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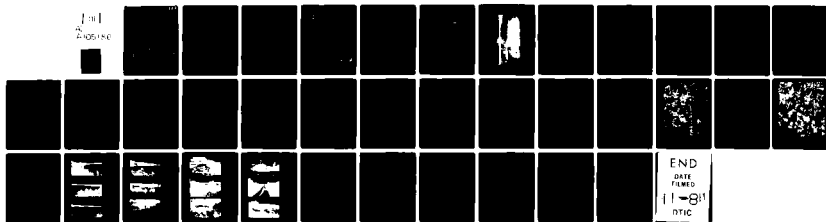
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AD A105156

LAKE MARIE DAM

MERCER COUNTY, MISSOURI

MO 10154

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.
FOR: STATE OF MISSOURI

JULY, 1978

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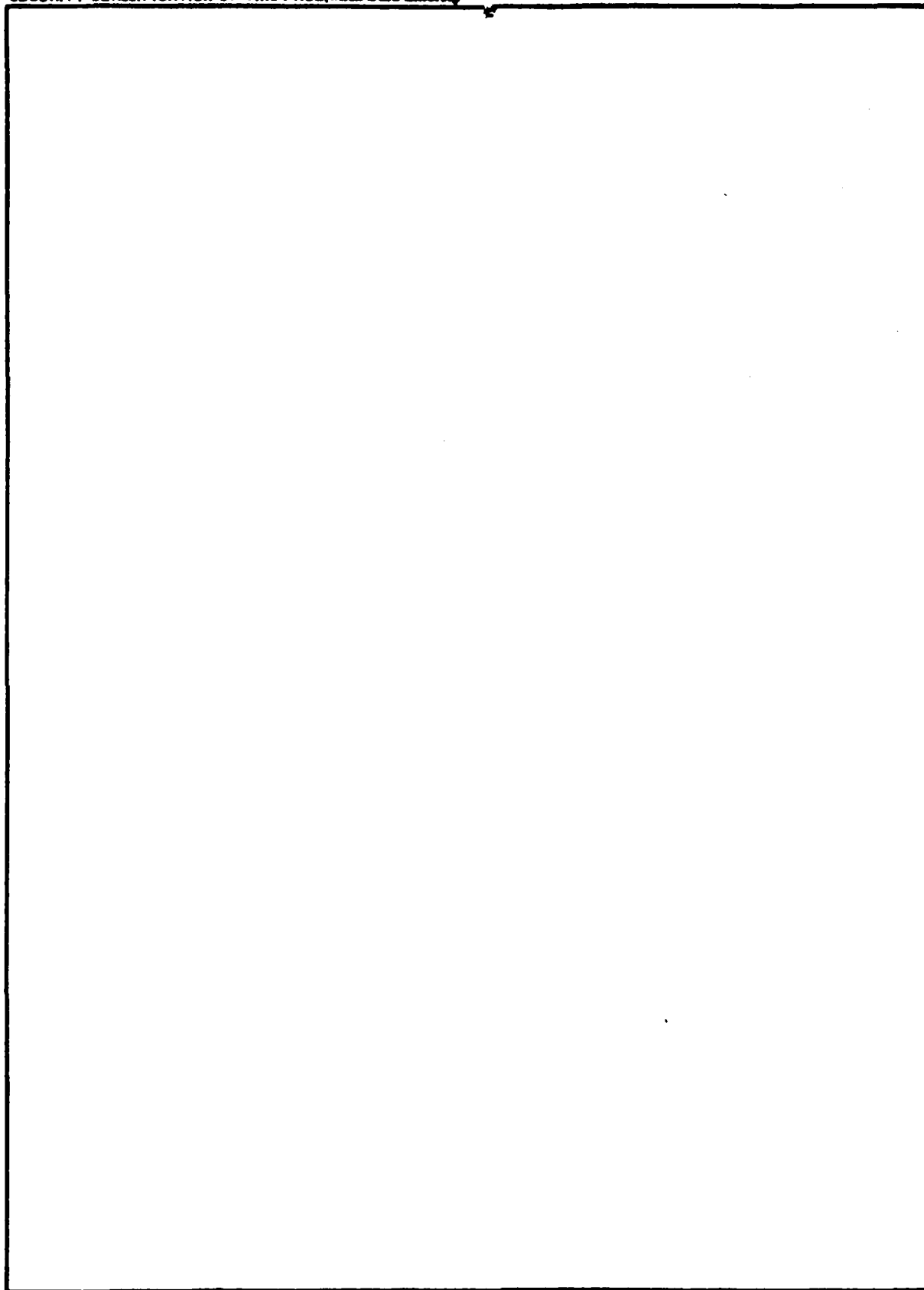
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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lake Marie Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lake Marie 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

25 SEP 1978

Date

APPROVED BY: **SIGNED**
Colonel, CE, District Engineer

25 SEP 1978

Date

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Lake Marie Dam
State Located	Missouri
County Located	Mercer County
Stream	Tributary to Pops Branch
Date of Inspection	July 13, 1978

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

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends four miles downstream of the dam. Hidden Valley Lake Dam (MO 10665) is approximately one-quarter of a mile downstream of Lake Marie Dam. Within the damage zone are ten mobile homes located between Lake Marie Dam and Hidden Valley Lake Dam, Hidden Valley Lake Dam, five mobile homes and one farmhouse with outbuildings located downstream of Hidden Valley Lake Dam.

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 the 100-year frequency flood as well as 40% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. 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 uncontrolled vegetation growing on both embankment slopes, and severe erosion of the spillway channel downstream from the dam.

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 E 8696
Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

SUBMITTED BY

SIGNED

Chief, Engineering Division

25 SEP 1960

Date

APPROVED BY

SIGNED

Colonel, CE, District Engineer

25 SEP 1960

Date



PHOTOGRAPH NO. 1
OVERVIEW
LOOKING SOUTH
TO DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE MARIE DAM - MO 10154

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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 Lake Marie 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) The dam is an earth fill which was originally constructed and used as a railroad grade. Topography adjacent to the site is rolling to moderately steep. Materials exposed on the slopes consist of fine grained glacial till.

(2) It was reported that the culvert through the railroad fill was plugged with concrete to form an impoundment.

(3) A narrow spillway was cut in glacial till on the right (west) 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 Sec. 36, T66N, R24W and the S 1/2 of Sec. 25, 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 intermediate 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 four miles downstream of the dam. Hidden Valley Lake Dam (MO 10665) is approximately one-quarter of a mile downstream of Lake Marie Dam. Within the damage zone are ten mobile homes located between Lake Marie Dam and Hidden Valley Lake Dam, five mobile homes and one farmhouse with outbuildings located downstream of Hidden Valley Lake Dam.

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 30 acre recreational lake.

g. Design and Construction History. No design or construction records were available on the dam. It was reported that the original railroad grade was constructed in the 1880's. The railroad grade was converted to an impounding dam about 20 years ago. At that time the culvert through the embankment was plugged with earth. The earth plug soon washed out and the culvert was then plugged with concrete. The crest width was increased sometime between 1971 and 1978. This was accomplished by dumping soil from the downstream crest. At that time a drain line was installed on the downstream slope parallel with the axis of the dam and located one third to one half way down the slope. The owner reported that the drain line was installed to "stabilize" the additional fill that was added to the downstream slope. On the basis of the reported location of the drain, it could be assumed that the drain would intercept the phreatic surface through the original embankment.

h. Normal Operating Procedure. There are no controlled outlet works for this dam. It was reported that the level of the lake is fairly stable. However, the spillway passed a flow about 2 feet in depth this spring (1978). This flow caused considerable damage to the spillway channel.

1.3 PERTINENT DATA

a. Drainage Area. - 342 acres.

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled earth channel cut through the old railroad grade on the right end of the dam.

(2) Estimated maximum flood at damsite - 300 c.f.s. which occurred in the spring of 1978.

(3) The spillway capacity at maximum pool elevation (963±) - 500 c.f.s.

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

(1) Top of dam - Slopes from 963± at right end to 969± at left end.

(2) Spillway crest - 960±

(3) Streambed at centerline - 917±

(4) Maximum tailwater - Unknown

d. Reservoir. Length of maximum pool - 3300±

e. Storage (Acre-feet). Top of dam - 720.

f. Reservoir Surface (Acres).

(1) Top of dam - 44 acres ±

(2) Spillway crest - 30 acres ±

g. Dam.

(1) Type - earth embankment, old railroad grade.

(2) Length - 1100 feet ±

(3) Height - 49 feet ±

(4) Top width - 20 feet ±

(5) Side slopes

(a) Downstream - 2.5 to 2.7H on 1V with berm 26 feet wide.
(Measured with hand level.)

(b) Upstream - exposed slope - 3H on 1V.

(6) Zoning - unknown.

(7) Impervious core - unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

(10) Riprap - the upstream face is plated with loose rock of variable size.

- h. Diversion and Regulating Tunnel. None.
- i. Spillway.
 - (a) Type - earth channel plated with loose limestone.
 - (b) Control section - a parabolic section.
 - (c) Crest elevation - 960± feet M.S.L.
 - (d) Upstream channel - clear and well grassed.
 - (e) Downstream channel - badly eroded for most of exit channel length.
- j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

It was reported that the culvert in the old railroad grade was plugged to form an impounding dam in about 1958. No construction data were available.

2.3 OPERATION

There are no controlled discharge structures for this dam. The lake levels remain fairly stable. The maximum water over the spillway was reported to be 2 feet in 1978.

2.4 EVALUATION

a. Availability. There were no engineering data available for this dam.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Lake Marie Dam was made on July 13, 1978. Engineers from the firm of Hoskins-Western-Sonderegger, Inc. making the inspection were: Rey Decker, Geology and Soil Mechanics, Garold Ulmer, Civil Engineer, and Richard Walker, Hydrology. Specific observations are discussed below.

b. Dam. A number of trees up to 6 inches in diameter are growing on the upstream slope. No slides or serious erosion was noted on the upstream slope. The downstream slope of the dam was covered with a dense growth of trees, shrubs, briars, and sweet clover. No seeps or slides were noted on the downstream slope but the dense growth made it difficult to determine the condition of this section of the embankment.

Rough measurements along the centerline of the dam indicate that the left (east) end of the embankment is 6 ft. $\pm$ higher in elevation than the right (west) end. This is shown on the centerline profile in Appendix C.

The abutments apparently consist of plastic glacial till. No slides or seepage was noted in the abutments. An active gully was noted along the toe of the dam on the left abutment. Seepage was observed along the toe of the dam between centerline stations 3+00 $\pm$ to 4+50 $\pm$ (see Appendix "C" for centerline stationing and profile). Water was ponded in the old channel downstream from centerline station 4+00 or 4+50. No boils were observed and all seepage was clear. It was not possible to observe the old railroad culvert which must be located somewhere in this vicinity. Attempts were unsuccessful in locating the outlet(s) for the tile line reportedly located along the downstream slope.

c. Appurtenant Structures. The spillway consists of a parabolic section cut through the old railroad grade on the right (west) end of the dam. The cross section of the spillway at the centerline of the dam and the profile of the spillway are shown in Appendix C. The inlet to the spillway is about 22 feet in width and heavily grassed. No erosion nor slides were noted in the inlet section. This uncontrolled spillway is the only structure to control pool levels at this dam.

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

e. Downstream Channel. The bottom of the outfall or exit section of the spillway is plated with loose limestone rock for a distance of about 50 feet downstream from the centerline of the dam. Below this point the channel is badly eroded into silty and sandy clay materials. The eroded channel extends for a distance of 300 feet $\pm$ where it passes under an access road and discharges into Hidden Valley Lake some 600 feet downstream from Lake Marie.

f. Downstream Hazards. A new home is located immediately adjacent to the downstream toe opposite about centerline station 2+00. Hidden Valley Lake is located approximately 600 feet downstream from this dam. Any significant discharge from Lake Marie will affect the operation and stability of Hidden Valley Lake dam.

3.2 EVALUATION

Due to the heavy vegetation it was not possible to fully observe structural conditions on the downstream slope. Trees on both the upstream and downstream slopes of the dam, left uncontrolled, could lead to potential failure. (Note: It was observed that trees on the upstream slope were being removed and mowing of the downstream slope was in progress on July 14, 1978, the day after our inspection.) The condition of the spillway indicates the need for remedial action in the near future to prevent serious potential of failure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam and no regulating procedures exist.

4.2 MAINTENANCE OF DAM

The amount of brush and the number and size of the trees on both slopes of the dam indicate that it has been several years since any vegetative control measures have been performed. The loose rock riprap or plating in the upper section of the spillway channel was installed after the spillway was damaged in the spring of 1978.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

The inspection team is not aware of any warning system at this dam.

4.5 EVALUATION

Trees growing on the upstream slope, trees and brush growing on the downstream slope and severe erosion of the emergency spillway channel could lead to potential failure if left uncontrolled.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

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

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

c. Visual Observations.

(1) The inlet channel to the spillway was clear of obstructions and well grassed.

(2) The spillway exit channel is plated with loose limestone rock for 50± feet below center line of dam but is badly eroded below that.

(3) Exit channel discharges into Hidden Valley Lake.

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

d. Overtopping Potential. The spillway is too small to pass the probable maximum flood without overtopping. One-half of the PMF will overtop the dam by 0.5 feet for a period of 1.0 hour. The spillway will pass 40% of the PMF without overtopping. The existing spillways will pass the 100-year frequency flood without overtopping. The overtopping occurs at the dam embankment on right side beginning at the spillway and extends eastward of spillway for a distance of 140 feet ±. The results of the routings through the dam are tabulated in regards to the following conditions.

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 963.0</u>	<u>Time Dam Overtopping Hr.</u>
100 Yr.	800	300	962.3	+0.7	0
1/2 PMF	1600	1300	963.5	-0.5	1
PMF	3200	2900	964.7	-1.7	3.5
0.40 PMF	1300	1100	963.1	+0.1	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 an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillway.

The St. Louis District, Corps of Engineers, in a letter dated 13 July, 1978 has estimated the damage zone. The estimated damage zone extends four miles downstream of the dam. Hidden Valley Lake Dam (MO 10665) is approximately one-quarter of a mile downstream of Lake Marie Dam. Within the damage zone are ten mobile homes located between Lake Marie Dam and Hidden Valley Lake Dam, Hidden Valley Lake Dam, five mobile homes and one farmhouse with outbuildings located downstream of Hidden Valley Lake Dam.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations which adversely affect the structural stability of this dam are discussed in Section 3. These include the following features: trees and rank vegetation on both slopes, seepage and ponded water along the downstream toe, gully erosion along the toe of the dam in the left embankment abutment trough, and possible seepage into and/or around the old railroad culvert which could not be observed due to dense vegetative cover.

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

c. Operating Records. There are no operating structures at this dam. The spillway passed a flow depth of 1 to 2 feet in the spring of 1978.

d. Post Construction Changes. Increasing the crest width in 1971-1973 could adversely or advantageously affect the structural stability of the dam. Additional studies and analyses would be required to make this determination. It should be noted that the downstream slope has a berm about 26 feet wide located about one-third of the distance from the downstream crest to the downstream toe. It is not known when this berm was installed but it must have been after the reservoir impoundment was performed since the slope below the berm is approximately 2.5H to 2.7H on 1V and the standard railroad fill is constructed with slopes of 1.5H on 1V. This berm should increase the structural stability of the dam.

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

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noted during the visual inspection which could lead to serious potential of failure if not corrected or controlled. These items include uncontrolled vegetation on both slopes of the dam and the size and condition of the spillway. The condition of the downstream slope, including the extent and affects of seepage along the toe of the dam, can be better assessed after the trees and brush have been removed. The Probable Maximum Flood will overtop the dam. The spillways will pass the 0.4 PMF without overtopping. The 0.5 PMF will overtop the dam for a distance of 50 feet $\pm$ east of the emergency spillway, and the Probable Maximum Flood will overtop for a distance of 140 feet $\pm$ east of the emergency spillway.

Overtopping of this dam will affect Hidden Valley Lake Dam (MO 10665) just downstream from Lake Marie.

b. Adequacy of Information. Since no engineering or construction data were available, the conclusions in this report are based upon performance history and visual observations. The inspection team considers that these data are sufficient to support the conclusions herein. Neither seepage nor stability analysis were found which is a deficiency that should be corrected in the future.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Phase II investigation is not called for. However, additional engineering data should be obtained by the owner at the owner's expense prior to increasing the height of the dam and/or constructing a spillway that is adequately sized and stable with respect to damage from erosion.

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) Clear the dam of uncontrolled growth of trees and shrubs.

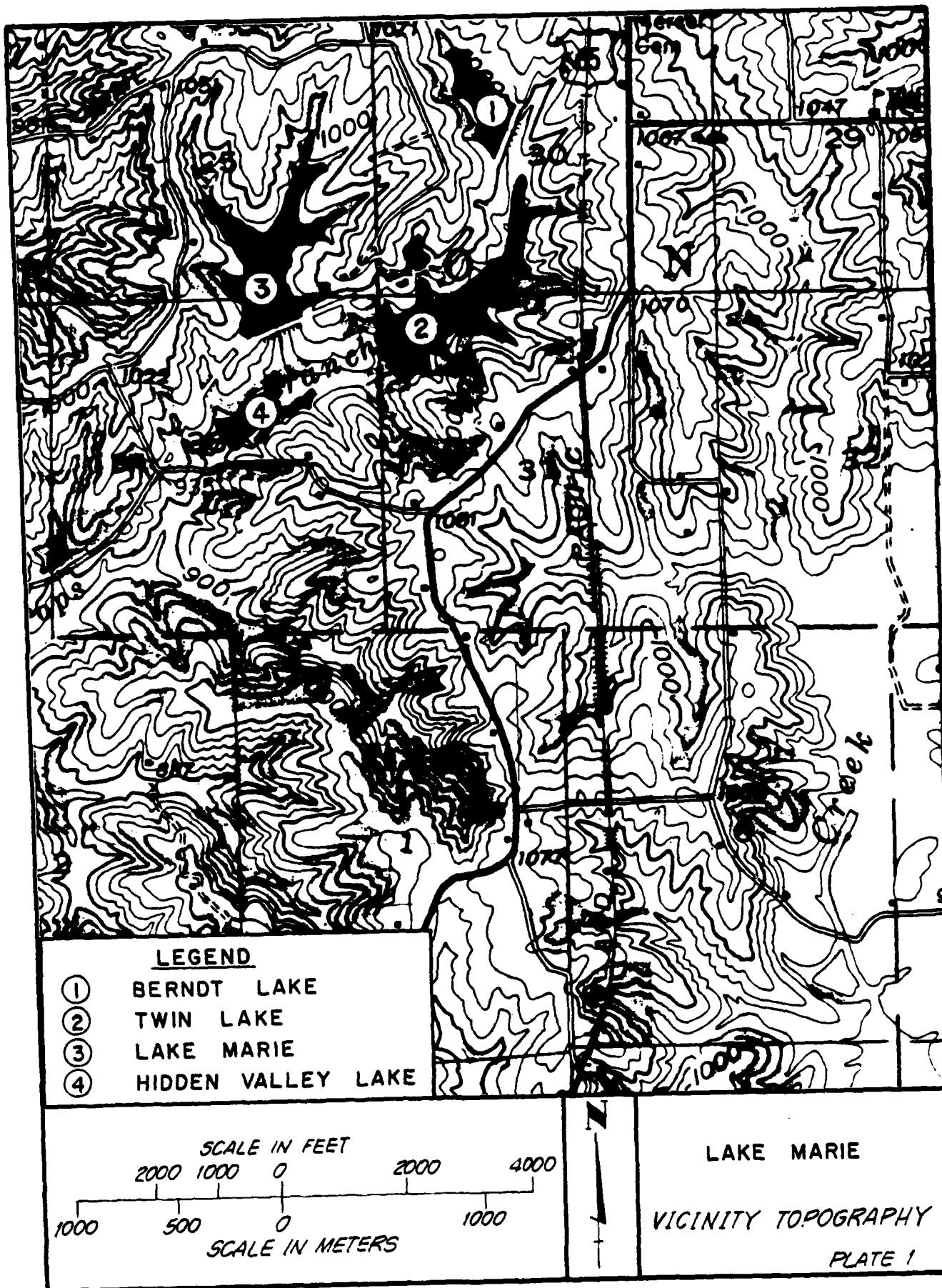
(2) The size of the spillway and/or the height of the dam should be increased to pass the probable maximum flood without overtopping the dam. If the height of the dam is increased, additional investigations and analyses should be conducted to determine the structural characteristics and stability of the present embankment. Seepage analyses should be conducted. 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.

b. O&M Maintenance and Procedures. The following O&M maintenance and procedures are recommended.

(1) A program should be developed and put into action to keep trees and brush off of the dam and to control other vegetation.

(2) The dam should be inspected regularly to determine the presence of seepage or slides on the downstream slope and the presence of erosional damage on the upstream slope and in the spillway channel.

APPENDIX A
MAPS

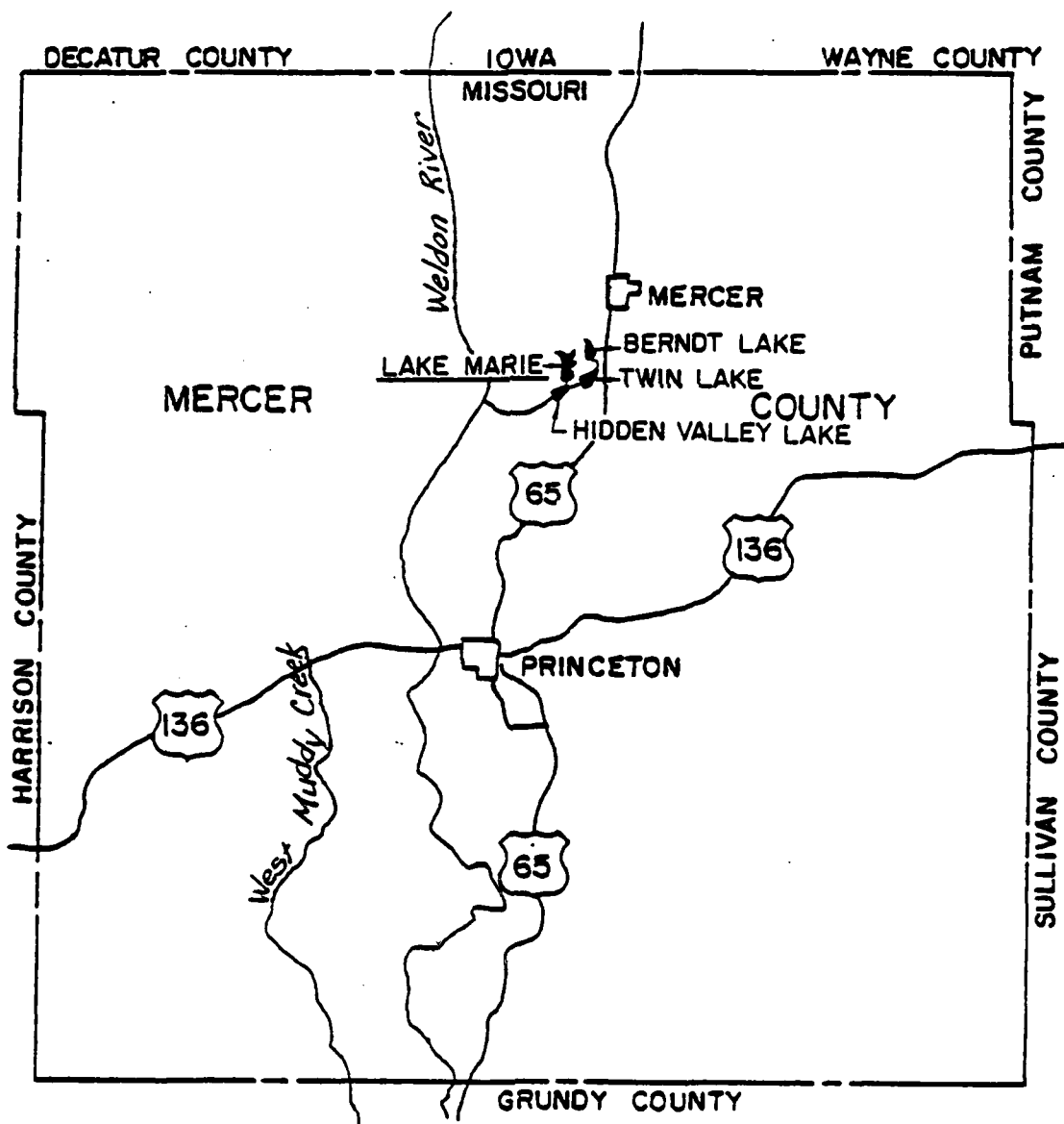




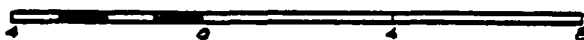
VICINITY MAP

SCALE IN MILES

100 0 100 200



SCALE IN MILES



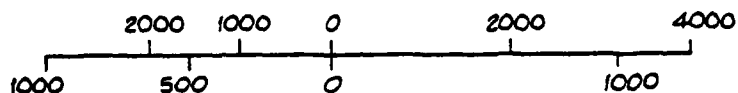
LOCATION MAP
PLATE 2



LEGEND

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

SCALE IN FEET



SCALE IN METERS

N



LAKE MARIE
ORTHOPHOTOGRAPH
PLATE 3

APPENDIX B
PHOTOGRAPHS



PHOTO NO. 2
UPSTREAM SLOPE
FROM EAST
ABUTMENT



PHOTO NO. 3
LOOKING UPSTREAM
TO NORTHEAST
FROM CENTER OF DAM



PHOTO NO. 4
LOOKING UPSTREAM
TO NORTH FROM
CENTER OF DAM



PHOTO NO. 5
LOOKING UPSTREAM
TO NORTHWEST
FROM CENTER OF DAM



PHOTO NO. 6
LOOKING DOWN-
STREAM FROM CENTER
OF DAM. HIDDEN
VALLEY LAKE IN
LEFT CENTER



PHOTO NO. 7
LOOKING DOWN
EMERGENCY SPILLWAY
FROM CENTERLINE
OF DAM



PHOTO NO. 8
LOOKING UPSTREAM
IN EMERGENCY SPILLWAY



PHOTO NO. 9
ENTRANCE TO
EMERGENCY SPILLWAY



PHOTO NO. 10
SEEP AREA AT
TOE OF DAM.
APPROX. STA. 4+00



PHOTO NO. 11
LOOKING AT
DOWNSTREAM
SLOPE

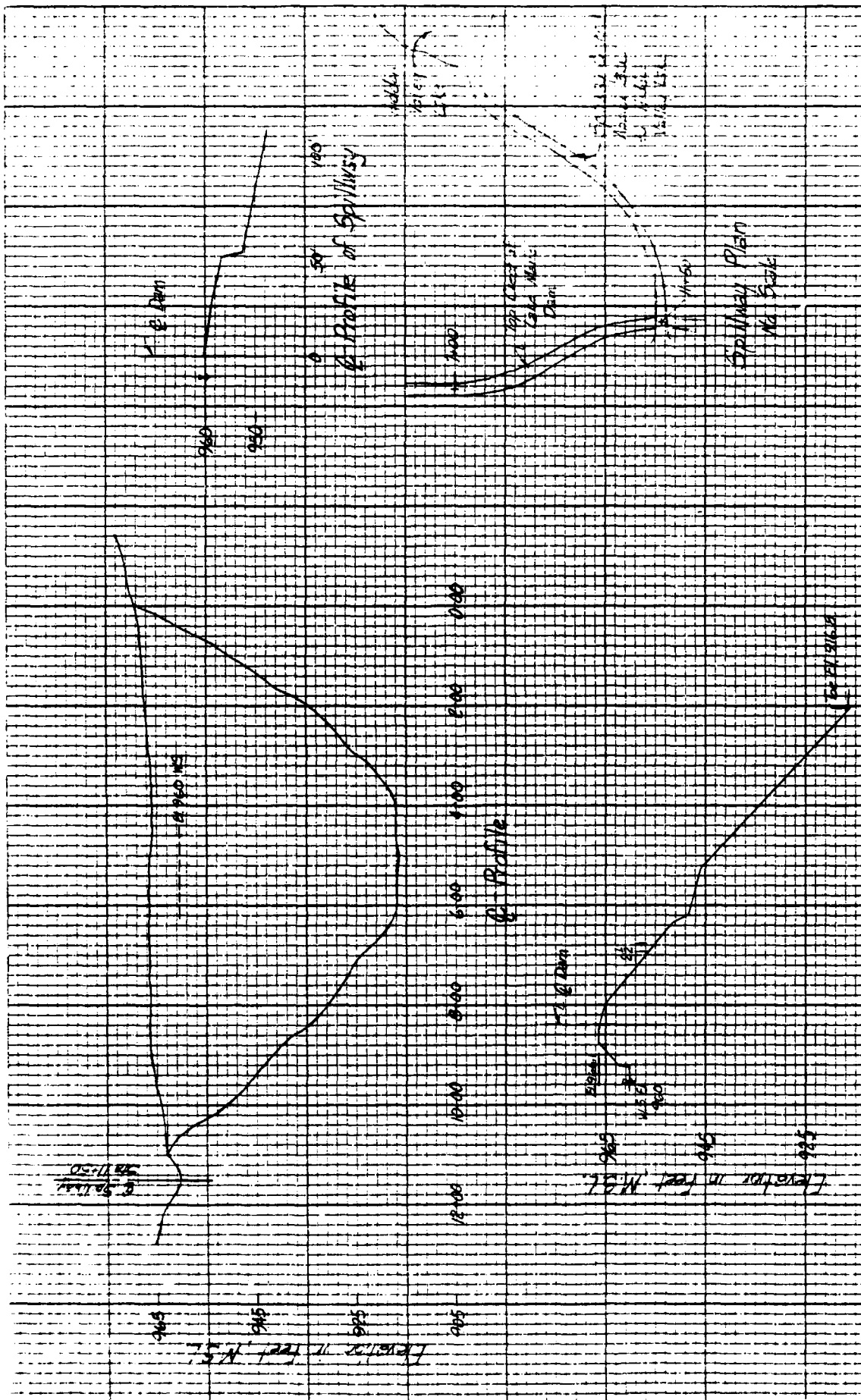


PHOTO NO. 12
CREST OF DAM
TAKEN FROM EAST
LOOKING WEST



PHOTO NO. 13
DOWNSTREAM
SLOPE TAKEN
FROM WEST END

APPENDIX C
PLANS AND REPORTS



LAKE MARIE DAM
 National Dam Safety Program
 PHASE I

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvilinear 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 = 0.534 square miles.

c. Time of concentration of runoff = 24 minutes.

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

e. The total forty-eight hour storm duration losses for the 100-year storm were 0.58 inches. The total losses for the forty-eight hour duration 1/2 PMF storm were 1.02 inches. The total losses for the PMF storm were 0.363 inches. These data are based on SCS runoff curve No. 94.4 and antecedent moisture conditions from SCS AMCIII.

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

2. The 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 = $0.25H_v$), 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; the coefficient C is based on the 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. The dam discharges downstream into Hidden Valley, No. Mo. 10665. The dam was routed together with Hidden Valley Dam to determine the impact of the discharge on Hidden Valley. The floods were routed using the SCS TR-20 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 the percentage of PMF at overtopping.

