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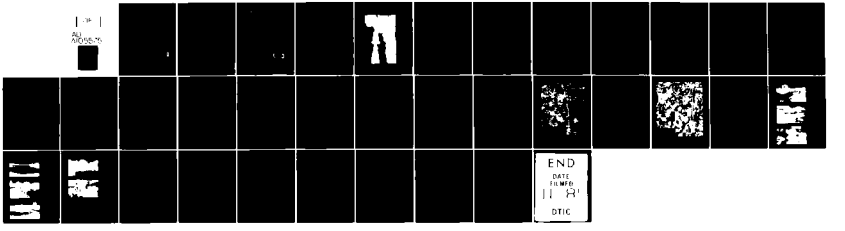

MISSOURI LEVEL II

MISSOURI-GRAND-CHARITON BASIN

AD A105575

HIDDEN VALLEY LAKE DAM

MERCER COUNTY, MISSOURI

MO 10665

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.

FOR: STATE OF MISSOURI

JULY, 1978

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Phase I Dam Inspection Report
National Dam Safety Program
Hidden Valley Lake Dam (MO 10665)
Mercer County, Missouri

5. TYPE OF REPORT & PERIOD COVERED
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6. PERFORMING ORG. REPORT NUMBER

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Dam Inventory and Inspection Section, LMSED-PD
210 Tucker Blvd., North, St. Louis, Mo. 63101

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11. CONTROLLING OFFICE NAME AND ADDRESS
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Dam Inventory and Inspection Section, LMSED-PD
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12. REPORT DATE
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18. SUPPLEMENTARY NOTES

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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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

IN REPLY REFER TO

SUBJECT: Hidden Valley Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Hidden Valley Lake Dam.

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

The St. Louis District has classified this dam as unsafe, non-emergency because the spillway will not pass 50 percent of the Probable Maximum Flood.

SUBMITTED BY: SIGNED
Chief, Engineering Division

25 SEP 1978
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

25 SEP 1978
Date

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Hidden Valley Lake Dam
State Located	Missouri
County Located	Mercer County
Stream	Pops Branch
Date of Inspection	July 14, 1978

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

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends three miles downstream of the dam. Within the damage zone are five mobile homes and one farmhouse with outbuildings.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 19% 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. Additional deficiencies, in accordance with the guidelines, are the lack of seepage and stability analysis. These analyses should be obtained in the future.

Other deficiencies visually observed by the inspection team were erosion along and under the pipe spillway, outlet end of pipe spillway submerged about one-half pipe diameter, severe erosion of the emergency spillway channel and dense growth of trees and brush in the channel downstream from the pipe spillway.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report. Copies of the report have been furnished the dam owner and the Governor of Missouri.

H.P. Hoskins E8696

Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

SUBMITTED BY SIGNED — 25 SEP 1978 (Date)

APPROVED BY SIGNED — 25 SEP 1978 (Date)

Colonel, CE, District Engineer

PHOTOGRAPH NO. 1
OVERVIEW OF LAKE AND DAM,
TAKEN FROM NORTH LOOKING
SOUTH. DAM IN CENTER OF
PHOTOGRAPH.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HIDDEN VALLEY LAKE DAM - MO 10665

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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 the Hidden Valley Lake Dam be made.

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

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) This dam is an earth fill located just downstream from the confluence of the drainageway that supplies Lake Marie and the drainageway that supplies Twin Lakes and Berndt Lake. The upper reaches of Hidden Valley Lake are approximately 500 feet downstream from the Lake Marie Dam and 1200 feet downstream from Twin Lake Dam. The orthophotoquad in Plate 3 shows the location of Hidden Valley Dam in relation to the three upstream dams.

(2) The primary spillway consists of an uncontrolled 30-inch diameter corrugated metal pipe located at about ℄ station 1+80.

(3) An uncontrolled emergency spillway is cut into the left (east) abutment.

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

b. Location. The dam is located in the north central portion of Mercer County, Missouri, as shown on Plate 2. The lake formed by the dam is located in the NE 1/4 of Section 36, T66N, R24W as shown on Plate 1. The lake is also shown on the Princeton NE Orthophotoquad (Plate 3).

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 c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends three miles downstream of the dam. Within the damage zone are five mobile homes and one farmhouse with outbuildings.

e. Ownership. This dam is owned by the Lake Marie Lot Owners Association, c/o Mary Berndt, Mercer, Missouri 64661.

f. Purpose of Dam. The dam forms a 14 acre recreational lake.

g. Design and Construction History. No design or construction data were available for this dam. It was reported that the dam was designed by an engineer in Illinois and that the dam was built in 1972 by Kent Construction Company from Iowa. It was also reported that the emergency spillway was repaired this year (1978). Repair consisted of placing loose rock in the bottom of the channel for about 30 feet downstream from the inlet and installing a series of woven wire checks across the eroded channel downstream from the rock placement.

h. Normal Operating Procedure. There are no controlled outlet works for this dam. It was reported that the lake level fluctuates about 2 feet between wet and dry years. It was also reported that the emergency spillway operates every year. Flow 1 to 1.5 feet in depth passed through the emergency spillway in 1978.

1.3 PERTINENT DATA

a. Drainage Area.

(1) Total drainage area (includes Berndt Lake, Twin Lake, and Lake Marie) - 1204 acres.

(2) Hidden Valley watershed only - 262 acres.

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled corrugated metal pipe principal spillway and an earth channel ungated emergency spillway.

(2) Estimated maximum flood at damsite - 800 c.f.s. ± which occurred in the spring of 1978.

(3) The principal spillway capacity varies from 0 c.f.s. at the invert elevation (910.0±) to 11 c.f.s. at the crest of the emergency spillway (911.5±).

(4) The principal spillway capacity at maximum pool elevation (913.3±) is 70 c.f.s. Maximum pool is assumed to be lowest elevation of dam crest.

(5) The emergency spillway capacity at maximum pool elevation is 765 c.f.s.

(6) The total spillway capacity at maximum pool elevation is 835 c.f.s.

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

(1) Top of dam - 913.3±

(2) Spillway -

(a) Primary, 30 CMP, invert - 910 ±.

(b) Emergency - 911.5 ±.

(3) Streambed at centerline of dam - 887 ±.

(4) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 1700 feet ±.

e. Storage (Acre-Feet). Top of dam - 100.

f. Reservoir Surface (Acres). Top of dam - 15 acres ±.

g. Dam.

(1) Type - earth embankment.

(2) Length - 440 feet ±.

(3) Height - 26 feet ±.

(4) Top width - 44 feet ±.

(5) Side slopes -

(a) Downstream - 3H on 1V (measured with hand level).

(b) Upstream - exposed section = 4:1.

(6) Zoning - unknown.

(7) Impervious core - unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

(10) Riprap - upstream slope riprapped with limestone rock.

h. Diversion and Regulating Tunnel. None.

i. Spillway.

(1) Principal -

(a) Type - 30" diameter corrugated metal pipe.

(b) Length of conduit - approximately 114 feet.

(c) Invert elevation - 910 feet m.s.l.

(2) Emergency -

(a) Type - an earth channel plated with loose limestone rock.

(b) Control section - a parabolic section approximately 75± feet in length and 1.8 feet below top of dam.

(c) Crest elevation - 911.5 feet m.s.l.

(d) Upstream channel - unobstructed.

(e) Downstream channel - badly eroded, four woven wire check dams were present within first 55 feet.

j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were readily available.

2.2 CONSTRUCTION

The dam was constructed in 1972. No other construction data were available.

2.3 OPERATION

No data on the operation of the spillways were available. It was reported that the emergency spillway operated this spring (1978) and caused considerable erosion in the spillway channel.

2.4 EVALUATION

a. Availability. No data were available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Hidden Valley Lake Dam was made on July 14, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska who made the inspection were: Rey S. Decker, Geology and Soil Mechanics, Garold Ulmer, Civil Engineer and Richard Walker, Hydrology. Specific observations are discussed below.

b. Dam. The upstream slope is covered with loose rock riprap consisting of moderately durable limestone. The riprap extends to within about 1 foot of the crest elevation of the dam. The downstream slope is well vegetated with grasses and sweet clover. Rough measurements along the crest of the dam indicate that the central portion is about 1 foot lower than the ends of the dam (see Appendix C).

No cracks, slides or abnormal deformations were noted in the embankment. No seepage was apparent on the downstream slope nor along the toe of the dam. No slides or seepage was noted in the abutments. Material in the abutments consists of CL or CH soils. The top of the dam is covered with road gravel.

c. Appurtenant Structures. The principal spillway consists of a 30-inch corrugated metal pipe passing through the dam at about ℄ station 1+80 (see Appendix C). A number of holes have been eroded along the sides and bottom of the outlet pipe. These holes extend from the downstream crest of the dam down to the outlet end and some of them appeared to extend under the pipe. The outlet end of the pipe was submerged about one half diameter at the time of the inspection. The reservoir level was about 0.5 foot above the invert elevation of the spillway inlet. Rough measurements indicate that there is about 3 feet of freeboard between the invert of the primary spillway and the top of the dam.

The emergency spillway consists of a parabolic channel cut into the left abutment. At the center line of the dam, the spillway has a maximum width of 75 feet ± and a maximum depth of 1.8 feet ± below the elevation of the top of the dam. There is no defined inlet or forebay section. The parabolic section extends about 15 feet upstream from the ℄ of the dam and about 25 feet downstream from ℄ of dam. The bottom 30 feet ± of this section has been plated with loose limestone rock to a depth of 1 to 1.5 feet. (This was reportedly done this spring.) The outlet channel downstream from the plated section was badly eroded. The bottom of the gully was 10 to 12 feet wide and the side slopes were nearly vertical. A series of four woven wire check dams had been constructed in the gully. The last or fourth check dam was approximately 55 feet downstream from the rock plated section. A deep narrow gully extended downstream from the last wire check dam.

d. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore.

e. Downstream Channel. Spillway discharge flows through a badly eroded gully. The channel downstream from the primary spillway channel is overgrown with trees and brush.

Three permanent trailer homes are located in the flood plain just downstream from the dam.

3.2 EVALUATION

Any significant flow through the emergency spillway could result in serious erosion and head cutting of the exit channel into the reservoir. Overtopping of the dam would cause erosion around and under the principal spillway which would result in serious potential of failure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillways. It was reported that water flowed through and damaged the emergency spillway this spring (1978).

4.2 MAINTENANCE

The heavy growth of trees and brush in the downstream channel from the primary spillway and the erosion along the sides and bottom of the outlet pipe indicate the lack of regular maintenance operations.

4.3 MAINTENANCE AND OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any warning system in effect for this dam.

4.5 EVALUATION

A serious potential of failure may result if the deficiencies noted in the spillways are not corrected.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No original hydrologic data were received from the owner.

b. Experience Data. The drainage area and lake surface area are developed from U.S.G.S. Princeton, MO (15') Quadrangle. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations.

(1) The principal spillway was eroded and possibly undermined along the sides of the outlet pipe from the downstream crest of the dam to the outlet.

(2) The principal spillway outlet was submerged at the time of inspection.

(3) The emergency spillway and exit channel are in the left abutment of the dam. The exit channel was badly eroded. Spillway releases could possibly endanger the integrity of the dam.

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. One-half the PMF will overtop the dam by 1.45 feet for a period of 6 hours. The 100-year frequency flood will overtop the dam by 0.19 feet for a period of 2 1/2 hours. The spillways will pass the 0.19 PMF without overtopping. 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. 913.3	Time Dam Overtopping Hr.
100 Yr.	1126	1060	913.49	-0.19	2.5
1/2 PMF	3485	*3562	914.75	-1.45	6.0
PMF	9929	9615	916.58	-3.28	10.0
0.19 PMF	1037	434	913.30	0	0

*Discrepancy due to inaccuracy of elevation-storage curves.

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

The St. Louis District, Corps of Engineers, in a letter dated 13 July, 1978 has estimated the damage zone as extending three miles downstream of the dam. Within the damage zone are five mobile homes and one farmhouse with outbuildings.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of deficiencies which adversely affect structural stability of this dam are discussed in Section 3.

b. Design and Construction Data. No design or construction data were available.

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

d. Post Construction Changes. It was reported that the rock plating and the wire check dams were installed in the emergency spillway after flows in the spillway caused serious erosion during the spring of 1978.

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

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The visually observed deficiencies in the stability of the emergency spillway and the primary spillway outlet should be corrected. The maximum design flood and floods caused by the 0.19 PMF discharges from Lake Marie, Twin Lakes and Berndt Lake will overtop the dam.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report were based upon performance history, and visual observations. Neither seepage or stability analyses were found which is a deficiency that should be corrected in the future. The inspection team considers that these data are sufficient to support the conclusion herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph "a", above, are not corrected in the near future, they will continue to deteriorate and lead to serious potential of failure.

d. Necessity for Phase II. Phase II investigation is not called for. However, additional engineering data should be obtained at the owners expense prior to increasing the height of the dam and/or constructing a new spillway that is adequately sized and stable with respect to damage from erosion (see paragraph 7.2).

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.

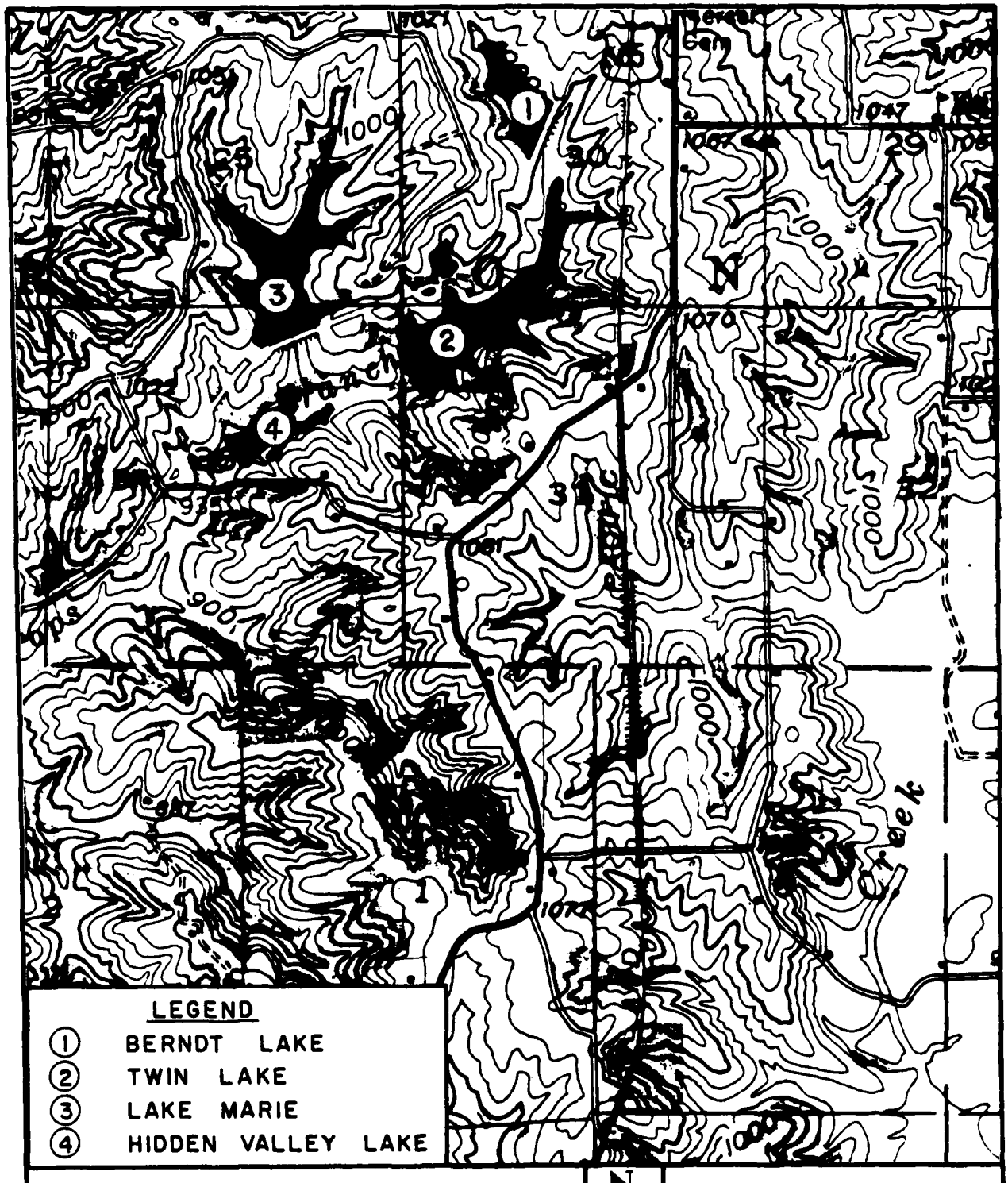
(1) The size of the spillway and/or the height of the dam should be increased to pass the probable maximum flood without overtopping the dam. If the height of the dam is increased, additional investigations and analyses should be conducted to determine the structural characteristics and stability of the present embankment. The services of an engineer experienced in the design of dams should be obtained to evaluate the present dam and to design the new structure and/or a spillway that is adequately sized and stable with respect to erosional damage.

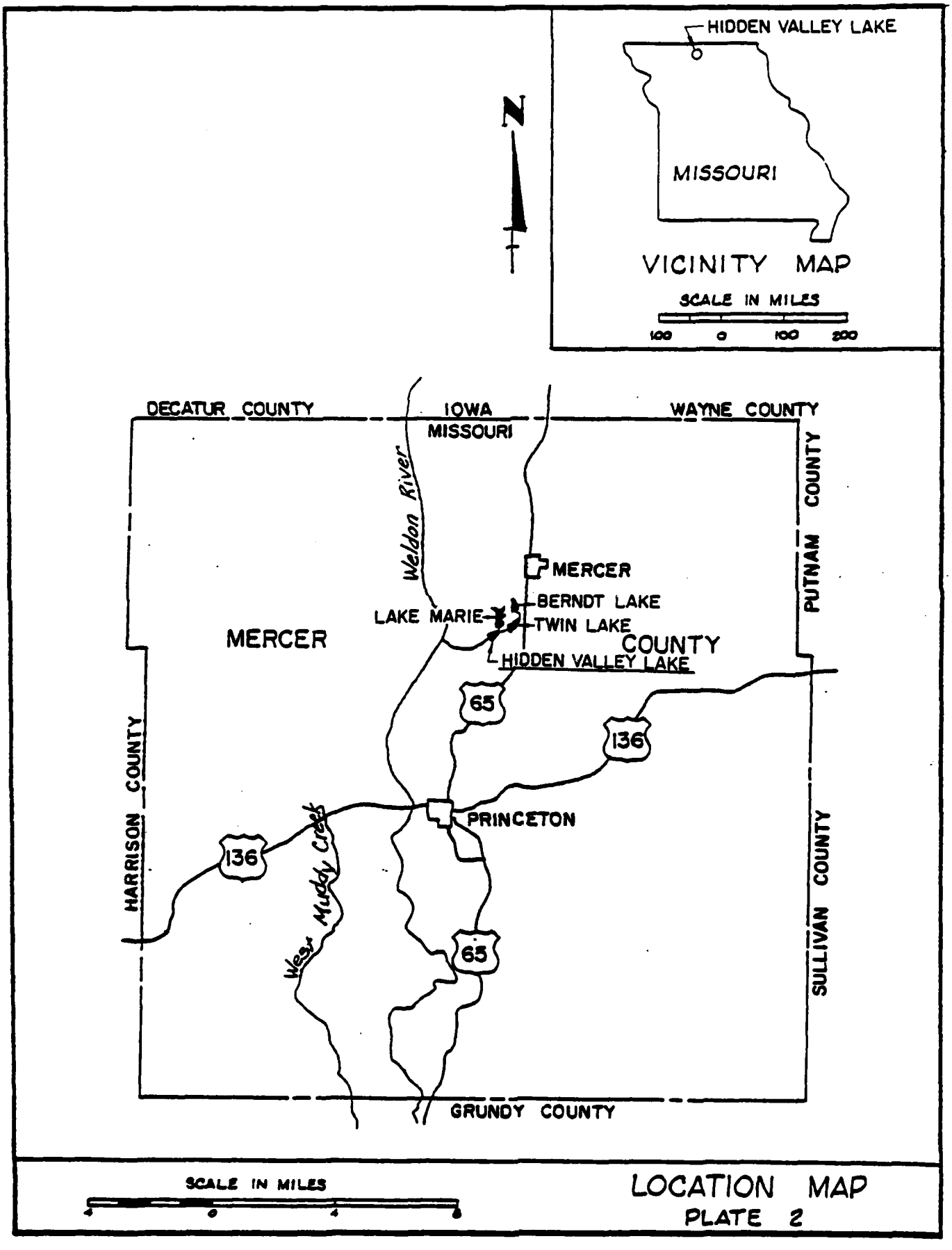
(2) The erosion and undermining of the primary spillway should be corrected if this spillway is included in plans to prevent overtopping of the dam.

(3) Seepage and stability analysis should be obtained.

b. O & M Maintenance and Procedures. When remedial measures to prevent overtopping of the dam are completed, a schedule of regular inspection and maintenance should be initiated. This maintenance schedule should be designed to control vegetation on the structure and to control excessive erosion in the spillway and outlet channel(s).

APPENDIX A
MAPS


LEGEND
1 BERNDT LAKE
2 TWIN LAKE
3 LAKE MARIE
4 HIDDEN VALLEY LAKE
SCALE IN FEET
2000 1000 0 2000 4000
1000 500 0 1000
SCALE IN METERS
N
HIDDEN VALLEY LAKE
VICINITY TOPOGRAPHY
PLATE 1


HIDDEN VALLEY LAKE
MISSOURI
VICINITY MAP
SCALE IN MILES
100 0 100 200
N
DECATUR COUNTY
IOWA
MISSOURI
WAYNE COUNTY
Weldon River
MERCER
BERNDT LAKE
LAKE MARIE
TWIN LAKE
MERCER COUNTY
HIDDEN VALLEY LAKE
PUTNAM COUNTY
65
136
HARRISON COUNTY
PRINCETON
136
West Muddy Creek
65
SULLIVAN COUNTY
GRUNDY COUNTY
SCALE IN MILES
4 0 4
LOCATION MAP
PLATE 2

LEGEND

1. BERNDT LAKE
2. TWIN LAKE
3. LAKE MARIE
4. HIDDEN VALLEY LAKE

SCALE IN FEET

2000 1000 0 2000 4000

1000 500 0 1000

SCALE IN METERS

N

HIDDEN VALLEY LAKE

ORTHOPHOTOGRAPH

PLATE 3

APPENDIX B
PHOTOGRAPHS

PHOTO. NO. 2
SPILLWAY AND
DAM FROM SOUTH-
EAST END. ROD
IN CONTROL SEC-
TION OF SPILLWAY.

PHOTO. NO. 3
LOOKING DOWN-
STREAM FROM
ENTRANCE TO
SPILLWAY (LEFT).

PHOTO NO. 4
OUTLET END
OF PIPE SPILL-
WAY.

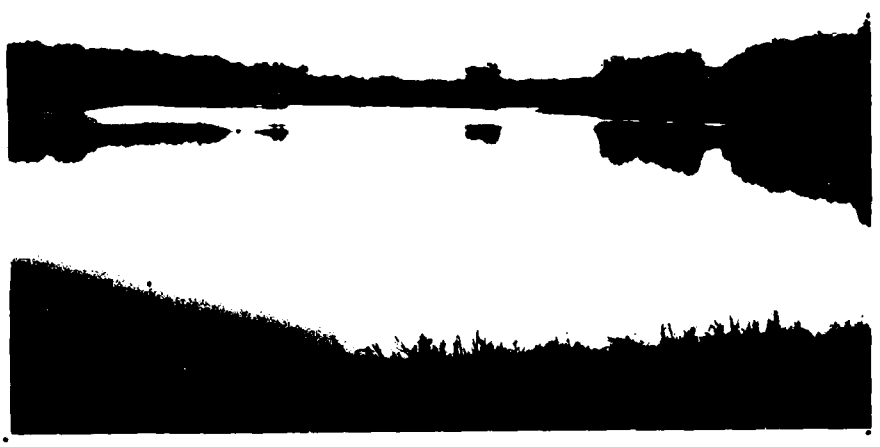


PHOTO. NO. 5
VIEW ACROSS
LAKE TO NORTH.
LAKE MARIE DAM
IN BACKGROUND.

PHOTO. NO. 6
LOOKING NORTH-
WEST. PIPE
SPILLWAY IN
CENTER.

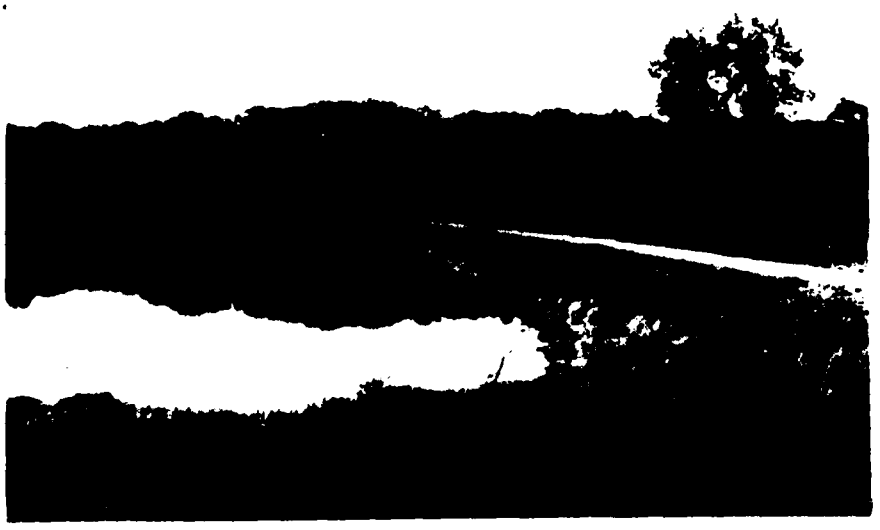


PHOTO. NO. 7
LOOKING SOUTH-
EAST AT UPSTREAM
FACE OF DAM.

PHOTO. NO. 8
LOOKING DOWN-
STREAM IN EAST
SPILLWAY. 1ST
WIRECHECK IN
CENTER. ROD
AT 2ND WIRECHECK.

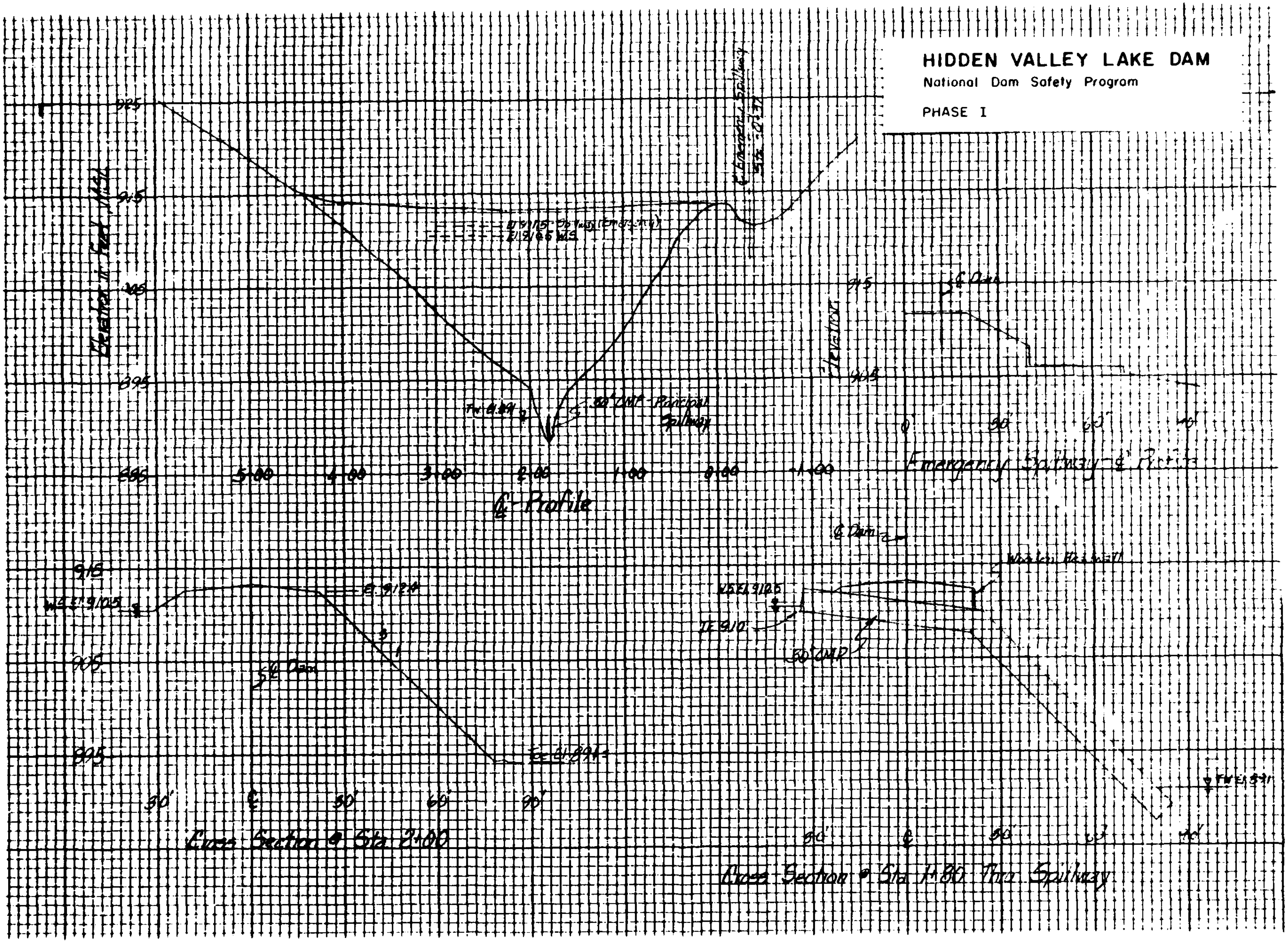
PHOTO. NO. 9
DOWNSTREAM
SLOPE FROM
SOUTHEAST END.

APPENDIX C
PLANS AND REPORTS

HIDDEN VALLEY LAKE DAM

National Dam Safety Program

PHASE I



APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvalinear unit hydrograph and the SCS TR-20 program were used to develop the inflow hydrographs (see Plates D1 and D2).

a. Forty-eight hour, 100-year rainfall for the dam location was obtained by applying the current OCE directives furnished 3 August, 1978 with various durational increments obtained from the 100-year rainfall tables taken from NOAA Technical Paper 40. The forty-eight hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current OCE directives mentioned previously.

b. Drainage area = 0.409 square miles (1.881 square miles total).

c. Time of concentration of runoff = 23 minutes.

d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The initial pool elevation was assumed at the invert of the spillway.

e. The total forty-eight hour storm duration losses for the 100-year storm were 0.28 inches. The total losses for the forty-eight hour duration 1/2 PMF storm were 0.55 inches. The total losses for the PMF storm were 0.41 inches. These data are based on SCS runoff curve No. 94.4 and antecedent moisture conditions from SCS AMC III.

f. Average soil loss rates = 0.05 inch per hour approximately.

2. The discharge ratings for the principal spillway are based on the full flow equation $\left(Q = a\sqrt{\frac{2gH}{1 + K_e + K_b + K_pL}}\right)$

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 = 0.12
K_p = coefficient for pipe friction loss = 0.0341
L = length of pipe, ft. = 114

The emergency spillway discharge ratings were developed using the concept of critical depth in the spillway control section and conservative head losses through the spillway entrance section (head loss = 0.1 H_v), where H_v is the velocity head at the spillway control section.

The flows over the dam crest 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 weir length; coefficient C is based on U.S. Geological Survey criteria.

3. The Probable Maximum Flood and fractions of it were routed through the dam to determine that percentage of PMF which just overtops the dam. This result was obtained by interpolation between 0.1 and 0.2 PMF, respectively. All three dams upstream of Hidden Valley Lake Dam -- Berndt Lake Dam (MO. 10472), Twin Lake Dam (MO. 10476), and Lake Marie Dam (MO. 10154) -- were included in the routing of the floods through the dam. The routings were made using the SCS TR-20 computer program. The input rainfall distributions, reservoir inflow hydrographs, and outflow hydrographs are shown on Plates D1 and D2 for the PMF, 1/2 PMF, 100-year flood, and percentage of PMF just overtopping.

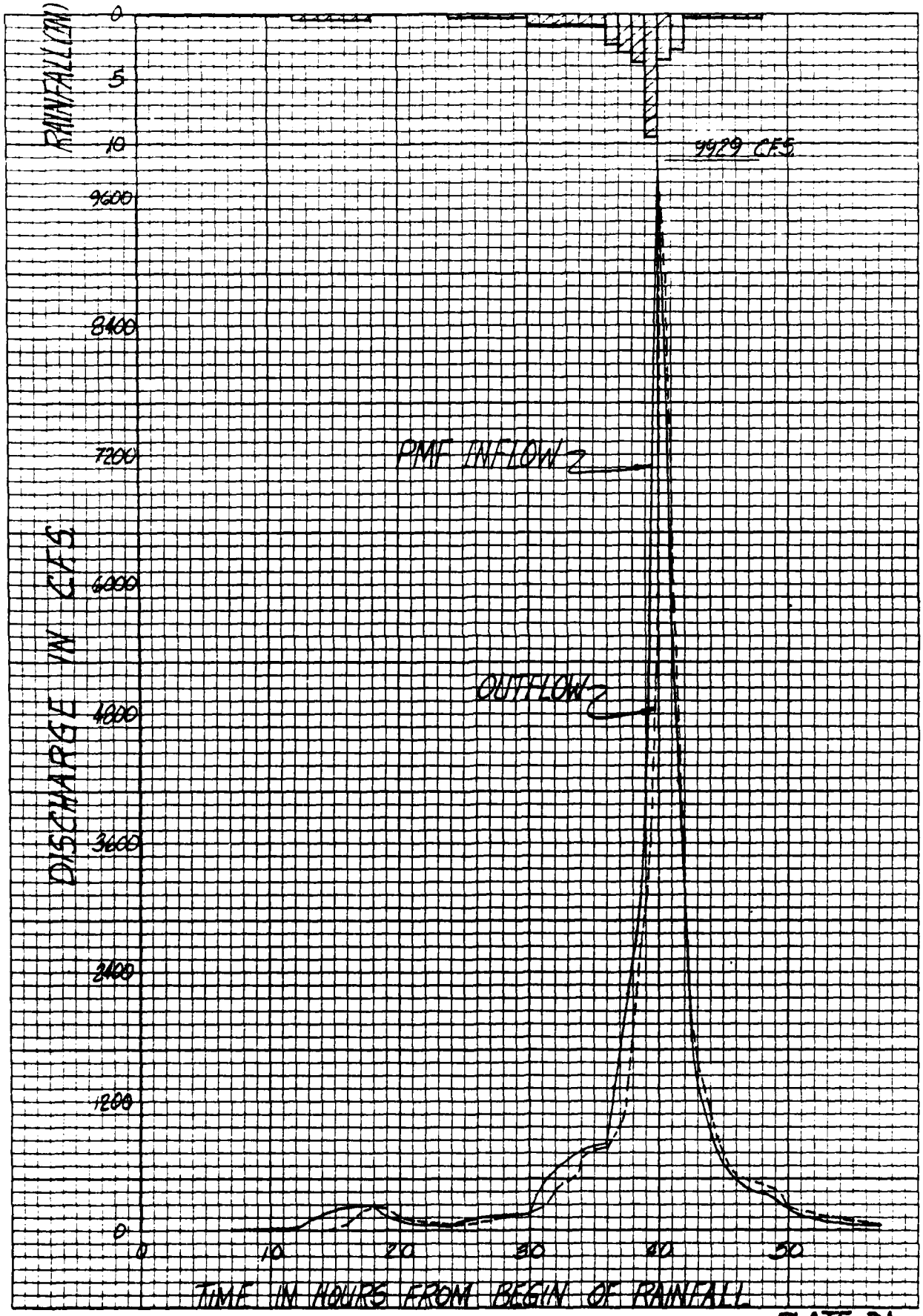

RAINFALL (IN)
0
5
10
9600
8400
7200
6000
4800
3600
2400
1200
0
DISCHARGE IN CFS
9979 CFS
PMF INFLOW
OUTFLOW
0
10
20
30
40
50
TIME IN HOURS FROM BEGIN OF RAINFALL

PLATE D1

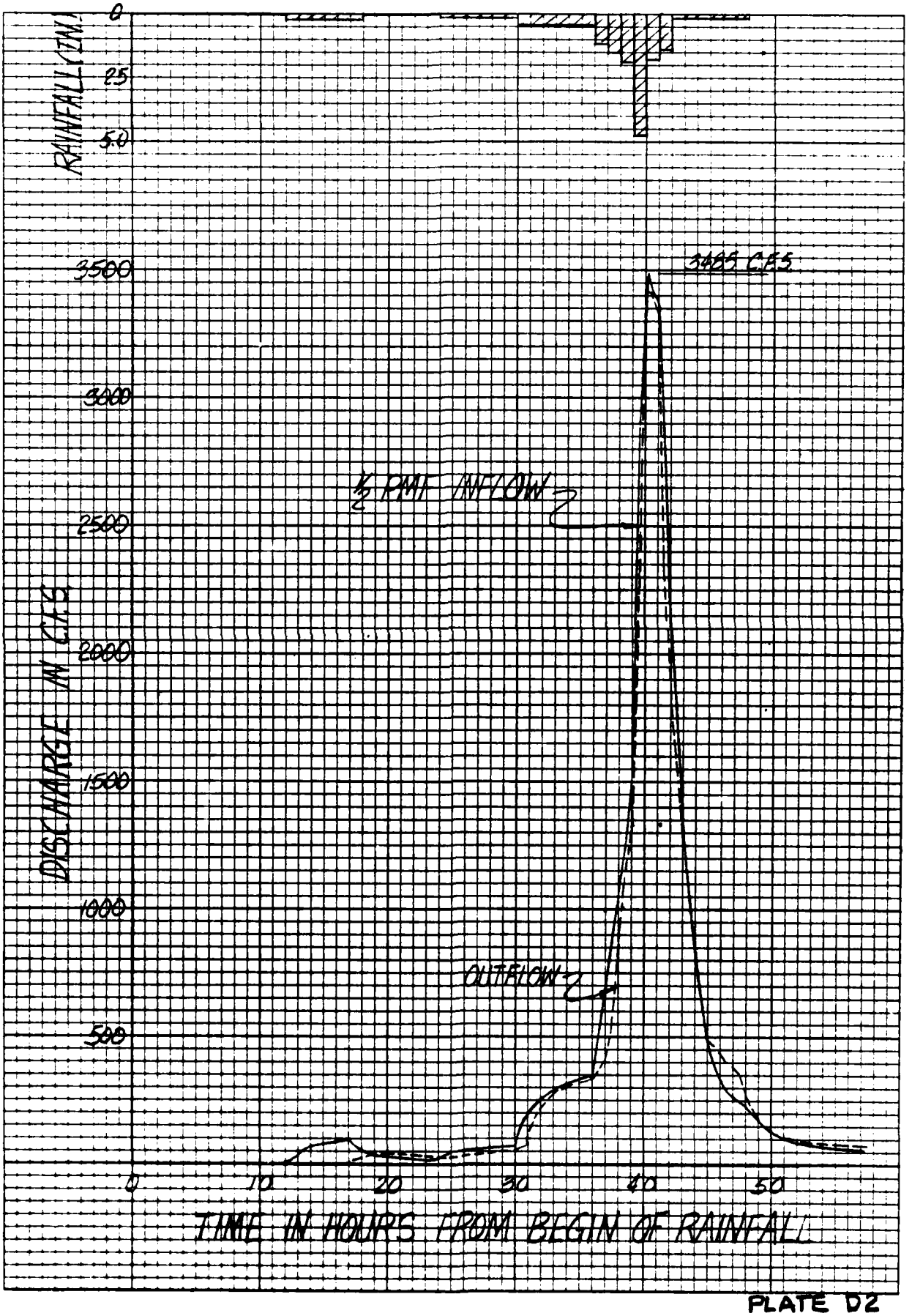
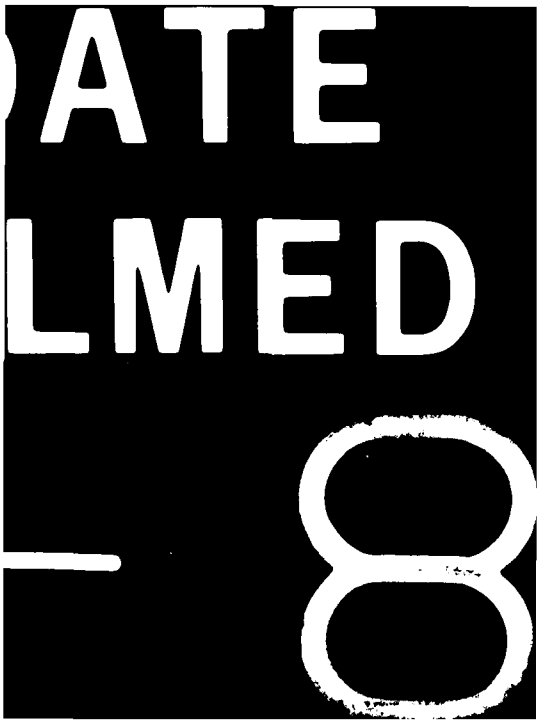

RAINFALL (IN)
0
25
5.0
DISCHARGE IN CFS
3500
3000
2500
2000
1500
1000
500
0
3455 C.F.S.
½ PMF INFLOW
OUTFLOW
10
20
30
40
50
TIME IN HOURS FROM BEGIN OF RAINFALL

PLATE D2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