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NATIONAL DAM SAFETY PROGRAM. FAYETTE OLD CITY LAKE DAM (MO 1013--ETC(U)  
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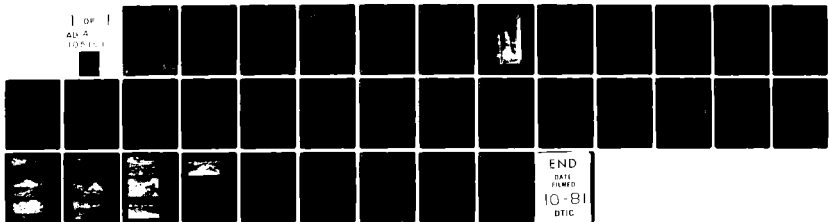
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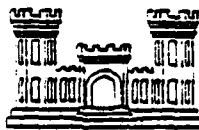
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FAYETTE OLD CITY LAKE DAM  
HOWARD COUNTY, MISSOURI  
MO 10131

AD A105151

PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM



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

SEPTEMBER, 1978

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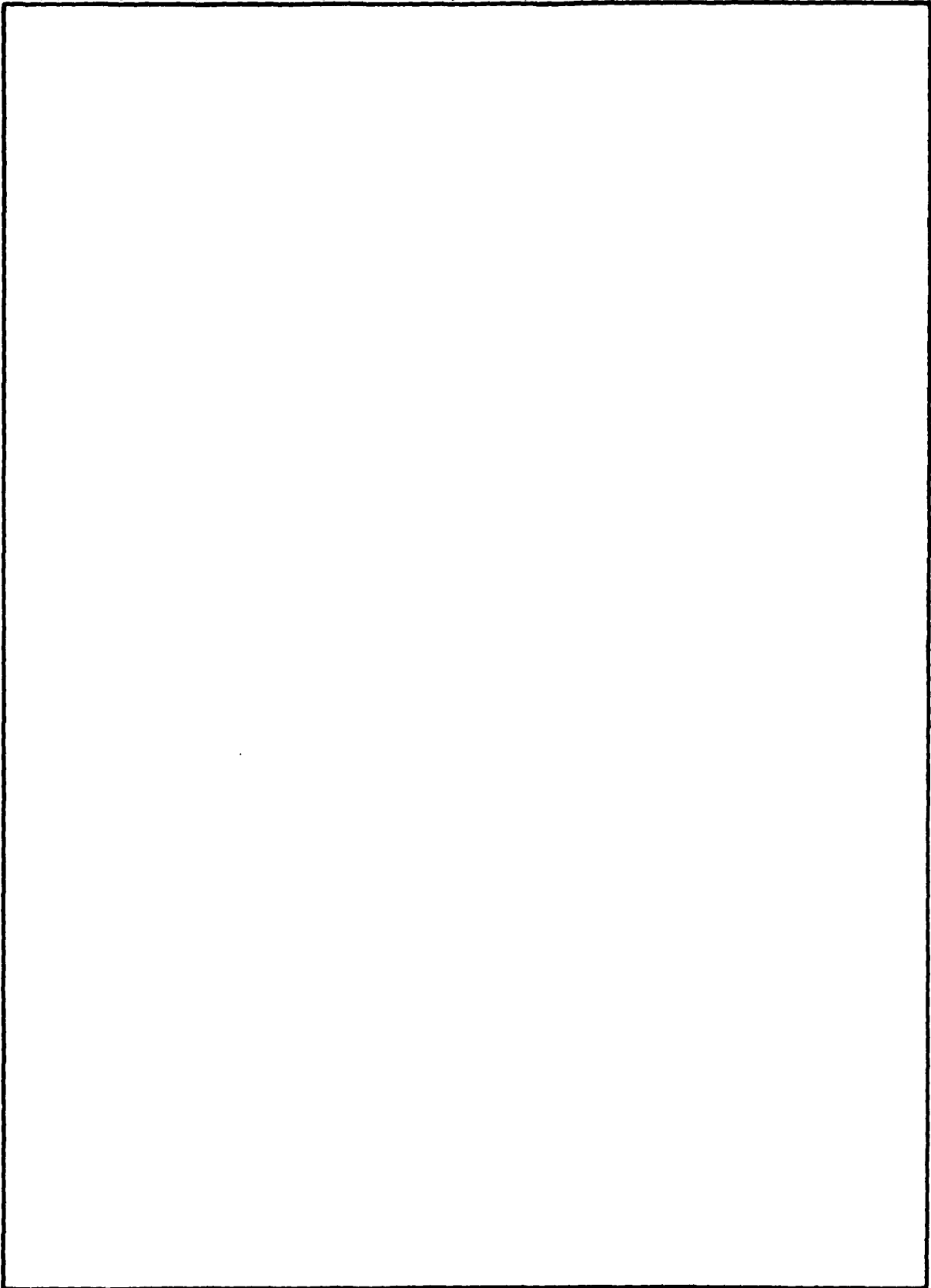
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7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc. 10 Harold P. /Hoskins/		6. PERFORMING ORG. REPORT NUMBER
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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

IN REPLY REFER TO

SUBJECT: Fayette Old City Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Fayette Old City Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SIGNED

21 DEC 1978

SUBMITTED BY: Chief, Engineering Division

Date

SIGNED

22 DEC 1978

APPROVED BY Colonel, CE, District Engineer

Date

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## PHASE I REPORT

### NATIONAL DAM SAFETY PROGRAM

Name of Dam	Fayette Old City Lake Dam
State Located	Missouri
County Located	Howard County
Stream	Adams Fork Offstream
Date of Inspection	September 13, 1978

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


The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends 1.5 miles downstream of the dam. Within the damage zone are two houses, one county road, one state road and one railroad crossing.

Our inspection and evaluation indicates that in consideration of the small volume of water impounded, the large floodplain downstream and the two houses downstream, 50% of the Probable Maximum Flood is the appropriate design flood. The spillway of this dam meets this criteria. The spillway will pass the 100-year event as well as 75% of the Probable Maximum Flood (PMF) 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.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other deficiencies visually observed by the inspection team were erosion of the upstream slope above the level of the riprap, some small rodent holes in the downstream slope, considerable seepage along the toe and downstream from the toe, blockage of the right side of the inlet to the spillway channel by soil and shrubs which apparently slipped from the abutment slope above the concrete lined spillway section, badly cracked and spalled concrete in the bottom and side slopes of the spillway, weeds and shrubs growing in the cracks of the spillway floor, lower end of concrete spillway chute undermined and collapsing due to erosion of the earth outlet channel and seepage emerging at end of and beneath the concrete spillway chute.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report.

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



PHOTOGRAPH NO. 1  
OVERVIEW OF  
DAM LOOKING  
EAST

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
FAYETTE OLD CITY LAKE DAM - ID NO. MO. 10131

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## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Fayette Old City 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 fill about 600 feet in length and 30 feet in height. Topography around the site is gently rolling to moderately steep. Soils on the slopes are apparently derived from loessial materials underlain by limestone. Upland soils are developed on relatively thin loess deposits.
  - (2) The uncontrolled spillway is cut into the abutment on the right end of the dam and consists of a concrete trapezoidal channel and chute.
  - (3) A drawdown system for municipal water supply consists of a hinged pipe inlet which can be raised and lowered with a winch and cable connected to an 8 inch cast iron pipe passing through the base of the dam. Flow in this system can be controlled with a valve at the downstream toe of the dam.
  - (4) Pertinent physical data are given in paragraph 1.3 below.

- b. Location. The dam is located in the central portion of Howard County, Missouri, as shown on Plate 2. The dam and the lake formed by the dam are shown on Plate 1 in the NW 1/4 of Section 15, T50N, R16W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends 1.5 miles downstream of the dam. Within the damage zone are two houses, one county road, one state road and one railroad crossing.
- e. Ownership. The dam is owned by the City of Fayette, 117 South Main Street, Fayette, Missouri 65248. Attention: Bobby Crowley, Superintendent of Water and Sewer Department.
- f. Purpose of the Dam. The dam forms a 12 acre lake that is used as supplemental water supply for the City of Fayette, Missouri.
- g. Design and Construction History. No design or construction data were available for this dam. The dam was constructed in 1909 (inventory data). It was reported that the present water supply line downstream from the dam was installed in 1977 as a replacement for the original line. The new line apparently connected with the original supply line at or near the control valve which is located near the downstream toe of the dam (see Appendix C).
- h. Normal Operating Procedures. The only controlled outlet for this dam is the water supply system. This system is operated as a supplemental water supply for the City of Fayette. No data were available on the operation of the spillway.

### 1.3 PERTINENT DATA

- a. Drainage Area - 116.6 acres (0.182 square miles).
- b. Discharge at Damsite.
  - (1) All discharge at the damsite is through a reinforced concrete emergency spillway.
  - (2) Estimated maximum flood at damsite - unknown.
  - (3) The emergency spillway capacity varies from 0 c.f.s. at elevation 706.5 feet to 710 c.f.s. at elevation 710.0 feet (maximum pool level and top of dam).

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

- (1) Top of dam - 710.0 ± (average).
- (2) Principal spillway crest - none.
- (3) Emergency spillway crest - 706.5 ±.
- (4) Streambed at centerline of dam - 680 ±.
- (5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 1300 feet ±.

e. Storage (Acre-feet). Top of dam (710.0) - 51.

f. Reservoir Surface (Acres)

- (1) Top of Dam - 14 ±.
- (2) Spillway Crest - 12 ±.

g. Dam.

- (1) Type - earth embankment.
- (2) Length - 630 feet ±.
- (3) Height - 30 feet ±.
- (4) Top width - 20 feet.
- (5) Side Slopes
  - (a) Downstream - 3H on 1V (measured).
  - (b) Upstream - 3H on 1V (measured on exposed face).
- (6) Zoning - unknown.
- (7) Impervious Core - unknown.
- (8) Cutoff - unknown.
- (9) Grout Curtain - unknown.
- (10) Wave Protection - Upstream slope riprapped with limestone rock.

h. Diversion and Regulation. Partial Fayette City water supply.

i. Spillway.

(1) Principal - none.

(2) Emergency.

(a) Type - Reinforced concrete lined trapezoidal channel with spillway chute.

(b) Control section - 40 feet bottom width; 1.6(h):1(v) side slopes, approximately 60 feet long from inlet to chute section.

(c) Crest elevation - 706.5 feet, M.S.L.

(d) Upstream channel - None, direct to reservoir.

(e) Downstream channel - Concrete chute on 40% grade outletting into an unstabilized earth channel.

j. Regulating Outlet. None.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No design data were available.

### 2.2 CONSTRUCTION

No construction data were available.

### 2.3 OPERATION

No data were available on the operation of the spillway. The water supply system is operable and used as needed.

### 2.4 EVALUATION

- a. Availability. No 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.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

- a. General. A visual inspection of Fayette Old City Lake Dam was made on September 13, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey Decker, Geology and Soil Mechanics; Gerald Ulmer, Civil Engineer; Richard Walker and Gordon Jamison, Hydrology. Specific observations are discussed below.
- b. Dam. The upstream slope is covered with limestone riprap that appeared to be in good shape. The riprap does not extend to the top of the dam and some erosion was observed above the level of the riprap. The crest and downstream slope are well vegetated with short grasses and vetch. Soils on the surface of the dam are highly plastic (CL or CH). Several small drying cracks were noted on the crest and downstream slope.

A few rodent holes were observed on the downstream slope. No slides or abnormal deformations were noted on the embankment.

No bedrock outcrops were observed in the area. According to Missouri Geological Survey maps, the bedrock in this area should consist of interbedded limestone and shale of upper and middle Pennsylvanian formations. The abutments for this dam were not exposed. They are expected to consist of re-worked loessial materials overlying limestone. No slides were noted on the abutments except at the inlet of the spillway. The nature of the underlying bedrock is not expected to have a significant influence on the performance or safety of this structure.

Considerable seepage was noted along the toe and downstream from the toe of the dam between centerline Stations 4+00 ± and 4+75 ±. The seepage effluent was ponded in this area and the quantity of discharge was not apparent. All seepage effluent appeared to be clear.

- c. Appurtenant Structures.

- (1) The spillway is located on the right abutment. It consists of a concrete lined trapezoidal channel and chute discharging into an unstabilized earth channel. The channel section has a bottom width of 40 feet. The right side (looking downstream) of the inlet to the channel is blocked by soil (and shrubs) which apparently slipped from the abutment slope above the concrete lined section.

The concrete in the bottom and side slopes of the spillway channel and chute is badly cracked and spalled with some weathered openings in the bottom up to 2 x 2 inches

in size. Many weeds and shrubs are growing in the cracks in the spillway floor. The earth outlet channel at the end of the chute is eroded with the lower end of the chute undermining and collapsing.

Seepage is discharging into the eroded channel at the end of and beneath the concrete chute. This seepage drains off into the floodplain below the dam and probably contributes to the ponded seepy area downstream from the dam as discussed in paragraph "b" above. The seepage discharging at the end of the chute spillway appeared to be clear.

The reservoir level was about 1 foot below the spillway elevation at the time of the inspection. Rough measurements indicate that there is about 3 feet of freeboard between the spillway crest and the top of dam.

- (2) The water supply structure consists of a hinged pipe inlet controlled by a winch and cable attached to the outer end of the pipe. The inlet pipe joins an 8 inch C.I. pipe which passes through the base of the dam at about centerline Station 4+50. A control valve for the pipeline is located in the right abutment near the downstream toe of the dam and about 10 feet above the elevation of the valley floor (see Appendix C). No seepage was noted in the area around the valve housing.

- d. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shoreline.
- e. Downstream Channel. The spillway discharges into an eroded gully which outlets onto the floodplain and into the old channel some 200 feet downstream from the dam. There are no significant obstructions in the outlet channel between the dam and the county road north of the dam.

### 3.2 EVALUATION

Any significant flow through the spillway could result in structural damage to the concrete and excessive erosion in the spillway and outlet channels with serious potential of failure.

Seepage along the toe of the dam could adversely affect structural stability of the dam under full pool conditions.

The earth plug in the entrance to the spillway and the vegetative growth in the spillway affect the hydraulic efficiency of the spillway. Wave erosion on the upstream face of the dam could lead to potential failure if left uncorrected.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There are no controlled outlet works for this dam other than the 8 inch water supply line. The pool level is controlled by rainfall, runoff, evaporation and the capacity of the uncontrolled spillway.

### 4.2 MAINTENANCE

The deterioration of the concrete and the vegetative growth and earth slump restriction in the spillway indicate a lack of regular maintenance operations.

### 4.3 MAINTENANCE AND OPERATING FACILITIES

There are no operating facilities to control the level of the lake. The facilities for water supply are operated as needed.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

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

### 4.5 EVALUATION

A serious potential of failure could result if the deficiencies noted in the spillway are not corrected.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

- a. Design Data. No original design data were found by the owner.
- b. Experience Data. The drainage area, reservoir water surface area, and elevation-storage data were developed from the USGS Fayette, Mo. 7 1/2 minute topographic quadrangle. The hydraulic computations for spillway and dam overtopping discharge ratings were developed from field measurements made during on-site inspection.
- c. Visual Observations.
  - (1) The spillway is at the right end of the dam.
  - (2) The spillway has spalling near its throat and end of chute. The floor and side slopes of the spillway are badly cracked and broken.
  - (3) The approach channel is full of brush and weeds. The right upstream corner is filled with slough material from the slope above the spillway side.
  - (4) The concrete chute is cracked and broken. The channel below the chute is eroded quite deep.
- d. Overtopping Potential. The emergency spillway is too small to pass the probable maximum flood without overtopping. The spillway will pass the one-half PMF and will pass the 24-hour 100-year frequency flood without overtopping. The spillway will pass 75% of the PMF without overtopping the dam. The results of the routings through the reservoir are tabulated in regards to the following conditions.

Frequency	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 710.0	Time Dam Overtopping Hrs.
100-Yr.	200	200	708.0	+1.7	-
1/2 PMF	600	500	709.2	+0.5	-
PMF	1100	1100	710.3	-0.3	0.8
75% PMF	800	700	710.0	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the PMF is the test for the adequacy of the dam and its spillways.

The St. Louis District, Corps of Engineers, in a letter dated 11 August, 1978 has estimated the damage zone as extending 1.5 miles downstream from the dam. Within the damage zone are two homes, one county road, one state highway, and one railroad crossing. This fact was verified by field inspection.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations. Visual observations of features that could adversely affect the structural stability of this dam include: deterioration of the concrete and obstructions in the spillway, erosion of the spillway outlet channel, and excessive seepage along the toe of the dam.
- b. Design and Construction Data. No design or construction data were available.
- c. Operating Records. No operating records were available.
- d. Post Construction Changes. The inspection team is not aware of any post construction changes that would affect the structural stability of this dam.
- e. Seismic Stability. This dam is in Seismic Zone 1. An earthquake of this magnitude is not expected to cause structural failure of this dam.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

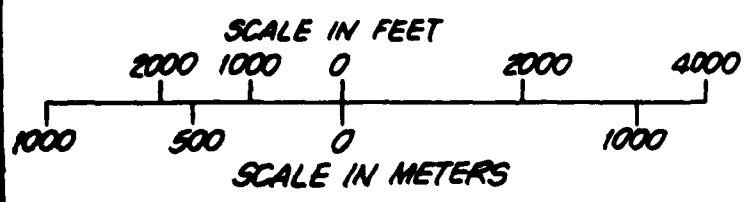
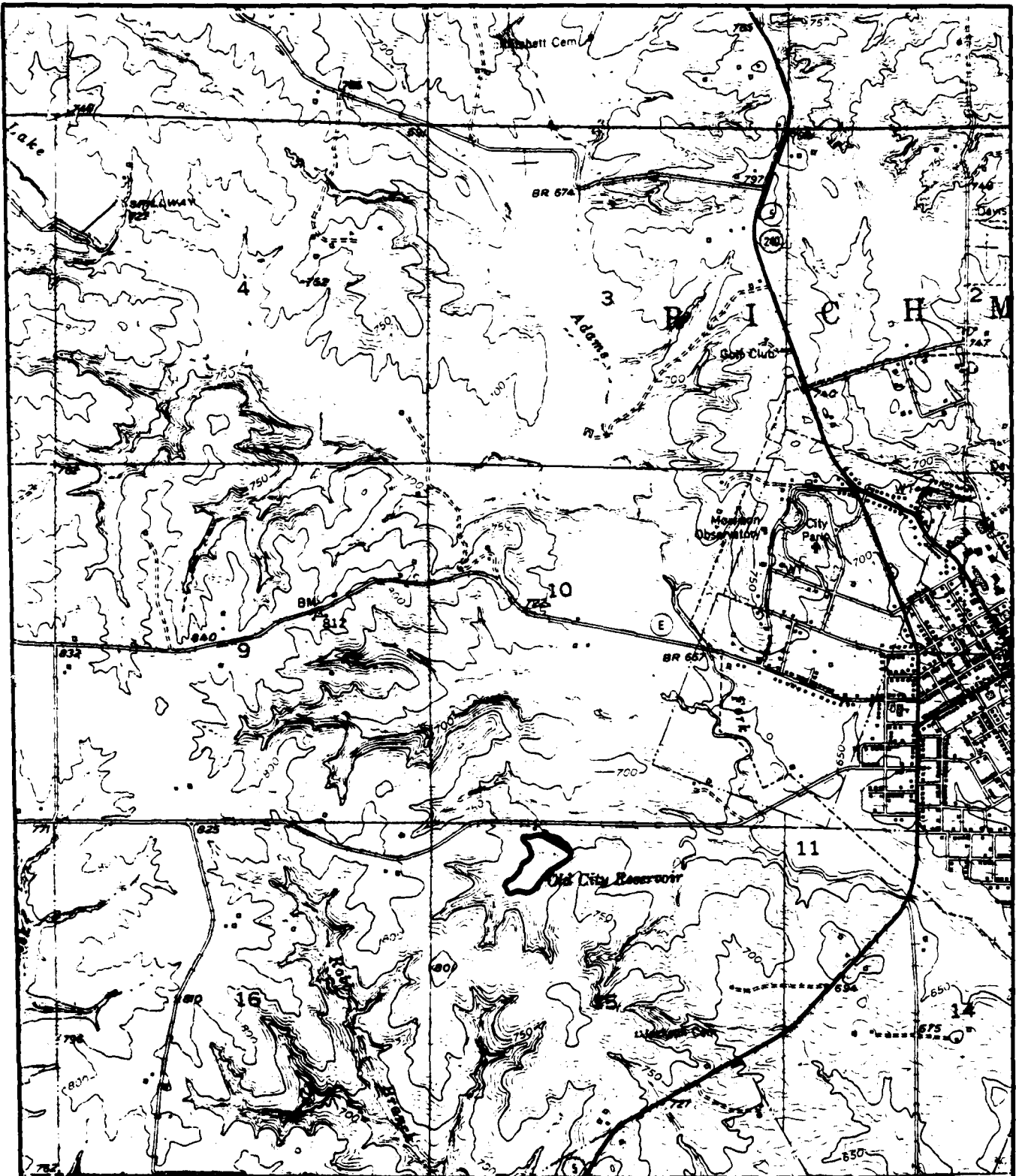
- a. Safety. The visually observed deficiencies in the spillway should be corrected. Seepage at the toe of the dam could adversely affect the safety of the structure at pool elevations above the normal level. The probable maximum flood (PMF) will just overtop the dam (0.3 foot) for a short period of time. This probably would not cause serious damage to the embankment but would damage the spillway. Available data indicate that under present conditions, the spillway will pass the flood resulting from 75% of the probable maximum flood without overtopping the dam.
- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report were based upon performance history and visual observations. The inspection team considers that these data are sufficient to support the conclusions herein. Neither seepage nor stability analyses were available which is a deficiency that should be corrected in the future.
- c. Urgency. If the deficiencies in the spillway are not corrected in the near future a serious potential of failure could result.
- d. Necessity for Phase II. Phase II investigations are not considered necessary.
- e. Seismic Stability. An earthquake of the magnitude to be expected in this area should not be hazardous to this dam.

### 7.2 REMEDIAL MEASURES

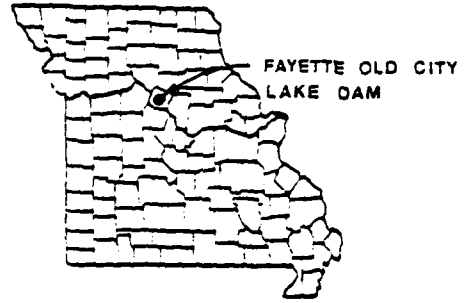
- a. Alternatives.
  - (1) The spillway should be repaired and cleaned out.
  - (2) Seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads). The services of an engineer experienced in the design of earth dams should be obtained to conduct these analyses. Based on the result of the seepage analysis the existing seepage should be eliminated or controlled.
- b. O & M Maintenance and Procedures.
  - (1) The erosion in the outlet channel for the spillway should be corrected and the channel stabilized.

- (2) Regular inspections of the dam should be initiated. The inspections should be designed to monitor earth slides, seepage, vegetative growth, deterioration of the concrete in the spillway, and erosion of the spillway outlet channel. The inspections should be followed by a preventative maintenance program that will cause repair to be done on a timely basis in order to protect the integrity of the dam.

APPENDIX A  
MAPS



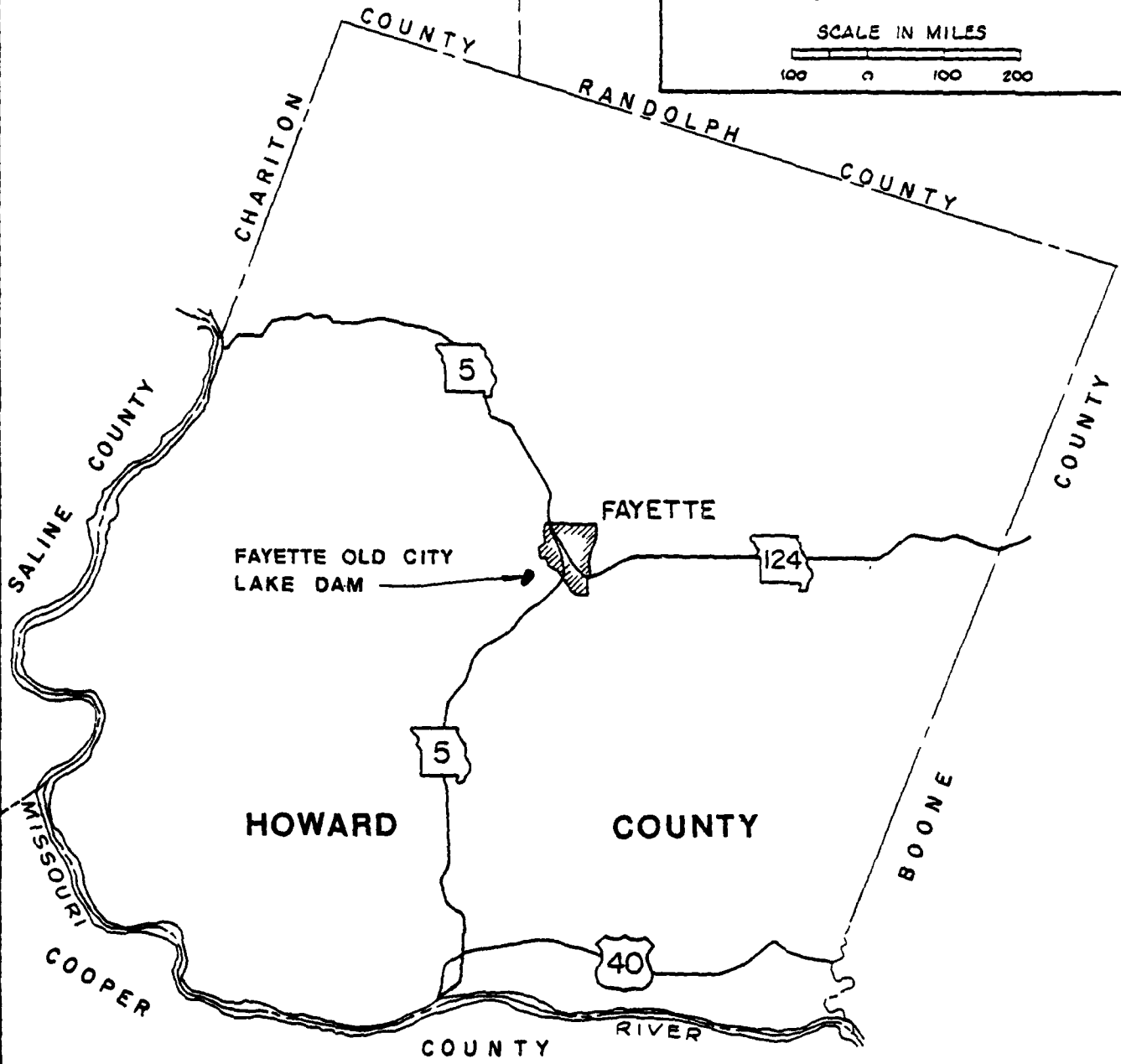
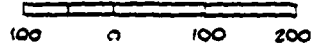
FAYETTE OLD CITY  
 LAKE DAM  
 VICINITY TOPOGRAPHY  
 PLATE I



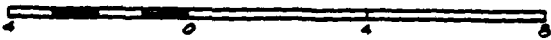
FAYETTE OLD CITY  
LAKE DAM

### VICINITY MAP

SCALE IN MILES



SCALE IN MILES



### LOCATION MAP PLATE 2

APPENDIX B  
PHOTOGRAPHS



PHOTO. NO. 2  
LOOKING UPSTREAM  
AT APPROACH TO  
SPILLWAY.



PHOTO. NO. 3  
LOOKING LEFT TO RIGHT  
UPSTREAM AT SPILLWAY.



PHOTO. NO. 4  
LOOKING DOWNSTREAM  
AT STATION 5+00 FROM  
TOP OF DAM.



PHOTO. NO. 5  
LOOKING UPSTREAM  
FROM LEFT TO RIGHT  
AT SPILLWAY.



PHOTO. NO. 6  
DOWNSTREAM END  
OF CONCRETE CHUTE.  
WATER AT BOTTOM  
INDICATES SEEPAGE.



PHOTO. NO. 7  
DOWNSTREAM  
SPILLWAY CHANNEL.



PHOTO. NO. 8  
SEEPAGE SPOT  
DOWNSTREAM. STATION 4+60±.



PHOTO. NO. 9  
LOOKING DOWNSTREAM  
AT UPSTREAM  
APPROACH TO SPILLWAY.

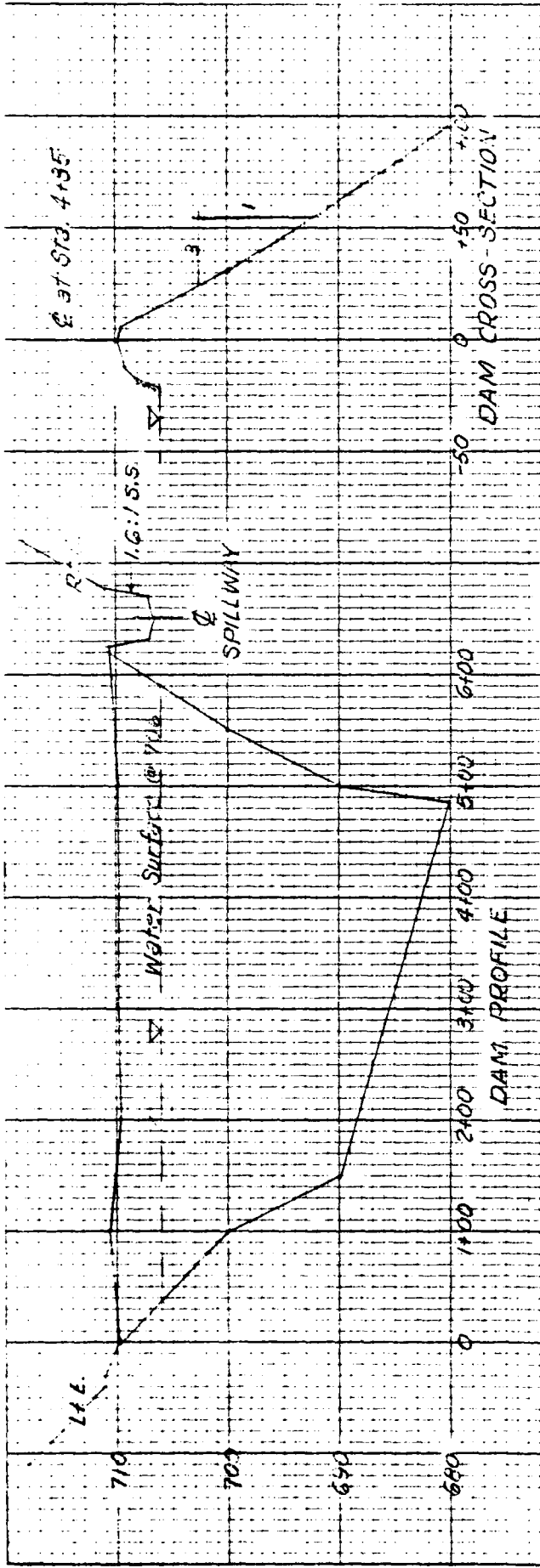


PHOTO. NO. 10  
UPSTREAM SLOPE  
OF DAM FROM  
LEFT END OF DAM.

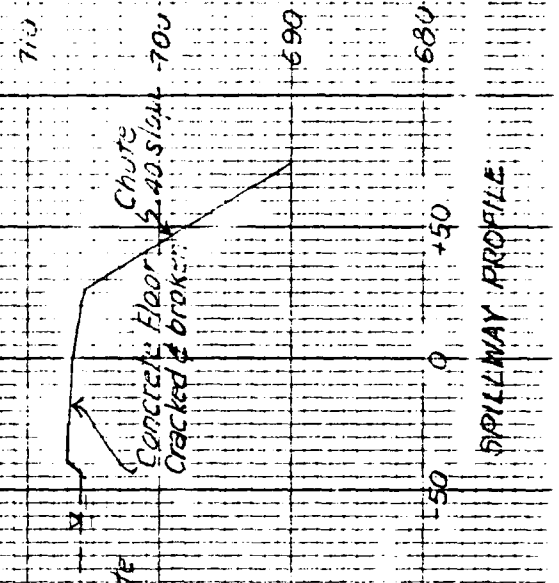
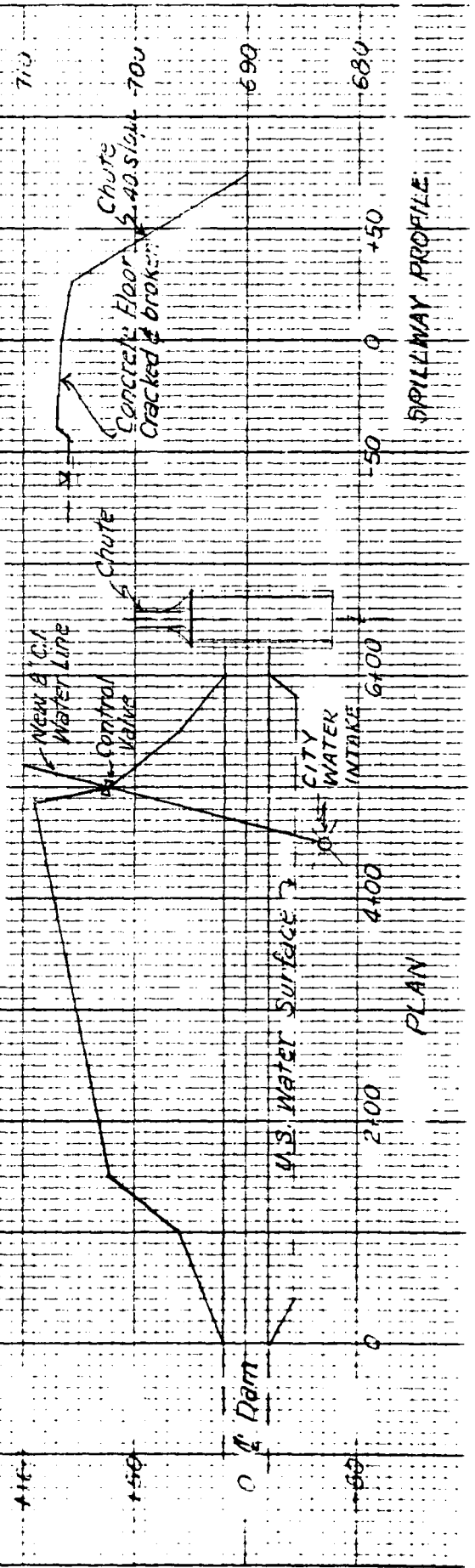


PHOTO. NO. 11  
DOWNSTREAM SLOPE  
FROM LEFT END  
OF DAM.

APPENDIX C  
PLAN, PROFILES & SECTION



**FAYETTE OLD CITY LAKE DAM**  
 National Dam Safety Program  
 PHASE I



APPENDIX D  
HYDROLOGIC COMPUTATIONS

## HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvilinear unit hydrograph and the SCS TR-20 program were used to develop the inflow hydrographs (see Plate D1). The inflow hydrograph for the 100-year flood was generated by the consultant using the TR-20 program.

a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 24-hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis District policy and guidance for hydraulics and hydrology.

b. Drainage area = 0.182 square mile (116.6 acres).

c. Time of concentration of runoff = 13 minutes.

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

e. The total 24-hour storm duration losses for the 100-year storm were 1.43 inches. The total losses for the 24-hour duration 1/2 PMF storm were 1.30 inches. The total losses for the PMF storm were 1.36 inches. These data are based on SCS runoff curve No. 91 and antecedent moisture conditions from SCS AMCIII.

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

2. The emergency spillway discharge rating was developed using the upstream standard step backwater method to develop a water surface in the reservoir. The flows over the dam crest were based on the broad-crested weir equation  $Q = CLH^{3/2}$ , where H is the head on the dam crest; the coefficient C, which varies with head, was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods".

3. Floods were routed through the reservoir using the TR-20 program to determine the capabilities of the spillway and dam embankment crest. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D1.

FAYETTE OLD CITY LAKE DAM

