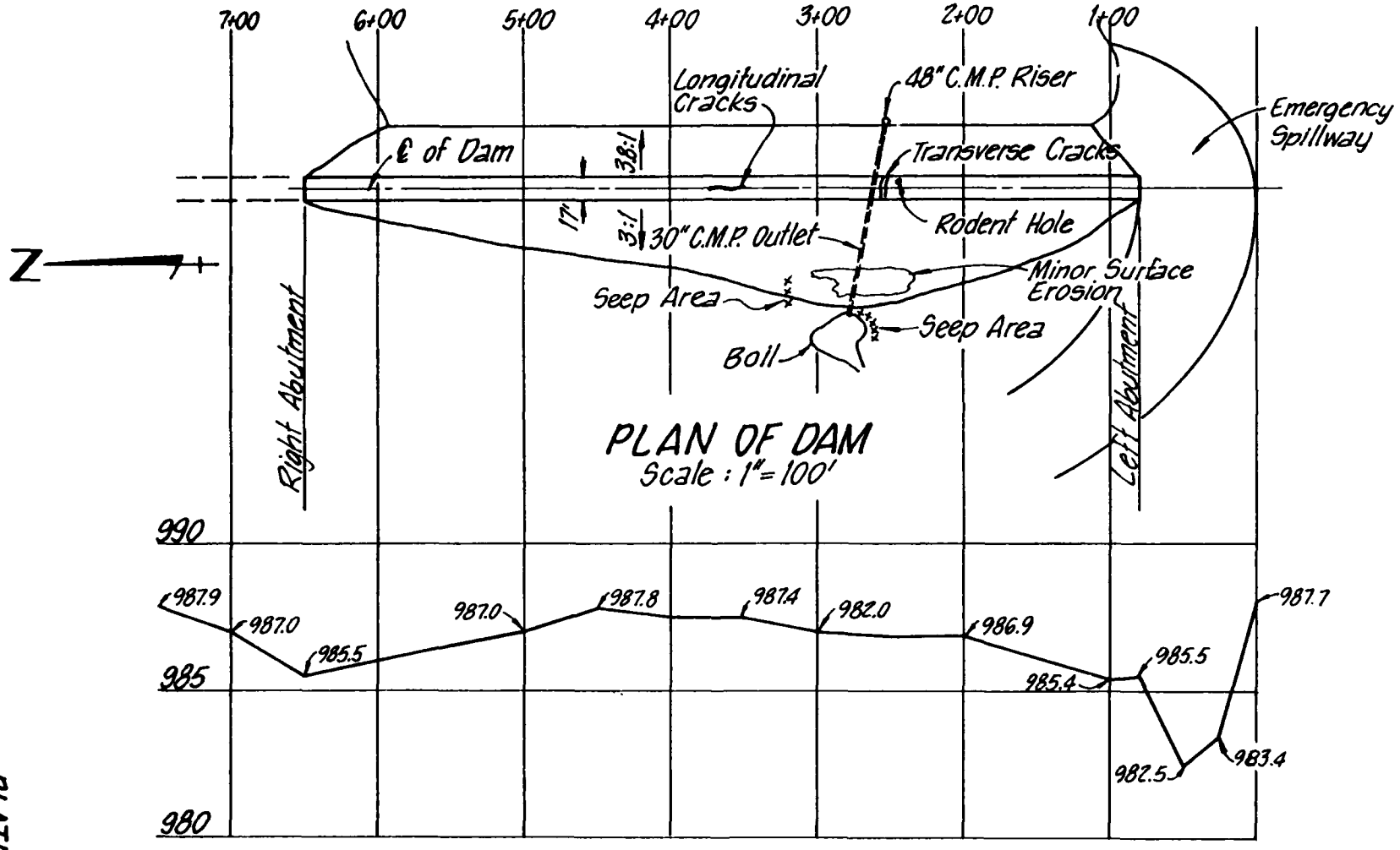


PHOTO NO. 18 - INLET RISER FOR ROAD STRUCTURE

PHOTO NO. 19 - LOOKING UPSTREAM FROM ROAD STRUCTURE. LIMPP DAM IN BACKGROUND

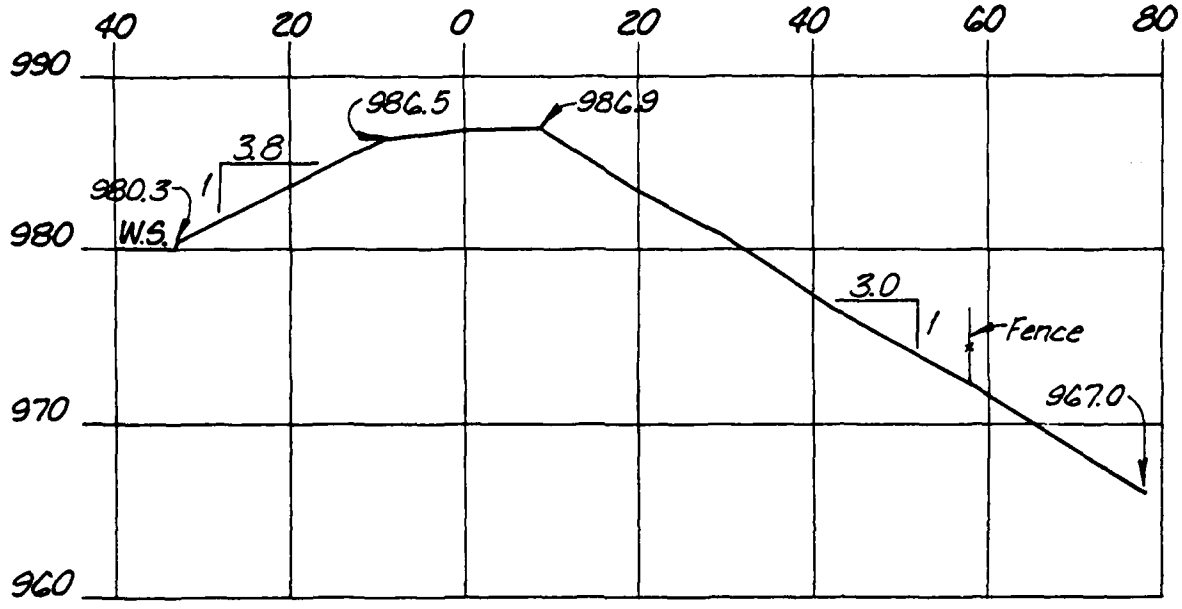
APPENDIX C
PROJECT PLATES



PLAN OF DAM
Scale : 1"= 100'

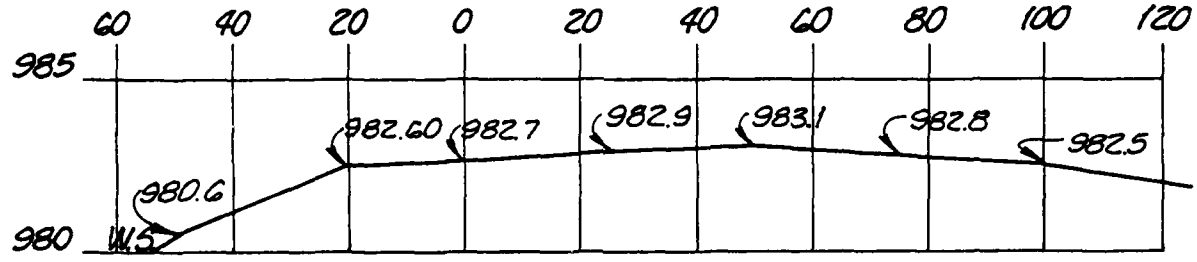
PROFILE ALONG CENTERLINE OF DAM
Scale: 1"= 100' H.
1"= 5' V.

PLATE C-1



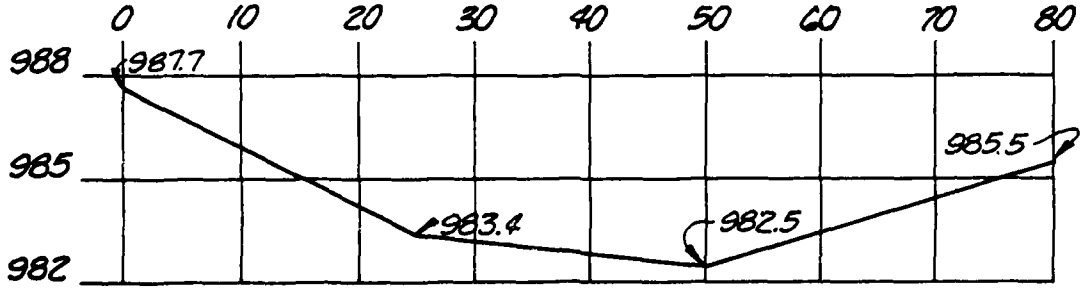
SECTION @ STA. 2+52

Scale : 1" = 20' H.
1" = 10' V.



℄ PROFILE OF SPILLWAY

Scale : 1" = 30' H.
1" = 5' V.



SPILLWAY SECTION (℄ of DAM)

Scale : 1" = 15' H.
1" = 5' V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

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

a. Twenty-four hour, 100-year and 10-year rainfall for the dam location were taken from the data for the rainfall station at Maryville, Missouri as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and Guidance for hydraulics and hydrology.

b. Drainage area = 1.145 square miles (733 acres).

c. Time of concentration of runoff = 35 minutes (computed from "Kirpich" formula).

d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year and 10-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the invert of the principal spillway.

e. The total twenty-four hour storm duration losses for the 100-year storm were 2.86 inches. The total losses for the PMF storm were 1.58 inches. These data are based on SCS runoff curve No. 88 and No. 75 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil group B (Marshal, Shelby, and Wabash Soils) and consists mostly of cropland.

f. Average soil loss rates = 0.07 inch per hour approximately (for PMF storm, AMC III).

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

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

1. Weir Flow equation ($Q = CLH^{1.5}$)
   where C = weir coefficient = 3.1
   L = effective weir length, ft. = 12.57
   H = total head, ft.

2. Full conduit flow equation

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

where a = cross-sectional area of pipe, ft^2 = 4.91
H = total head, ft.
K_e = coefficient for entrance loss = 0.5
K_b = coefficient for bend loss = 0.75
K_p = coefficient for pipe friction loss = 0.0341
L = length of pipe, ft. = 112

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

c. The flows over the dam are based on the broad-crested weir equation ($Q = CLH^{1.5}$) where H is the head on the dam crest, L is the effective length acting as a weir, and C is an appropriate weir coefficient which varies with head and is based on U.S. Geological Survey criteria. The weir coefficient C varied from 2.52 to 3.04 while the effective length varied from 20 to 100 feet depending upon the differences in the profile elevations.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The input and output data sheets for the one-half PMF are attached as Appendix D.

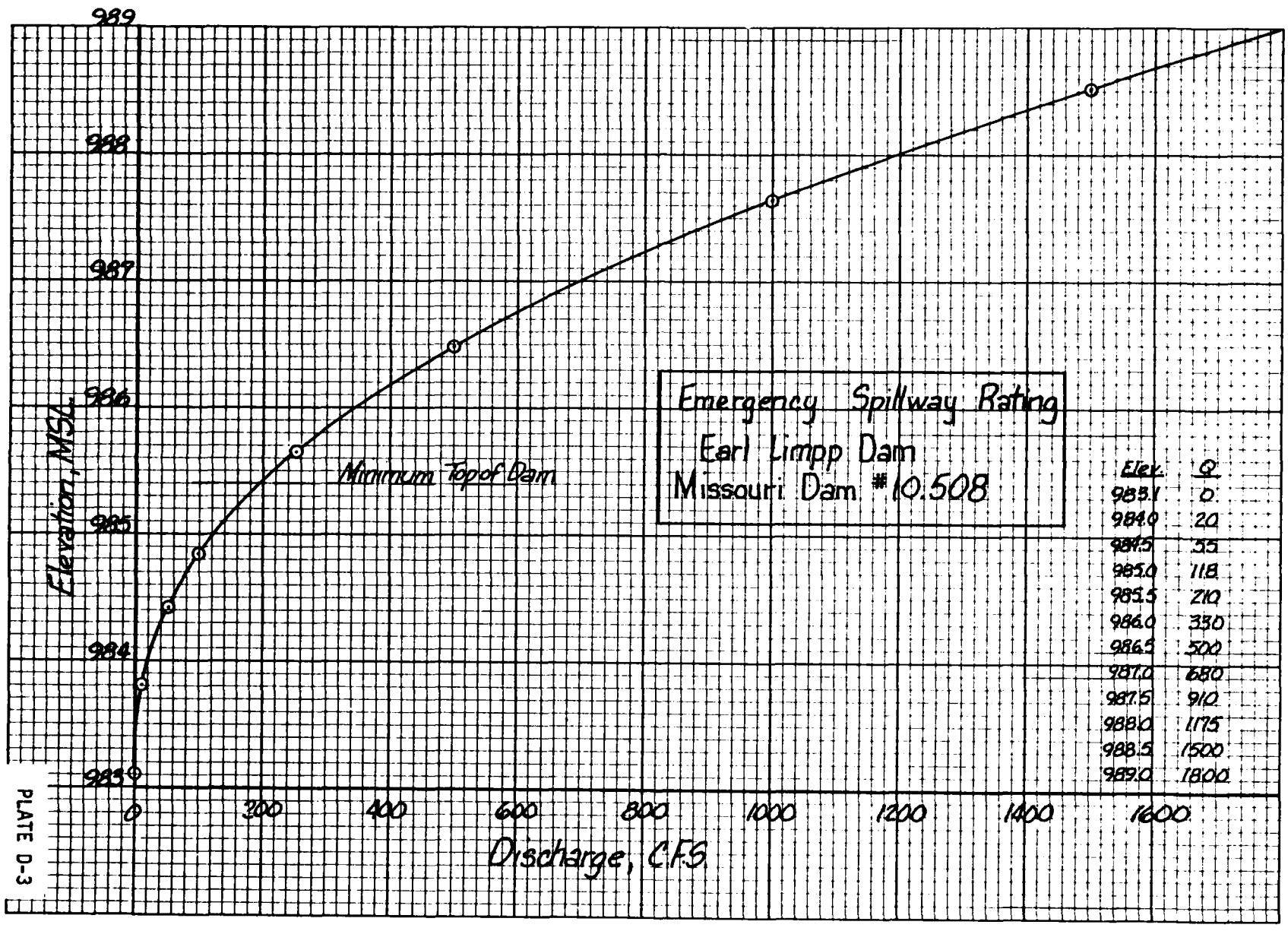

Emergency Spillway Rating
Earl Limpp Dam
Missouri Dam #10.508
Minimum Top of Dam
Elevation, MSL
Discharge, CFS
989
988
987
986
985
984
983
0
200
400
600
800
1000
1200
1400
1600
Elev. Q
983.1 0
984.0 20
984.5 55
985.0 118
985.5 210
986.0 330
986.5 500
987.0 680
987.5 910
988.0 1175
988.5 1500
989.0 1800

PLATE D-3

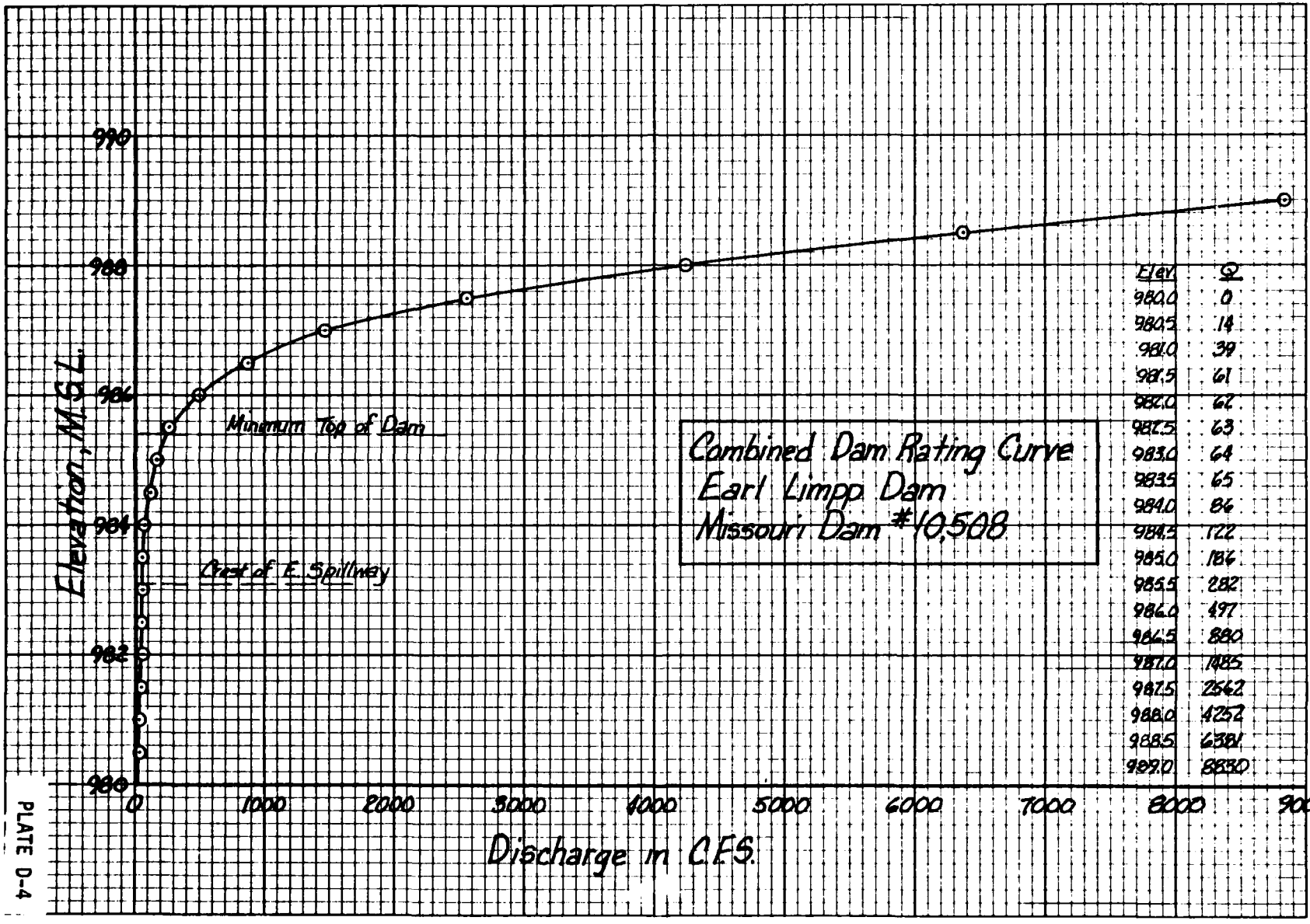

Combined Dam Rating Curve
Earl Limpp Dam
Missouri Dam #10,508
Minimum Top of Dam
Crest of E. Spillway
Elevation M.S.L.
Discharge in C.F.S.
990
988
986
984
982
980
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Elev. Q
980.0 0
980.5 14
981.0 39
981.5 61
982.0 62
982.5 63
983.0 64
983.5 65
984.0 86
984.5 122
985.0 186
985.5 282
986.0 497
986.5 880
987.0 1085
987.5 2562
988.0 4252
988.5 6381
989.0 8830

PLATE D-4

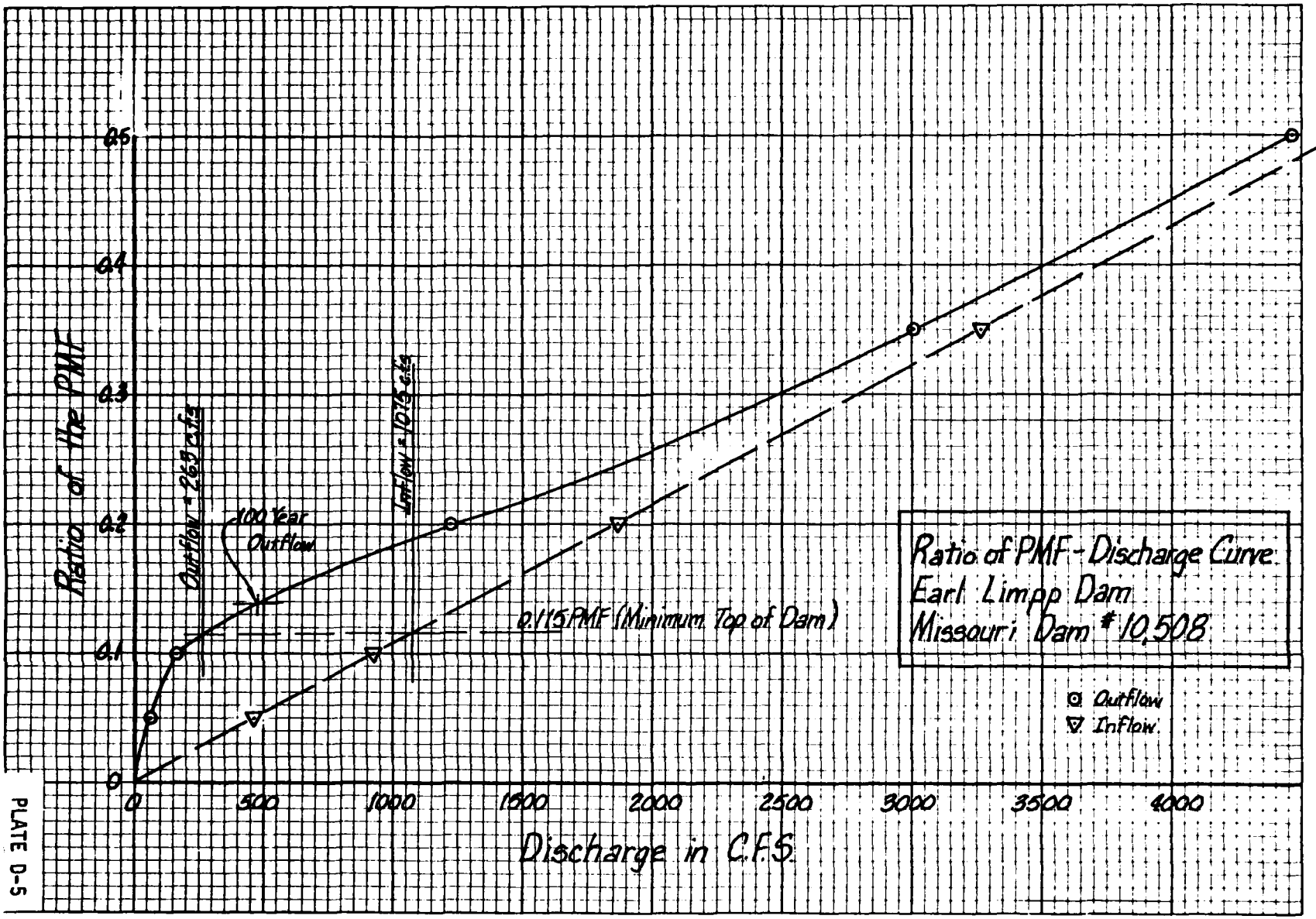

Ratio of the PMF
0.5
0.4
0.3
0.2
0.1
0
Outflow = 265 c.f.s.
100 Year Outflow
Inflow = 1015 c.f.s.
0.115 PMF (Minimum Top of Dam)
Ratio of PMF - Discharge Curve
Earl Limpp Dam
Missouri Dam # 10,508
Outflow
Inflow
0
500
1000
1500
2000
2500
3000
3500
4000
Discharge in C.F.S.

PLATE D-5

```
A1      ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF FARL LIMPP DAM-10508
A3      RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 0C0288C0C0000000Q000005 ____ ___ C0000000000000C000000003
R1000005
J 000001C000000400000001
J10C0.7000000.3500000.5000000.6500000.80000001.0
K CC0J0000000001                        0         00000001
K1      CALCULATION OF INFLOW HYDROGRAPH TO 10508 RES
M 000001000000020001.145 ____ 0001.145000001.0 ___ ___ 00000001
P       000023.80000010200000121000001 30
T                                               -1.     -88.
M2      0000.354
X CC0000-.01    00000001
K 000001000000002                       2         00000001
K1      ROUTED FLOWS THRU 10508 RES
Y                       00000C010000001
Y1000001                                        -990.0        -1
Y40980.0000980.5000981.0000981.5000982.0000982.5000983.0000983.5000984.0000984.5
Y40985.0000985.5000986.0000986.5000987.0000987.5000988.0000988.5000989.0
Y5000100000000140000039000000610000006200000063C0000064000C065000000860000122
Y5000186000002820000049700007880000014850002562000042520000638100008830
$S0000000000146000004000000788000013700000257300006167
$F0960.0000980.0000990.0001000.0001010.0001020.0001040.0
$10979.7
$D0985.4C00003.0000001.500000000
K 000099
A
A
A
A
A
```

PMF
Input Data

PLATE D-6

PMF Output Data

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

RUN  DATE  79/06/21.
     TIME  19.42.28.

                ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
                HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF EARL LIMPP DAM-10508
                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       3       0
                                  JOPER     NWI   LROPT   TRACE
                                      5       0       0       0

                        MULTI-PLAN ANALYSES TO BE PERFORMED
                            NPLAN= 1 NRTIO= 6 LRTIO= 1
                RTIOS=    .20     .35     .50     .65     .80    1.00

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

                            SUB-AREA RUNOFF COMPUTATION

                CALCULATION OF INFLOW HYDROGRAPH TO 10508 RES

                          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    1.15    0.00    1.15    1.00   0.000      0      1      0

                                    PRECIP DATA
                        SPFE     PMS      R6     R12     R24     R48     R72     R96
                        0.00   23.80  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  -88.00    0.00    0.00

          CURVE NO =  -88.00  WETNESS =   -1.00  EFFECT CN =   88.00

                                UNIT HYDROGRAPH DATA
                            TC=   0.00    LAG=   .35

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

          UNIT HYDROGRAPH 23 END OF PERIOD ORDINATES, TC=    0.33 HOURS, LAG=    .25  VOL= 1.00
          153.    481.    994.   1336.   1391.   1238.    987.    664.    465.    317.
          241.    170.    121.     85.     60.     43.     30.     21.     15.     12.
            8.      5.      2.
```

PLATE D-7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4665.	1456.	450.	450.	129661.
CMS	132.	41.	13.	13.	3672.
INCHES		11.83	14.63	14.63	14.63
MM		300.43	371.62	371.62	371.62
AC-FT		722.	893.	893.	893.
THOUS CU M		890.	1101.	1101.	1101.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6065.	1893.	585.	585.	168559.
CMS	172.	54.	17.	17.	4773.
INCHES		15.38	19.02	19.02	19.02
MM		390.56	483.10	483.10	483.10
AC-FT		938.	1161.	1161.	1161.
THOUS CU M		1158.	1432.	1432.	1432.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7464.	2329.	720.	720.	207457.
CMS	211.	66.	20.	20.	5875.
INCHES		18.92	23.41	23.41	23.41
MM		480.68	594.59	594.59	594.59
AC-FT		1155.	1429.	1429.	1429.
THOUS CU M		1425.	1762.	1762.	1762.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9330.	2912.	900.	900.	259322.
CMS	264.	82.	25.	25.	7343.
INCHES		23.66	29.26	29.26	29.26
MM		600.86	743.23	743.23	743.23
AC-FT		1444.	1786.	1786.	1786.
THOUS CU M		1781.	2203.	2203.	2203.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU 10508 RES

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		ISTR
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 -980. -1

STAGE	980.00	980.50	981.00	981.50	982.00	982.50	983.00	983.50	984.00	984.50
	985.00	985.50	986.00	986.50	987.00	987.50	988.00	988.50	989.00	
FLOW	0.00	14.00	39.00	61.00	62.00	63.00	64.00	65.00	86.00	122.00
	186.00	282.00	497.00	880.00	1485.00	2562.00	4252.00	6381.00	8830.00	
CAPACITY=	0.	146.	400.	788.	1370.	2573.	6167.			
ELEVATION=	960.	980.	990.	1000.	1010.	1020.	1040.			

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
979.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
985.4	3.0	1.5	0.

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	2.	2.
2.	2.	2.	2.	2.	2.	2.	3.	3.	3.
4.	4.	5.	5.	6.	6.	7.	7.	8.	9.
9.	10.	10.	11.	11.	12.	12.	13.	14.	14.
16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
26.	27.	28.	29.	30.	31.	32.	32.	33.	34.
35.	36.	37.	38.	39.	40.	40.	41.	42.	43.
43.	44.	45.	45.	46.	47.	47.	48.	49.	49.
50.	51.	51.	52.	53.	54.	54.	56.	58.	60.
61.	61.	61.	61.	62.	62.	62.	62.	62.	62.
63.	63.	63.	63.	63.	63.	64.	64.	64.	64.
64.	65.	65.	67.	72.	77.	82.	87.	96.	104.
112.	120.	132.	146.	159.	175.	199.	242.	320.	471.
710.	936.	1140.	1223.	1220.	1167.	1089.	1001.	916.	852.
805.	761.	722.	687.	657.	630.	605.	582.	560.	538.
517.	498.	488.	479.	471.	463.	455.	447.	436.	422.
402.	379.	353.	327.	300.	279.	268.	257.	246.	236.
226.	216.	207.	198.	190.	183.	178.	173.	168.	164.
159.	155.	151.	146.	143.	139.	135.	132.	128.	125.
122.	120.	118.	117.	115.	113.	112.	110.	109.	107.
106.	104.	103.	102.	100.	99.	98.	96.	95.	94.
93.	91.	90.	89.	88.	87.	86.	85.	85.	84.
84.	83.	82.	82.	81.	81.	80.	80.		

STORAGE

146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
147.	147.	147.	147.	147.	147.	147.	147.	147.	147.
147.	147.	147.	147.	147.	147.	147.	147.	147.	147.

DVN

STATION 000002, PLAN 1, RATIO 3

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.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	2.	2.	2.	2.	2.	2.	2.	3.
3.	3.	3.	3.	3.	3.	4.	4.	4.	4.
4.	4.	4.	5.	5.	5.	6.	7.	7.	8.
9.	11.	12.	13.	14.	17.	19.	22.	24.	26.
29.	31.	34.	36.	39.	41.	43.	45.	47.	50.
52.	54.	56.	58.	60.	61.	61.	61.	61.	61.
62.	62.	62.	62.	62.	62.	62.	62.	62.	62.
63.	63.	63.	63.	63.	63.	63.	63.	63.	64.
64.	64.	64.	64.	64.	64.	64.	64.	64.	65.
65.	65.	65.	66.	68.	71.	74.	78.	82.	90.
101.	113.	129.	152.	175.	203.	236.	268.	318.	384.
445.	507.	599.	676.	742.	797.	843.	881.	930.	968.
1002.	1037.	1074.	1112.	1149.	1182.	1212.	1236.	1257.	1273.
1285.	1292.	1293.	1296.	1315.	1376.	1552.	2018.	2709.	3662.
4250.	4460.	4237.	3829.	3326.	2855.	2486.	2242.	2018.	1829.
1680.	1567.	1483.	1443.	1407.	1374.	1339.	1302.	1261.	1218.
1177.	1140.	1108.	1082.	1060.	1043.	1027.	1006.	969.	908.
843.	774.	697.	618.	544.	484.	447.	412.	380.	349.
321.	296.	278.	268.	259.	250.	241.	233.	225.	218.
211.	204.	198.	192.	186.	182.	179.	175.	172.	169.
166.	163.	160.	157.	155.	152.	150.	147.	145.	143.
140.	138.	136.	134.	132.	131.	129.	127.	125.	124.
122.	121.	121.	120.	119.	118.	117.	117.	116.	115.
115.	114.	113.	113.	112.	111.	111.	110.		

STORAGE

146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	147.	147.	147.	147.	147.	147.	147.	147.	147.
147.	147.	147.	148.	148.	148.	148.	148.	148.	148.
148.	149.	149.	149.	149.	149.	149.	149.	149.	150.
150.	150.	150.	150.	150.	151.	151.	152.	153.	154.
155.	156.	157.	158.	159.	160.	161.	163.	164.	165.
166.	167.	169.	170.	171.	173.	174.	175.	176.	178.
179.	180.	181.	183.	184.	185.	186.	187.	189.	190.
191.	193.	194.	195.	196.	198.	199.	200.	202.	203.
204.	206.	207.	208.	210.	211.	212.	214.	215.	216.
218.	219.	220.	222.	223.	224.	226.	227.	229.	230.
231.	233.	234.	235.	237.	238.	240.	242.	245.	249.
253.	257.	262.	266.	271.	275.	280.	284.	288.	292.
295.	299.	302.	304.	307.	308.	310.	311.	312.	313.
314.	314.	315.	316.	317.	317.	318.	319.	319.	319.
320.	320.	320.	320.	320.	322.	325.	330.	338.	345.
349.	350.	349.	346.	342.	339.	336.	333.	330.	328.
326.	325.	324.	323.	322.	321.	321.	320.	319.	318.
317.	317.	316.	315.	315.	315.	314.	314.	313.	312.
310.	308.	305.	302.	300.	298.	295.	293.	291.	290.
288.	287.	285.	284.	283.	281.	280.	279.	278.	277.

PLATE D-10

276.	275.	275.	274.	273.	272.	272.	271.	270.	270.
269.	268.	268.	267.	267.	266.	266.	265.	265.	264.
264.	264.	263.	263.	262.	262.	262.	261.	261.	261.
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258.	257.	257.	257.	257.	256.	256.	256.		

STAGE

980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0
980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0
980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0
980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0
980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0	980.0
980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1
980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1	980.1
980.1	980.2	980.2	980.2	980.2	980.2	980.2	980.2	980.3	980.3
980.3	980.4	980.4	980.5	980.5	980.6	980.6	980.7	980.7	980.7
980.8	980.8	980.9	980.9	981.0	981.0	981.1	981.1	981.2	981.2
981.3	981.3	981.4	981.4	981.5	981.5	981.6	981.6	981.7	981.7
981.8	981.8	981.9	981.9	982.0	982.0	982.1	982.1	982.2	982.2
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985.9	986.0	986.1	986.2	986.3	986.4	986.5	986.5	986.5	986.6
986.6	986.6	986.7	986.7	986.7	986.7	986.8	986.8	986.8	986.8
986.8	986.8	986.8	986.8	986.9	986.9	987.0	987.2	987.5	987.8
988.0	988.0	988.0	987.9	987.7	987.6	987.5	987.4	987.2	987.2
987.1	987.0	987.0	987.0	986.9	986.9	986.9	986.8	986.8	986.8
986.7	986.7	986.7	986.7	986.6	986.6	986.6	986.6	986.6	986.5
986.5	986.4	986.3	986.2	986.1	986.0	985.9	985.8	985.7	985.7
985.6	985.5	985.5	985.4	985.4	985.3	985.3	985.2	985.2	985.2
985.1	985.1	985.1	985.0	985.0	985.0	984.9	984.9	984.9	984.9
984.8	984.8	984.8	984.8	984.8	984.7	984.7	984.7	984.7	984.7
984.6	984.6	984.6	984.6	984.6	984.6	984.6	984.5	984.5	984.5
984.5	984.5	984.5	984.5	984.5	984.4	984.4	984.4	984.4	984.4
984.4	984.4	984.4	984.4	984.4	984.4	984.3	984.3		

PEAK OUTFLOW IS 4460. AT TIME 16.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4460.	1376.	395.	395.	113699.
CMS	126.	39.	11.	11.	3220.
INCHES		11.18	12.83	12.83	12.83
MM		284.03	325.87	325.87	325.87
AC-FT		683.	783.	783.	783.
THOUS CU M		842.	966.	966.	966.

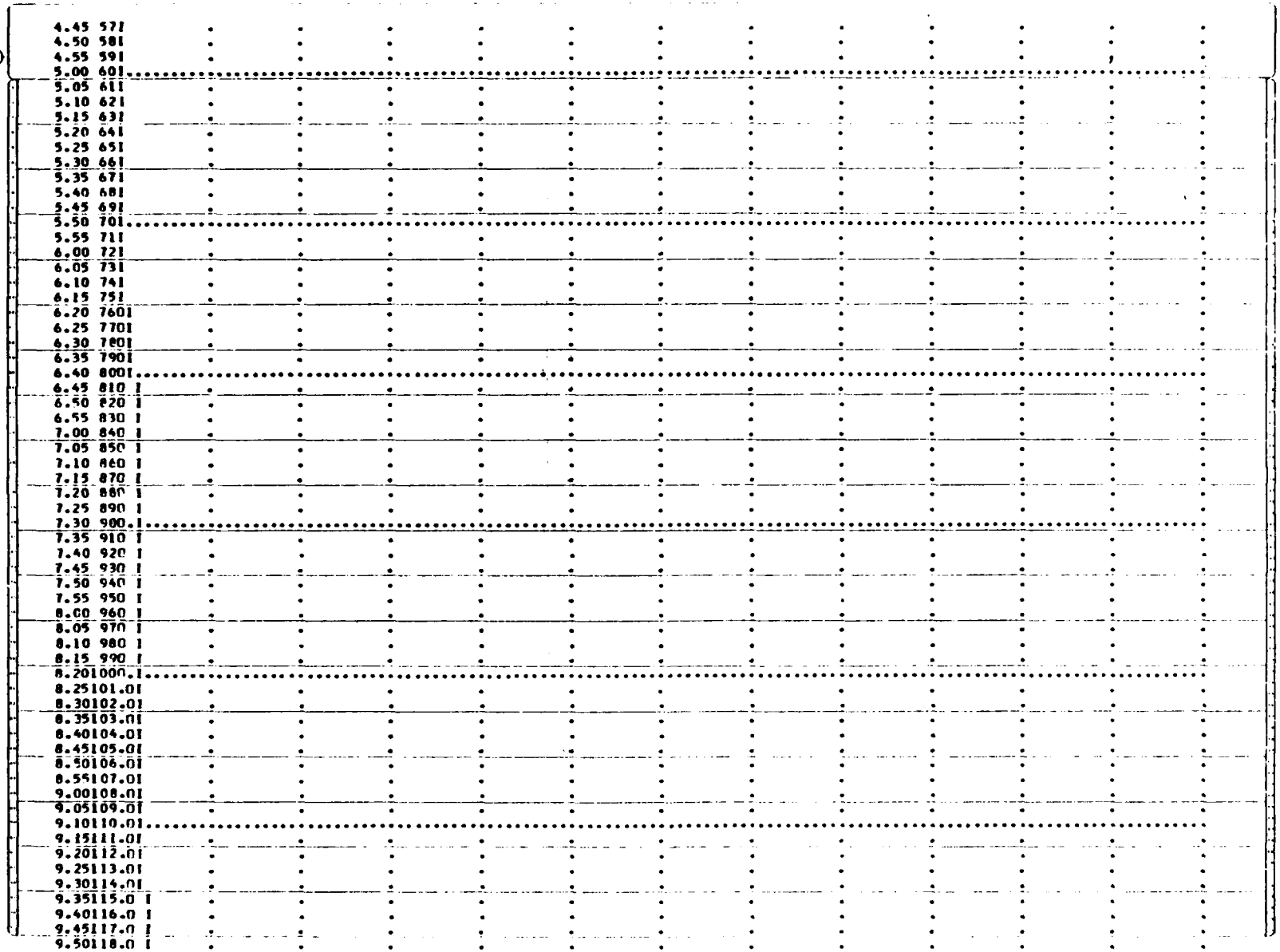
MVF

STATION000002

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

	0.	1000.	2000.	3000.	4000.	5000.	0.	0.	0.	0.	0.	0.	0.
.05	11												
.10	21												
.15	31												
.20	41												
.25	51												
.30	61												
.35	71												
.40	81												
.45	91												
.50	101												
.55	111												
1.00	121												
1.05	131												
1.10	141												
1.15	151												
1.20	161												
1.25	171												
1.30	181												
1.35	191												
1.40	201												
1.45	211												
1.50	221												
1.55	231												
2.00	241												
2.05	251												
2.10	261												
2.15	271												
2.20	281												
2.25	291												
2.30	301												
2.35	311												
2.40	321												
2.45	331												
2.50	341												
2.55	351												
3.00	361												
3.05	371												
3.10	381												
3.15	391												
3.20	401												
3.25	411												
3.30	421												
3.35	431												
3.40	441												
3.45	451												
3.50	461												
3.55	471												
4.00	481												
4.05	491												
4.10	501												
4.15	511												
4.20	521												
4.25	531												
4.30	541												
4.35	551												
4.40	561												

PLATE D-12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5.05 611
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5.15 631
5.20 641
5.25 651
5.30 661
5.35 671
5.40 681
5.45 691
5.50 701
5.55 711
6.00 721
6.05 731
6.10 741
6.15 751
6.20 7601
6.25 7701
6.30 7801
6.35 7901
6.40 8001
6.45 810 I
6.50 820 I
6.55 830 I
7.00 840 I
7.05 850 I
7.10 860 I
7.15 870 I
7.20 880 I
7.25 890 I
7.30 900.I
7.35 910 I
7.40 920 I
7.45 930 I
7.50 940 I
7.55 950 I
8.00 960 I
8.05 970 I
8.10 980 I
8.15 990 I
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PLATE D-13

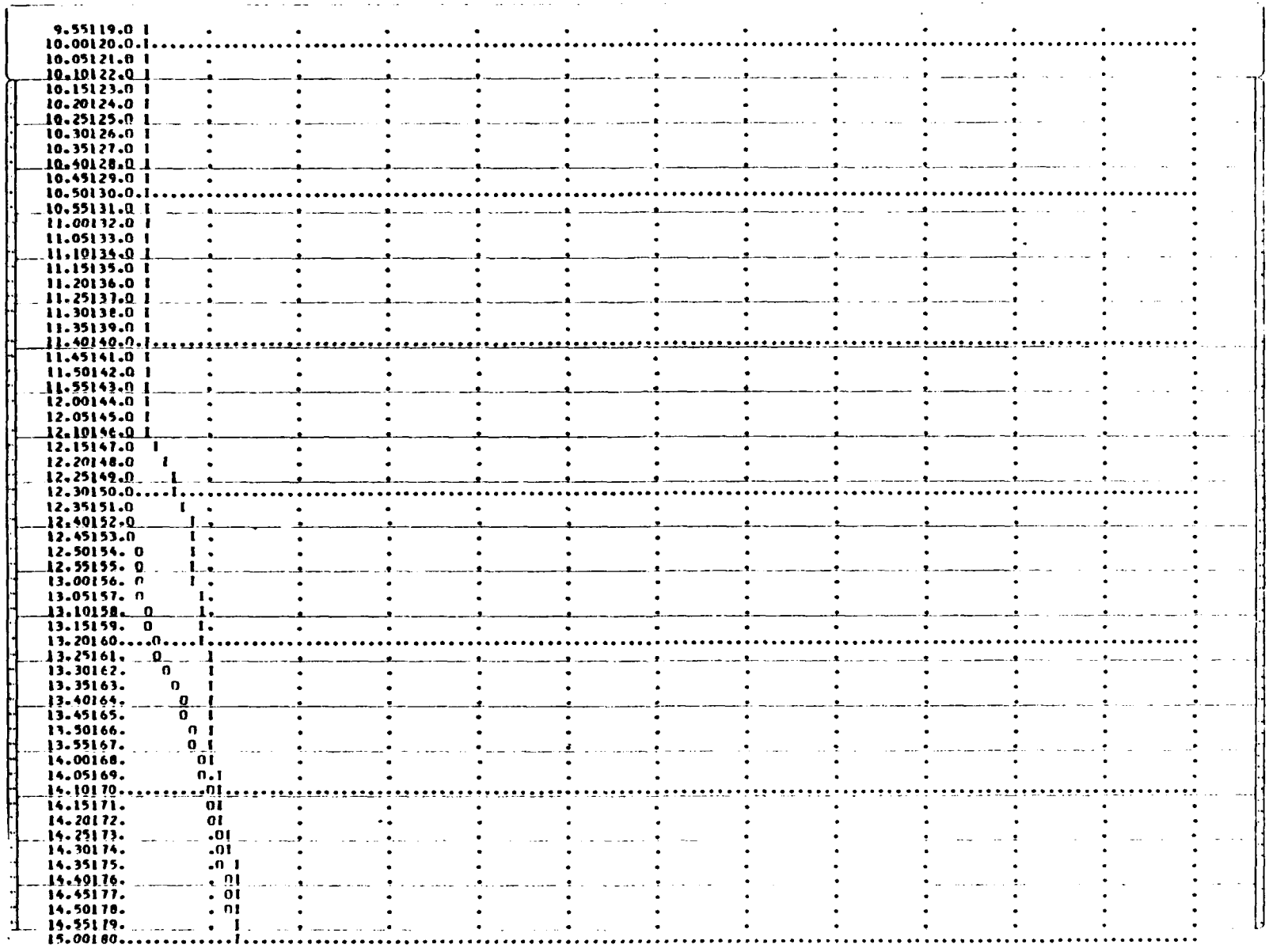
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PLATE D-14

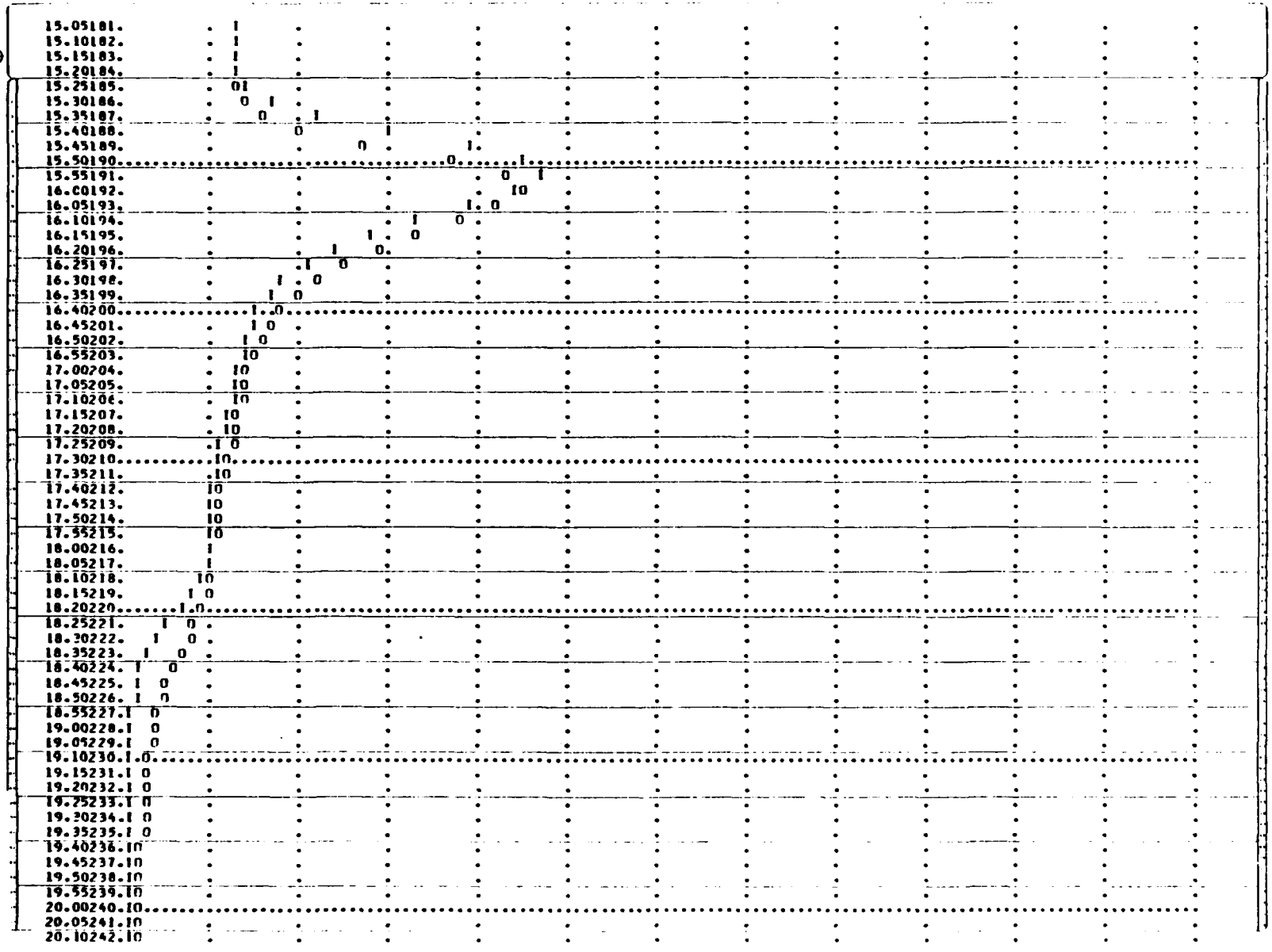
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PLATE D-15

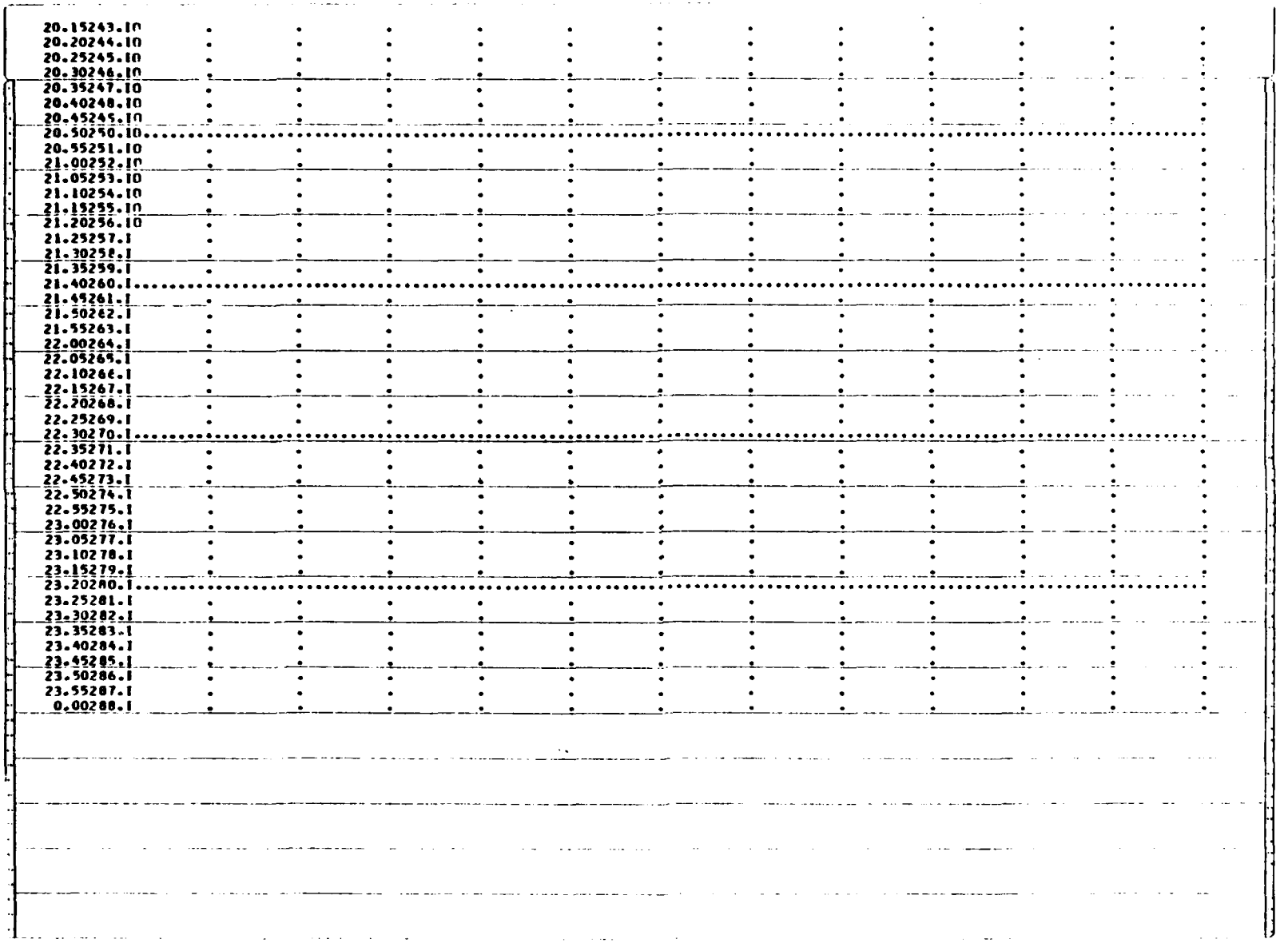

PLATE D-16

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 .20	RATIO 2 .35	RATIO 3 .50	RATIO 4 .65	RATIO 5 .80	RATIO 6 1.00
HYDROGRAPH AT	000001	1.15	1	1866.	3266.	4665.	6065.	7464.	9330.
		(2.97)	(	52.84)(	92.47)(	132.10)(	171.73)(	211.36)(	264.20)(
ROUTED TO	000002	1.15	1	1223.	3009.	4460.	5848.	7232.	9050.
		(2.97)	(	34.64)(	85.21)(	126.29)(	165.59)(	204.79)(	256.27)(

PLATE D-17

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	980.00	979.70	985.40
STORAGE	146.	144.	283.
OUTFLOW	0.	0.	263.

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
.20	986.78	1.38	318.	1223.	3.25	16.17	0.00
.35	987.63	2.23	340.	3009.	5.17	16.00	0.00
.50	988.05	2.65	350.	4460.	6.42	16.00	0.00
.65	988.37	2.97	359.	5848.	7.08	16.00	0.00
.80	988.67	3.27	366.	7232.	7.92	16.00	0.00
1.00	989.04	3.64	376.	9050.	9.42	16.00	0.00

PLATE D-18

END

DATE
FILMED

11-81

DTIC