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MISSOURI - KANSAS CITY BASIN ②

LAKE CHAMPETRA DAM
BOONE COUNTY, MISSOURI
MO. 30880

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD A105327	
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake Champetra Dam (MO 30880) Boone County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report.
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		6. PERFORMING ORG. REPORT NUMBER
		8. CONTRACT OR GRANT NUMBER(s)
		DACW43-79-C-0046
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
		11. REPORT DATE May 1979
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		13. NUMBER OF PAGES Approximately 70
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Rey S. /Decker Gordon /Jamison Michael /McMeekin Harold P. /Hoskins		15. SECURITY CLASS. (of this report) UNCLASSIFIED
16. DIST Approved for release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE 12 60
17. DISTRIBUTION STATEMENT	National Dam Safety Program. Lake Champetra Dam (MO 30880), Missouri - Kansas City Basin, Boone County, Missouri. Phase I Inspection Report.	
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.		

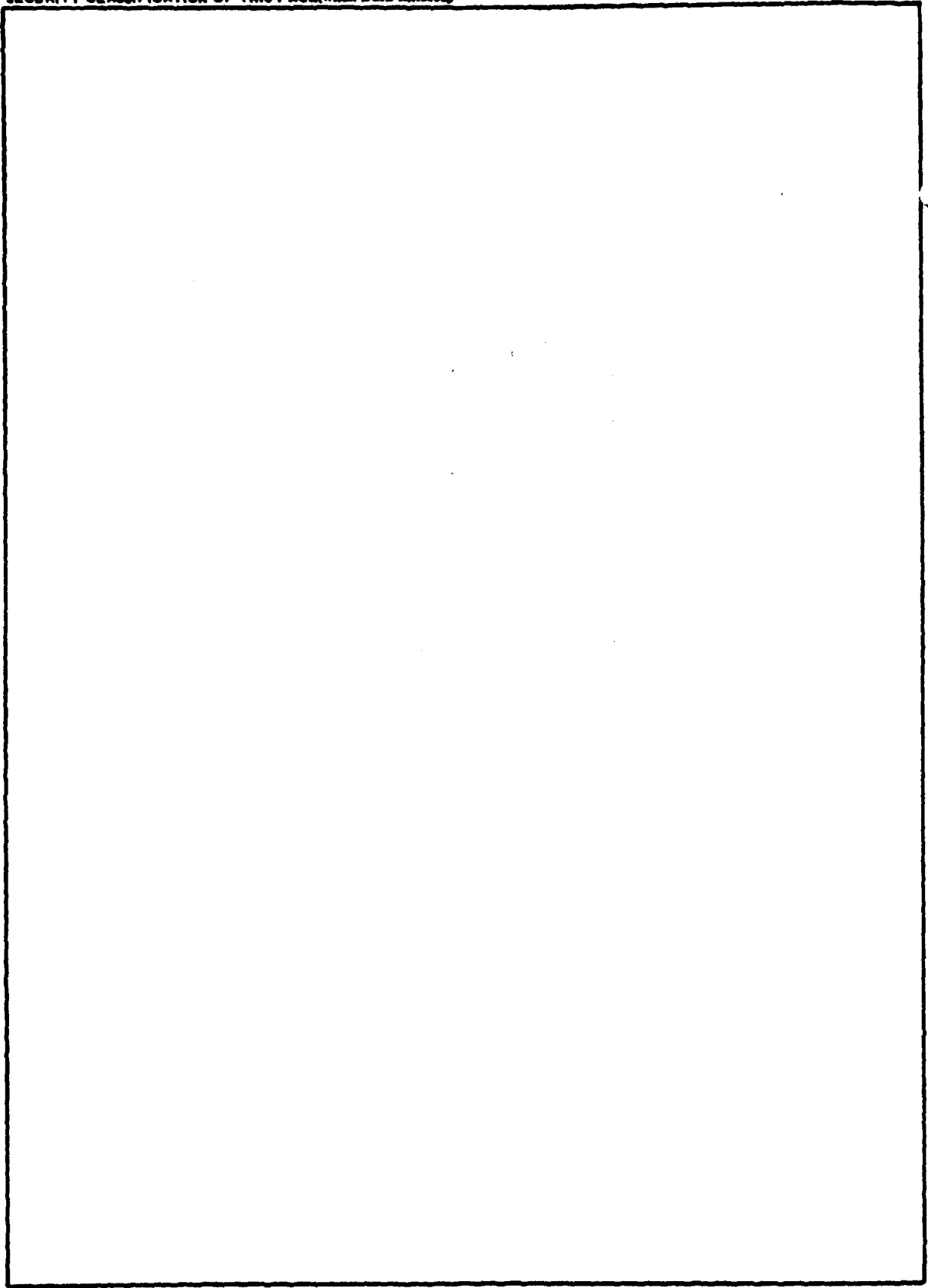
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LAKE CHAMPETRA DAM
BOONE COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. 30880

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI
MAY, 1979

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Corps of Engineers



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

IN REPLY REFER TO

SUBJECT: Lake Champetra Dam Phase I Inspection Report

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

20 DEC 1979

Chief, Engineering Division

Date

APPROVED:

SIGNED

20 DEC 1979

Colonel, CE, District Engineer

Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam
State Located
County Located
Stream
Date of Inspection

Lake Champetra Dam
Missouri
Boone County
Tributary Cedar Creek
May 31, 1979

↓
Lake Champetra Dam was inspected by an interdisciplinary team of engineers, ~~from Hoskins Western Sonderger, 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 approximately five and one half miles (and at this point enters the Missouri River) downstream from the dam. Within the damage zone are several farm dwellings, two secondary roads, and a bridge on Highway 63.

↓
Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for an intermediate dam having a high hazard potential. 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 15% of the Probable Maximum Flood and also the 10-year 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.

↑
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.

Other deficiencies observed during the inspection are small trees growing on the downstream slope, seepage outcrops in both abutment troughs, the plugged condition of the principal spillway riser, the absence of a trash rack on the principal spillway riser, the storage of a float boat or diving platform at the entrance to the emergency spillway and the fact that the low point on the crest of the dam is lower in elevation than the high point in the emergency spillway.

It is recommended that the Owner take action to correct or control the deficiencies stated above and described in detail in the body of this report.

Rey S. Decker
Rey S. Decker
E-3703

Gordon G. Jamison
Gordon Jamison

Michael M. Meekin
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H. P. Hoskins
Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE CHAMPETRA DAM - MO 30880
BOONE 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 Lake Champetra 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 an earth fill about 675 feet in length with a maximum height of 58 feet $\pm$ located in moderately steep topography. Valley slopes are covered with colluvial loess from the uplands and clay residuum from the underlying bedrock.
 - (2) The principal spillway consists of a 24-inch diameter steel riser connected with a 12-inch diameter welded steel pipe conduit passing through the embankment.
 - (3) A vegetated earth emergency spillway is cut through the left abutment.
 - (4) The dam is equipped with a 12 inch gate valve controlled drawdown pipe.

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

- b. Location. The dam is located in the southeast corner of Boone County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the NW $\frac{1}{4}$ of Section 13, T45N, R12W. The lake formed behind the dam is shown in the NW $\frac{1}{4}$ of Section 13, T45N, R12W, and the NE $\frac{1}{4}$ of Section 14, T45N, R12W.
- 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 1.1c. above. Based on referenced guidelines, this dam is in the high hazard classification. The estimated damage zone extends approximately five and one half miles (and at this point enters the Missouri River) downstream from the dam. Within the damage zone are several farm dwellings, two secondary roads, and a bridge on Highway 63.
- e. Ownership. The dam is owned by Kenneth Adams, Hartsburg, Missouri 56039.
- f. Purpose of Dam. The dam forms a recreational lake covering about 38 acres and impounding about 530 acre-feet of water.
- g. Design and Construction History. It was reported by Kenneth Adams that the dam was constructed in 1970 by Martin Brothers, Fulton, Missouri, and that it was designed by Bernard Browning from Fulton, Missouri. (Mr. Browning was contacted several times without success in securing plans for this dam.) It was also reported by Kenneth Adams that test holes were drilled on the site, that the dam has a clay core and was compacted with sheepsfoot rollers.
- h. Normal Operating Procedure. All spillways are uncontrolled and there are no operating procedures for this dam.

1.3 PERTINENT DATA

- a. Drainage Area. 597 acres (0.93 square miles).
- b. Discharge at Damsite.

- (1) All discharges at the damsite are through a steel pipe principal spillway. The crest of the emergency spillway is above the low point on the dam.
 - (2) Estimated maximum flood at damsite -- unknown.
 - (3) The principal spillway capacity varies from 0 c.f.s. at elevation 609.7 to 15 c.f.s. at the crest of the dam (elevation 613.9 feet).
- c. Elevations (feet above M.S.L.).
- (1) Top of dam - 613.9 $\pm$ (low point)
 - (2) Principal spillway crest - 609.7 $\pm$
 - (3) Emergency spillway crest - 614.1 $\pm$
 - (4) Streambed at center line - 555.6 $\pm$
 - (5) Maximum tailwater - unknown
- d. Reservoir. Length (feet) of maximum pool - 3,100 $\pm$.
- e. Storage (Acre-feet).
- (1) Top of dam - 690 $\pm$
 - (2) Principal spillway crest - 530 $\pm$
- f. Reservoir Surface (Acres).
- (1) Top of dam - 47 $\pm$
 - (2) Principal spillway crest - 38 $\pm$
- g. Dam.
- (1) Type - Earth fill
 - (2) Length - 675 feet $\pm$ (measured)
 - (3) Height - 58 feet $\pm$ (measured)
 - (4) Top width - 24 to 26 feet (measured)
 - (5) Side slopes
 - (a) Downstream 2.8 to 2.9H to 1V (measured)
 - (b) Upstream 4H on 1V (measured on exposure)
 - (6) Zoning - unknown
 - (7) Impervious core - unknown
 - (8) Cutoff - unknown
 - (9) Grout curtain - unknown
 - (10) Wave protection - vegetated earth berm at normal pool elevation with no riprap.
 - (11) Internal drains - unknown
- h. Diversion Channel and Regulating Tunnel. None
- i. Spillway.

(1) Principal

- (a) Type - uncontrolled, drop inlet, 24-inch diameter steel pipe riser, 6 feet + high with 12-inch steel pipe conduit. The presence of antiseep collars is not known.
- (b) Crest (invert) elevation - 609.7 feet +
Outlet - 556.4 feet +
- (c) Length - 230 feet +

(2) Emergency

- (a) Type - uncontrolled, vegetated earth, cut through the left abutment, "U" shaped section about 55 feet across the top.
- (b) Control section - well vegetated earth, weir crest.
- (c) Crest elevation - 614.1 feet +
- (d) Approach Channel - well vegetated on slope of about 8%.
- (e) Exit Channel - well vegetated on slope exceeding 5%.

j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam. Kenneth Adams reported that the dam was designed by Bernard Browning, Fulton, Missouri.

2.2 CONSTRUCTION

No construction data were available. It was reported that the dam was built in 1970 by Martin Brothers, Fulton, Missouri.

2.3 OPERATION

No data were available on spillway operation. It was reported by Kenneth Adams that the emergency spillway has not operated. The highest reservoir level observed by the owner was about elevation 612 feet ± and the lowest water level was about 608.5 feet.

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 conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the Lake Champetra Dam was made on May 31, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison, Hydrology; and M. McMeekin, Civil Engineer. Kenneth Adams, owner, met with the inspection crew prior to the inspection.
- b. Dam.
 - (1) Geology and soils (abutment and embankment). The abutments consist of a thin mantle of CL or CH soil colluvium-residium over limestone bedrock. Limestone and chert float rocks (rocks detached from bedrock strata by weathering processes) are exposed on the valley sides. The bedrock is probably a member of the Jefferson City formation which is generally horizontally bedded and fractured. No indications of sink holes or solution cavities were noted in the area. Auger borings on the dam indicated plastic CL or CH materials to depths of 2 feet. The materials were probably borrowed from the colluvial-residual soils covering the valley slopes. Materials in the valley bottom consist of alluvial-colluvial plastic CL soils containing limestone and chert gravels. These soils are derived from the upland loess mantle and the residual soils developed on the valley slopes.
 - (2) Upstream Slope. The upstream slope is well vegetated with adapted grasses and clover. The compacted earth berm, 10 to 15 feet in width, extends from just below the normal pool level into the reservoir. It appeared to be on a slight slope with no water over it at the spillway elevation and 4 to 6 inches of water covering the lake side crest of the berm. Very little erosion was observed on the berm or upstream face. No rodent holes, slides or deformations were observed.
 - (3) Crest. The crest is well vegetated except for two vehicular travel ruts. The section between stations 4+50 and 6+00 (over the old channel) is about one foot lower in elevation than the ends of the dam which could be due to a lack of overfill to compensate for foundation consolidation. No holes, cracks or abnormal deformation were noted along the crest.

- (4) Downstream slope. The downstream slope is well vegetated with grass. A few very small cottonwood trees were observed toward the right end of the dam. No rodent holes, cracks or abnormal deformations were noted on the slope. Seepage outcrops in both abutment troughs. The seep in the right abutment trough emerges at about elevation 591 feet and extends down the trough almost to the toe of the dam. The seepage discharge is carried in a narrow gully or channel varying in depth from 1 to 2 feet. Total seepage effluent from the right abutment was estimated at 0.5 gal/min. It was all clear but rust stained. Seep from the left abutment emerges at about elevation 586 feet (lower than the right abutment). Seep from the left abutment is also collected in a narrow ditch 2 to 2.5 feet in depth and discharges into the principal spillway scour hole. Total seep from the left abutment was estimated at 1 gal/min. All seepage was clear. No seepage was observed on the downstream slope of the dam and it would appear that the seepage observed comes through the limestone abutments.
- (5) Miscellaneous. The excellent vegetation cover, the dimensions of the dam and the materials apparent in the dam would indicate that it could withstand significant overtopping without serious damage.

c. Appurtenant Structures.

- (1) The principal spillway at the time of the inspection was not operating effectively. In fact, the top of the riser was submerged. A subsequent visit to the site showed that the inlet to the 12-inch steel pipe conduit at the bottom of the riser was almost completely plugged with a tree stump and trash. The owner was notified of this condition by letter. There is no trash rack over the top of the riser. No deterioration was noted in the steel riser or conduit.
- (2) The emergency spillway is well vegetated. The exit channel just downstream from the crest is partially blocked by the storage of a float boat or diving platform. It did not appear that the spillway had operated. No slides, slumps or erosion was noted in the spillway. Discharges from the spillway should not endanger the dam.

(3) Drawdown facilities consist of a 12-inch diameter welded steel pipe, with gate valve at the lower end, which passes through the base of the dam at about Station 6 + 30. The valve appears to be operable. It was reported by Kenneth Adams that this drawdown pipe was initially installed to pass the normal stream flow during construction of the dam.

- d. Reservoir Area. No significant erosion or wave wash was noted around the shoreline of the reservoir.
- e. Downstream Channel. The small natural channel downstream from the dam is overgrown with trees and shrubs. However, there is a broad, open, nearly level flood plain adjacent to the channel that should rapidly dissipate any flood crests in the channel.

3.2 EVALUATION

This structure appears to be in good shape. The present seepage through the abutments should not significantly affect the safety of the dam.

Deficiencies in maintenance of the spillways, plugged principal spillway riser and partially blocked emergency spillway, increase the potential for overtopping, and should be corrected. However, it would appear that the dam could withstand considerable overtopping without serious damage.

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

There does not appear to be a maintenance plan for this structure. Maintenance of the spillways is deficient. The principal spillway should be opened, and a suitable trash rack should be installed to prevent future plugging. The obstruction in the emergency spillway channel should be removed. The trees should be removed from the downstream slope and measures taken to prevent their recurrence.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facility consists of a 12-inch diameter welded steel drawdown pipe, with gate valve at the lower end, which passes through the base of the dam at about Station 6+30. The valve appears to be operable.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure if regular maintenance operations are initiated in the near future.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam. Therefore, 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 Jefferson City NW, Missouri 7.5 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. There are no available records of reservoir operation. It was reported by Kenneth Adams that the vegetated, earthen emergency spillway has never operated. It was also reported by Kenneth Adams that after a 7 or 8 inch rainfall the water in the reservoir reached an elevation 2 feet below the emergency spillway crest.
- c. Visual Observations.
 - (1) The steel pipe principal spillway was observed to be plugged with a tree stump and roots, severely limiting the spillway capacity. A letter was written to the owner strongly suggesting this condition be corrected.
 - (2) The vegetated, earthen emergency spillway, located on the left abutment of the dam is in good condition. The exit channel, just downstream from the crest is partially blocked with a float boat or diving platform. Discharges from the emergency spillway will not endanger the dam.
 - (3) The dam is equipped with a 12-inch diameter welded steel pipe drawdown facility which is operated by a gate valve at the outlet end.
- d. Overtopping Potential. The principal spillway is too small to pass the probable maximum flood or the 100-year flood without overtopping. The crest of the emergency spillway is above the low point on the dam. The principal spillway will pass 15% of the PMF and also the 10-year flood without overtopping of the dam. The dam could probably stand significant overtopping without serious damage. The results of the routings through the dam are tabulated below.

<u>Frequency</u>	<u>Peak Inflow Discharge c.f.s.</u>	<u>Peak Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 613.9</u>	<u>Duration of Overtopping Hr.</u>
100 Yr.	2210	70	614.2	-0.3	9±
1/2 PMF	4620	3830	615.9	-2.0	11+
PMF	9250	8180	616.9	-3.0	13+
0.15 PMF	1390	15	613.9	0.0	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 an intermediate size. Therefore, 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 embankment slopes and dimensions should provide adequate safety against shear failures. The present seepage through the abutments does not appear to significantly affect the structural integrity of the dam but could ultimately cause adverse effects by saturating the downstream toe sections of the embankment, unless it is collected and controlled by drains.

The effects of overtopping are not known but would appear to be minimal on structure stability.

- 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. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- 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.
- 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. There does not appear to be any serious potential of failure of this structure. The approximate analyses presented in Section 5 of this report indicate that the 100-year storm occurrence will overtop the dam by 0.3 feet for about 9 hours and 50 percent of the Probable Maximum Flood will overtop the dam by 2.0 feet for about 11 hours. Additional studies would be required to determine the actual potential for overtopping and the adverse effects of such overtopping. The present seepage through the abutments does not appear to significantly affect the structural integrity of the dam but could ultimately cause adverse effects by saturating the downstream toe sections of the embankment unless it is collected and controlled by drains.

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. Deficiencies in maintenance of this structure, which include tree growth on the embankment and blockages in the emergency spillway control section and the principal spillway riser could ultimately lead to potential of failure if left uncontrolled.

- 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 were not available which is considered a deficiency.
- c. Urgency. The recommendations in paragraph 7.2a relative to protection against overtopping should be pursued on a high priority basis. Other remedial measures recommended in paragraph 7.2 should be accomplished in the near future.
- d. Necessity for Phase II. Phase II investigation is not considered necessary.
- e. Seismic Stability. This dam is located in Seismic Zone I. An earthquake of this magnitude is not expected to be hazardous to this dam but stability analyses should include the appropriate earthquake loading.

7.2 REMEDIAL MEASURES

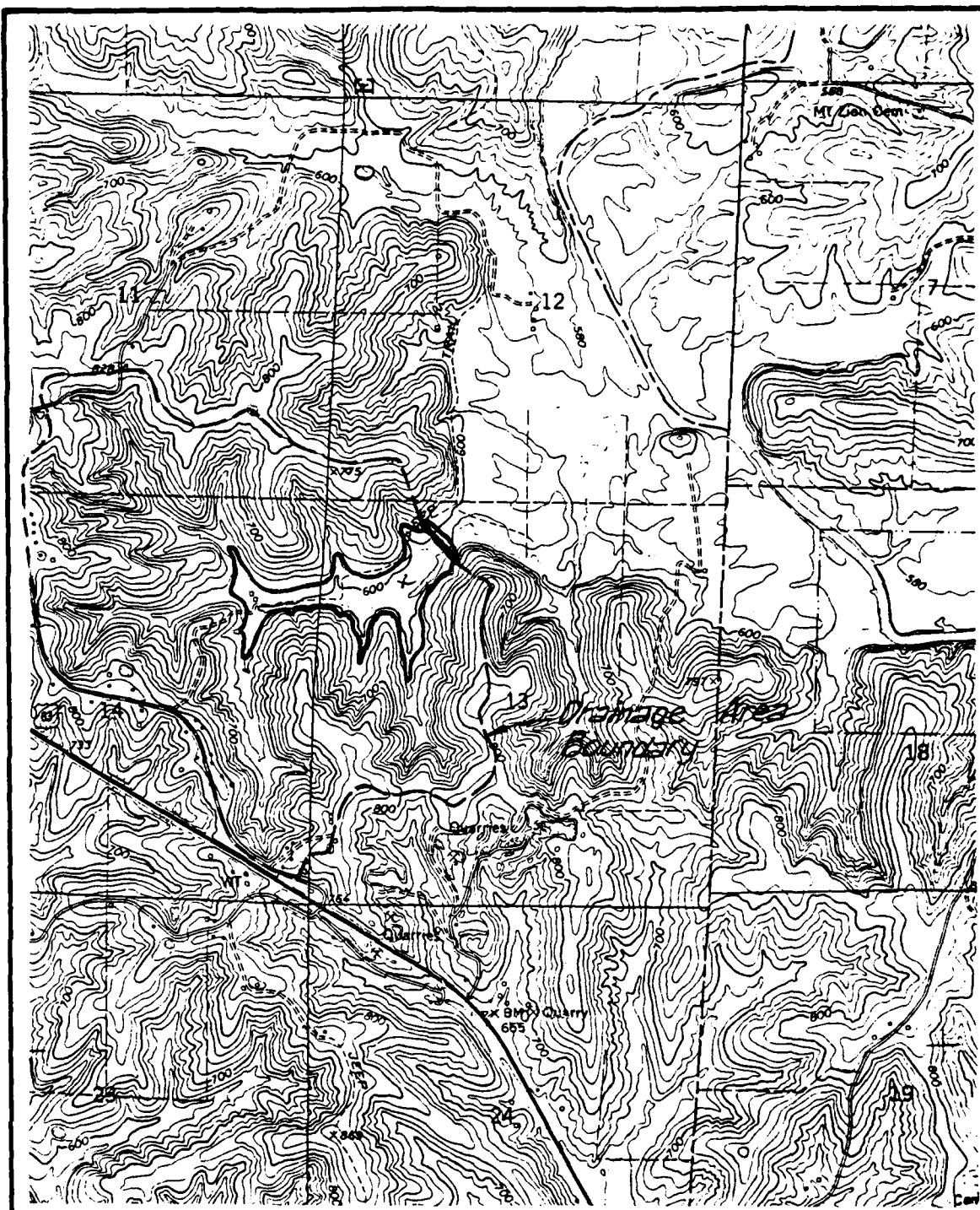
a. Overtopping and Stability

1. Additional information should be obtained on the topographic characteristics of the reservoir to determine the actual potential of overtopping the dam and to determine the corrective measures required to minimize or eliminate this potential. Corrective measures to be considered should include the following:
 - (a) Provide a uniform crest elevation of 616+ which would be approximately two feet above the present low section of the dam.
 - (b) Lower the crest and/or increase the cross section of the existing emergency spillway to provide capacity to pass the Probable Maximum Flood.
2. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", including appropriate earthquake loadings, should be performed.
3. Seepage discharge in both abutment troughs should be collected and controlled by means of properly designed drains. Discharge from the drains should be monitored for quantity and clarity.
4. The services of an engineer experienced in the design and construction of earth dams should be obtained to perform the above analyses and to design the corrective measures, as required.

b. O & M Procedures

1. The principal spillway should be opened up and measures (trash rack) installed to prevent recurrence of plugging.
2. Obstructions in the emergency spillway should be removed and measures taken to keep the channel open.
3. The small trees and shrubs should be removed from the downstream slope of the dam and measures taken to prevent recurrence of growth.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000

Contour Interval 20 Feet



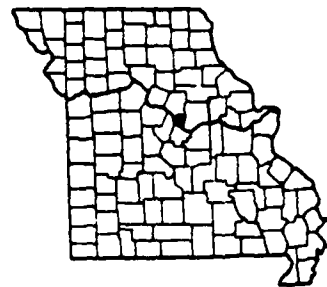
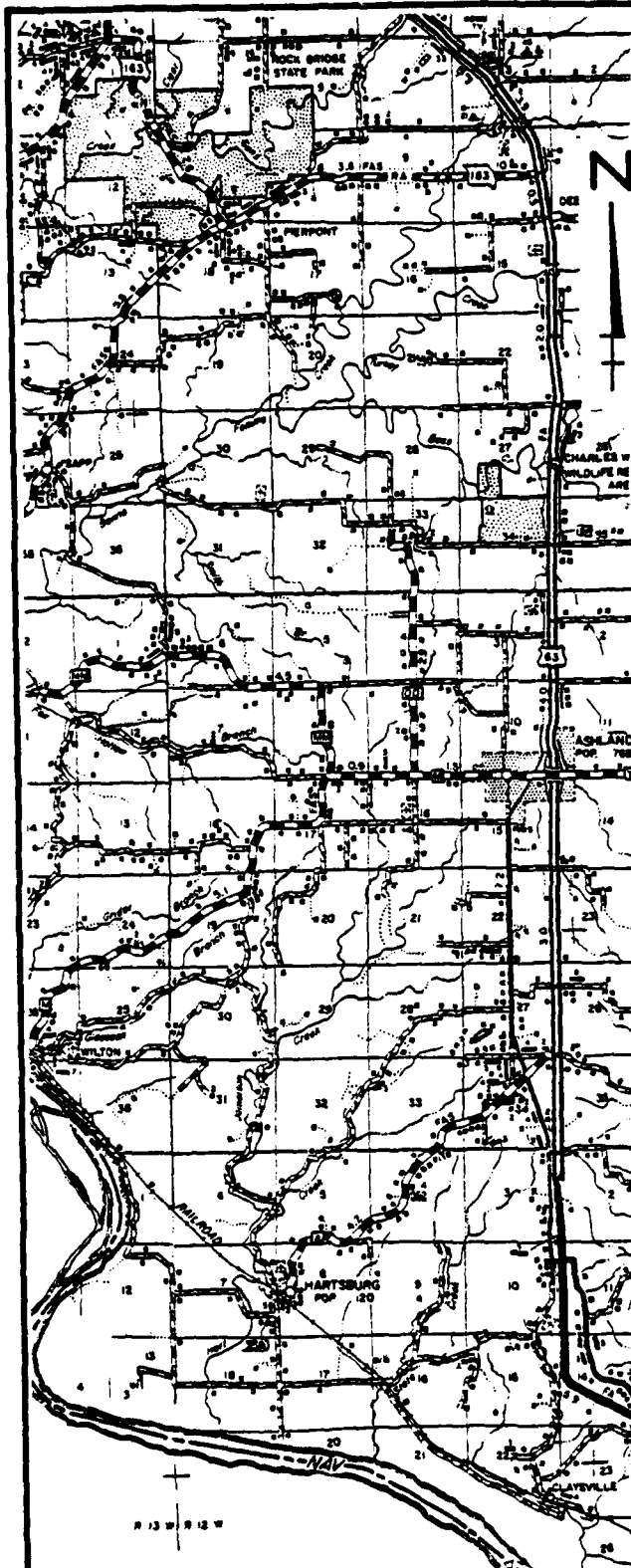
VICINITY TOPOGRAPHY

LAKE CHAMPETRA DAM

BOONE COUNTY, MISSOURI

MO. 30880

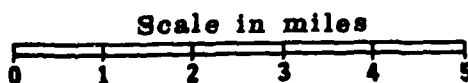
PLATE A-1



VICINITY MAP

ID NO. MO 30880
BOONE COUNTY

LAKE CHAMPETRA DAM



LOCATION MAP

PLATE A-2

APPENDIX B
PHOTOGRAPHS

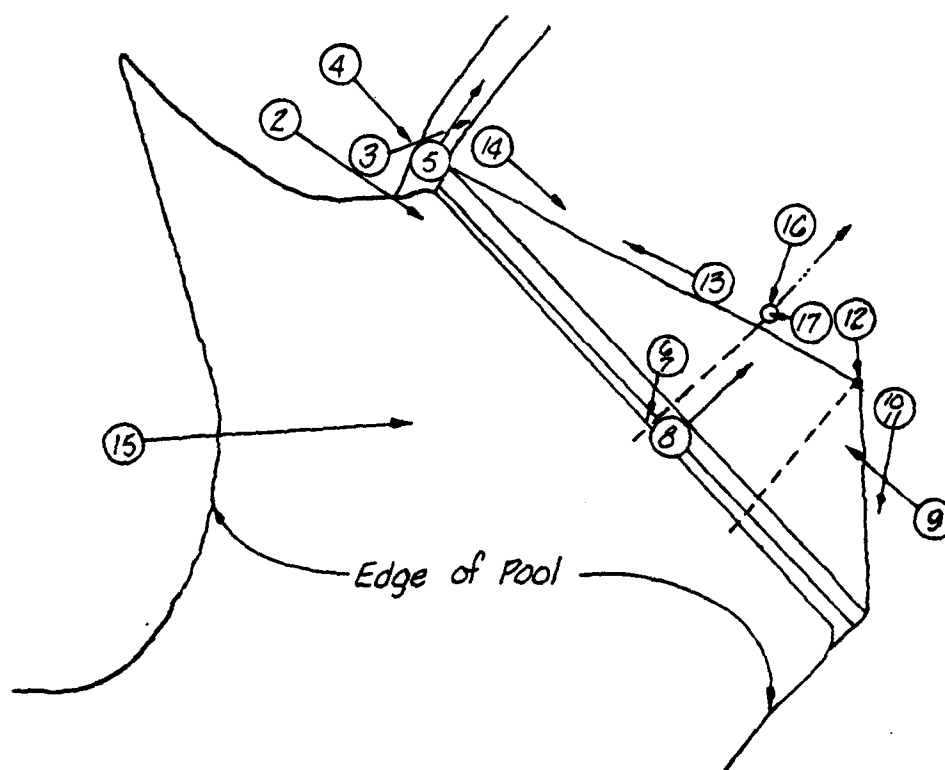
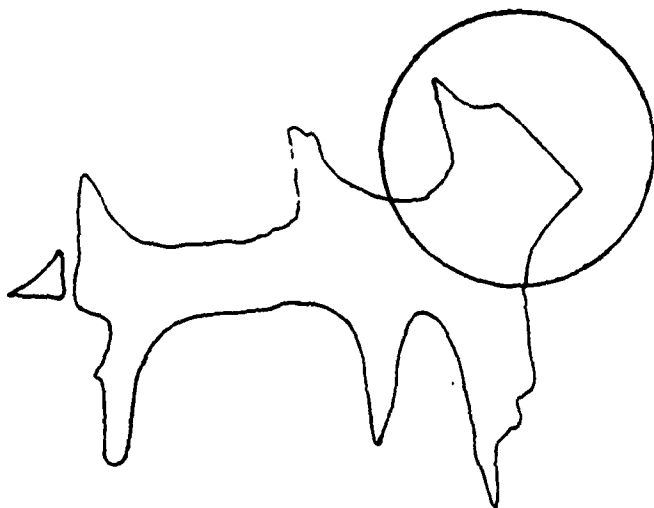


PHOTO INDEX

LAKE CHAMPETRA DAM

BOONE COUNTY, MISSOURI

MO. 30880

PLATE B-1



PHOTO NO. 2 - UPSTREAM FACE FROM LEFT ABUTMENT



PHOTO NO. 3 - VIEW DOWNSTREAM IN EMERGENCY SPILLWAY.



PHOTO NO. 4 - CREST FROM LEFT ABUTMENT



PHOTO NO. 5 - DOWNSTREAM IN EMERGENCY SPILLWAY FROM SPILLWAY
CREST



PHOTO NO. 6 - INLET END
OF PRINCIPAL SPILLWAY



PHOTO NO. 7 - INLET END OF PRINCIPAL SPILLWAY



PHOTO NO. 8 - LOOKING DOWNSTREAM FROM STA. 5+00
PRINCIPAL SPILLWAY OUTLET AT LOWER CENTER



PHOTO NO. 9 - DOWNSTREAM SLOPE FROM RIGHT ABUTMENT

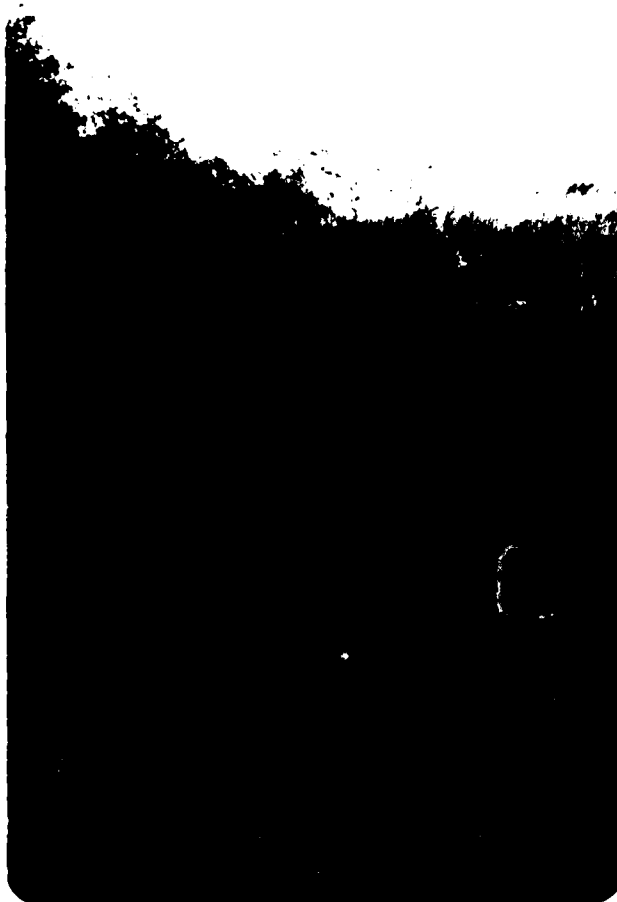


PHOTO NO. 10 - SPRING AREA
IN RIGHT ABUTMENT.



PHOTO NO. 11 - SEEPY AREA
IN RIGHT ABUTMENT TROUGH.
AUGER STANDING IN GULLY
CUT BY SEEPAGE.



PHOTO NO. 12 - VALVE AT OUTLET END OF DRAWDOWN PIPE

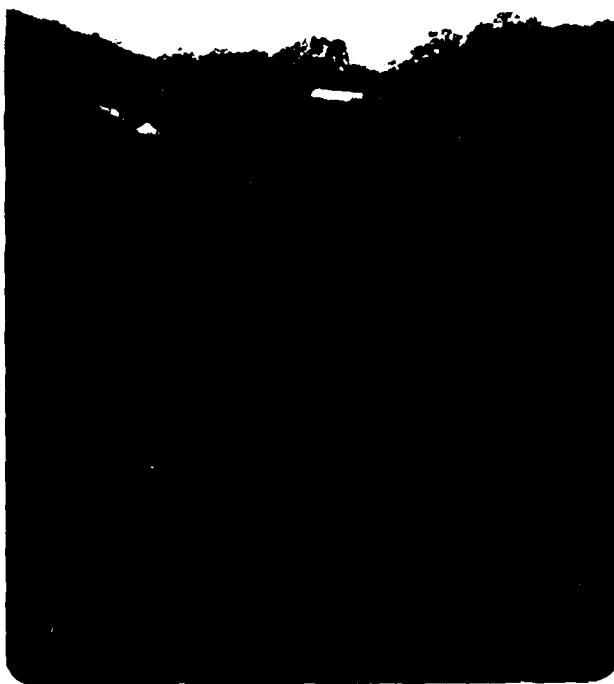


PHOTO NO. 13 - SEEPY AREA
IN LEFT DOWNSTREAM ABUTMENT
TROUGH



PHOTO NO. 14 - SEEPY AREA ALONG LEFT END OF TOE LOOKING
TOWARD RIGHT ABUTMENT



PHOTO NO. 15 - OVERVIEW TAKEN FROM UPSTREAM ON LEFT

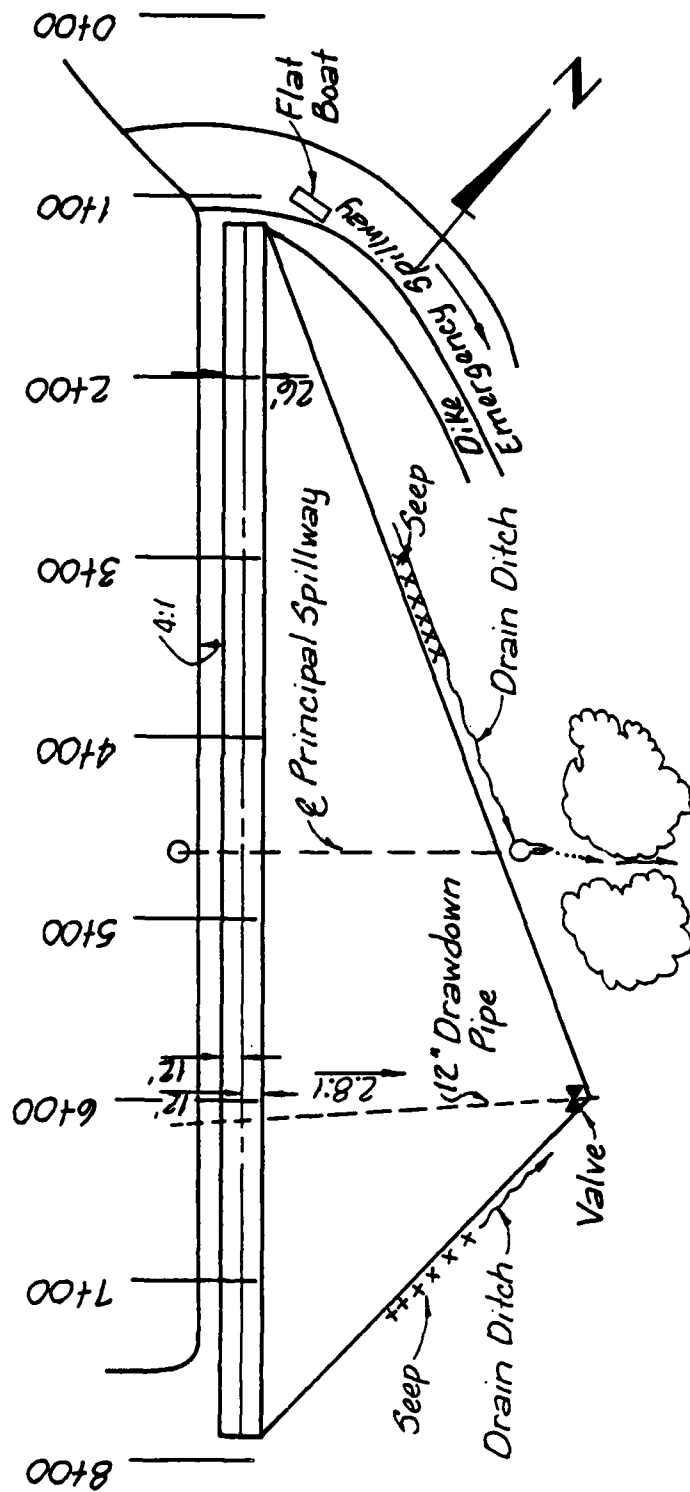


PHOTO NO. 16 - OUTLET END OF PRINCIPAL SPILLWAY



PHOTO NO. 17 - SEEPAGE EFFLUENT FROM LEFT SIDE OF DAM ENTERING
PRINCIPAL SPILLWAY SCOUR HOLE

APPENDIX C
PROJECT PLATES



PLAN OF DAM

Scale: 1" = 100'

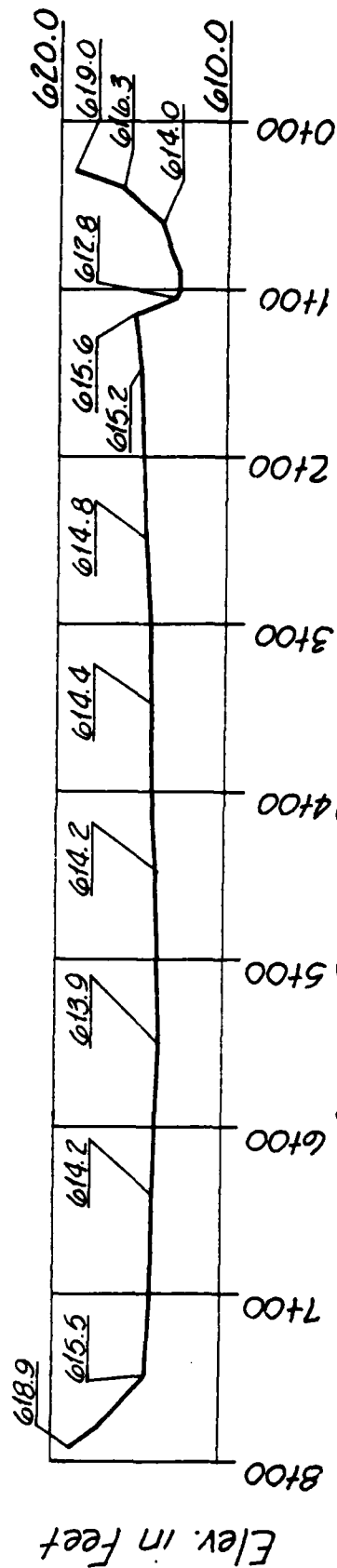
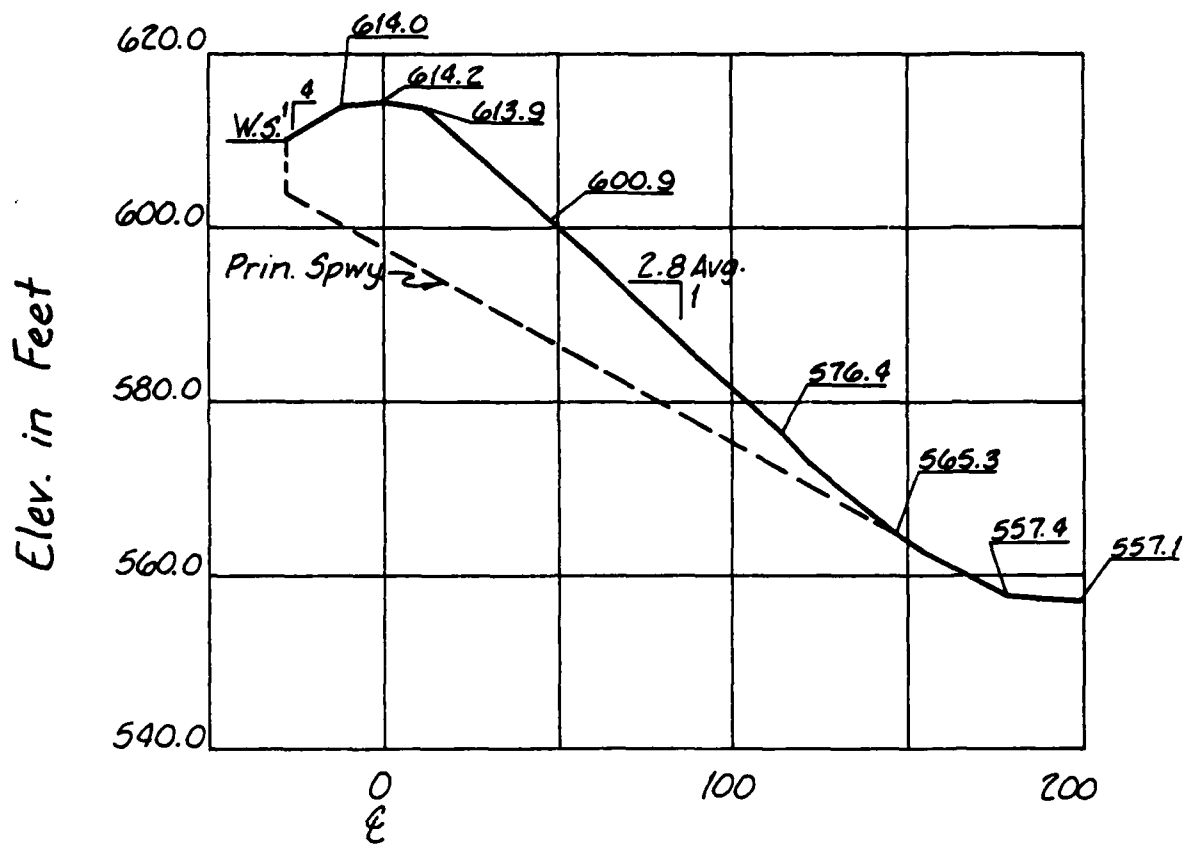


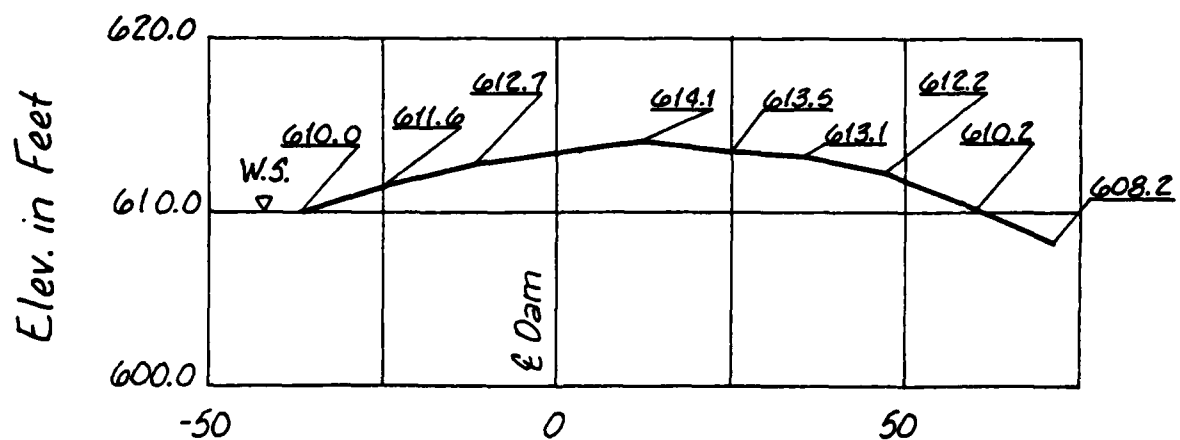
PLATE C-1



SECTION OF DAM AT STA. 6+00

Scale: 1" = 50' Horiz.

1" = 20' Vert.



PROFILE OF EMERGENCY SPILLWAY AT CENTERLINE

Scale: 1" = 25' Horiz.

1" = 10' Vert.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

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

a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Jefferson City, Mo. 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 = 0.93 square miles (597 acres).

c. Time of concentration of runoff = 25 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 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 principal spillway crest.

e. The total twenty-four hour storm duration losses for the 100-year storm were 2.90 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 C and D (Freeburg silt loam, Winfield and Steep Stony Land) and consists mostly of grassland and woodland.

f. Average soil loss rate = 0.07 inch per hour for the PMF.

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

The discharge rating curve for the principal spillway was developed using the weir equation $Q = CLH^{3/2}$ ($C=3.1$, $L=6.24$ ft. and $H=0.0$ ft. to 0.6 ft.), the orifice flow equation $Q = C A (2gH)^{1/2}$ ($C_c=0.52$, $A=3.14$ ft.² and $H=0.6$ ft. to 1.1 ft.) and the Bernoulli energy equation for full flow.

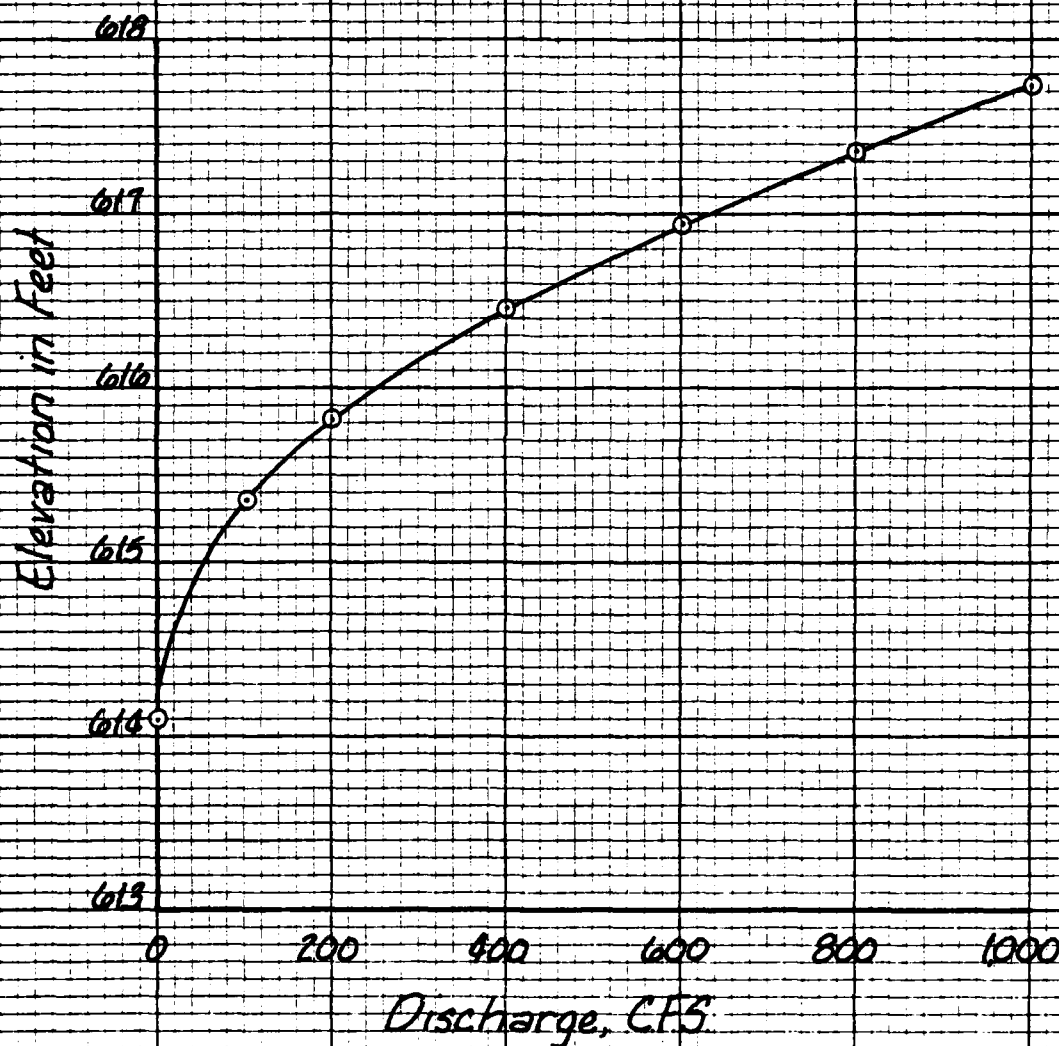
The discharge rating curve for flow over the dam crest was developed using the HEC-1 (Dam Safety Version) program.

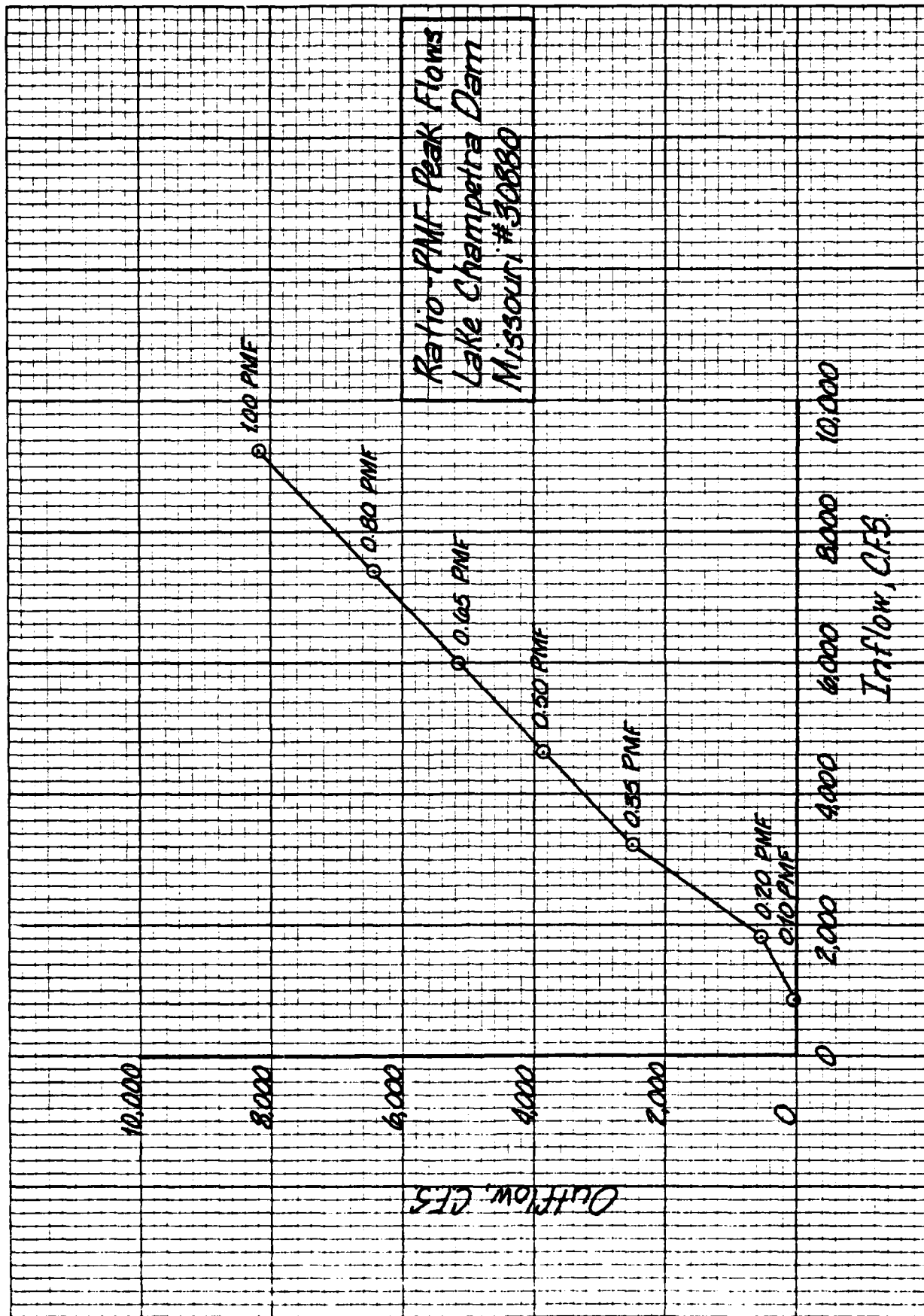
Flow over the dam was computed using the HEC-1 option for non-level dam crests (cards \$L and \$V). This option accounts for the fact that the dam crest is not level by dividing the crest into rectangular and trapezoidal sections and computing critical flow through each section. The weir coefficient shown in the output is not used in the computations.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program. The input, output, and plotted hydrographs are included in this Appendix.



Emergency Spillway Rating Curve
 Lake Champetra Dam
 Missouri #30880





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

RUN DATE= 79/08/06.
 TIME= 19.41.05.

MISSOURI DAM INSPECTION 793181
 ADAMS DAM 30880
 RATIOS OF PMF ROUTED-0.10 0.20 0.35 0.50 0.65 0.80 1.00

JOB SPECIFICATION									
NO	NHR	NMIN	IDAY	THR	IMIN	METRC	TPLY	TPRY	NSTAN
288	0	5	0	0	0	0	0	3	0
JOPER NWT LRUPT TRACE									
5 0 0 0									

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= .10 .20 .35 .50 .65 .80 1.00
 NPLAN= 1 NR10= 7 LR10= 1

***** SUB-AREA RUNOFF COMPUTATION *****

CALCULATION OF INFLOW HYDROGRAPH TO ADAMS LAKE

ISTAQ	ICOMP	TECON	ITAPE	JPLT	JPRY	INAME	TSAGE	TAUTO
000001	0	0	0	2	0	1	0	0

HYDROGRAPH DATA

THYDG	IUHG	IARLA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.93	0.00	.93	1.00	0.000	0	1	0

PRECIP DATA

SPEE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.00	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LRUPT	STRKR	DLTKR	RTIOL	ERAIN	SINKS	RTIOL	STRIC	CNSYL	ALSHR	RTIHP
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 WEINSS = -1.00 EFFECT CN = 88.00

UNIT HYDROGRAPH DATA

LC= 0.00 LAG= .25

RECESSION DATA

STRIC= 0.00 QRCN= -.01 RTICR= 1.00

UNIT HYDROGRAPH 17 END OF PERIOD ORIGINATES, TC= 0.00 HOURS, LAG= .25 VOL= 1.00

273.	933.	1486.	1158.	693.	431.	279.	174.	109.
08.	43.	27.	17.	12.	7.	2.		

END-OF-PERIOD FLOW

011111

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

PEAK	925.	6-HOUR	250.	24-HOUR	77.	72-HOUR	77.	TOTAL VOLUME	22202.
CFS	26.		7.		2.		2.		629.
CMS									3.08
INCHES			2.50	3.08	3.08				78.34
MM			63.42	78.34	78.34				153.
AC-FT			124.	153.	153.				189.
THOUS CU M			153.	189.	189.				

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

PEAK	1850.	6-HOUR	499.	24-HOUR	154.	72-HOUR	154.	TOTAL VOLUME	44404.
CFS	52.		14.		4.		4.		1257.
CMS									6.17
INCHES			4.99	6.17	6.17				156.69
MM			126.84	156.69	156.69				306.
AC-FT			248.	306.	306.				377.
THOUS CU M			305.	377.	377.				

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

PEAK	3237.	6-HOUR	874.	24-HOUR	270.	72-HOUR	270.	TOTAL VOLUME	77707.
CFS	92.		25.		8.		8.		2200.
CMS									10.80
INCHES			8.74	10.80	10.80				274.20
MM			221.97	274.20	274.20				535.
AC-FT			433.	535.	535.				660.
THOUS CU M			534.	660.	660.				

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

PEAK	4624.	6-HOUR	1248.	24-HOUR	385.	72-HOUR	385.	TOTAL VOLUME	111009.
CFS	131.		35.		11.		11.		3143.
CMS									15.42
INCHES			12.48	15.42	15.42				391.71
MM			317.10	391.71	391.71				765.
AC-FT			619.	765.	765.				943.
THOUS CU M			763.	943.	943.				

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

PEAK	6011.	6-HOUR	1623.	24-HOUR	501.	72-HOUR	501.	TOTAL VOLUME	144312.
CFS	170.		46.		14.		14.		4086.
CMS									20.05
INCHES			16.23	20.05	20.05				509.23
MM			412.22	509.23	509.23				994.
AC-FT			805.	994.	994.				1226.
THOUS CU M			992.	1226.	1226.				

HYDROGRAPH AT STAD00001 FOR PLAN 1, RTIO 6

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
7398.	1997.	617.	617.	177615.
CFS				
210.	57.	17.	17.	5029.
INCHES	19.97	24.67	24.67	24.67
MM	507.35	626.74	626.74	626.74
AC-FT	990.	1223.	1223.	1223.
THOUS CU M	1221.	1509.	1509.	1509.

HYDROGRAPH AT STAD00001 FOR PLAN 1, RTIO 7

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
9248.	2696.	771.	771.	222019.
CFS				
262.	71.	22.	22.	6287.
INCHES	24.97	30.84	30.84	30.84
MM	634.19	783.43	783.43	783.43
AC-FT	1238.	1529.	1529.	1529.
THOUS CU M	1527.	1886.	1886.	1886.

HYDROGRAPH ROUTING

RESERVOIR ROUTING OF HYDROGRAPH AT ADAMS LAKE

ISTAQ	ICOMP	IECUN	ITAPE	JPLT	JPAT	INAME	ISTAGE	IAUTO
00002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRCS	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSK	X	TSK	STOKA	ISPRAT
1	0	0	0.000	0.000	0.000	-610.	-1

STAGE	607.70	609.90	610.40	610.80	614.10	615.40	615.80	616.50	617.00	617.40
	617.70	618.60								

FLOW	0.00	2.00	10.00	14.00	15.00	115.00	215.00	415.00	615.00	815.00
	1615.00	1615.00								

SURFACE AREA	0.	2.	18.	60.	93.
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CAPACITY	0.	2.	175.	920.	2436.
----------	----	----	------	------	-------

ELEVATION	576.	580.	600.	620.	640.
-----------	------	------	------	------	------

CREL	SPWID	COBW	EXPW	ELEV	COUL	CAREA	EXPL
609.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA			
IUPEL	CUOD	EXPU	DAMWID
613.9	3.0	1.5	677.

CREST LENGTH	13.	125.	250.	415.	530.	645.	677.
AT ON BELOW							

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

40VF*

STATION000002

✓

0.	2000.	4000.	6000.	8000.	10000.	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	.	.	.	.	.	.	.	.	.	.	.

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	RATIO	1	RATIO	2	RATIO	3	RATIO	4	RATIO	5	RATIO	6	RATIO	7
					.10		.20		.35		.50		.65		.80		1.00
RATIOS APPLIED TO FLOWS																	
HYDROGRAPH AT 00001																	
		.93	1	925.	1850.	3237.	4624.	6011.	7398.	9248.							
		(2.41)	(	26.19)	(52.38)	(91.66)	(130.94)	(170.22)	(209.50)	(261.88)							
ROUTED TO 00002																	
		.93	1	15.	568.	2531.	3832.	5128.	6432.	8177.							
		(2.41)	(	.42)	(16.10)	(71.68)	(108.50)	(145.22)	(182.14)	(231.55)							

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION STORAGE	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
433.	609.70	609.70	613.90
OUTFLOW	0.	433.	602.
		0.	15.

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	FAILURE HOURS
.10	613.21	0.00	571.	15.	0.00	19.00	0.00
.20	614.71	.81	638.	568.	8.25	16.42	0.00
.35	615.56	1.66	679.	2531.	9.58	16.00	0.00
.50	615.94	2.04	698.	3832.	10.58	15.92	0.00
.65	616.27	2.37	714.	5128.	11.25	15.92	0.00
.80	616.57	2.67	730.	6432.	11.67	15.92	0.00
1.00	616.93	3.03	748.	8177.	12.75	15.92	0.00

