

AD-A106 303

BLACK AND VEATCH KANSAS CITY MO  
NATIONAL DAM SAFETY PROGRAM, FOPPEL LAKE DAM (MO 20494), MISSOURI--ETC(U)  
DEC 80 E R BURTON, H L CALLAHAN

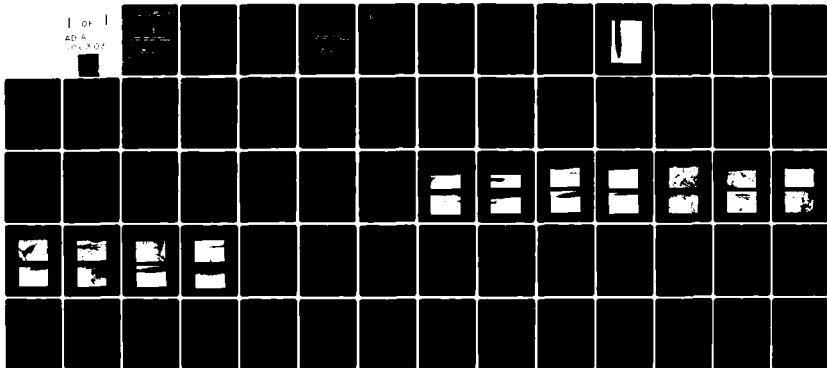
F/G 13/13

DACW43-81-C-0037

NL

UNCLASSIFIED

1 of 1  
AD-A106 303



END  
DATE  
FILMED  
11-81  
DTIC

**LEVEL 1**



**MISSOURI-KANSAS CITY BASIN**

AD A 10053003

**POFFEL LAKE DAM  
JOHNSON COUNTY, MISSOURI  
NO 2844**

**DTIC  
ELECTE  
OCT 28 1981  
S E**

**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**

**FILE COPY**



**United States Army  
Corps of Engineers**

**St. Louis District**

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

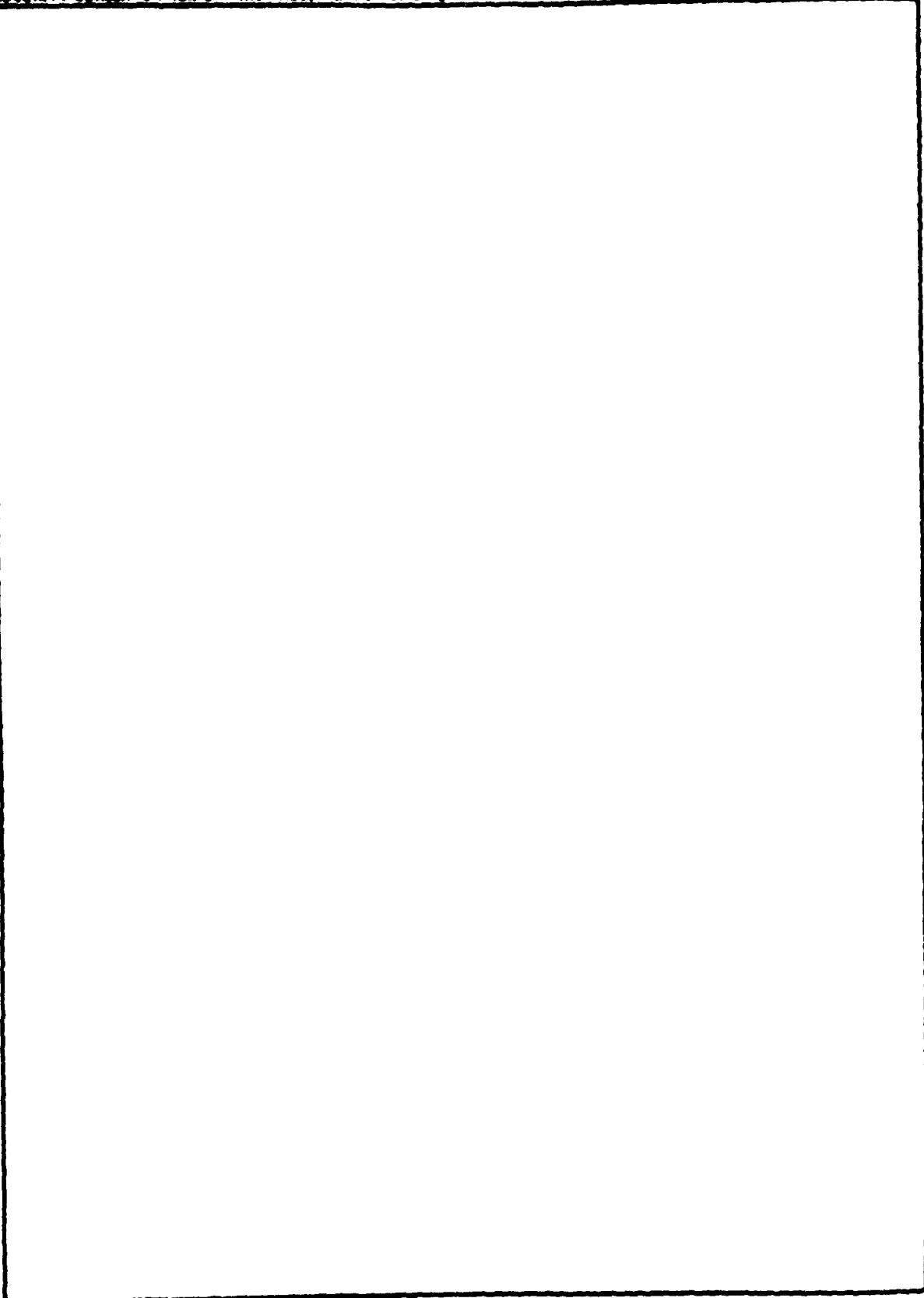
**FOR: STATE OF MISSOURI**

For public use only. Not for distribution to contractors.

**DECEMBER 1980**

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS UNIFORM CATALOGING FORM	
1 REPORT NUMBER	2 GOVT ACCESSION NO.	3 RECIPIENT'S CATALOG NUMBER	
4 TITLE (and Subtitle)		5 TYPE OF REPORT & PERIOD COVERED	
6 AUTHOR		7 PERFORMING ORG. REPORT NUMBER	
7 AUTHORING ORGANIZATION NAME(S) AND ADDRESS(ES)		8 CONTRACT OR GRANT NUMBER(S)	
8 CONTROLLING OFFICE NAME AND ADDRESS		9 PROGRAM ELEMENT PROJECT TASK AREA & WORK UNIT NUMBER	
9 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)		10 REPORT DATE	
10 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)		11 NUMBER OF PAGES	
11 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)		12 SECURITY CLASS. of this report	
12 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)		13a DECLASSIFICATION DOWNGRADING SCHEDULE	
13 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
14 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
15 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
16 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
17 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
18 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
19 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
20 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
21 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
22 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
23 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
24 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
25 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
26 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
27 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
28 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
29 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
30 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
31 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
32 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
33 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
34 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
35 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
36 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
37 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
38 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
39 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
40 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
41 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
42 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
43 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
44 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
45 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
46 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
47 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
48 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
49 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			
50 DISTRIBUTION STATEMENT (See instructions for reporting distribution statement)			

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

# MISSOURI-KANSAS CITY BASIN

FOFFEL LAKE DAM  
JOHNSON COUNTY, MISSOURI  
MO 20494

## PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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

**St. Louis District**

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

FOR: STATE OF MISSOURI

DECEMBER 1980



**DEPARTMENT OF THE ARMY**  
**ST. LOUIS DISTRICT CORPS OF ENGINEERS**  
 210 TUCKER BOULEVARD NORTH  
 ST. LOUIS, MISSOURI 63101

REPLY TO  
 ATTENTION OF

**SUBJECT: Foffel Lake Dam, MO. I.D. No. 20494 Phase I Inspection Report.**

This report presents the results of field inspection and evaluation of the Foffel Lake Dam (MO 20494).

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:

- a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- b. Overtopping of the dam could result in failure of the dam.
- c. Dam failure significantly increases the hazard to loss of life downstream.

**SIGNED** <sup>22</sup>  
~~26~~ MAY 1981  
 SUBMITTED BY: \_\_\_\_\_ Date \_\_\_\_\_  
 Chief, Engineering Division

**SIGNED** 26 MAY 1981  
 APPROVED BY: \_\_\_\_\_ Date \_\_\_\_\_  
 Colonel, CE, District Engineer

Accession for	
NTIS	<input checked="" type="checkbox"/>
DTIC	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
<b>A</b>	

FOFFEL LAKE DAM  
JOHNSON COUNTY, MISSOURI  
MISSOURI INVENTORY NO. 20494

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:  
BLACK & VEATCH  
CONSULTING ENGINEERS  
KANSAS CITY, MISSOURI

UNDER DIRECTION OF  
ST. LOUIS DISTRICT CORPS OF ENGINEERS  
FOR  
GOVERNOR OF MISSOURI

DECEMBER 1980

PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Foffel Lake Dam
State Located	Missouri
County Located	Johnson County
Stream	Tributary of Clear Fork of Blackwater River
Date of Inspection	11 December 1980

Foffel Lake Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. 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. According to the St. Louis District, Corps of Engineers, failure of the dam would threaten lives and property. The estimated damage zone extends approximately one and one-half miles downstream of the dam. Within the estimated damage zone are two trailer courts with more than fifteen trailer units, a railroad, a motel and service station, commercial development, more than five residential dwellings, and two highways. Contents of the estimated downstream damage zone were verified by the inspection team.

Our inspection and evaluation indicates 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 not pass the probable maximum flood without overtopping but will pass 25 percent of the probable maximum flood. The spillway will pass the flood which has a one percent chance of occurrence in any given year (100-year flood). The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. Considering the downstream damage zone and the volume of water stored in the reservoir, the spillway design flood should be 100 percent of the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

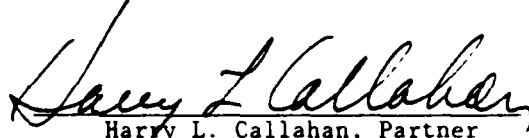


Based on visual observations, this dam appears to be in good condition. Deficiencies visually observed by the inspection team were extremely steep upstream slope, erosion and sloughing of the upstream slope at the waterline due to wave action, erosion of the unlined spillway discharge channel at the embankment toe, seepage on the downstream slope near the toe of the north-south portion of the embankment and animal burrows in the embankment. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.



Edwin R. Burton, PE  
Missouri E-10137



Harry L. Callahan, Partner  
Black & Veatch



OVERVIEW OF DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
FOFFEL LAKE DAM

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
	SECTION 1 - PROJECT INFORMATION	
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	2
	SECTION 2 - ENGINEERING DATA	
2.1	Design	5
2.2	Construction	5
2.3	Operation	5
2.4	Geology	5
2.5	Evaluation	5
	SECTION 3 - VISUAL INSPECTION	
3.1	Findings	7
3.2	Evaluation	8
	SECTION 4 - OPERATIONAL PROCEDURES	
4.1	Procedures	10
4.2	Maintenance of Dam	10
4.3	Maintenance of Operating Facilities	10
4.4	Description of Any Warning System in Effect	10
4.5	Evaluation	10
	SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1	Evaluation of Features	11
	SECTION 6 - STRUCTURAL STABILITY	
6.1	Evaluation of Structural Stability	13
	SECTION 7 - ASSESSMENT/REMEDIAL MEASURES	
7.1	Dam Assessment	14
7.2	Remedial Measures	14

TABLE OF CONTENTS (Cont'd)

LIST OF PLATES

<u>Plate No.</u>	<u>Title</u>
1	Location Map
2	Vicinity Topography
3	Dam Plan
4	Dam Cross Sections
5	Dam Crest Profile
6	Photo Index

LIST OF PHOTOGRAPHS

<u>Photo No.</u>	<u>Title</u>
1	Upstream Face of Dam Looking West
2	Upstream Face of Dam Looking North
3	Crest of Dam Looking South
4	Crest of Dam Looking East
5	Crest of Dam Looking West
6	Crest of Dam Looking West from East End
7	Downstream Face of Dam Looking South
8	Downstream Face of Dam Looking West
9	Upstream End of Spillway Pipe
10	Downstream End of Spillway Pipe
11	Channel Downstream of Spillway Pipe Outlet
12	Ditch Along Downstream Toe of Dam

TABLE OF CONTENTS (cont.)

LIST OF PHOTOGRAPHS

<u>Photo No.</u>	<u>Title</u>
13	Ditch to Highway Culvert Inlet
14	Inlet to Highway Culvert
15	Outlet from Highway Culvert
16	Area Downstream of Highway Culvert
17	Seepage Area at Downstream Toe of Dam
18	Near Vertical Upstream Face of Dam due to Erosion and Sloughing
19	Erosion and Sloughing of Upstream Face of Dam
20	Area West of Dam Viewed from Dam
21	Low Point Along Highway West of Dam
22	Area Downstream of Highway

APPENDIX

Appendix A - Hydrologic and Hydraulic Analyses

BIBLIOGRAPHY

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-507, 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 District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Foffel 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) The dam is an earth structure located in the valley of a tributary of the Clear Fork of the Blackwater River (see Plate 1). The lake appears to have been formed by the damming of a highway construction borrow pit. The watershed is an area of minor topographic relief of low hills consisting of about 25 percent grasslands, 50 percent croplands, and 25 percent lake surface area. The dam is approximately 1,035 feet long along the crest and 20 feet high. The dam crest is about 8 feet wide. The downstream face of the dam has a nonuniform slope.

(2) The spillway is an 18-inch, 40 feet long corrugated metal pipe conduit located near the right end of the embankment. Left and right are used herein for directional reference while looking downstream. The flow through the conduit is not controlled. There is no trash rack or headwall. The spillway outlet channel consists of a narrow, unlined section and a relatively flat overflow section.

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

b. Location. The dam is located in east-central Johnson County, Missouri, as indicated on Plate 1. The lake formed by the dam is located in the area shown on the United States Geological Survey 7.5 minute series quadrangle map for Knob Noster, Missouri in Section 15 of T46N, R24W.

1. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

2. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

3. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

4. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

5. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

6. The purpose of this study is to determine the effect of the design of the highway on the amount of damage to the highway structure and the amount of damage to the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface. The study is based on the data collected from the study of the highway structure and the highway surface.

APPENDIX A

1. Estimated maximum damage to the highway structure.

2. Estimated maximum damage to the highway surface.

3. Normal loss due to the design of the highway structure and the highway surface.

4. Estimated maximum damage to the highway structure.

5. Estimated maximum damage to the highway surface.

1. The first part of the document  
describes the general situation  
of the country and the  
state of the economy.

2. The second part of the document  
describes the state of the  
economy and the state of  
the country.

3. The third part of the document  
describes the state of the  
country and the state of  
the economy.

4. The fourth part of the document  
describes the state of the  
economy and the state of  
the country.

5. The fifth part of the document  
describes the state of the  
country and the state of  
the economy.

6. The sixth part of the document  
describes the state of the  
economy and the state of  
the country.

7. The seventh part of the document  
describes the state of the  
country and the state of  
the economy.

8. The eighth part of the document  
describes the state of the  
economy and the state of  
the country.

9. The ninth part of the document  
describes the state of the  
country and the state of  
the economy.

10. The tenth part of the document  
describes the state of the  
economy and the state of  
the country.

11. The eleventh part of the document  
describes the state of the  
country and the state of  
the economy.

12. The twelfth part of the document  
describes the state of the  
economy and the state of  
the country.



(7) Impervious core - Unknown.

(8) Cutoff - Unknown.

(9) Grout curtain - Unknown.

(10) Diversion and Regulating Tunnel - None.

(11) Spillway:

(a) Type - 18-inch corrugated metal pipe.

(b) Invert elevation - 832.0 feet m.s.l.

(c) Gates - None.

(d) Upstream channel - None.

(e) Downstream channel - Discharges to an eroded ditch located near the toe of the dam and then to a 30-inch concrete culvert through the embankment of Highway 50.

(12) Emergency Spillway - None.

(13) Regulating Outlets - None.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Design data were not available.

### 2.2 CONSTRUCTION

Construction records were unavailable.

### 2.3 OPERATION

Operational records and documentation of past floods were unavailable.

### 2.4 GEOLOGY

The site for the dam and reservoir is located across a broad shallow swale on a gently sloping hillside. The dam impounds the drainage of a small intermittent headwater tributary of the Clear Fork of the Blackwater River.

The soils in the area of the dam and reservoir are the Deepwater, Haig and Sampsel soil series. The Deepwater soil series consists of deep, moderately well-drained soils formed in residuum from shales on uplands. The Deepwater soils are classified for engineering purposes as ML or CL materials. The Haig soil series consists of poorly drained soils formed in loess under prairie vegetation on uplands. The Haig soils are classified for engineering purposes as CL, OL, and CH materials. The Sampsel soil series consists of poorly drained soils on ridgetops (Reference 1).

The bedrock in the area of the dam and reservoir consists of interbedded shale, siltstone, and sandstone of the Cabiness subgroup, Cherokee group of the Des Moinesian series of the Pennsylvanian system. The depth to bedrock is not known (Reference 2).

### 2.5 EVALUATION

a. Availability. No engineering data were available.

b. Adequacy. No engineering data were available. Thus, an assessment of the design, construction, and operation could not be made. 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. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General. A visual inspection of Foffel Lake Dam was made on 11 December 1980. The inspection team consisted of Edwin Burton, team leader; Robert Pinker, geologist; Gary Van Riessen, geotechnical engineer; Alan Reif, civil engineer; and Paul MacRoberts, hydraulics/hydrologic engineer. The dam appeared to be in good condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. No cracking, sliding, or other signs of settlement or instability were observed. However, the upstream slope of the embankment is steep and some minor sloughing on the upstream face has occurred as a result of undercutting by wave action. No instruments to measure the performance of the dam were observed.

A seepage area was observed on the downstream slope of the embankment near the toe. Wet soils and standing water have provided an area for cattail growth. Clear flow of less than 1 gpm was observed at the lower end of the seepage area. No toe drains or relief wells were observed.

The dam crest has a mowed grass/weed cover with some worn spots, probably due to foot and vehicle traffic. Wave action erosion was observed on the upstream slope. There is no riprap protection on this dam. The ditch leading from the 18-inch corrugated metal pipe conduit spillway is cutting into the toe of the embankment.

Two or three small trees, 1-inch diameter or less, are growing on the embankment. A few small animal burrows were observed on both the upstream and downstream faces.

No evidence was found to indicate that the embankment had ever been overtopped.

There was evidence that a maintenance program was in effect which includes mowing of the crest grass/weeds and the cutting of small trees on the embankment.

c. Appurtenant Structures. The inspection team observed the following items pertaining to the appurtenant structures. The spillway is an 18-inch corrugated metal pipe conduit located near the right end of the embankment with no control mechanism. There was evidence of erosion in the unlined spillway discharge channel downstream of the spillway. The spillway was considered to be in good condition. It

should be noted that an abnormally large spillway discharge would probably cause damage to the embankment in the vicinity of the spillway.

There was no development in the spillway area which would suffer damage due to flow through the spillway.

d. Geology. The soil in the area around the dam and reservoir consists of silty clay. The soils were visually classified as CL materials.

No rock outcrops were observed. It is anticipated the foundation and abutments consist of either shale or silty clay. The depth to bedrock could not be determined.

Auger samples of the materials in the embankment were taken with an Oakfield sampler near the downstream crest of the embankment. The materials in the sample were visually classified for engineering purposes as ML and CL materials. Based on these samples, it is surmised that the embankment is constructed of materials similar to those in the samples.

e. Reservoir Area. No slumping or slides of the reservoir banks were observed. The watershed for the lake is primarily cultivated agricultural land. The contributing watershed was not particularly channelized. Some small ditches were observed. The contributing area was essentially clear of debris and trees. Some brush was observed along the east watershed boundary. The lake was noted to be clean with no siltation.

f. Downstream Channel. The spillway discharges to a channel which enters a 30-inch concrete culvert under U.S. Highway 50. The natural channel downstream from Highway 50 is relatively clear, although the overbanks have extensive brush and tree growth. Large flows passing the dam would probably overflow the highway at its low point which is approximately 1,000 feet west of the dam.

### 3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control.

The potential for sloughing, erosion, or sliding of embankment material is enhanced by the presence of the relatively steep side slopes and the lack of erosion protection on the upstream face.

The growth of trees and brush, if allowed to go unchecked, could cause deterioration of the embankment. The roots of trees can loosen the embankment material and leave voids through which water can pass.

The area of seepage on the downstream slope which was observed should be monitored regularly for quality and quantity. Seepage can cause internal erosion creating cavities and underground channels, thereby weakening the embankment and/or abutments.

The eroded unlined discharge channel at the embankment toe near the right abutment should be repaired and protected against further erosion.

The absence of riprap on the upstream slope of the dam has resulted in wave action erosion. If not corrected wave action will continue to erode the embankment and could lead to slope stability problems.

Burrowing animals will continue to damage the embankment if a program is not undertaken to eliminate them. Piping failure of embankments have resulted from damage caused by burrowing animals.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, seepage, evaporation, transpiration, and capacity of the uncontrolled spillway.

### 4.2 MAINTENANCE OF DAM

There was evidence that maintenance has been performed which includes the mowing of the crest grass/weeds and the cutting of small trees and brush.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system or preplanned scheme for alerting downstream residents for this dam.

### 4.5 EVALUATION

A maintenance program should continue to include mowing the grass cover and cutting small trees and brush on the embankment in order to discourage animal burrowing.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data. No design data were available.

b. Experience Data. The drainage area and lake surface area are developed from the USGS Knob Noster Quadrangle Map. The dam layout is from a survey made during the inspection.

c. Visual Observations.

(1) The spillway appears to be in good condition. The lake level at the time of the inspection (El. 831.6) was below the spillway invert level. There were no obstructions to flow in the immediate downstream channel. The spillway discharge enters a 30-inch concrete highway culvert immediately downstream from the dam's toe near the center of the dam.

(2) There is no emergency spillway for this dam.

(3) Spillway discharges may endanger the integrity of the dam in the immediate vicinity of the spillway.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 25 percent of the probable maximum flood without overtopping the dam. The spillway will pass the one percent chance flood estimated to have a peak outflow of 5 cfs developed by a 24-hour, one percent chance rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the downstream hazard and the volume of water stored in the reservoir, the appropriate spillway design flood should be 100 percent of the probable maximum flood. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 77 cfs of the total discharge from the reservoir of 85 cfs. The estimated duration of overtopping is 8.5 hours with a maximum height of 0.8 feet. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 820 cfs of the total discharge from the reservoir of 830 cfs. The estimated duration of overtopping is 10.7 hours with a maximum height of 1.6 feet. The embankment could be jeopardized should overtopping occur for these periods of time.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately one and one-half



miles downstream of the dam. Within the defined damage zone are two trailer courts with more than fifteen trailer units, a motel and service station, a railroad, commercial development, more than five residential dwellings, and two highways. These various facilities could be severely damaged and lives lost should failure of the dam occur. Contents of the estimated downstream damage zone were verified by the inspection team. There does not appear to be any flood plain regulations or other constraints in force to limit future downstream development.

## SECTION c - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

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

c. Operating Records. No operational records exist.

d. Postconstruction Changes. It is not known whether or not any changes have been made to the dam subsequent to its construction.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone. The seismic stability of an earth dam is dependent upon a number of factors: embankment and foundation material classifications and shear strengths; abutment materials, conditions, and strengths; embankment zoning, and embankment geometry. Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored and/or controlled. These are erosion on the upstream slope, erosion of the unlined spillway discharge channel at the embankment toe near the right abutment, the seepage area on the downstream slope, and animal burrows in the embankment. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. Due to the absence of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed as soon as possible to implement remedial measures recommended in paragraph 7.2b. If the safety deficiencies listed in paragraph 7.1a are not corrected, they will continue to deteriorate and lead to a serious potential of failure. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5b are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

### 7.2 REMEDIAL MEASURES

a. Alternatives. The spillway size and/or height of the dam would need to be increased or the lake level would need to be permanently lowered to increase available flood storage to effectively pass the recommended spillway design flood.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended and should be carried out under the direction of a professional engineer experienced in the design, construction, and maintenance of earth dams.

(1) Riprap should be placed on the upstream face of the dam to an elevation above normal lake level to prevent wave induced erosion of the embankment material.

(2) The seepage area noted during the visual inspection should be closely monitored and documented as to quantity and quality of flow. Any significant changes should be evaluated.

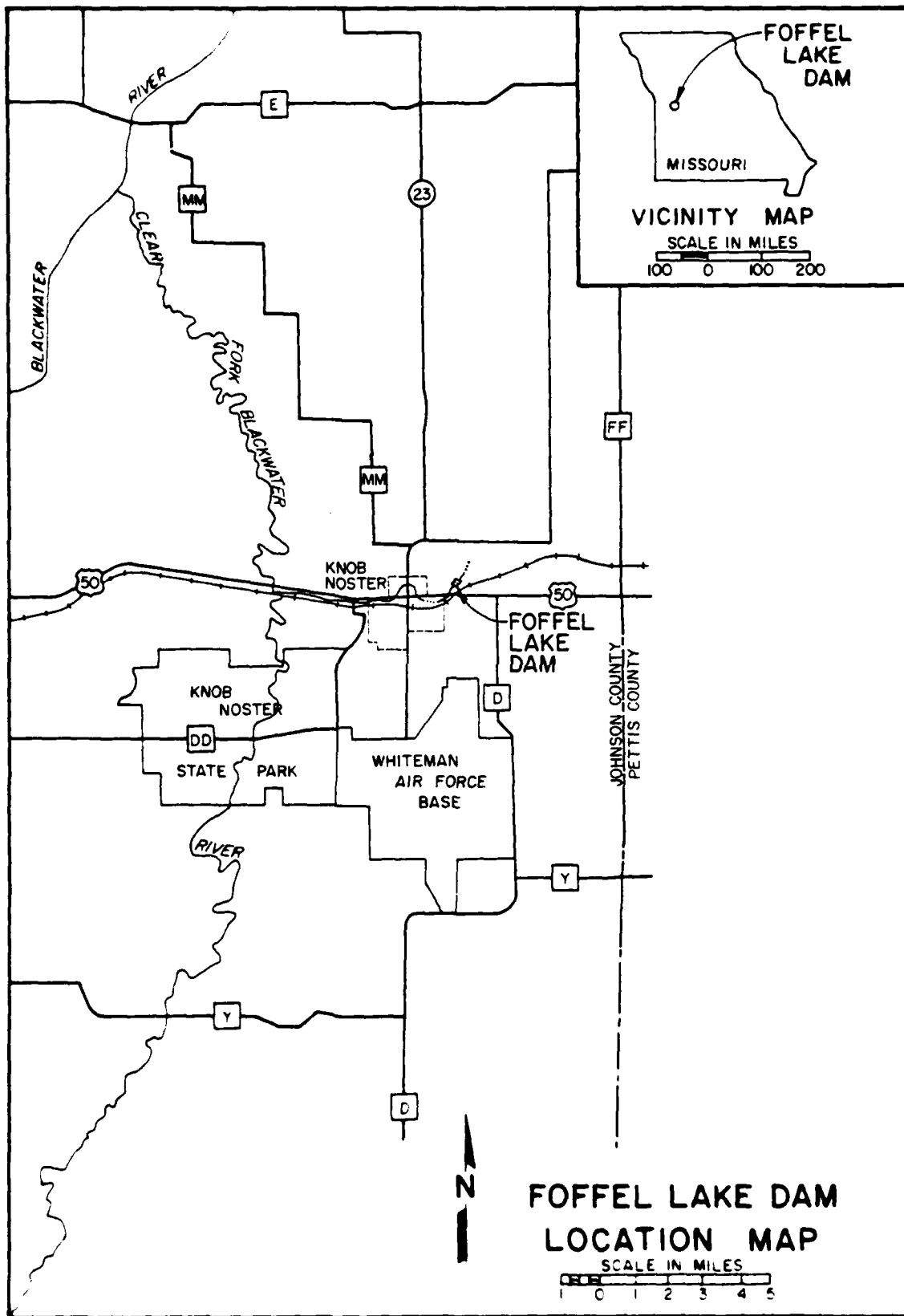
(3) A maintenance program to remove and control the growth of brush and trees on the embankment should be continued. Grass/weed cover on the embankment should be cut periodically.

(4) The spillway discharge ditch on the downstream slope of the embankment near the right abutment should be repaired. A paved ditch or other means of protection may be required to control the concentrated runoff.

(5) The animal burrows in the embankment should be corrected since they contribute to the occurrence of piping. Control measures should be implemented under the direction of a qualified engineer to discourage animal activity in the area. The embankment slope should be monitored during this repair.

(6) Seepage and stability analyses should be performed.

(7) A detailed inspection of the dam should be made periodically. This inspection should include measurement of seepage flows and analyzing water samples taken from the seep and lake. The findings of these inspections should be documented and made a matter of record. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase.



**FOFFEL LAKE DAM  
LOCATION MAP**

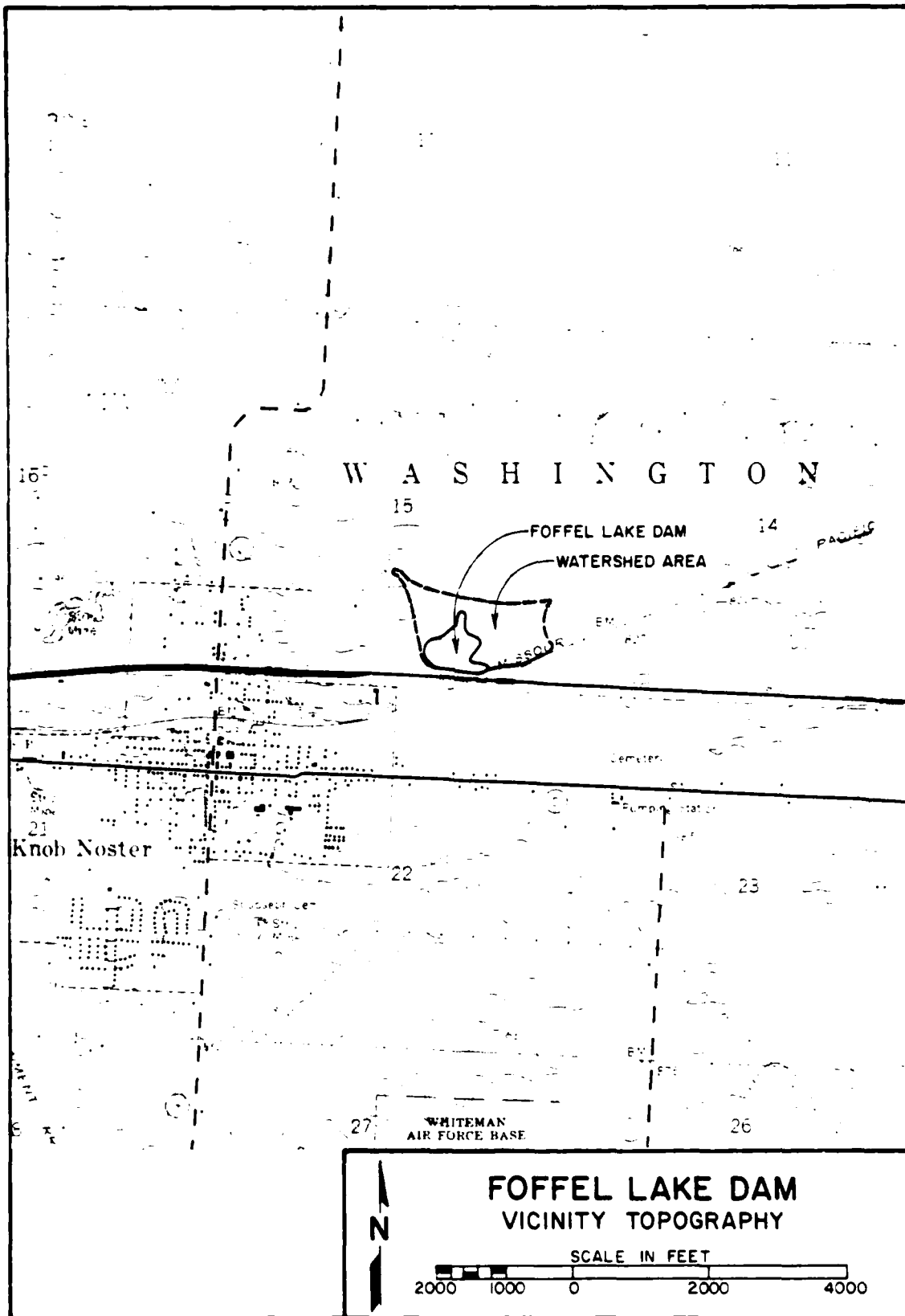


PLATE 2

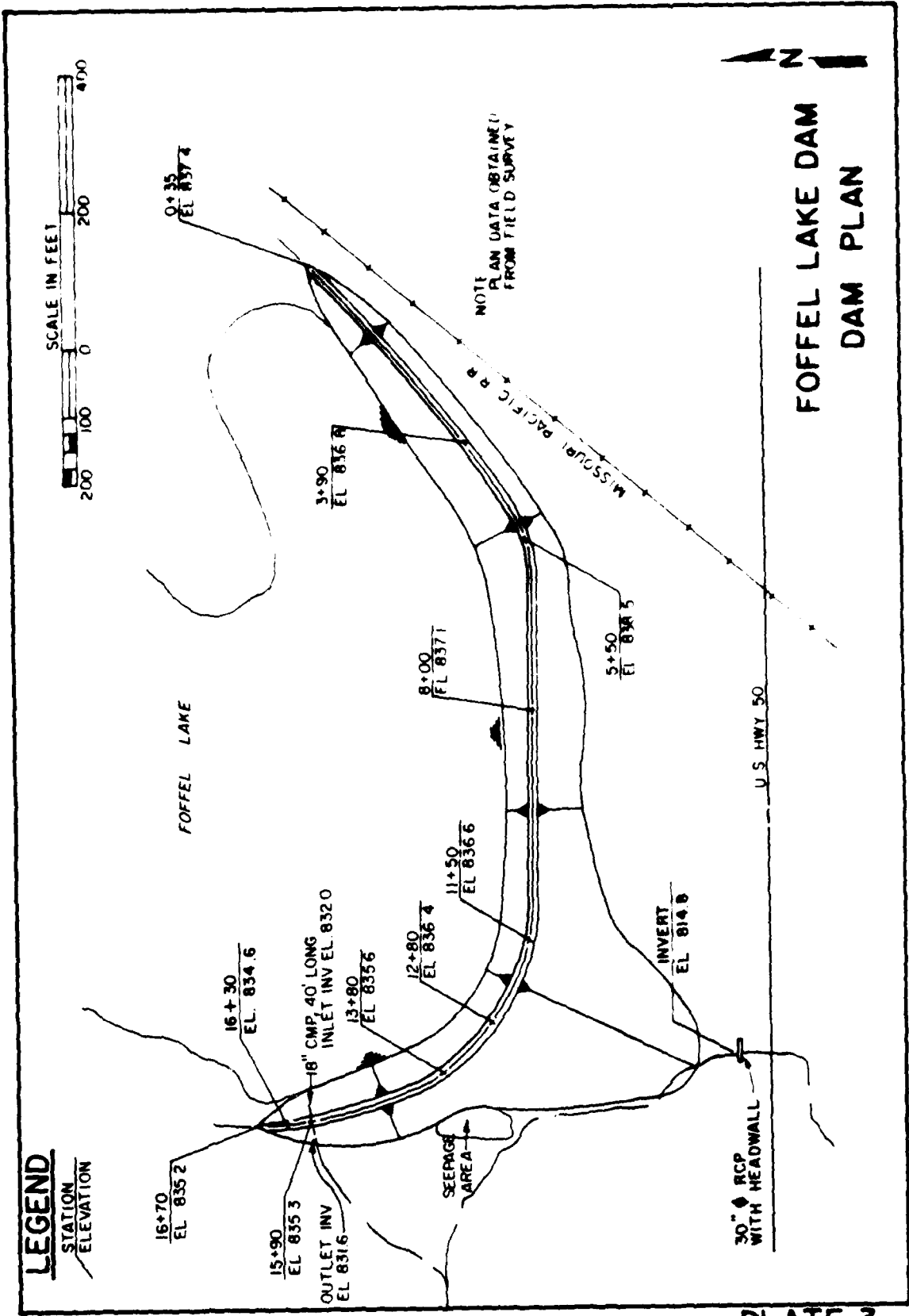
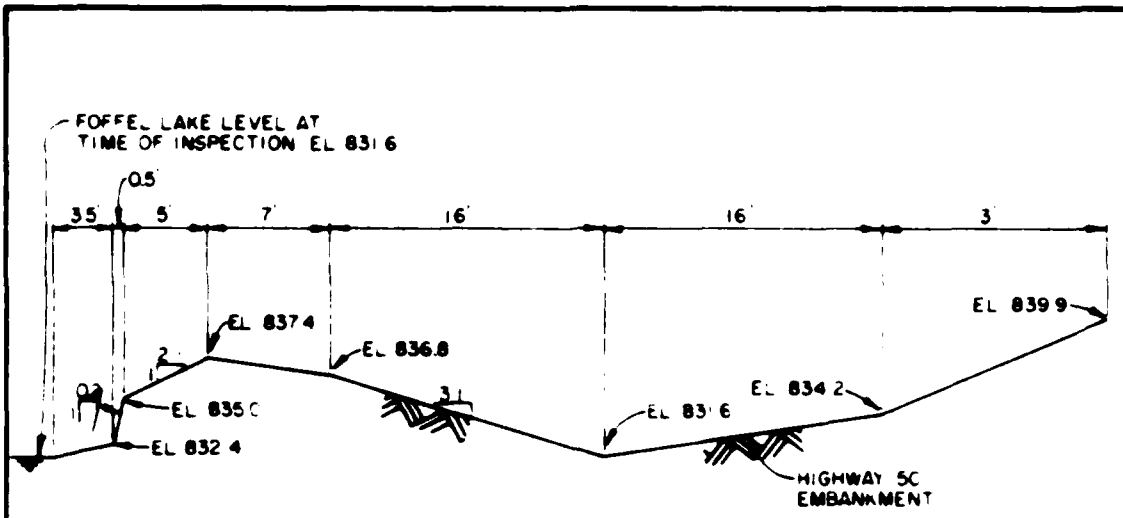
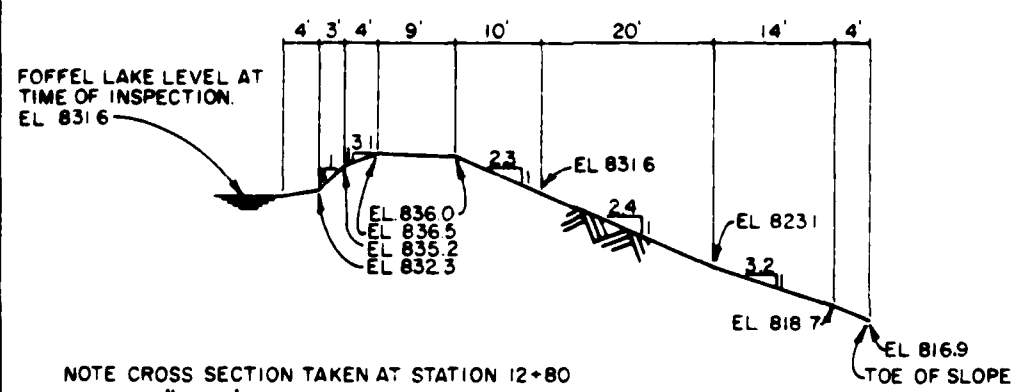


PLATE 3



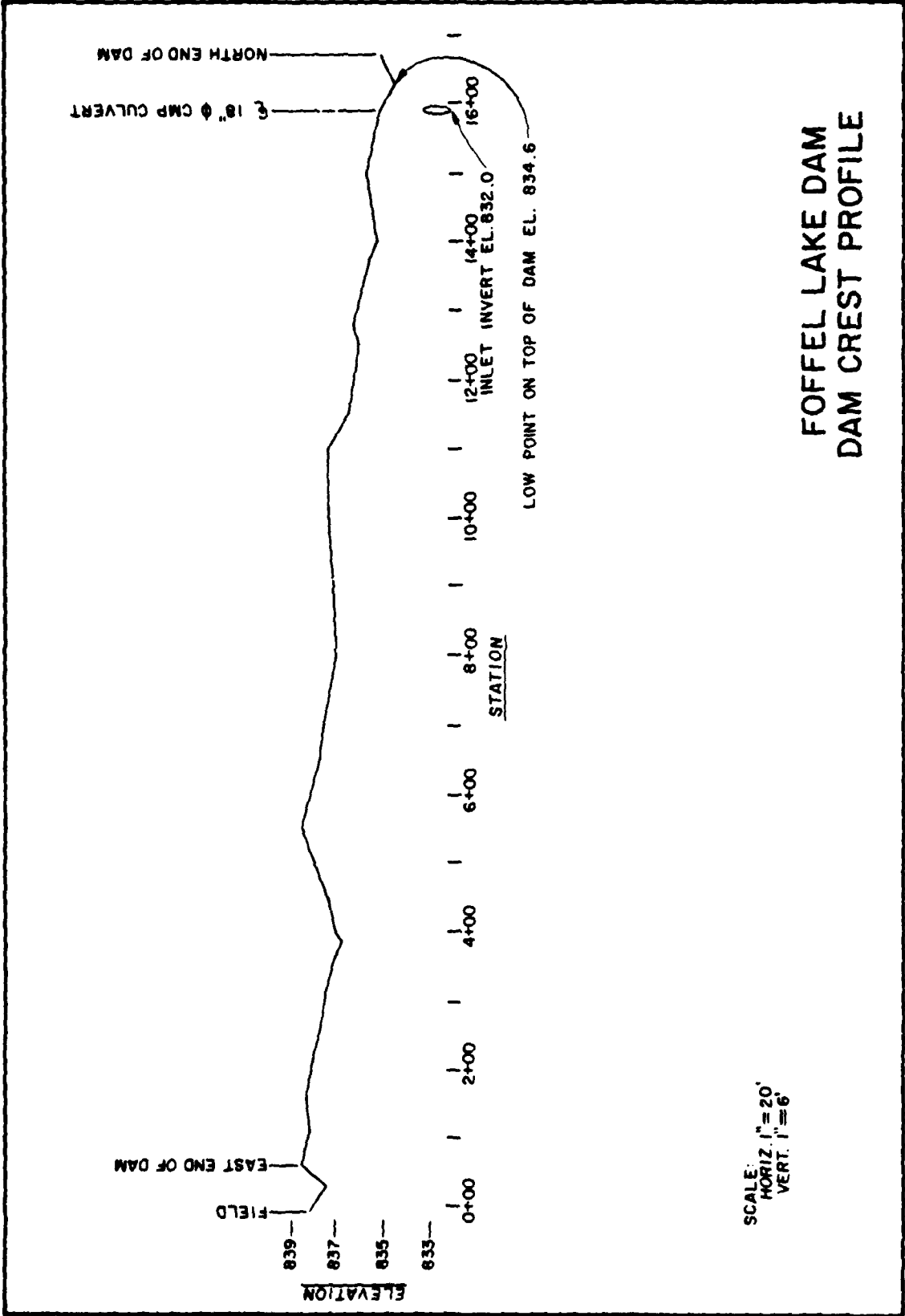
NOTE CROSS SECTION TAKEN AT STATION 9+90  
SCALE 1"=10'



NOTE CROSS SECTION TAKEN AT STATION 12+80  
SCALE 1"=20'

**FOFFEL LAKE DAM  
DAM CROSS SECTIONS**

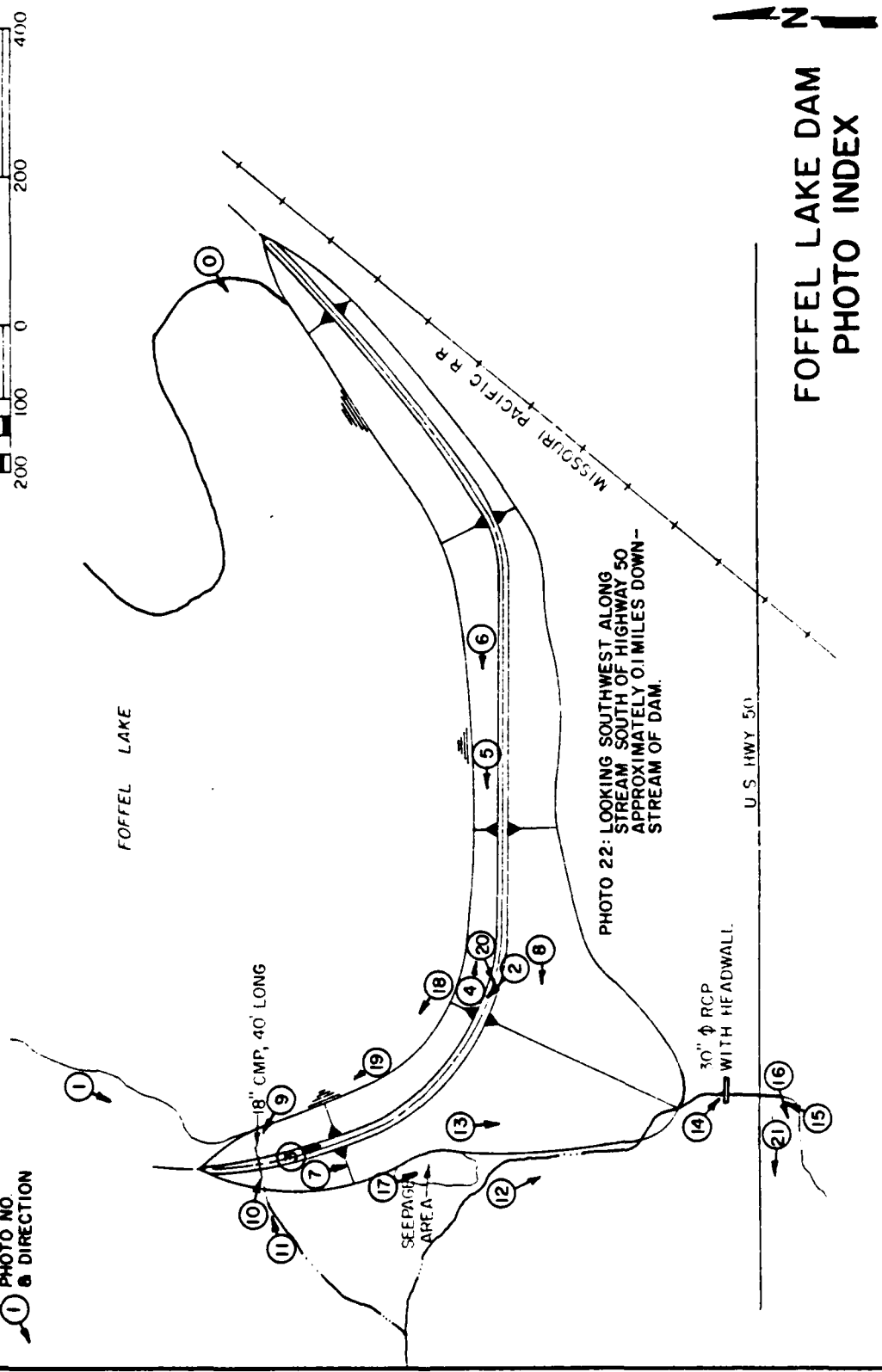
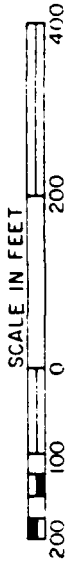




**FOFFEL LAKE DAM  
DAM CREST PROFILE**

**LEGEND**

① PHOTO NO  
➔ DIRECTION



**FOFFEL LAKE DAM  
PHOTO INDEX**

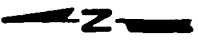




PHOTO 1: UPSTREAM FACE OF DAM LOOKING WEST



PHOTO 2: UPSTREAM FACE OF DAM LOOKING NORTH



PHOTO 3: CREST OF DAM LOOKING SOUTH

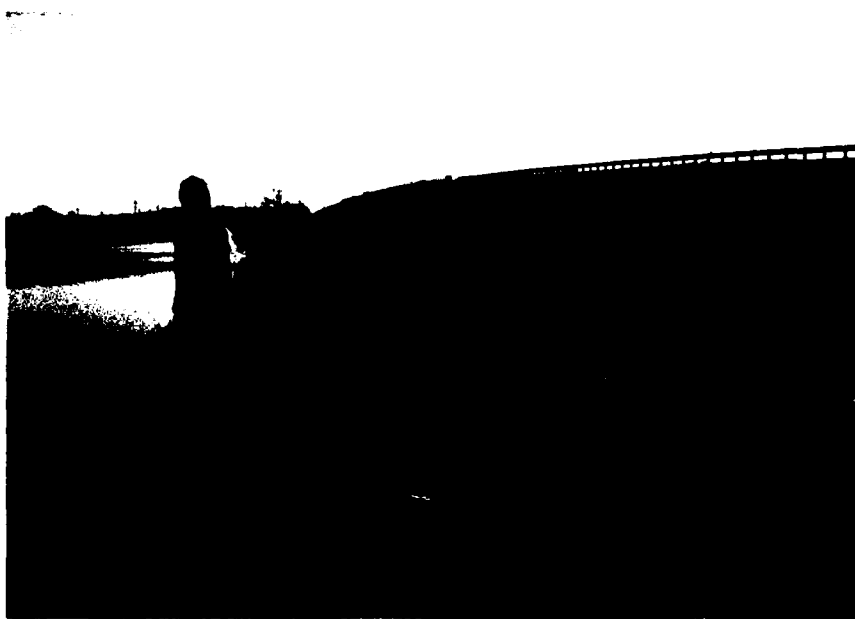


PHOTO 4: CREST OF DAM LOOKING EAST



PHOTO 5: CREST OF DAM LOOKING WEST

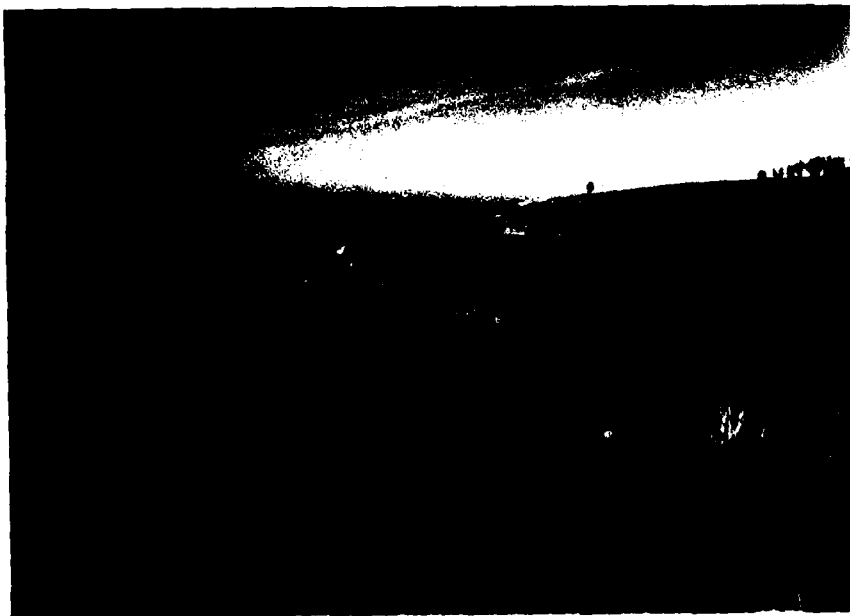


PHOTO 6: CREST OF DAM LOOKING WEST FROM EAST END

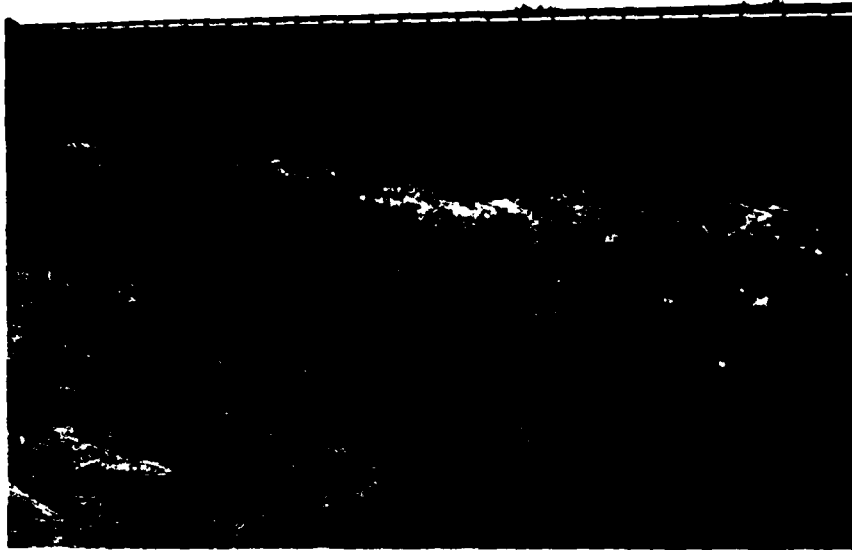


PHOTO 7: DOWNSTREAM FACE OF DAM LOOKING SOUTH



PHOTO 8: DOWNSTREAM FACE OF DAM LOOKING WEST

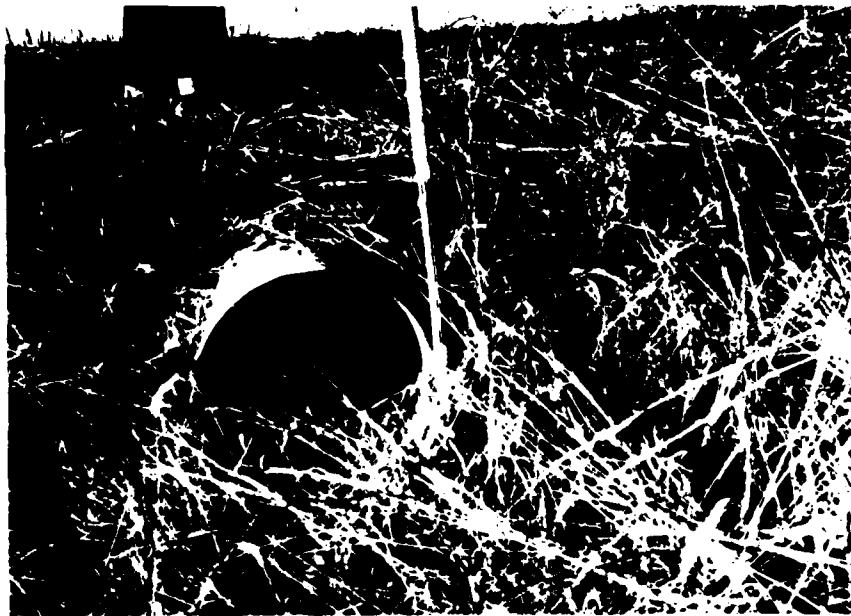


PHOTO 9: UPSTREAM END OF SPILLWAY PIPE



PHOTO 10: DOWNSTREAM END OF SPILLWAY PIPE



PHOTO 11: CHANNEL DOWNSTREAM OF SPILLWAY PIPE OUTLET

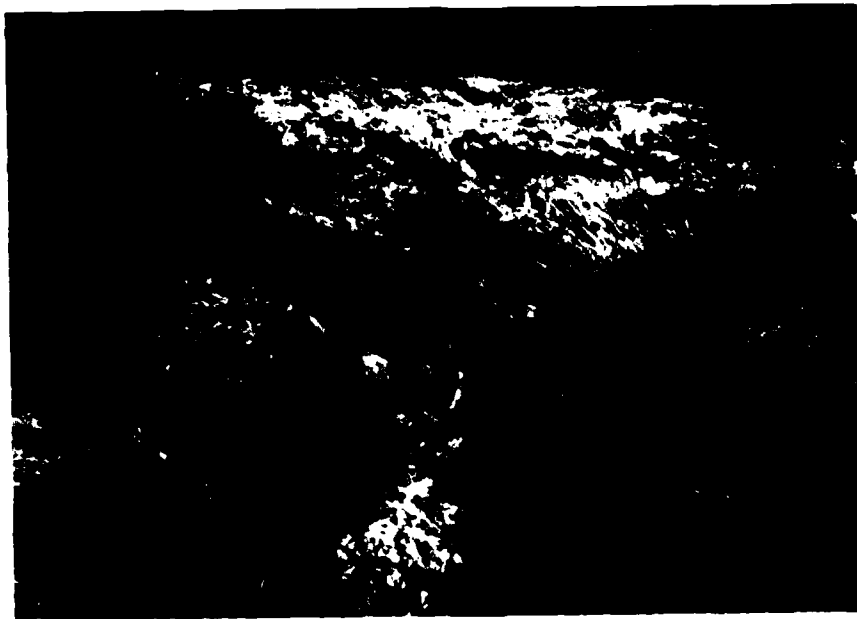


PHOTO 12: DITCH ALONG DOWNSTREAM TOE OF DAM



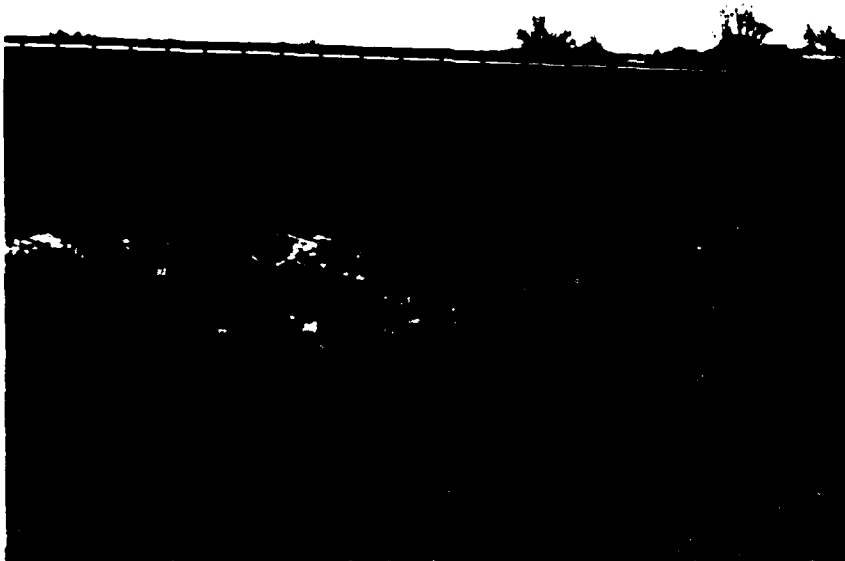


PHOTO 13: DITCH TO HIGHWAY CULVERT INLET

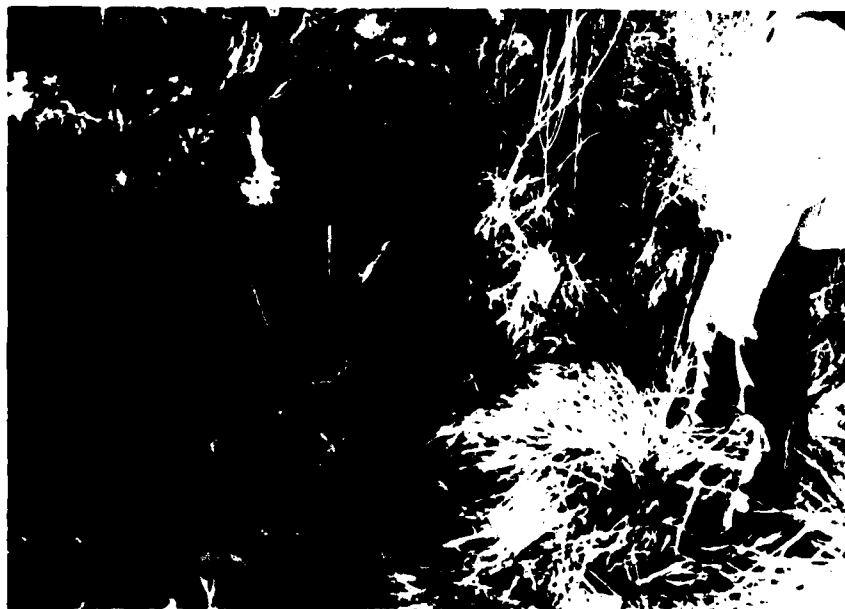


PHOTO 14: INLET TO HIGHWAY CULVERT



PHOTO 15: OUTLET FROM HIGHWAY CULVERT



PHOTO 16: AREA DOWNSTREAM OF HIGHWAY CULVERT



PHOTO 17: SEEPAGE AREA AT DOWNSTREAM TOE OF DAM



PHOTO 18: NEAR VERTICAL UPSTREAM FACE OF DAM DUE TO EROSION AND SLOUGHING



PHOTO 19: EROSION AND SLOUGHING OF UPSTREAM FACE OF DAM



PHOTO 20: AREA WEST OF DAM VIEWED FROM DAM

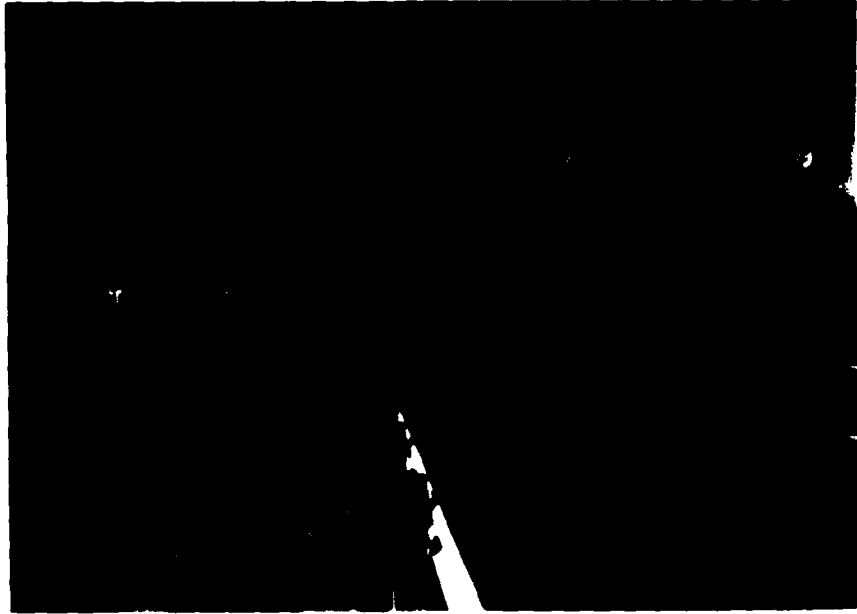


PHOTO 21: LOW POINT ALONG HIGHWAY WEST OF DAM



PHOTO 22: AREA DOWNSTREAM OF HIGHWAY

APPENDIX A  
HYDROLOGIC AND HYDRAULIC ANALYSES

## HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was determined using the computer program HEC-1 (Dam Safety Version) (reference 6).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 27" (HMR-27) (reference 4). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-27 and EM 110-2-1511 (reference 5). The Sweet Springs, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corp. of Engineers, was used when the one percent chance probability flood was routed through the reservoir and spillway.

The synthetic unit hydrograph for the watershed was developed by the computer program using the Soil Conservation Service (SCS) method (references 7 and 8). Time of concentration ( $T_c$ ) was determined using the "Kirpich" formula and verified by the SCS and Navy methods. The parameters for the unit hydrograph are shown in Table 1.

The SCS curve number (CN) method was used in computing the infiltration losses for the rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2.

The reservoir routing was performed using the modified puls method. The initial reservoir pool elevation for the routing of each storm was determined to be equivalent to the inlet invert elevation of the spillway at elevation 832.0 feet m.s.l. in accordance with antecedent storm conditions AMC II and AMC III preceding the one percent probability and probable maximum storms as outlined by the U.S. Army Corps of Engineers, St. Louis District (reference 7). The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curve for the spillway is shown in Table 4. The flow over the crest of the dam was determined using the non-level dam crest option (SI and SV cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir.

The result of the routing analysis indicates that 25 percent of the PMP will not overtop the dam.

A summary of the routing analysis for different ratios of the PMP is shown in Table 5.

The computer input data and a summary of the output data are presented at the back of this appendix.



TABLE 1  
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	47 acres
Length of Longest Watercourse (L)	0.22 miles
Elevation Difference in Watershed (H)	83 feet
Lag Time ( $L_g$ )	0.05 hours
Time of concentration ( $T_c$ )	0.08 hours
Duration (D)	0.7 min. (use 5 minute intervals)

<u>Time (Min.) *</u>	<u>Discharge (cfs) *</u>
0	0
5	388
10	143
15	33
20	7
25	2

\* From HEC-1 computer output

FORMULAS USED:

$$T_c = (11.9 L^3/H)^{0.385}$$

$$L_g = 0.6 T_c$$

$$D = 0.133 T_c$$

TABLE 2

RAINFALL-RUNOFF VALUES

<u>Selected Storm Event</u>	<u>Storm Duration (Hours)</u>	<u>Rainfall (Inches)</u>	<u>Runoff (Inches)</u>	<u>Loss (Inches)</u>
PMP	24	32.76	32.14	0.62
1% Probability	24	7.49	5.96	1.53

Additional Data:

- 1) The soil associations in this watershed are Norris, Deepwater, Sampsel, Snead, and Haig (Reference 1).  
 40 percent of drainage area in hydrologic soil group C.  
 60 percent of drainage area in hydrologic soil group D.  
 33 percent of the land use was grassland.  
 67 percent of the land use was cropland.
- 2) SCS Runoff Curve CN = 95 (AMC III) for the PMF.
- 3) SCS Runoff Curve CN = 87 (AMC II) for the one percent probability flood (Reference 8).

TABLE 3

ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

<u>Elevation (feet-MSL)</u>	<u>Lake Surface Area (acres)</u>	<u>Lake Storage (acre-ft)</u>	<u>Spillway Discharge (cfs)</u>
*832.0	10.3	48	0
**834.6	15.1	80	7.3

\*Spillway Pipe Inlet Invert Elevation  
 \*\*Top of Dam Elevation

The relationships in Table 3 were developed from the Knob Noster, Missouri 7.5 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAY RATING CURVE

<u>Reservoir Elevation (ft.-msl)</u>	<u>Spillway Discharge (cfs)</u>
*832.0	0
832.9	2.5
833.7	5.0
**834.6	7.3

\*Spillway Inlet Invert Elevation  
 \*\*Top of Dam Elevation

METHOD USED:

Spillway release rates were determined by nomographs for corrugated metal pipe culverts with inlet or outlet control (Reference9).

TABLE 5

RESULTS OF FLOOD ROUTINGS

<u>Ratio of PMF</u>	<u>Peak Inflow (cfs)</u>	<u>Peak Lake Elevation (ft.-msl)</u>	<u>Total Storage (ac.-ft.)</u>	<u>Peak Outflow (cfs)</u>	<u>Depth (ft.) Over Top of Dam</u>	<u>Duration Over Top of Dam (hrs.)</u>
-	0	*832.0	48	0	-	--
0.25	328	834.3	76	7	0	0
0.50	656	835.4	91	85	0.8	8.5
1.00	1,312	836.2	105	830	1.6	10.7

\*Spillway Inlet Invert Elevation



.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

.....  
 PROJECT 9477: DATE 7/2/78 PAGE 4  
 PROGRAM W/3/8-1V TIME 10:55:56 001100  
 .....

NO.	NO.	PERIOD	MAIN	EXCS	LOSS	COMP	NO.	NO.	PERIOD	MAIN	EXCS	LOSS	COMP
1.01	1.01	1	.01	.00	.01	0	1.01	12.05	145	.01	.21	.00	.00
1.01	1.01	2	.01	.00	.01	0	1.01	12.15	146	.01	.21	.00	.00
1.01	1.01	3	.01	.00	.01	0	1.01	12.25	147	.01	.21	.00	.00
1.01	1.01	4	.01	.00	.01	0	1.01	12.35	148	.01	.21	.00	.00
1.01	1.01	5	.01	.00	.01	0	1.01	12.45	149	.01	.21	.00	.00
1.01	1.01	6	.01	.00	.01	0	1.01	12.55	150	.01	.21	.00	.00
1.01	1.01	7	.01	.00	.01	0	1.01	13.05	151	.01	.21	.00	.00
1.01	1.01	8	.01	.00	.01	0	1.01	13.15	152	.01	.21	.00	.00
1.01	1.01	9	.01	.00	.01	0	1.01	13.25	153	.01	.21	.00	.00
1.01	1.01	10	.01	.00	.01	0	1.01	13.35	154	.01	.21	.00	.00
1.01	1.01	11	.01	.00	.01	0	1.01	13.45	155	.01	.21	.00	.00
1.01	1.01	12	.01	.00	.01	0	1.01	13.55	156	.01	.21	.00	.00
1.01	1.01	13	.01	.00	.01	0	1.01	14.05	157	.01	.25	.00	.00
1.01	1.01	14	.01	.00	.01	0	1.01	14.15	158	.01	.25	.00	.00
1.01	1.01	15	.01	.00	.01	0	1.01	14.25	159	.01	.25	.00	.00
1.01	1.01	16	.01	.00	.01	0	1.01	14.35	160	.01	.25	.00	.00
1.01	1.01	17	.01	.00	.01	0	1.01	14.45	161	.01	.25	.00	.00
1.01	1.01	18	.01	.00	.01	0	1.01	14.55	162	.01	.25	.00	.00
1.01	1.01	19	.01	.00	.01	0	1.01	14.65	163	.01	.25	.00	.00
1.01	1.01	20	.01	.00	.01	0	1.01	14.75	164	.01	.25	.00	.00
1.01	1.01	21	.01	.00	.01	0	1.01	14.85	165	.01	.25	.00	.00
1.01	1.01	22	.01	.00	.01	0	1.01	14.95	166	.01	.25	.00	.00
1.01	1.01	23	.01	.00	.01	0	1.01	15.05	167	.01	.25	.00	.00
1.01	1.01	24	.01	.00	.01	0	1.01	15.15	168	.01	.25	.00	.00
1.01	1.01	25	.01	.00	.01	0	1.01	15.25	169	.01	.25	.00	.00
1.01	1.01	26	.01	.00	.01	0	1.01	15.35	170	.01	.25	.00	.00
1.01	1.01	27	.01	.00	.01	0	1.01	15.45	171	.01	.25	.00	.00
1.01	1.01	28	.01	.00	.01	0	1.01	15.55	172	.01	.25	.00	.00
1.01	1.01	29	.01	.00	.01	0	1.01	15.65	173	.01	.25	.00	.00
1.01	1.01	30	.01	.00	.01	0	1.01	15.75	174	.01	.25	.00	.00
1.01	1.01	31	.01	.00	.01	0	1.01	15.85	175	.01	.25	.00	.00
1.01	1.01	32	.01	.00	.01	0	1.01	15.95	176	.01	.25	.00	.00
1.01	1.01	33	.01	.00	.01	0	1.01	16.05	177	.01	.25	.00	.00
1.01	1.01	34	.01	.00	.01	0	1.01	16.15	178	.01	.25	.00	.00
1.01	1.01	35	.01	.00	.01	0	1.01	16.25	179	.01	.25	.00	.00
1.01	1.01	36	.01	.00	.01	0	1.01	16.35	180	.01	.25	.00	.00
1.01	1.01	37	.01	.00	.01	0	1.01	16.45	181	.01	.19	.00	.00
1.01	1.01	38	.01	.00	.01	0	1.01	16.55	182	.01	.19	.00	.00
1.01	1.01	39	.01	.00	.01	0	1.01	16.65	183	.01	.19	.00	.00
1.01	1.01	40	.01	.00	.01	0	1.01	16.75	184	.01	.19	.00	.00
1.01	1.01	41	.01	.00	.01	0	1.01	16.85	185	.01	.19	.00	.00
1.01	1.01	42	.01	.00	.01	0	1.01	16.95	186	1.64	1.64	.00	.00
1.01	1.01	43	.01	.00	.01	0	1.01	17.05	187	2.71	2.71	.00	.00
1.01	1.01	44	.01	.00	.01	0	1.01	17.15	188	1.06	1.06	.00	.00
1.01	1.01	45	.01	.00	.01	0	1.01	17.25	189	.08	.08	.00	.00
1.01	1.01	46	.01	.00	.01	0	1.01	17.35	190	.58	.58	.00	.00
1.01	1.01	47	.01	.00	.01	0	1.01	17.45	191	.39	.39	.00	.00
1.01	1.01	48	.01	.00	.01	0	1.01	17.55	192	.16	.16	.00	.00
1.01	1.01	49	.01	.00	.01	0	1.01	17.65	193	.30	.30	.00	.00
1.01	1.01	50	.01	.00	.01	0	1.01	17.75	194	.70	.70	.00	.00
1.01	1.01	51	.01	.00	.01	0	1.01	17.85	195	.30	.30	.00	.00
1.01	1.01	52	.01	.00	.01	0	1.01	17.95	196	.70	.70	.00	.00
1.01	1.01	53	.01	.00	.01	0	1.01	18.05	197	.70	.70	.00	.00

END-OF-PERIOD FROM



TIME	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1.01 9.10	110	07	77	1.01 21.10	254
1.01 9.15	111	07	77	1.01 21.15	255
1.01 9.20	112	07	77	1.01 21.20	256
1.01 9.25	113	07	77	1.01 21.25	257
1.01 9.30	114	07	77	1.01 21.30	258
1.01 9.35	115	07	77	1.01 21.35	259
1.01 9.40	116	07	77	1.01 21.40	260
1.01 9.45	117	07	77	1.01 21.45	261
1.01 9.50	118	07	77	1.01 21.50	262
1.01 9.55	119	07	77	1.01 21.55	263
1.01 10.00	120	07	77	1.01 22.00	264
1.01 10.05	121	07	77	1.01 22.05	265
1.01 10.10	122	07	77	1.01 22.10	266
1.01 10.15	123	07	77	1.01 22.15	267
1.01 10.20	124	07	77	1.01 22.20	268
1.01 10.25	125	07	77	1.01 22.25	269
1.01 10.30	126	07	77	1.01 22.30	270
1.01 10.35	127	07	77	1.01 22.35	271
1.01 10.40	128	07	77	1.01 22.40	272
1.01 10.45	129	07	77	1.01 22.45	273
1.01 10.50	130	07	77	1.01 22.50	274
1.01 10.55	131	07	77	1.01 22.55	275
1.01 11.00	132	07	77	1.01 23.00	276
1.01 11.05	133	07	77	1.01 23.05	277
1.01 11.10	134	07	77	1.01 23.10	278
1.01 11.15	135	07	77	1.01 23.15	279
1.01 11.20	136	07	77	1.01 23.20	280
1.01 11.25	137	07	77	1.01 23.25	281
1.01 11.30	138	07	77	1.01 23.30	282
1.01 11.35	139	07	77	1.01 23.35	283
1.01 11.40	140	07	77	1.01 23.40	284
1.01 11.45	141	07	77	1.01 23.45	285
1.01 11.50	142	07	77	1.01 23.50	286
1.01 11.55	143	07	77	1.01 23.55	287
1.01 12.00	144	07	77	1.02 24.00	288

SMA 74.74 32.14 07 14.74  
 ( 472.0) ( 816.0) ( 16.0) ( 501.0)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1212	201	74	74	1279
77	6	2	2	77
	25.31	72.17	72.17	32.17
	647.87	815.79	815.79	815.79
	100	177	177	177
	173	156	156	156

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
120	10	16	16	459
5	1	1	1	137
	6.37	6.37	6.37	6.37
	170.77	201.95	201.95	201.95

CFS  
 CFS  
 INCHES  
 AC-FT  
 THOUS CU-F



CFS	656.	101.	32.	72.	9195.
CMS	19.	3.	1.	1.	260.
INCHES	16.68	16.04	16.06	16.06	16.06
AC-FT	321.43	407.50	407.89	407.89	407.89
THOUS CU Y	50.	63.	63.	63.	63.
	42.	70.	70.	70.	70.

HYDROGRAPH AT STA 1 FOR PLAN 1, P110 7

PEAK	72.	111.	35.	35.	1011F.
CFS	20.	3.	1.	1.	28F.
INCHES	13.92	17.66	17.66	17.66	17.66
AC-FT	383.5F	448.6F	448.6F	448.6F	448.6F
THOUS CU Y	55.	70.	70.	70.	70.
	68.	76.	76.	76.	76.

HYDROGRAPH AT STA 1 FOR PLAN 1, P110 8

PEAK	707.	121.	3.	70.	11037.
CFS	22.	15.19	19.27	19.27	19.27
INCHES	385.77	489.47	489.47	489.47	489.47
AC-FT	70.	76.	76.	76.	76.
THOUS CU Y	76.	94.	94.	94.	94.

HYDROGRAPH AT STA 1 FOR PLAN 1, P110 9

PEAK	1512.	601.	64.	64.	18796.
CFS	17.	5.	2.	2.	571.
INCHES	25.31	32.17	32.12	32.12	32.12
AC-FT	642.87	815.70	815.70	815.70	815.70
THOUS CU Y	100.	127.	127.	127.	127.
	122.	156.	156.	156.	156.

HYDROGRAPH ROUTING

ROUTE THROUGH SPILLWAY

ICTAG	ICOMP	IFCON	ITAGE	JFLT	JRPT	INAME	TSTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA



PROJECT NO: 6472 DATE: 22 JAN 65  
 PROGRAM: M2122-1V TIME: 13.2366 CASE: 1-1

PLAN	6-INCH	24-INCH	72-INCH	TOTAL VOLUME
CFS	374	46	46	1376
MS	26	1	1	177
INCHES	22.5	22.5	24.92	28.6
PI	57.77	58.22	58.22	67.22
AC-FT	11	50	50	75
THOLS CL M	1200	110	110	1120

\*\*\*\*\*

PLAN II - AND STORAGE (EAC OF PILES) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (ECONOMIC PILES PER SECOND)  
 AREA IN SQUARE FEET (SQUARE FEET PER PILE)

PLAN	AREA	PLAN RATIO	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8
PLAN I	107	1	1.00	236	439	505	550	590	620	650
PLAN II	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN III	107	1	0.75	70	80	90	100	110	120	130
PLAN IV	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN V	107	1	0.75	70	80	90	100	110	120	130
PLAN VI	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN VII	107	1	0.75	70	80	90	100	110	120	130
PLAN VIII	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN IX	107	1	0.75	70	80	90	100	110	120	130
PLAN X	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XI	107	1	0.75	70	80	90	100	110	120	130
PLAN XII	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XIII	107	1	0.75	70	80	90	100	110	120	130
PLAN XIV	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XV	107	1	0.75	70	80	90	100	110	120	130
PLAN XVI	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XVII	107	1	0.75	70	80	90	100	110	120	130
PLAN XVIII	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XIX	107	1	0.75	70	80	90	100	110	120	130
PLAN XX	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XXI	107	1	0.75	70	80	90	100	110	120	130
PLAN XXII	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XXIII	107	1	0.75	70	80	90	100	110	120	130
PLAN XXIV	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XXV	107	1	0.75	70	80	90	100	110	120	130
PLAN XXVI	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XXVII	107	1	0.75	70	80	90	100	110	120	130
PLAN XXVIII	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05
PLAN XXIX	107	1	0.75	70	80	90	100	110	120	130
PLAN XXX	107	1	0.25	11.05	13.05	14.65	16.25	17.85	19.45	21.05

PROJECT 5477: DATE 20 JAN 71 PAGE 10  
 FACILITY: ...  
 FACILITY: ...

CLARIFICATION OF DWP SAFETY ANALYSIS

STATION NO.	ELEVATION STORAGE	INITIAL VALUE	SPILLWAY CRYST	TOP OF DAM	TIME OF FAILURE
25	234.00	76	76	10.17	10.17
26	235.00	81	81	4.25	4.25
27	235.00	84	84	3.83	3.83
28	235.16	85	85	3.23	3.23
29	235.24	87	87	2.42	2.42
30	235.26	88	88	2.00	2.00
31	235.26	90	90	1.47	1.47
32	235.26	92	92	1.00	1.00
33	235.26	94	94	0.67	0.67
34	235.26	96	96	0.47	0.47
35	235.26	98	98	0.33	0.33
36	235.26	100	100	0.25	0.25
37	235.26	105	105	10.00	10.00

PROJECT 0477 DATE 15 JAN 68 PAGE 1

PROJECT 0477 DATE 15 JAN 68 PAGE 1

PROGRAM 447/04-14 TIME 18:13:00

PROGRAM 447/04-14 TIME 18:13:00

ADMISSION PLAN INSTRUCTION PROGRAM  
 A251, LOUIS DISTRICT US ARMY CORPS OF ENG  
 APOFFICE LARK DAM (100-181)

ADMISSION PLAN INSTRUCTION PROGRAM  
 A251, LOUIS DISTRICT US ARMY CORPS OF ENG  
 APOFFICE LARK DAM (100-181)

NO	UNIT	QTY	UNIT PRICE	TOTAL	QTY	UNIT PRICE	TOTAL
1	01	288	7.454	2136.72	0	0	0
2	01	004	0.05	0.20	0	0	0
3	01	004	0.05	0.20	0	0	0
4	01	004	0.05	0.20	0	0	0
5	01	004	0.05	0.20	0	0	0
6	01	004	0.05	0.20	0	0	0
7	01	004	0.05	0.20	0	0	0
8	01	004	0.05	0.20	0	0	0
9	01	004	0.05	0.20	0	0	0
10	01	004	0.05	0.20	0	0	0
11	01	004	0.05	0.20	0	0	0
12	01	004	0.05	0.20	0	0	0
13	01	004	0.05	0.20	0	0	0
14	01	004	0.05	0.20	0	0	0
15	01	004	0.05	0.20	0	0	0
16	01	004	0.05	0.20	0	0	0
17	01	004	0.05	0.20	0	0	0
18	01	004	0.05	0.20	0	0	0
19	01	004	0.05	0.20	0	0	0
20	01	004	0.05	0.20	0	0	0
21	01	004	0.05	0.20	0	0	0
22	01	004	0.05	0.20	0	0	0
23	01	004	0.05	0.20	0	0	0
24	01	004	0.05	0.20	0	0	0
25	01	004	0.05	0.20	0	0	0
26	01	004	0.05	0.20	0	0	0
27	01	004	0.05	0.20	0	0	0
28	01	004	0.05	0.20	0	0	0
29	01	004	0.05	0.20	0	0	0
30	01	004	0.05	0.20	0	0	0
31	01	004	0.05	0.20	0	0	0
32	01	004	0.05	0.20	0	0	0
33	01	004	0.05	0.20	0	0	0
34	01	004	0.05	0.20	0	0	0
35	01	004	0.05	0.20	0	0	0
36	01	004	0.05	0.20	0	0	0
37	01	004	0.05	0.20	0	0	0
38	01	004	0.05	0.20	0	0	0
39	01	004	0.05	0.20	0	0	0
40	01	004	0.05	0.20	0	0	0
41	01	004	0.05	0.20	0	0	0
42	01	004	0.05	0.20	0	0	0
43	01	004	0.05	0.20	0	0	0
44	01	004	0.05	0.20	0	0	0
45	01	004	0.05	0.20	0	0	0
46	01	004	0.05	0.20	0	0	0
47	01	004	0.05	0.20	0	0	0
48	01	004	0.05	0.20	0	0	0
49	01	004	0.05	0.20	0	0	0
50	01	004	0.05	0.20	0	0	0
51	01	004	0.05	0.20	0	0	0
52	01	004	0.05	0.20	0	0	0
53	01	004	0.05	0.20	0	0	0
54	01	004	0.05	0.20	0	0	0
55	01	004	0.05	0.20	0	0	0
56	01	004	0.05	0.20	0	0	0
57	01	004	0.05	0.20	0	0	0
58	01	004	0.05	0.20	0	0	0
59	01	004	0.05	0.20	0	0	0
60	01	004	0.05	0.20	0	0	0
61	01	004	0.05	0.20	0	0	0
62	01	004	0.05	0.20	0	0	0
63	01	004	0.05	0.20	0	0	0
64	01	004	0.05	0.20	0	0	0
65	01	004	0.05	0.20	0	0	0
66	01	004	0.05	0.20	0	0	0
67	01	004	0.05	0.20	0	0	0
68	01	004	0.05	0.20	0	0	0
69	01	004	0.05	0.20	0	0	0
70	01	004	0.05	0.20	0	0	0
71	01	004	0.05	0.20	0	0	0
72	01	004	0.05	0.20	0	0	0
73	01	004	0.05	0.20	0	0	0
74	01	004	0.05	0.20	0	0	0
75	01	004	0.05	0.20	0	0	0
76	01	004	0.05	0.20	0	0	0
77	01	004	0.05	0.20	0	0	0
78	01	004	0.05	0.20	0	0	0
79	01	004	0.05	0.20	0	0	0
80	01	004	0.05	0.20	0	0	0
81	01	004	0.05	0.20	0	0	0
82	01	004	0.05	0.20	0	0	0
83	01	004	0.05	0.20	0	0	0
84	01	004	0.05	0.20	0	0	0
85	01	004	0.05	0.20	0	0	0
86	01	004	0.05	0.20	0	0	0
87	01	004	0.05	0.20	0	0	0
88	01	004	0.05	0.20	0	0	0
89	01	004	0.05	0.20	0	0	0
90	01	004	0.05	0.20	0	0	0
91	01	004	0.05	0.20	0	0	0
92	01	004	0.05	0.20	0	0	0
93	01	004	0.05	0.20	0	0	0
94	01	004	0.05	0.20	0	0	0
95	01	004	0.05	0.20	0	0	0
96	01	004	0.05	0.20	0	0	0
97	01	004	0.05	0.20	0	0	0
98	01	004	0.05	0.20	0	0	0
99	01	004	0.05	0.20	0	0	0
100	01	004	0.05	0.20	0	0	0

PROJECT 0477 DATE 15 JAN 68 PAGE 1

PROJECT 0477 DATE 15 JAN 68 PAGE 1

PROGRAM 447/04-14 TIME 18:13:00

PROGRAM 447/04-14 TIME 18:13:00



DATA CENTER

PROJECT NAME

PROJECT NUMBER

PROJECT DATE

PROJECT LOCATION

PROJECT DESCRIPTION

ITEM SPECIFICATION

ITEM NO. ITEM NAME ITEM TYPE ITEM CODE ITEM STATUS

.....

SUB-PREP REPORT COMPUTATION

PREP REPORT (24 HRS. 100-YEAR INFLUENCE)

ITEM NO. ITEM NAME ITEM TYPE ITEM CODE ITEM STATUS

HYDROGRAPH DATA

ITEM NO. ITEM NAME ITEM TYPE ITEM CODE ITEM STATUS

FLOOD DATA

Table with columns: NO, STORM, QAV, DAY, PREP. PATTERN, and multiple columns of values (e.g., .01, .02, .03, .04, .05, .06, .07, .08, .09, .10, .11, .12, .13, .14, .15, .16, .17, .18, .19, .20, .21, .22, .23, .24, .25, .26, .27, .28, .29, .30).

FLOOD HYDROGRAPH PACKAGE - MEC-1

```

    .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
    .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
    .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
    .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
    .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
  
```

```

LPOPT STRKR DLTRK RTIOL RTRCK STRTL CNSTL ALSM RTRMP
    0 .00 .00 1.00 .00 .00 -1.00 -87.00 .00 .00
    CURVE NO = -P7.00 WEINSS = -1.00 EFFECT CN = 87.00
  
```

```

          TC = .00 LAG = .05
          STABO = .00 OPCSNE = .00 RTIOR = 1.00
    RECEIVING DATA
  
```

TIME INCREMENT TOO LARGE--(NHO IS (Y LAF/Z))

UNIT HYDROGRAPH 5 END OF PERIOD ORIGINATES, TC = .00 HOURS, LAG = .05 VOL = 1.00

MO.DA	HR.MN	PERIOD	END-OF-PERIOD FLOW				RECEIVING DATA						
			RAIN	EXCS	LOSS	COMP 0	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP 0
1.01	05	1	.01	.00	.01	0.	1.01	12.05	145	.85	.78	.07	.01
1.01	10	2	.01	.00	.01	0.	1.01	12.10	146	.96	.76	.07	.01
1.01	15	3	.01	.00	.01	0.	1.01	12.15	147	.26	.74	.07	.01
1.01	20	4	.01	.00	.01	0.	1.01	12.20	148	.14	.73	.07	.01
1.01	25	5	.01	.00	.01	0.	1.01	12.25	149	.13	.73	.07	.01
1.01	30	6	.01	.00	.01	0.	1.01	12.30	150	.14	.73	.07	.01
1.01	35	7	.01	.00	.01	0.	1.01	12.35	151	.07	.71	.07	.01
1.01	40	8	.01	.00	.01	0.	1.01	12.40	152	.07	.71	.07	.01
1.01	45	9	.01	.00	.01	0.	1.01	12.45	153	.07	.71	.07	.01
1.01	50	10	.01	.00	.01	0.	1.01	12.50	154	.07	.71	.07	.01
1.01	55	11	.01	.00	.01	0.	1.01	12.55	155	.07	.71	.07	.01
1.01	00	12	.01	.00	.01	0.	1.01	13.00	156	.07	.71	.07	.01
1.01	05	13	.01	.00	.01	0.	1.01	13.05	157	.07	.71	.07	.01
1.01	10	14	.01	.00	.01	0.	1.01	13.10	158	.07	.71	.07	.01
1.01	15	15	.01	.00	.01	0.	1.01	13.15	159	.07	.71	.07	.01
1.01	20	16	.01	.00	.01	0.	1.01	13.20	160	.07	.71	.07	.01
1.01	25	17	.01	.00	.01	0.	1.01	13.25	161	.07	.71	.07	.01
1.01	30	18	.01	.00	.01	0.	1.01	13.30	162	.07	.71	.07	.01
1.01	35	19	.01	.00	.01	0.	1.01	13.35	163	.07	.71	.07	.01
1.01	40	20	.01	.00	.01	0.	1.01	13.40	164	.07	.71	.07	.01
1.01	45	21	.01	.00	.01	0.	1.01	13.45	165	.07	.71	.07	.01
1.01	50	22	.01	.00	.01	0.	1.01	13.50	166	.07	.71	.07	.01
1.01	55	23	.01	.00	.01	0.	1.01	13.55	167	.07	.71	.07	.01
1.01	00	24	.01	.00	.01	0.	1.01	14.00	168	.07	.71	.07	.01
1.01	05	25	.01	.00	.01	0.	1.01	14.05	169	.07	.71	.07	.01
1.01	10	26	.01	.00	.01	0.	1.01	14.10	170	.07	.71	.07	.01
1.01	15	27	.01	.00	.01	0.	1.01	14.15	171	.07	.71	.07	.01
1.01	20	28	.01	.00	.01	0.	1.01	14.20	172	.07	.71	.07	.01



1.01	2.25	29	.01	.70	.01	0.	1.01	14.75	173	.02	.00	15.
1.01	2.70	30	.01	.70	.01	0.	1.01	14.75	174	.02	.00	15.
1.01	2.75	31	.01	.70	.01	0.	1.01	14.75	175	.02	.00	15.
1.01	2.40	32	.01	.70	.01	0.	1.01	14.40	176	.02	.00	15.
1.01	2.45	33	.01	.70	.01	0.	1.01	14.45	177	.02	.00	15.
1.01	2.50	34	.01	.70	.01	0.	1.01	14.50	178	.02	.00	15.
1.01	2.55	35	.01	.70	.01	0.	1.01	14.55	179	.02	.00	15.
1.01	2.60	36	.01	.70	.01	0.	1.01	15.00	180	.02	.00	15.
1.01	2.65	37	.01	.70	.01	0.	1.01	15.05	181	.02	.00	15.
1.01	2.70	38	.01	.70	.01	0.	1.01	15.10	182	.02	.00	15.
1.01	2.75	39	.01	.70	.01	0.	1.01	15.15	183	.02	.00	15.
1.01	2.80	40	.01	.70	.01	0.	1.01	15.20	184	.02	.00	15.
1.01	2.85	41	.01	.70	.01	0.	1.01	15.25	185	.02	.00	15.
1.01	2.90	42	.01	.70	.01	0.	1.01	15.30	186	.02	.00	15.
1.01	2.95	43	.01	.70	.01	0.	1.01	15.35	187	.02	.00	15.
1.01	3.00	44	.01	.70	.01	0.	1.01	15.40	188	.02	.00	15.
1.01	3.05	45	.01	.70	.01	0.	1.01	15.45	189	.02	.00	15.
1.01	3.10	46	.01	.70	.01	0.	1.01	15.50	190	.02	.00	15.
1.01	3.15	47	.01	.70	.01	0.	1.01	15.55	191	.02	.00	15.
1.01	3.20	48	.01	.70	.01	0.	1.01	16.00	192	.02	.00	15.
1.01	3.25	49	.01	.70	.01	0.	1.01	16.05	193	.02	.00	15.
1.01	3.30	50	.01	.70	.01	0.	1.01	16.10	194	.02	.00	15.
1.01	3.35	51	.01	.70	.01	0.	1.01	16.15	195	.02	.00	15.
1.01	3.40	52	.01	.70	.01	0.	1.01	16.20	196	.02	.00	15.
1.01	3.45	53	.01	.70	.01	0.	1.01	16.25	197	.02	.00	15.
1.01	3.50	54	.01	.70	.01	0.	1.01	16.30	198	.02	.00	15.
1.01	3.55	55	.01	.70	.01	0.	1.01	16.35	199	.02	.00	15.
1.01	3.60	56	.01	.70	.01	0.	1.01	16.40	200	.02	.00	15.
1.01	3.65	57	.01	.70	.01	0.	1.01	16.45	201	.02	.00	15.
1.01	3.70	58	.01	.70	.01	0.	1.01	16.50	202	.02	.00	15.
1.01	3.75	59	.01	.70	.01	0.	1.01	16.55	203	.02	.00	15.
1.01	3.80	60	.01	.70	.01	0.	1.01	17.00	204	.02	.00	15.
1.01	3.85	61	.01	.70	.01	0.	1.01	17.05	205	.02	.00	15.
1.01	3.90	62	.01	.70	.01	0.	1.01	17.10	206	.02	.00	15.
1.01	3.95	63	.01	.70	.01	0.	1.01	17.15	207	.02	.00	15.
1.01	4.00	64	.01	.70	.01	0.	1.01	17.20	208	.02	.00	15.
1.01	4.05	65	.01	.70	.01	0.	1.01	17.25	209	.02	.00	15.
1.01	4.10	66	.01	.70	.01	0.	1.01	17.30	210	.02	.00	15.
1.01	4.15	67	.01	.70	.01	0.	1.01	17.35	211	.02	.00	15.
1.01	4.20	68	.01	.70	.01	0.	1.01	17.40	212	.02	.00	15.
1.01	4.25	69	.01	.70	.01	0.	1.01	17.45	213	.02	.00	15.
1.01	4.30	70	.01	.70	.01	0.	1.01	17.50	214	.02	.00	15.
1.01	4.35	71	.01	.70	.01	0.	1.01	17.55	215	.02	.00	15.
1.01	4.40	72	.01	.70	.01	0.	1.01	18.00	216	.02	.00	15.
1.01	4.45	73	.02	.70	.01	0.	1.01	18.05	217	.01	.00	15.
1.01	4.50	74	.02	.70	.01	0.	1.01	18.10	218	.01	.00	15.
1.01	4.55	75	.02	.70	.01	0.	1.01	18.15	219	.01	.00	15.
1.01	4.60	76	.02	.70	.01	0.	1.01	18.20	220	.01	.00	15.
1.01	4.65	77	.02	.70	.01	0.	1.01	18.25	221	.01	.00	15.
1.01	4.70	78	.02	.70	.01	0.	1.01	18.30	222	.01	.00	15.
1.01	4.75	79	.02	.70	.01	0.	1.01	18.35	223	.01	.00	15.
1.01	4.80	80	.02	.70	.01	0.	1.01	18.40	224	.01	.00	15.
1.01	4.85	81	.02	.70	.01	0.	1.01	18.45	225	.01	.00	15.
1.01	4.90	82	.02	.70	.01	0.	1.01	18.50	226	.01	.00	15.
1.01	4.95	83	.02	.70	.01	0.	1.01	18.55	227	.01	.00	15.
1.01	5.00	84	.02	.70	.01	0.	1.01	19.00	228	.01	.00	15.

**BLACK P V E A T**

**PROJECT 0617**  
**PROGRAM H2VCC-1V**

**DATE 03 JUN 1964**

**BLACK P V E A T**  
**EXCC HYPERGRAPH PAGE - PCC-1**  
**TIME 10:01:30 CASE 11**

1.01	7.05	95	.02	.01	.01	3.	1.01	19.05	229	.01	.01	.00	5.
1.01	7.10	96	.02	.01	.01	3.	1.01	19.10	230	.01	.01	.00	5.
1.01	7.15	97	.02	.01	.01	3.	1.01	19.15	231	.01	.01	.00	5.
1.01	7.20	98	.02	.01	.01	3.	1.01	19.20	232	.01	.01	.00	5.
1.01	7.25	99	.02	.01	.01	3.	1.01	19.25	233	.01	.01	.00	5.
1.01	7.30	90	.02	.01	.01	3.	1.01	19.30	234	.01	.01	.00	5.
1.01	7.35	91	.02	.01	.01	3.	1.01	19.35	235	.01	.01	.00	5.
1.01	7.40	92	.02	.01	.01	3.	1.01	19.40	236	.01	.01	.00	5.
1.01	7.45	93	.02	.01	.01	3.	1.01	19.45	237	.01	.01	.00	5.
1.01	7.50	94	.02	.01	.01	3.	1.01	19.50	238	.01	.01	.00	5.
1.01	7.55	95	.02	.01	.01	3.	1.01	19.55	239	.01	.01	.00	5.
1.01	8.00	96	.02	.01	.01	3.	1.01	20.00	240	.01	.01	.00	5.
1.01	8.05	97	.02	.01	.01	3.	1.01	20.05	241	.01	.01	.00	5.
1.01	8.10	98	.02	.01	.01	3.	1.01	20.10	242	.01	.01	.00	5.
1.01	8.15	99	.02	.01	.01	3.	1.01	20.15	243	.01	.01	.00	5.
1.01	8.20	100	.02	.01	.01	3.	1.01	20.20	244	.01	.01	.00	5.
1.01	8.25	101	.02	.01	.01	3.	1.01	20.25	245	.01	.01	.00	5.
1.01	8.30	102	.02	.01	.01	3.	1.01	20.30	246	.01	.01	.00	5.
1.01	8.35	103	.02	.01	.01	3.	1.01	20.35	247	.01	.01	.00	5.
1.01	8.40	104	.02	.01	.01	3.	1.01	20.40	248	.01	.01	.00	5.
1.01	8.45	105	.02	.01	.01	3.	1.01	20.45	249	.01	.01	.00	5.
1.01	8.50	106	.02	.01	.01	3.	1.01	20.50	250	.01	.01	.00	5.
1.01	8.55	107	.02	.01	.01	3.	1.01	20.55	251	.01	.01	.00	5.
1.01	9.00	108	.02	.01	.01	3.	1.01	21.00	252	.01	.01	.00	5.
1.01	9.05	109	.02	.01	.01	3.	1.01	21.05	253	.01	.01	.00	5.
1.01	9.10	110	.02	.01	.01	3.	1.01	21.10	254	.01	.01	.00	5.
1.01	9.15	111	.02	.01	.01	3.	1.01	21.15	255	.01	.01	.00	5.
1.01	9.20	112	.02	.01	.01	3.	1.01	21.20	256	.01	.01	.00	5.
1.01	9.25	113	.02	.01	.01	3.	1.01	21.25	257	.01	.01	.00	5.
1.01	9.30	114	.02	.01	.01	3.	1.01	21.30	258	.01	.01	.00	5.
1.01	9.35	115	.02	.01	.01	3.	1.01	21.35	259	.01	.01	.00	5.
1.01	9.40	116	.02	.01	.01	3.	1.01	21.40	260	.01	.01	.00	5.
1.01	9.45	117	.02	.01	.01	3.	1.01	21.45	261	.01	.01	.00	5.
1.01	9.50	118	.02	.01	.01	3.	1.01	21.50	262	.01	.01	.00	5.
1.01	9.55	119	.02	.01	.01	3.	1.01	21.55	263	.01	.01	.00	5.
1.01	10.00	120	.02	.01	.01	3.	1.01	22.00	264	.01	.01	.00	5.
1.01	10.05	121	.02	.01	.01	3.	1.01	22.05	265	.01	.01	.00	5.
1.01	10.10	122	.02	.01	.01	3.	1.01	22.10	266	.01	.01	.00	5.
1.01	10.15	123	.02	.01	.01	3.	1.01	22.15	267	.01	.01	.00	5.
1.01	10.20	124	.02	.01	.01	3.	1.01	22.20	268	.01	.01	.00	5.
1.01	10.25	125	.02	.01	.01	3.	1.01	22.25	269	.01	.01	.00	5.
1.01	10.30	126	.02	.01	.01	3.	1.01	22.30	270	.01	.01	.00	5.
1.01	10.35	127	.02	.01	.01	3.	1.01	22.35	271	.01	.01	.00	5.
1.01	10.40	128	.02	.01	.01	3.	1.01	22.40	272	.01	.01	.00	5.
1.01	10.45	129	.02	.01	.01	3.	1.01	22.45	273	.01	.01	.00	5.
1.01	10.50	130	.02	.01	.01	3.	1.01	22.50	274	.01	.01	.00	5.
1.01	10.55	131	.02	.01	.01	3.	1.01	22.55	275	.01	.01	.00	5.
1.01	11.00	132	.02	.01	.01	3.	1.01	23.00	276	.01	.01	.00	5.
1.01	11.05	133	.02	.01	.01	3.	1.01	23.05	277	.01	.01	.00	5.
1.01	11.10	134	.02	.01	.01	3.	1.01	23.10	278	.01	.01	.00	5.
1.01	11.15	135	.02	.01	.01	3.	1.01	23.15	279	.01	.01	.00	5.
1.01	11.20	136	.02	.01	.01	3.	1.01	23.20	280	.01	.01	.00	5.
1.01	11.25	137	.02	.01	.01	3.	1.01	23.25	281	.01	.01	.00	5.
1.01	11.30	138	.02	.01	.01	3.	1.01	23.30	282	.01	.01	.00	5.
1.01	11.35	139	.02	.01	.01	3.	1.01	23.35	283	.01	.01	.00	5.
1.01	11.40	140	.02	.01	.01	3.	1.01	23.40	284	.01	.01	.00	5.



ELEVATION	875.3	875.9	876.1	876.4	876.6	877.4	877.5	STAGE
	END-OF-PERIOD HYDROGRAPH ORDINATES							
	NO. DA	PR. MA	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	
1.01	05	1	08	0	0	0	48	877.5
1.01	10	2	17	0	0	0	48	877.0
1.01	15	3	25	0	0	0	48	877.0
1.01	20	4	32	0	0	0	48	877.0
1.01	25	5	42	0	0	0	48	877.0
1.01	30	6	50	0	0	0	48	877.0
1.01	35	7	58	0	0	0	48	877.0
1.01	40	8	67	0	0	0	48	877.0
1.01	45	9	75	0	0	0	48	877.0
1.01	50	10	83	0	0	0	48	877.0
1.01	55	11	92	0	0	0	48	877.0
1.01	1:00	12	1:00	0	0	0	48	877.0
1.01	1:05	13	1:08	0	0	0	48	877.0
1.01	1:10	14	1:17	0	0	0	48	877.0
1.01	1:15	15	1:25	0	0	0	48	877.0
1.01	1:20	16	1:33	0	0	0	48	877.0
1.01	1:25	17	1:42	0	0	0	48	877.0
1.01	1:30	18	1:50	0	0	0	48	877.0
1.01	1:35	19	1:58	0	0	0	48	877.0
1.01	1:40	20	1:67	0	0	0	48	877.0
1.01	1:45	21	1:75	0	0	0	48	877.0
1.01	1:50	22	1:83	0	0	0	48	877.0
1.01	1:55	23	1:92	0	0	0	48	877.0
1.01	2:00	24	2:00	0	0	0	48	877.0
1.01	2:05	25	2:08	0	0	0	48	877.0
1.01	2:10	26	2:17	0	0	0	48	877.0
1.01	2:15	27	2:25	0	0	0	48	877.0
1.01	2:20	28	2:33	0	0	0	48	877.0
1.01	2:25	29	2:42	0	0	0	48	877.0
1.01	2:30	30	2:50	0	0	0	48	877.0
1.01	2:35	31	2:58	0	0	0	48	877.0
1.01	2:40	32	2:67	0	0	0	48	877.0
1.01	2:45	33	2:75	0	0	0	48	877.0
1.01	2:50	34	2:83	0	0	0	48	877.0
1.01	2:55	35	2:92	0	0	0	48	877.0
1.01	3:00	36	3:00	0	0	0	48	877.0
1.01	3:05	37	3:08	0	0	0	48	877.0
1.01	3:10	38	3:17	0	0	0	48	877.0
1.01	3:15	39	3:25	0	0	0	48	877.0
1.01	3:20	40	3:33	0	0	0	48	877.0
1.01	3:25	41	3:42	0	0	0	48	877.0
1.01	3:30	42	3:50	0	0	0	48	877.0
1.01	3:35	43	3:58	0	0	0	48	877.0
1.01	3:40	44	4:07	0	0	0	48	877.0
1.01	3:45	45	4:15	0	0	0	48	877.0
1.01	3:50	46	4:23	0	0	0	48	877.0
1.01	3:55	47	4:32	0	0	0	48	877.0
1.01	4:00	48	4:40	0	0	0	48	877.0
1.01	4:05	49	4:48	0	0	0	48	877.0
1.01	4:10	50	4:57	0	0	0	48	877.0
1.01	4:15	51	5:05	0	0	0	48	877.0



PROJECT 9472 DATE 05 JAN 67 PAGE 3  
 PROGRAM W27/02-1V TIME 18:03:20 CASE 300

U. S. A. R. V. L. A. T. C. H.  
 HYDROGRAPH TABLE - REC-1

SUPPORT OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STOPFACE OUTFLOW	INITIAL VALUE 872.00 42. 0.	SPILLWAY CREST 832.00 42. 0.	TOP OF DAM 834.00 50. 7.	RATIO OF PPE 1.00	MAXIMUM DEPTH OVER DAM 0.00	MAXIMUM STORAGE AC-FT 67.	MAXIMUM OUTFLOW CFS 5.	DURATION OVER TOP HOURS 0.00	TYPE OF MAX OUTFLOW HOURS 16.04	TIME OF FAILURE HOURS 0.00
	MAXIMUM RESERVOIR ELEVATION 853.67										

SECT.

#### BIBLIOGRAPHY

- (1) U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Johnson County, Missouri.
- (2) Mary H. McCracken, Missouri Division of Geological Survey, Geologic Map of Missouri, 1961.
- (3) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, April 1980 Modification, Davis, California.
- (4) U.S. Department of the Army, Corps of Engineers, Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours, Hydrometeorological Report No. 33, Reprinted October 1967, Washington, D.C.
- (5) U.S. Department of the Army, Corps of Engineers, Standard Project Flood Determinations, Civil Engineer Bulletin No. 52-8, EM 1110-2-1411, Revised 1965, Washington, D.C.
- (6) U.S. Department of Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.
- (7) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 12 December 1979.
- (8) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.
- (9) U.S. Department of Commerce, Bureau of Public Roads, Hydraulic Engineering Circular No. 5, Hydraulic Charts for the Selection of Highway Culverts, December, 1965.

END

DATE  
FILMED

11-81

DTIC