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ANDERSON ENGINEERING INC SPRINGFIELD MO
NATIONAL DAM SAFETY PROGRAM, ROY DAVIS DAM (MO 30056); WHITE BA--ETC(U)
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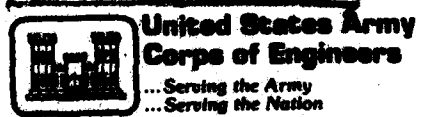
**ROY DAVIS DAM
REYNOLDS COUNTY, MISSOURI
MO 30056**

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PHASE 1 INSPECTION REPORT

⑥ **NATIONAL DAM SAFETY PROGRAM.**

Roy Davis Dam (MO 30056), White Basin,
Reynolds County, Missouri. Phase I
Inspection Report.



St. Louis District / 9. Final rept.

15 DACW43-79-C-0070

10 John M. /Healy Steven L. /Brady
Tom /Beckley Nelson /Morales Dan /Kerns

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

FOR: STATE OF MISSOURI

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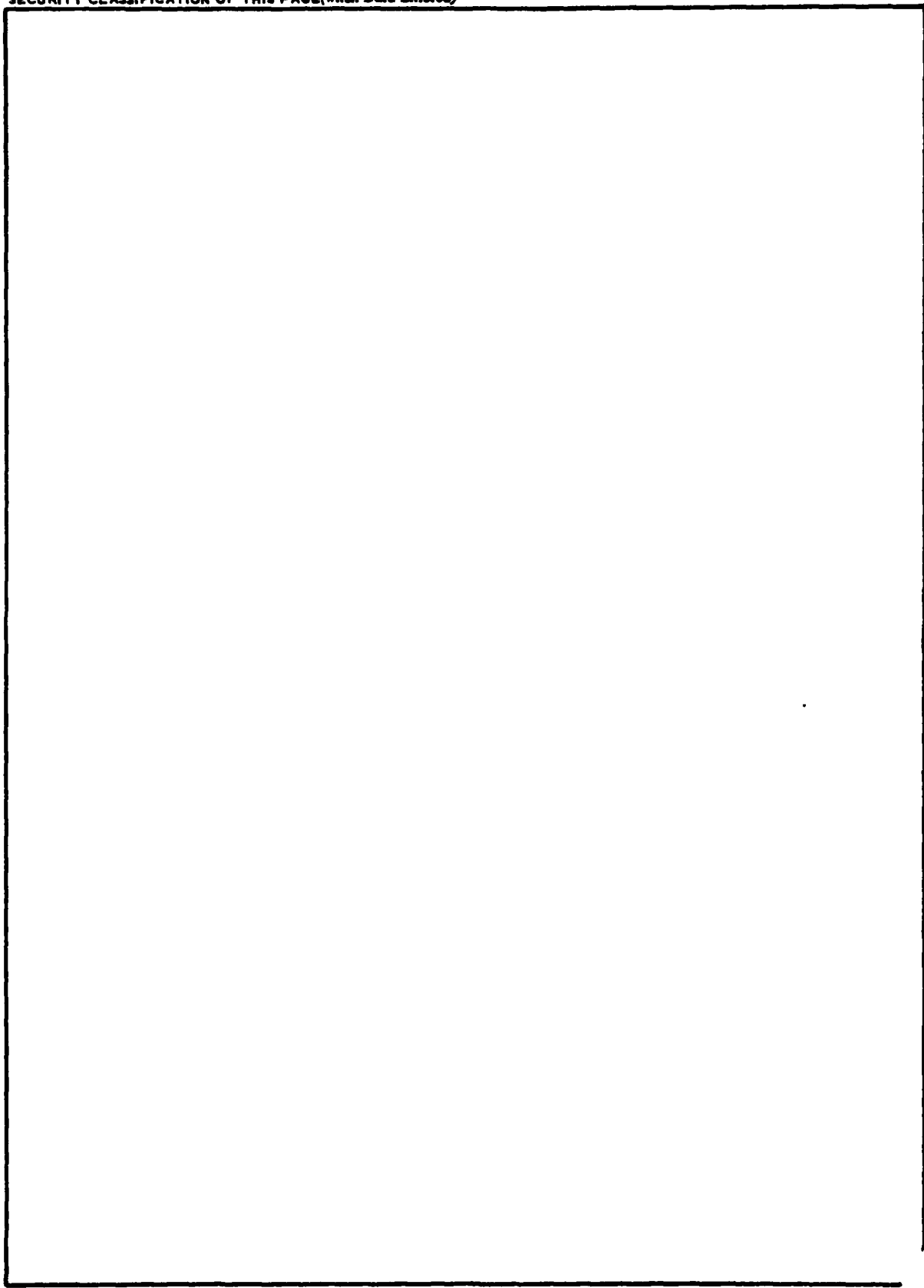
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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
 210 TUCKER BOULEVARD, NORTH
 ST. LOUIS, MISSOURI 63101

REPLY TO
 ATTENTION OF

LMSD-P

SUBJECT: Roy Davis Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Roy Davis Dam.

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

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillways will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

SUBMITTED BY:

Chief, Engineering Division

8 APR 1980

Date

SIGNED

APPROVED BY:

Colonel, CE, District Engineer

8 APR 1980

Date

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ROY DAVIS DAM
REYNOLDS COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30056

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by

Anderson Engineering, Inc. Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction of
St. Louis District, Corps of Engineers

For
Governor of Missouri

March, 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Roy Davis Dam
State Located: Missouri
County Located: Reynolds County
Stream: Smalls Creek
Date of Inspection: 16 August 1979

Roy Davis Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. 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 they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are four dwellings. The dam is in the small size classification, since it is greater than 25 ft. high but less than 40 ft. high, and the maximum storage capacity is greater than 50 acre-ft. but less than 1000 acre-ft.

Our inspection and evaluation indicates that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 9 percent of the Probable Maximum Flood without overtopping. 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 guidelines require that a dam of small size with a high downstream hazard potential pass 50


to 100 percent of the PMF. Considering the height of the dam (26 feet), the volume of water impounded (117 acre-ft.), and the large floodplain downstream, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year frequency flood will overtop the dam. The 100-year flood is one that has a 1 percent chance of being equalled or exceeded in any given year. Analysis of the data indicates that the 10-year frequency flood will not overtop the dam. The 10-year flood is one that has a 10 percent chance of being exceeded in any given year.

Deficiencies visually observed by the inspection team were: (1) No erosion protection on front face of dam; (2) Wet areas (apparent seepage) at downstream toe; (3) Logs and debris around primary spillway inlet; (4) Seepage underneath primary spillway pipe outlet; (5) Undermining of the end of the concrete emergency spillway; and (6) Disrepair of the primary spillway trash rack. Another deficiency was the lack of seepage and stability analysis records.

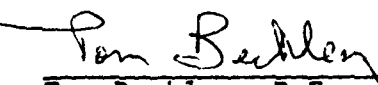
It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.



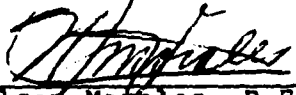
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AERIAL VIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

ROY DAVIS DAM - ID No. 30056

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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 be made of Roy Davis Dam in Reynolds County, Missouri.

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 a 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 Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." 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:

Roy Davis Dam is an earth fill structure approximately 26 ft. high and 400 ft. long at the crest. The appurtenant works consist of a 24 in. diameter corrugated metal pipe (CMP) primary spillway located in the west half of the embankment, concrete lined emergency spillway located at the west end of the dam, and an 8 in. diameter black iron drain-down pipe located just east of the center of the dam. Sheet 3 of Appendix A shows a plan, profile and typical section of the embankment.

B. Location:

The dam is located in the Northwestern part of Reynolds County, Missouri on Smalls Creek. The dam and lake are within the Bunker, Missouri 7.5 minute quadrangle sheet (Section 6, T32N, R2W - latitude 37 29.5'; longitude 91 12.2'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 26 ft. and a maximum storage capacity of approximately 117 acre-ft., the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately one mile downstream of the dam. Located within the damage zone are four dwellings.

E. Ownership:

The dam is owned by Roy Davis. The owner's address is Box 118, Bunker, Missouri 63629.

F. Purpose of the Dam:

The dam was constructed primarily for recreational purposes, although some flood protection is also provided.

G. Design and Construction History:

Although some design assistance was reportedly provided by the Soil Conservation Service on the embankment, no plans or records were available as the Reynolds County field office at Ellington had no such records. The dam was constructed by Hines and Ellerman Contractors of Eminence, Missouri, in 1952. Mr. John Hines said that the contracting firm disbanded in 1966 and that he had no plans for the Davis Dam. Material for the dam was reportedly obtained from the west abutment downstream of the dam. A key trench was provided for the dam according to the owner and the contractor. The key trench was cut down 4 to 10 ft. and filled with compacted clay. A creek gravel and soil layer was hit in the key trench excavation. Mr. Hines said they tried to go through this layer but did not get to bedrock. The embankment soil was placed and compacted with earthmovers.

The 8 in. black iron drain-down pipe was installed during construction to allow normal stream flow to pass through the embankment. The original emergency spillway was grass covered however considerable erosion occurred due to the frequency of use of the spillway and the amount of flow. The emergency spillway was repaired under the assistance of the Soil Conservation Service (SCS) on two occasions prior to 1962. Some of this repair consisted of installing a rock and mortar lining which also washed out. A concrete chute spillway was built on the downstream face in about 1969 according to the owner. Letters of inspection of the spillway and recommendations for stopping the erosion problem from the SCS are included as sheets 5 thru 11 in Appendix A. No other modifications have been made to the dam.

H. Normal Operative Procedures:

Normal flows are passed by the 24 in. CMP primary spillway and the 8 in. iron drain-down pipe both of which are uncontrolled. A concrete lined emergency spillway would come into use for major floods. The owner indicated that the highest water occurred this spring when flow was 12 in. over the emergency spillway. He also said that the dam had never been overtopped.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 672 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through uncontrolled spillways.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 1109 ft., MSL): 673 cfs
- (3) Estimated Capacity of Primary Spillway: 33 cfs
- (4) Estimated Experienced Maximum Flood at Dam Site: 158 cfs

- (5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable
- (6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (7) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

- (1) Top of Dam: 1109 ft., MSL
- (2) Principal Spillway Crest: 1103.34 ft., MSL
- (3) Emergency Spillway Crest: 1106.8 ft., MSL
- (4) Principal Outlet Pipe Invert: 1087.66 ft., MSL
- (5) Streambed at Centerline of Dam: 1083 ft., MSL
- (6) Pool on Date of Inspection: 1103.34 ft., MSL
- (7) Apparent High Water Mark: 1107.8 ft., MSL
- (8) Maximum Tailwater: Unknown
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Top of Dam: 1510 ft.
- (2) At Principal Spillway Crest: 1200 ft.
- (3) At Emergency Spillway Crest: 1440 ft.

E. Storage Capacities:

- (1) At Principal Spillway Crest: 54 Acre-ft.
- (2) At Top of Dam: 117 Acre-ft.

(3) At Emergency Spillway Crest: 92 Acre-ft.

F. Reservoir Surface Areas:

(1) At Principal Spillway Crest: 8 Acres

(2) At Top of Dam: 14 Acres

(3) At Emergency Spillway Crest: 12 Acres

G. Dam:

(1) Type: Earth

(2) Length at Crest: 400 ft.

(3) Height: 26 ft.

(4) Top Width: 16 ft.

(5) Side Slopes: Upstream slope 1.89H:IV to water line. Water line to upstream toe slope unknown; Downstream varies, 1.92H:IV & 2.27H:IV.

(6) Zoning: None

(7) Impervious Core: None

(8) Cutoff: Mr. Roy Davis indicated that a key trench with depth from 4 ft. to 10 ft. deep had been filled with compacted clay. These dimensions were not verified by this inspection.

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: None

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location: West half of dam at Sta. 2+30
- (2) Type: 24 in. diameter CMP

I.2 Emergency Spillway:

- (1) Location: West abutment
- (2) Type: Trapezoidal cut with concrete lining slope.
(See Sheet 3 of Appendix A and Sheet 4 of Appendix C for details).

J. Regulating Outlets:

An 8 in. diameter black iron drain-down pipe located at Sta. 3+35. The drain-down pipe has a 12 in. pipe riser that extends to approximately elevation 1103.3 ft., MSL. The riser has a band 6 ft. below the top of the pipe that can be removed to lower the lake level. No valves are associated with this outlet and water was flowing over the top of the riser on the day of the field inspection. The outlet of the drain-down pipe is a 12 in. pipe. The change in pipe diameter takes place somewhere in the embankment.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exist for this dam. No documentation of construction inspection records has been obtained. To our knowledge there are no documented maintenance data.

A. Surveys:

No information regarding pre-construction surveys was able to be obtained. Sheet 3 of Appendix A presents a plan, profile, and cross section of the dam from survey data obtained during the site inspection. The benchmark used was the southeast corner of the emergency spillway wall with an estimated elevation of 1107.8 ft., MSL.

B. Geology and Subsurface Materials:

The site is located in the Ozarks geologic region of Missouri. The Ozarks are characterized topographically by hills, plateaus and deep valleys. The most common bedrock types are dolomite, sandstone and chert.

Information supplied by the Missouri Geological Survey indicates that the bedrock in the valley is in a transition zone between the Gasconade and Eminence formations of the Canadian and Cambrian Systems. Both formations are primarily composed of massive, thickly bedded, medium to coarse grained dolomite. The Gasconade formation contains a persistent sandstone unit that is called the Gunter member. Caves, springs, seeps and other solution phenomena are common to these formations. The publication "Caves of Missouri" lists two caves known to exist in Reynolds County. These caves are located in section 9, T32N, R2E and section 23, T31N, R2E.

The "Geologic Map of Missouri" indicates a normal fault passing 5 miles southwest of the site in a northwest-southeasterly direction. The Missouri Geological Survey has indicated that the faults in this area are generally considered to be inactive and have been for several hundred million years.

Soils in the area of the dam site appear to be primarily thin deposits of residual silty clays with rock fragments. The soils are of the Clarksville-Fullerton-Talbott

Soil Association and have developed from thin loessial soils deposited over weathered material from cherty dolomites. The loessial thickness map indicates that upland areas may have between 2.5 and 5.0 ft. of loess cover.

C. Foundation and Embankment Design:

The owner indicated that the material for the dam was taken from the hillside on the west abutment just downstream of the dam site and consists of residual silty clays with chert rock. A key trench filled with compacted clay was installed under the dam. No zoning of the embankment was used nor is there any internal drainage features in the dam. No design computations or construction inspection records were available.

D. Hydrology and Hydraulics:

No hydraulic and hydrologic design data were obtained. Our analysis of the PMF are presented in Appendix C. These analysis were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass 9 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will overtop the dam.

E. Structure:

The appurtenant structures are the 24 in. primary spillway pipe, the 8 in. drawdown pipe, and the concrete lined emergency spillway. The emergency spillway has been used several times however the concrete appears in good condition.

2.2 CONSTRUCTION:

No construction inspection data were available.

2.3 OPERATION:

To our knowledge, there are no operating records. The owner indicated that grass on the dam is cut regularly.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation. 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:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 16 August 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Tom Beckley P.E.- Anderson Engineering, Inc. (Civil Engineer)
Steve Brady P.E.- Anderson Engineering, Inc. (Civil Engineer)
John Healy P.E.-Hanson Engineers, Inc.(Geotechnical Engineer)
Nelson Morales P.E.- Hanson Engineers, Inc. (Hydrologic and Hydraulic Engineer)
Dan Kerns E.I.T.- Hanson Engineers, Inc. (Geotechnical Engineer)

B. Dam:

The dam appears to be generally in good condition. No obvious seepage through the embankment was noted. The dam has been constructed on a slight curve which is concave to the downstream direction. The dam is fairly level across the crest and no surface cracking or unusual movement was obvious.

There are two apparent areas of seepage at the downstream toe. The areas are to the west of the 8 in. drawdown pipe outlet and to the west of the 24 in. primary spillway pipe (See sheet 4, Appendix A). The apparent seepage is manifested by wet, soft ground, cattails, and small pools of water with iron staining. No flow of water could be observed in either of these areas. The valley downstream of the dam (300 ft. past dam) has several areas of standing water and cattail growth. This wet area in the valley could be due to drainage from the hillside.

Water was seeping out under the 24 in. diameter primary spillway pipe outlet at the downstream toe. The flow was a trickle and was less than 1/8 gpm. The water was clear and no soil particles were observed in the water.

The embankment was clear of weeds and appeared to be mowed on a regular basis. The contacts at the abutment on the downstream side appeared to be in good condition. No animal holes were noted in the embankment.

The upstream face of the embankment had some minor erosion at the waters edge from wave action. No riprap was noted on the front face. No evidence was seen of settlement, sinkholes, slides, or other vertical movement of the embankment.

The drawdown pipe had considerable flow from the outlet. Water was backed up at the outlet such that the outlet was submerged. Some sediment appeared to be carried in the water from the pipe which indicates the possibility that the pipe has seepage around it or the pipe has failed. Due to the amount of water around the outlet, the existence of seepage could not be determined.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The primary spillway is a 24 in. diameter CMP. The approach to the spillway is clear. A wire mesh trash rack is built around the pipe inlet. The trash rack is insufficient as logs and debris were around and in the pipe inlet. The outlet area is clear with a plunge pool. On the day of inspection, the lake water level was at the same elevation as the pipe invert.

C.2 Emergency Spillway:

The emergency spillway has a concrete lining (see sheet 3 of Appendix A for details). The concrete appears to be in good condition. The end of the concrete chute has undermined about 1 1/2 ft. The approach to the spillway is clear as is the discharge channel. The emergency spillway has been used several times. According to Mr. Roy Davis the most water through the spillway occurred this spring when the water was up to the side walls of the concrete lining (approximately 12 in. over the spillway).

D. Reservoir:

The slopes adjacent to the watershed are moderate and no sloughing or serious erosion was noted. The watershed is primarily timber.

E. Downstream Channel:

The downstream channel is the old streambed. The streambed is covered with creek gravel. Considerable trees and brush line the streambed. Releases from both spillways are away from the dam and would not be expected to endanger its integrity.

3.2 EVALUATION:

Two seepage areas were noted at the toe of the embankment. Some seepage was also detected under the 24 in. primary spillway pipe. These areas should be inspected by an engineer experienced in the design and construction of dams. The outlet of the drawdown pipe should also be inspected by an engineer to determine if seepage is occurring around the pipe. Some erosional damage was present on the upstream face of the dam.

Erosion protection may be advisable. The primary spillway trash rack has considerable logs and debris around it which should be removed and the rack should be repaired or modified so that it will function. The end of the emergency spillway has undermined approximately 1 1/2 ft.

Photographs of the dam, appurtenment structures, the reservoirs, and the watershed are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam, except for the drawdown pipe. The spillways are uncontrolled, so that the pool is normally controlled by rainfall, runoff, evaporation, and seepage.

4.2 MAINTENANCE OF DAM:

The owner indicated that the grass is cut periodically.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Although the drawdown facilities appear to be in good condition, it is not known whether they are regularly maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Trees and brush growth should be cut annually. Animal holes should be filled, and erosional areas should be maintained as they develop. The dam should be periodically inspected to detect possible seepage under or through the embankment, especially in the apparent seepage areas noted in this report, and in the area of the drawdown pipe outlet.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. Our hydrologic and hydraulic analyses using U.S. Army Corps of Engineers guidelines appears in Appendix C.

C. Visual Observations:

The approaches to the primary and emergency spillways are both clear. The trash rack around the primary spillway has considerable logs and debris around it and the rack needs repairing. The outlets of both spillways are clear and well away from the dam such that releases would not be expected to endanger its integrity. Water was flowing into the drawdown pipe inlet. The water level on the day of inspection was 1103.34 ft., MSL.

The primary spillway is a 24 in. diameter CMP with invert at 1103.34 ft., MSL. The emergency spillway is located at the west abutment. A concrete lining for the spillway begins at the downstream edge of the top of the embankment and extends 66 ft. down the back face. The concrete lining is 40 ft. wide at the top and 19 1/2 ft. wide at the bottom (see sheet 3, Appendix A for details). Some undermining has occurred at the bottom of the concrete spillway (see photo no. 18). Mr. Davis said the water over the emergency spillway was the highest he had ever seen it this spring (approximately 12 in. over the spillway). The high water mark found at the time of inspection was about elevation 1107.8. No indication of overtopping was found.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 9 percent of the Probable Maximum Flood. 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 recommended guidelines from the Department of the Army, Office of the Chief Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the height of the dam (26 ft.), the volume of water impounded (117 acre-ft.), and the large floodplain downstream, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will not pass a 100-year frequency flood without overtopping.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 1.93 ft. at elevation 1110.93. The duration of the overtopping will be 5.58 hours, and the maximum outflow will be 5399 cfs. The maximum discharge capacity of the spillways is 673 cfs. The 100-year frequency flood was also routed through the spillways and dam. The result indicates that the dam will be overtopped by 0.57 ft. at elevation 1109.57. The duration of the overtopping will be 0.67 hours. Analysis of the data indicates that the 10-year frequency flood will not overtop the dam. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

It is reported that the material came from the west abutment and consists of silty clay soils with chert fragments. A key trench was installed and filled with compacted clay. Soils in the embankment were placed and compacted with earthmovers. The original emergency spillway was grass lined however a concrete lining was built in 1969 due to severe erosion problems. No design or construction data was found. Correspondence from the SCS concerning the spillway erosion problem are included in Appendix A as sheets 5 thru 11. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

In 1969 a concrete lining was built into the emergency spillway. This is discussed in Section 1.2G.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be corrected or controlled. These items are: (1) no erosion protection on front face of the dam; (2) wet areas (apparent seepage) at the downstream toe; (3) logs and debris around primary spillway inlet; (4) seepage under primary spillway pipe outlet; (5) undermining of the end of the concrete emergency spillway; and (6) the disrepair of the primary spillway trash rack. Another deficiency was the lack of seepage and stability analysis records.

The dam will be overtopped by flows in excess of 9 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to a failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the defi-

ciencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the future. The item recommended in paragraph 7.2 regarding an increase to the spillway size and/or the height of the dam should be pursued on a high priority basis. Priority should also be given to investigation and continued observation of the apparent seepage areas.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

- (1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

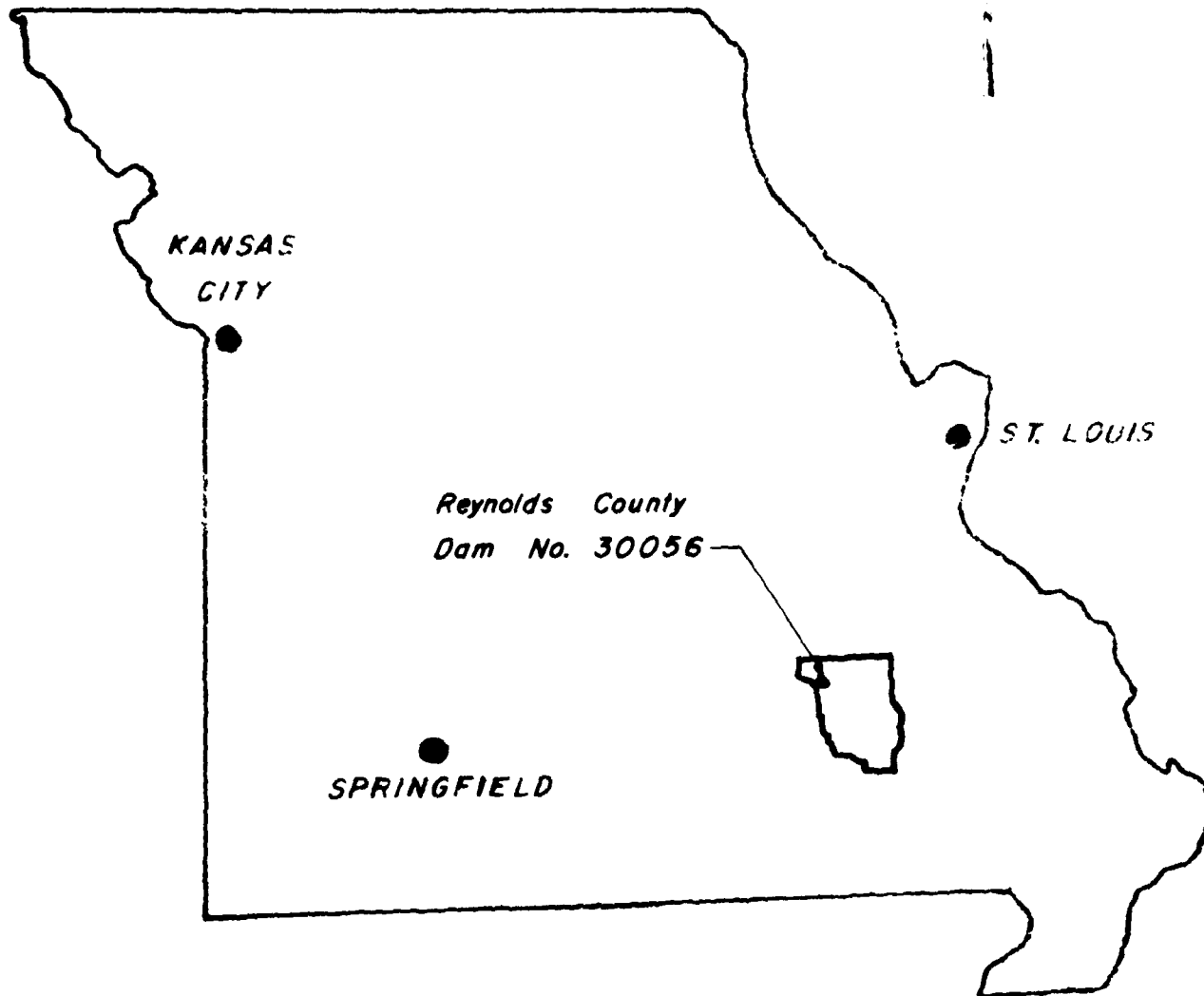
B. O & M Procedures:

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.
- (2) The erosion on the front face should be corrected and maintained. Erosion protection may be advisable.
- (3) The apparent seepage areas at the downstream toe and the outlet of the 24 in. pipe should be investigated by

an engineer experienced in the design and construction of dams. Remedial measures may be required. As a minimum these areas should be inspected periodically in an effort to detect an increase in the quantity of seepage or any indication that soil particles are being carried by the water. In this event, an engineer experienced in the design and construction of dams should be contacted immediately. The area around the exit of the draindown pipe should be inspected to determine whether seepage is occurring along the pipe. Remedial measures may be required.

- (4) The logs and debris should be cleared from around the inlet to the primary spillway.
- (5) Repair of erosion under the end of the emergency spillway lining and installation of an end wall to prevent future erosion.
- (6) The trash rack should be repaired and perhaps modified so that it will not allow debris to get to the pipe inlet.
- (7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A



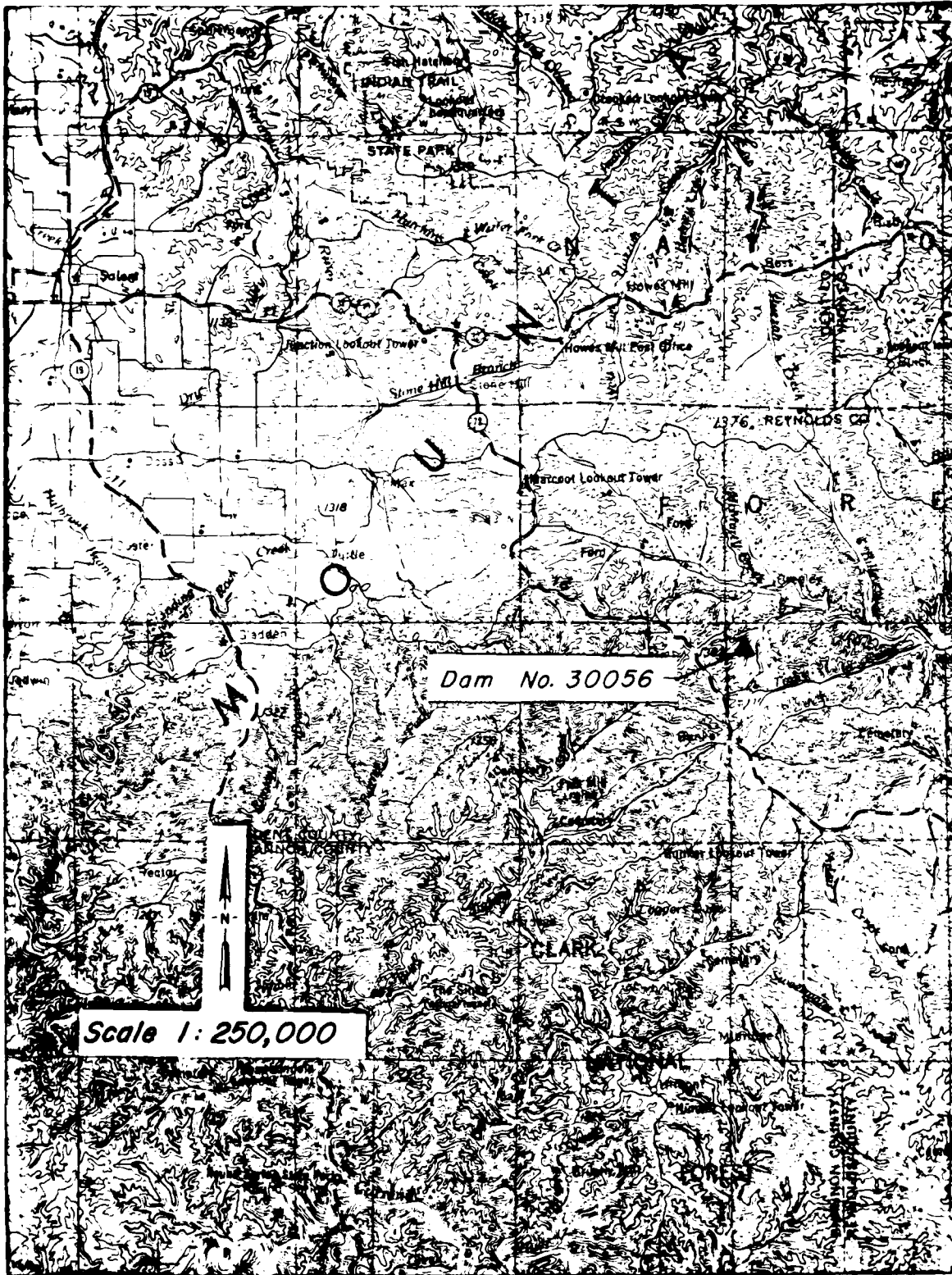
KANSAS
CITY

ST. LOUIS

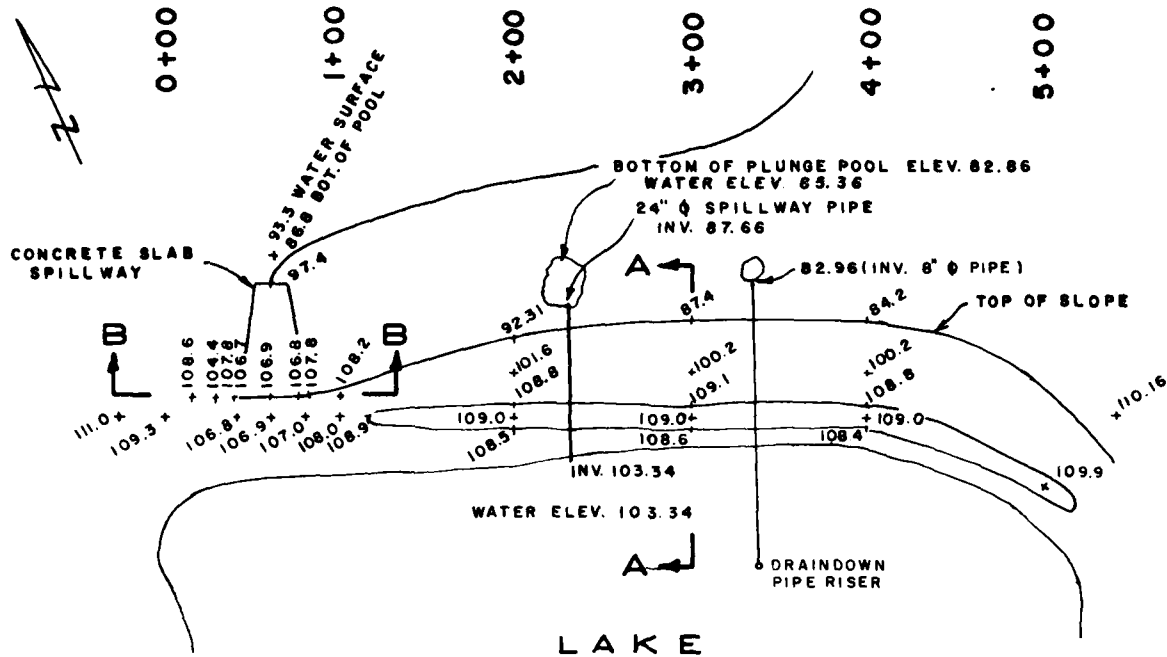
Reynolds County
Dam No. 30056

SPRINGFIELD

LOCATION MAP

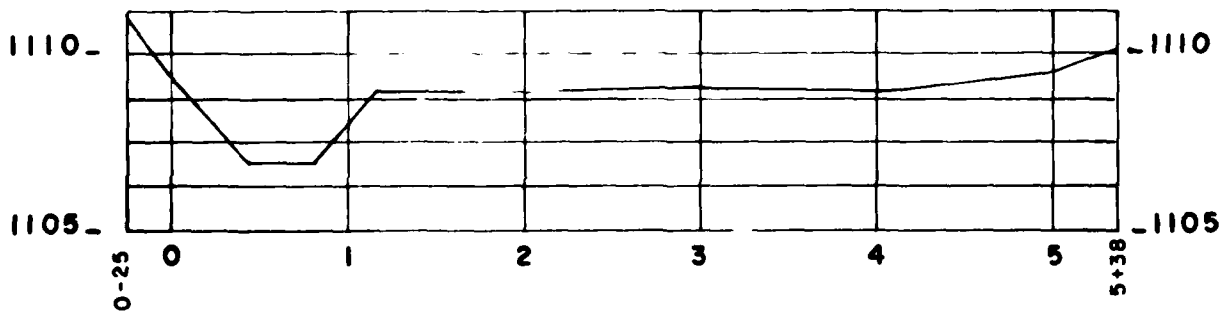
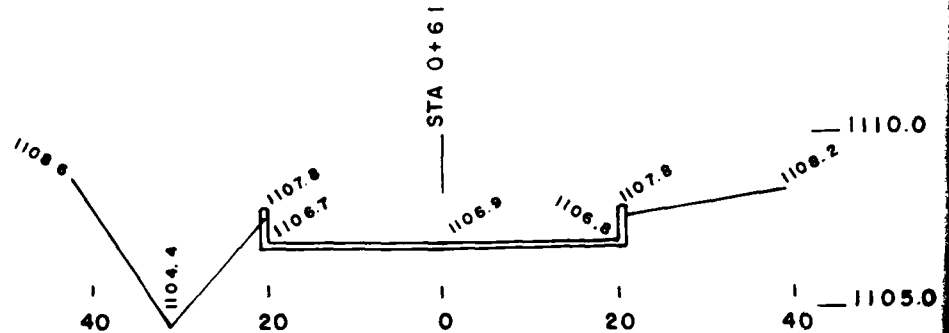


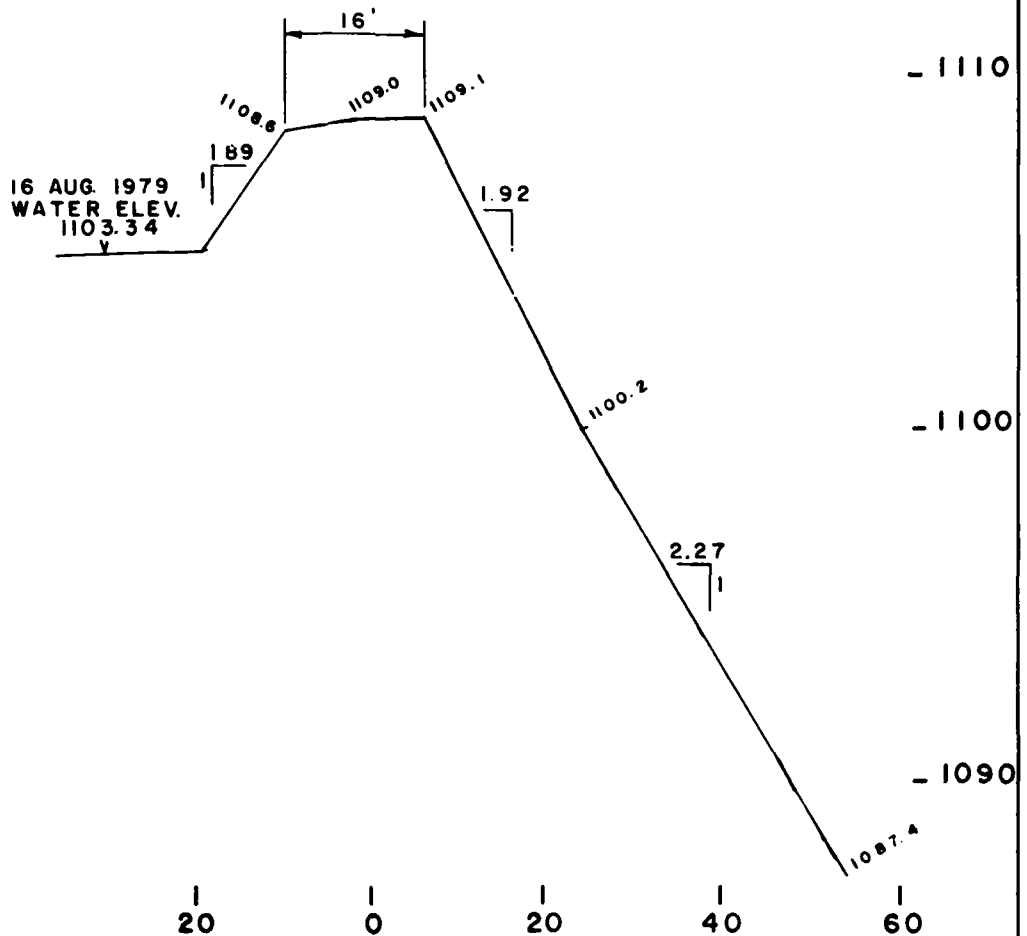
SITE VICINITY MAP



BENCHMARK:
 SOUTHEAST CORNER OF EMERGENCY
 SPILLWAY WALL = 1107.8 FEET MSL

NOTE:
 ADD 1000.00 TO ELEVATIONS
 SHOWN ON PLAN VIEW FOR MSL
 ELEVATIONS.





SECTION A-A STA 3+00

ELEVATIONS
FEW FOR MSL

SECTION

SHEET 3 OF APPENDIX A

ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

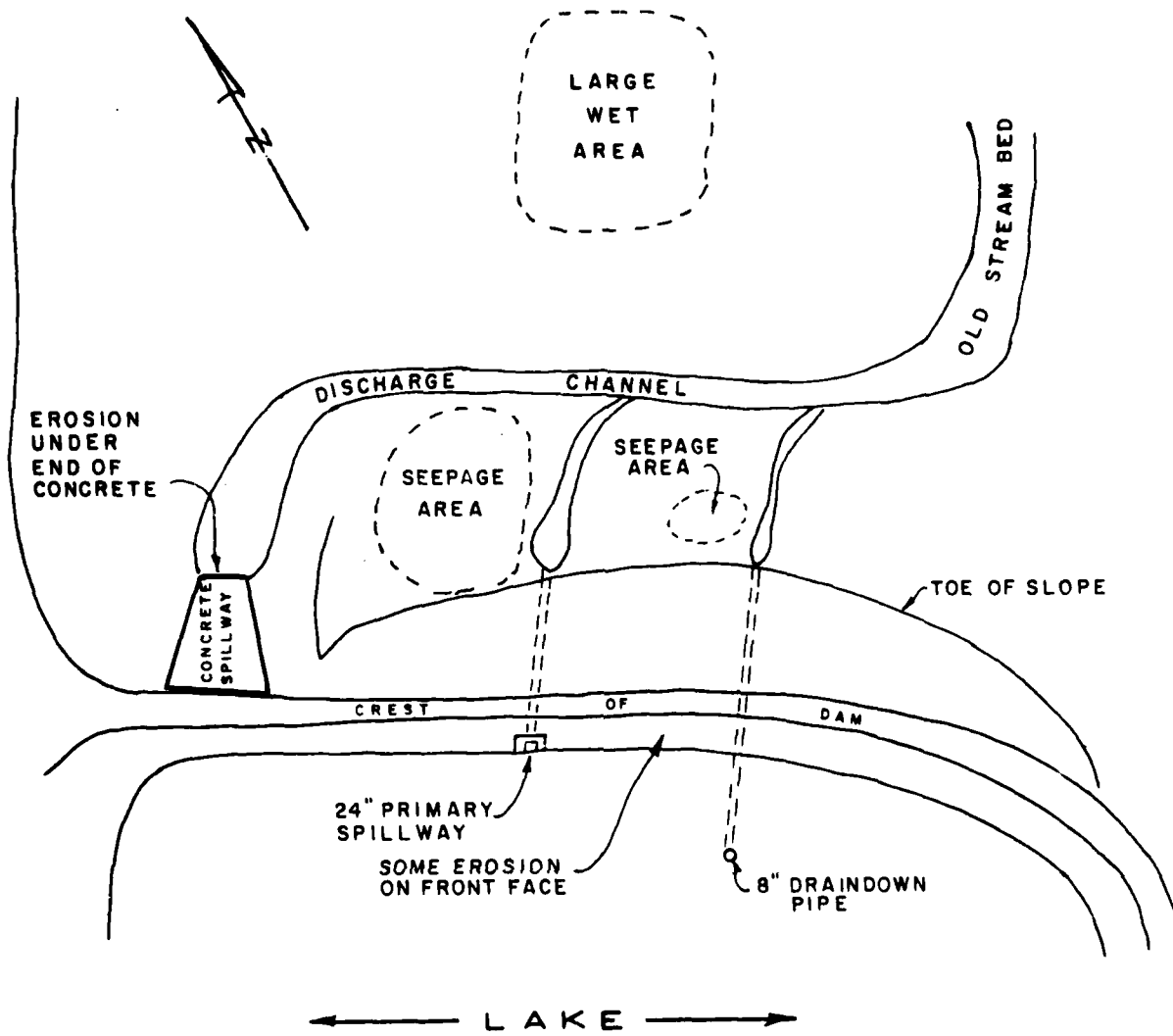
ROY DAVIS DAM

MO. No. 30056

PLAN & PROFILE

REYNOLDS COUNTY, MO.

12



PLAN SKETCH
 INSPECTION OBSERVATION
 DAM No. MO. 30056

expensive measure and must be properly designed and installed.

3. Raise the crest of the side spillway, which also calls for raising the top of the dam, so that the side spillway is used less frequently. The side spillway will need to be repaired and brought up to grade, but since it will not be taxed so often, the vegetation will not need to be as heavy as indicated in Solution 1 above.

Davis stated that the second solution listed above would be easiest for him to install and requested an estimate of cost be furnished him. I agreed to send this to Paige to pass on to Davis, but told them that a structure of this type recommended by the SCS would be rather costly. At that time, Davis could determine if he would want us to furnish a design of this type of structure or consider some other solution to the problem.

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NO-13
2/7/55

REQUEST FOR ENGINEERING ASSISTANCE

Request No. 1 Date June 5, 1962

District Reynolds Cooperator No. 276 Photo No. 8-36

Cooperator Ray Davis Address Bunker Blinnard

If Second Party Involved, Who? _____ Program Benefiting SDC
(SCD, ACP, WP, etc.)

Group Enterprise, Name _____

Statement of Problem: Spilling water from turbine.

<u>What Needed</u>	<u>Date Needed</u>	<u>Approved By</u>	<u>Date Scheduled</u>	<u>Date Completed</u>
Investigation	_____	_____	_____	<u>6/14/62</u>
Prelim. Survey	_____	_____	_____	_____
Final Survey	_____	_____	_____	_____
Design	_____	_____	_____	_____
Construction	_____	_____	_____	_____
Training	_____	_____	_____	_____

Remarks: _____

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ENGINEER'S REPORT

Date Request Received 6/14/62 Date Investigation Made 6/14/62

Preliminary Findings (Negative or Positive) _____

Disposition: *See attached memo to files*

Statement of Problem:

Conservation Measures on Watershed:

Probable Job Classification:

ADA _____ W _____ Design Flow for Q 50 = CFS for Q25 = CFS for Q10 =

Recommendations: Type of Structure, Materials needed, Costs, etc.

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ENGINEER

Orto E. Griesel
Engineer

UNITED STATES GOVERNMENT

Memorandum

TO : Charles Paige, Work Unit Conservationist: June 19, 1952
SCS, Ellington, Missouri

FROM : Otto E. Griessel, Engineering Specialist
SCS, Columbia, Missouri

Otto E. Griessel

SUBJECT: ENGINEERING - Estimate of Chute Structure on Roy Davis
Farm - Reynolds County

Last week when you, Roy Davis and I looked over the eroded side spillway of the structure on his farm, it was agreed that I would make a rough estimate of the materials needed for a reinforced concrete chute to be built for the purpose of controlling the erosion in the side spillway. The type of chute I have in mind is shown on the attached sheet, SS-5, Chute Spillway. It will have a box inlet, a flume section on a 3:1 slope, and an apron section. It will have approximately a 20-foot drop through a chute and it will have an overall length of 75 to 85 feet. The estimated amount of concrete is between 35 and 45 cubic yards and the steel will run approximately 100 pounds per cubic yard of concrete.

Remember these are rough figures. It will take additional surveys and a detailed design to make a closer estimate of the materials. After you have talked this over with Roy, please let me know what he has decided to do.

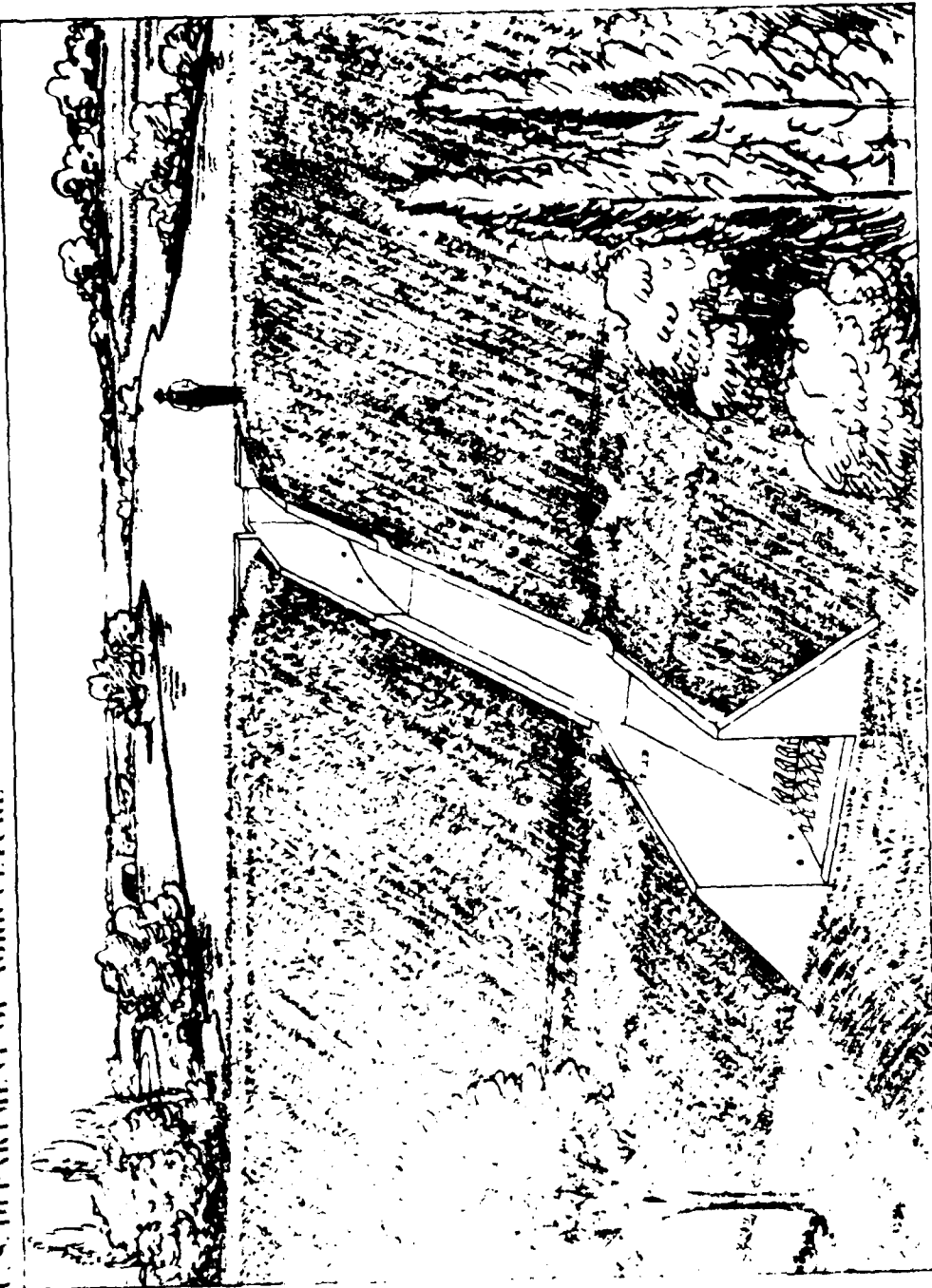
cc: T. E. Presley

Attachment

THIS PAGE IS UNCLASSIFIED
DATE 09-11-2001 BY 60322/UC/STP

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



Chute Spillway

Bill Hance, WUC
Salem, Mo.
Art Isom, Area Engineer
SCS, Houston, Mo.

April 15, 1966

ENR - Roy Davis Structure, Reynolds Co.

Otto Griesel was down this week and I discussed this problem with him. The wire baskets will not solve Mr. Davis' problem. The flow is too frequent to install the pervious rock and expect it to hold. Water will flow between the wire baskets and the earth foundation. The earth under the rock basket will erode and although the wire will yield, the spillway will not become stable.

I have done some work on the possibility of a series of drop structures to take up the fall. This is not the answer. The problem is not the grade in the emergency; it is the frequency and amount of flow.

There are two possible solutions:

1. Provide more temporary storage by a) lowering the permanent pool or b) raising the emergency crest and top of fill.
2. Install a reinforced concrete chute spillway. Attached is a copy of the letter with the estimate of the chute. The higher figures should be considered.

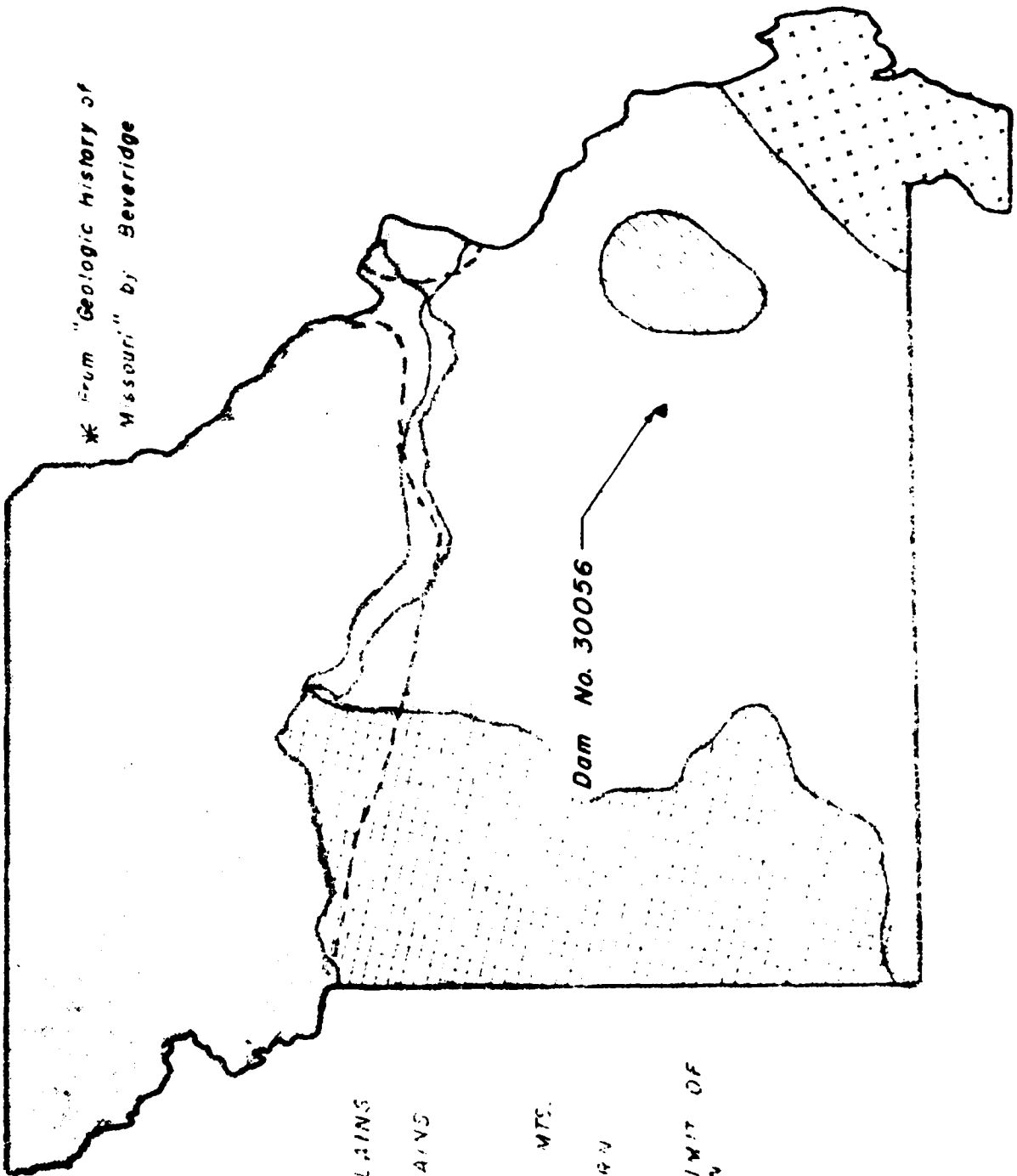
We will help on either of the two, raising the fill or constructing a chute. Any other route would result in the problem coming up again in a few years. Mr. Davis indicated he wanted to solve his problem permanently. We feel either method listed above will do that for him.

cc: Ellington
Griesel

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APPENDIX B

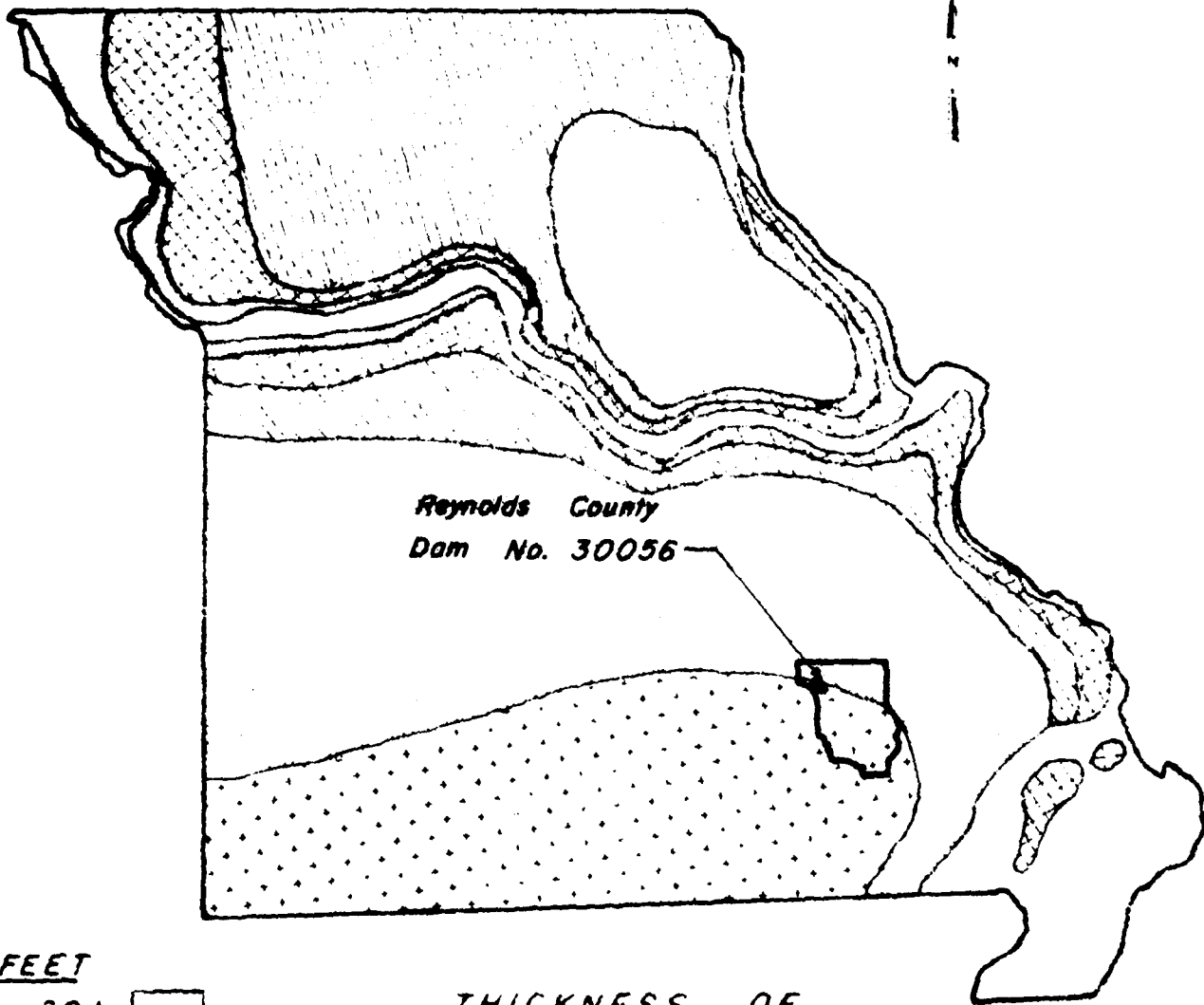
MAJOR GEOLOGIC REGIONS OF MISSOURI



* From "Geologic history of Missouri" by Beveridge

- SCATTERED PLAINS
- ▨ WESTERN PLAINS
- ▩ OZARKS
- ▧ ST. FRANCOIS MTS.
- ▤ SOUTHWESTERN LOWLANDS
- SOUTHERN LIMIT OF GLACIATION

* From "Soils of Missouri"

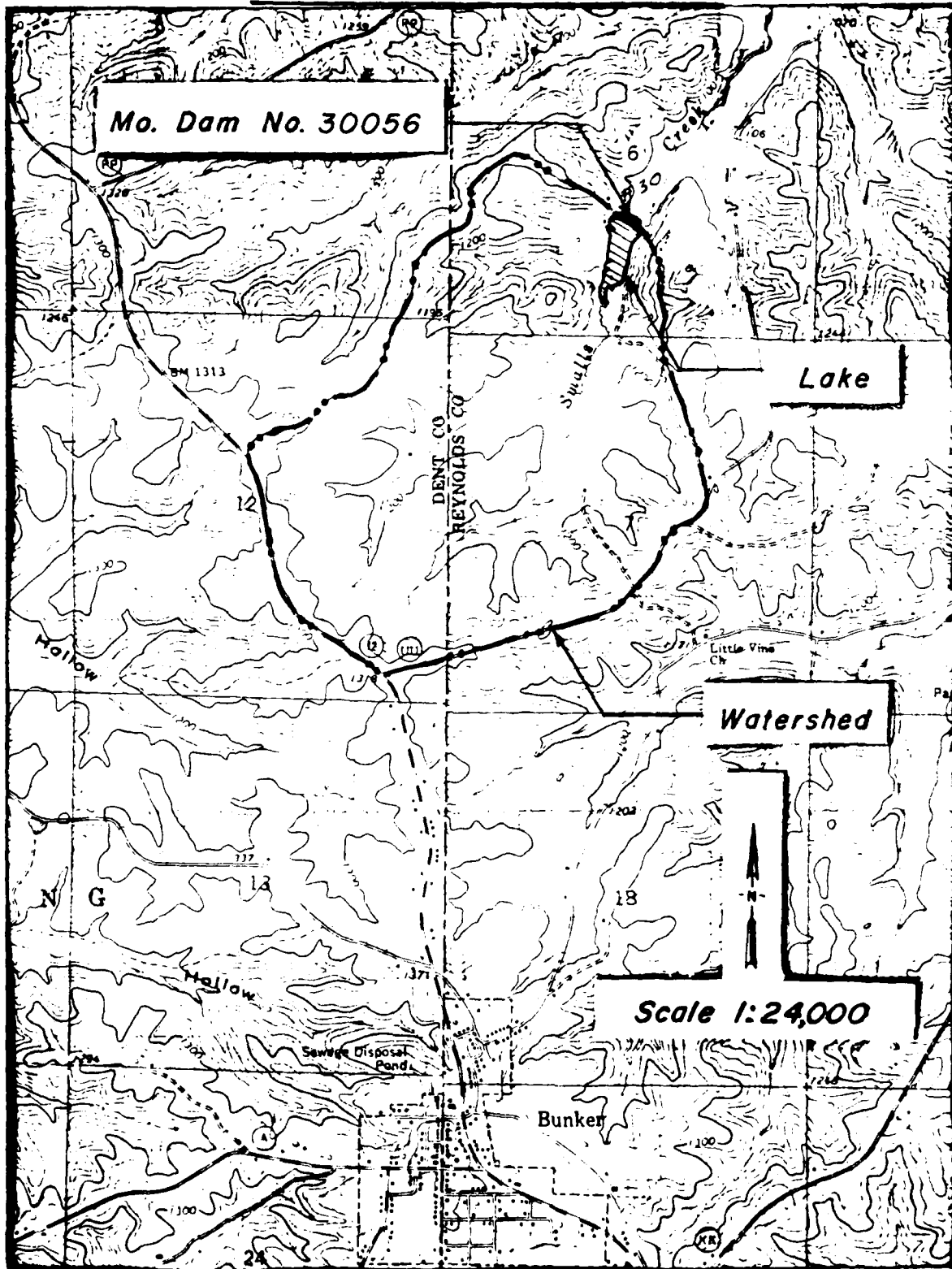


<u>FEET</u>	
20+	
10-20	
5-10	
2.5-5	
2.5-	

THICKNESS OF
LOESSIAL DEPOSITS

APPENDIX C

From Bunker 7.5' Quad



LAKE AND WATERSHED MAP

HYDRAULICS AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. The owner, Roy Davis, indicated that the dam has never been overtopped and that the emergency spillway operates every year. He also said that the highest depth of water over the crest of the emergency spillway occurred this year (about 12 in.). The high water mark encountered the day of the inspection was about elevation 1107.8. No indication of overtopping was found.

Visual Inspection: At the time of inspection, the pool level was approximately at normal pool.

Overtopping Potential: Flood routings were performed to determine the overtopping potential. The watershed and the reservoir surface areas were obtained by planimeter from the U.S.G.S. Bunker, Missouri 7.5 minute quadrangle map. The storage volume was developed from this data. A 5 minute interval unit graph was developed for the watershed, which resulted in a peak inflow of 1745 c.f.s. and a time to peak of 17 minutes. Application of the probable maximum precipitation, minus losses resulted in a flood hydrograph peak inflow of 11,089 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

Based on our analyses, the combined spillways will pass 9 percent of the Probable Maximum Flood (PMF). 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 recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that the structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering the height of the dam (26 ft.), the volume of water impounded (117 acre-ft.), and the large floodplain downstream, 50 percent of the PMF has been determined to be the appropriate spillway design flood.

The routing of the 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 1.93 ft. at elevation 1110.93. The duration of the overtopping will be 5.58 hours, and the maximum outflow will be 5399 c.f.s. The maximum discharge capacity of the combined spillways is 673 cfs.

The 100-year frequency flood was also routed through the spillways and dam. The result indicates that the dam will be overtopped by 0.57 ft. at elevation 1109.57. The duration of the overtopping will be 0.67 hours.

Analysis of the data indicates that the 10-year frequency flood will not overtop the dam. The computer input, output and hydrographs for 50 percent of the PMF are presented on the last sheets of this Appendix C.

OVERTOPPING ANALYSIS FOR ROY DAVIS DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.

Hydraulic Inputs Are as Follows:

- a. Twenty-four Hour Rainfall of 26.6 Inches for 200 Square Miles - All Season Envelope
- b. Drainage Area = 672 Acres; = 1.05 Square Miles
- c. Travel Time of Runoff 0.42 Hrs.; Lag Time 0.25 Hrs.
- d. Soil Conservation Service Soil Group C
- e. Soil Conservation Service Runoff Curve No. 85 (AMC III). SCS Runoff Curve No. 70 (AMC II).
- f. Proportion of Drainage Basin Impervious 0.02

2. Spillways

- a. Primary Spillway: 24 inch CMP, Crest El. 1103.3
- b. Emergency Spillway: Trapezoidal cut with concrete lining chute.
Length 40 ft.; Side Slopes 1:20 & 1:15; C=Varies
- c. Dam Overflow
Length 400 ft.; Crest El. 1109.0; C = 3.0

3. Spillway and Dam Rating:

Curve Prepared by Hanson Engineers. Data Provided to Computer on Y4 and Y5 Cards. (See sheet 5 Appendix C)

Methods:

Entrance control flow in CMP considered for the primary spillway.

Equation Used for Emergency Spillway: $\frac{Q^2}{g} = \frac{A^3}{T}$

Note: Time of Concentration From Equation $T_c = \frac{(11.9 L)^{.385}}{(H)^{.385}}$

California Culvert Practice, California Highways and Public Works, September, 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph
 - a. Peak - 1745 c.f.s.
 - b. Time to Peak 17 Min.
2. Flood Routings Were Computed by the Modified Puls Method
 - a. Peak Inflow
50% PMF 5544 c.f.s.; 100% PMF 11089 c.f.s.
 - b. Peak Elevation
50% PMF 1110.93; 100% PMF 1112.31
 - c. Portion of PMF That Will Reach Top of Dam
9%; Top of Dam Elev. 1109.0 ft.

Computer Input and Output Data are shown on the following sheets of this Appendix.

A OVERTOPPING ANALYSIS FOR ROY DAVIS DAM (# 30)
A STATE ID NO. 30056 CO. NO. 179 CO. NAME REYNOLDS
A HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 79511
B 300 5
B1 5
J 1 7 1
J1 .05 .10 .15 .20 .30 .50 1.0
K 0 1 3 1
K1 INFLOW HYDROGRAPH COMPUTATION **
M 1 2 1.05 1.05 1 1
P 0 26.6 102 120 130
T -1 -85 0.02
U2 0.42 0.25
X 0 -.1 2
K 1 2 0 4 1
K1 RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
Y 1 1
Y1 1 54 -1
Y41103.3 1104.3 1105.3 1106.8 1107.8 1109 1110 1111 1112 1114
Y5 0 8 13 23 158 673 1397 2240 3184 5750
9A 0 8 12 14 25.7
9E 1083 1103.3 1106.8 1109 1120
991103.3
9D 1109 3.0 1.5 400
K 99

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS						
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
HYDROGRAPH AT	1	1.05 (2.72)	1	554. (15.70)	1109. (31.40)	1663. (47.10)	2218. (62.80)	3327. (94.20)	5544. (157.00)	11089. (313.99)
ROUTED TO	2	1.05 (2.72)	1	248. (7.03)	823. (23.29)	1497. (42.39)	2068. (58.55)	3183. (90.13)	5399. (152.88)	10991. (311.22)

SUMMARY OF DAM SAFETY ANALYSIS

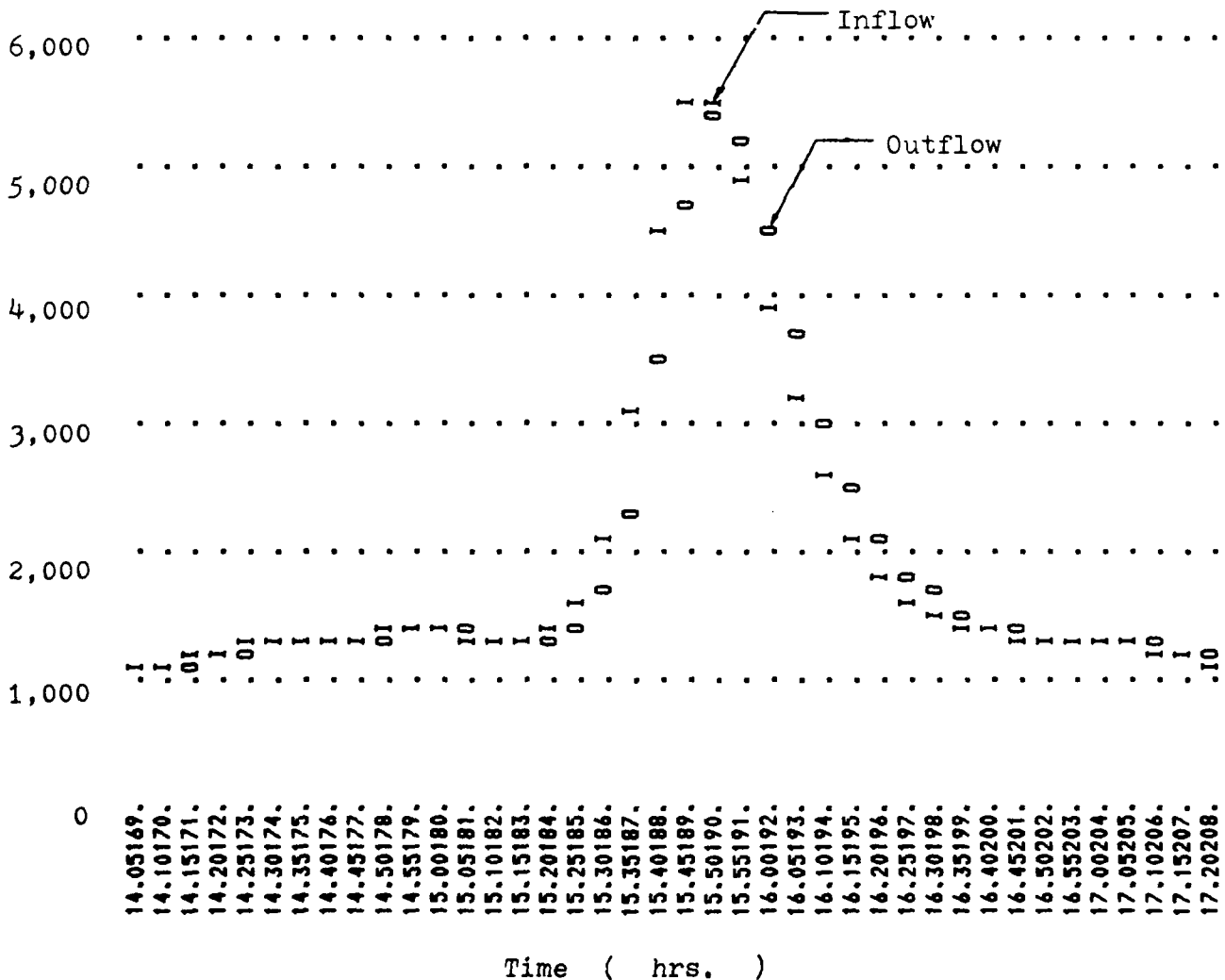
PLAN 1	ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
	STORAGE	OUTFLOW	STORAGE	AC-FT	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP	TIME OF FAILURE
			1103.25	104.	1103.30	248.	0.00	16.17
			54.	119.	54.	823.	0.33	16.00
			0.	125.	0.	1497.	0.67	15.92
				129.		2068.	0.92	15.92
				135.		3183.	3.17	15.83
				146.		5399.	5.58	15.83
				169.		10991.	6.75	15.83

INPUT - OUTPUT
HYDROGRAPH

FOR 50% P.M.F.

Max. Inflow = 5544 c.f.s.

Max. Outflow = 5399 c.f.s.



Time (hrs.)

APPENDIX D

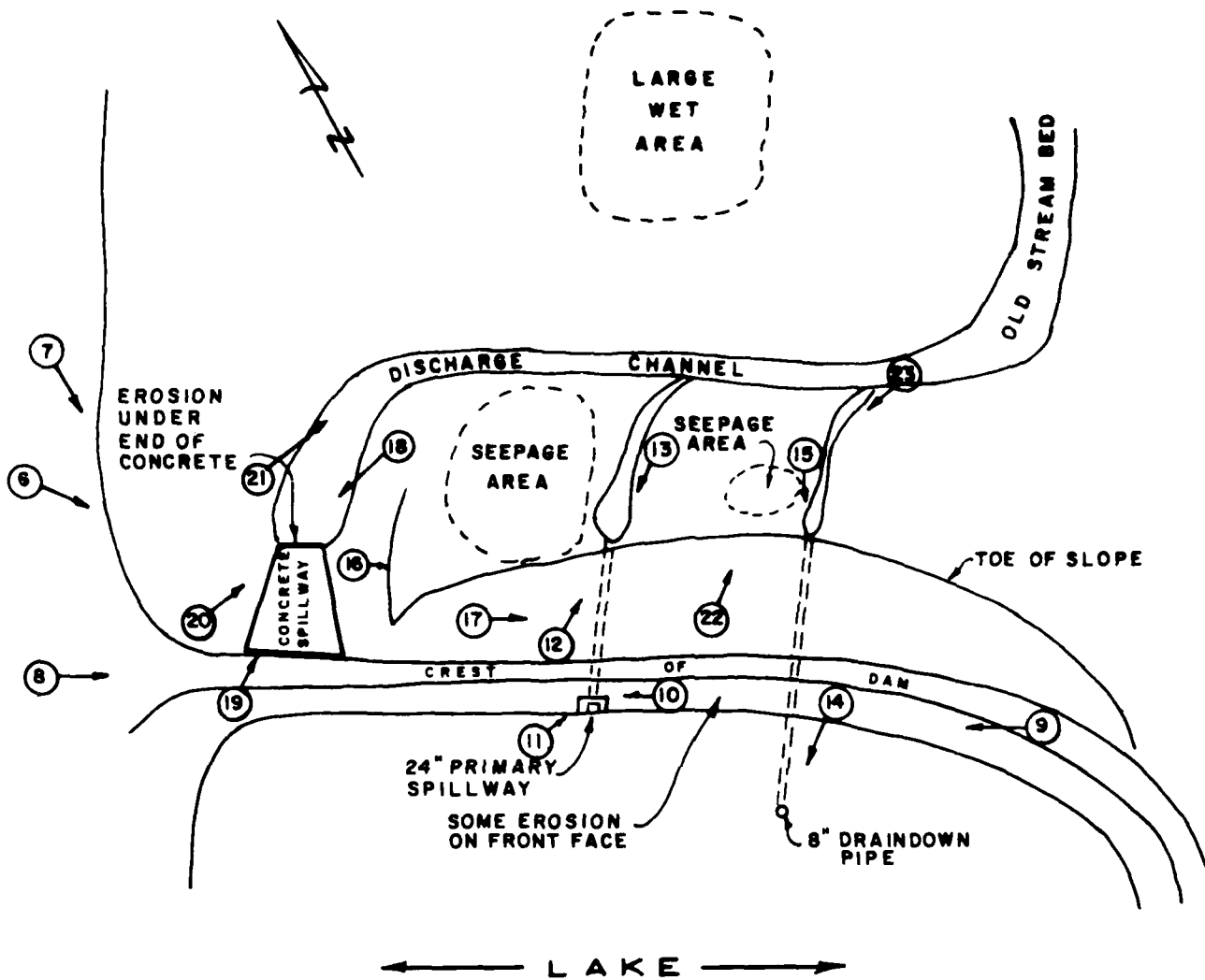
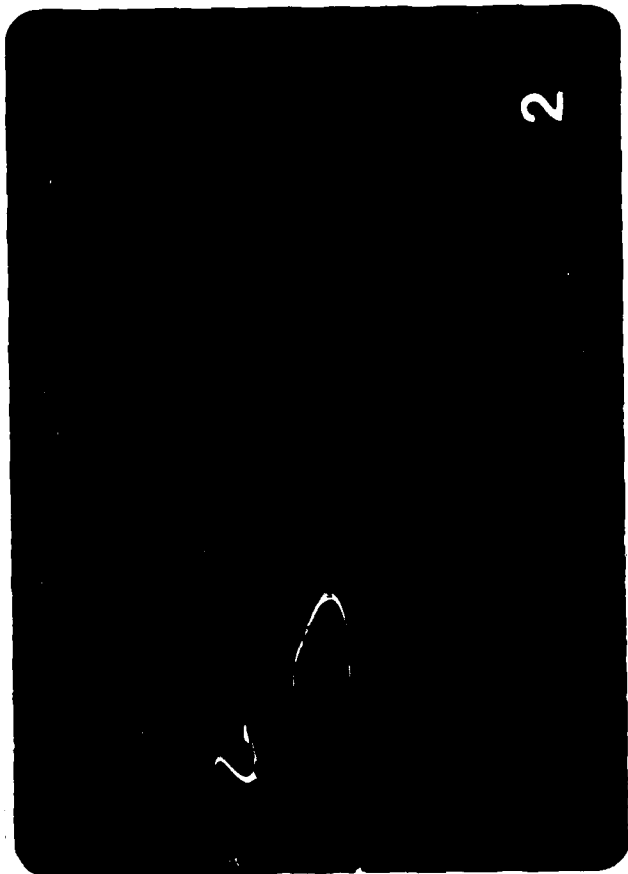


PHOTO INDEX

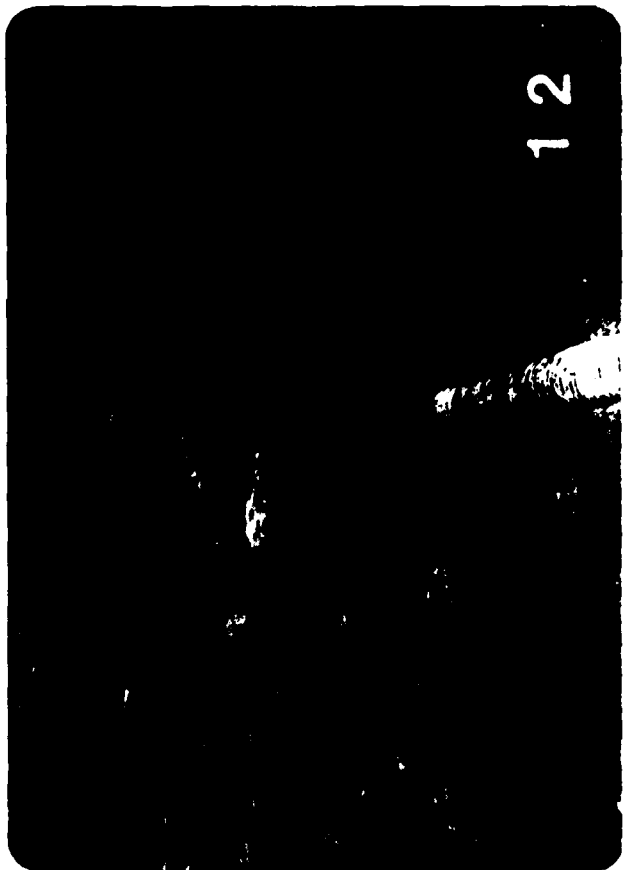
DAM No. MO. 30056

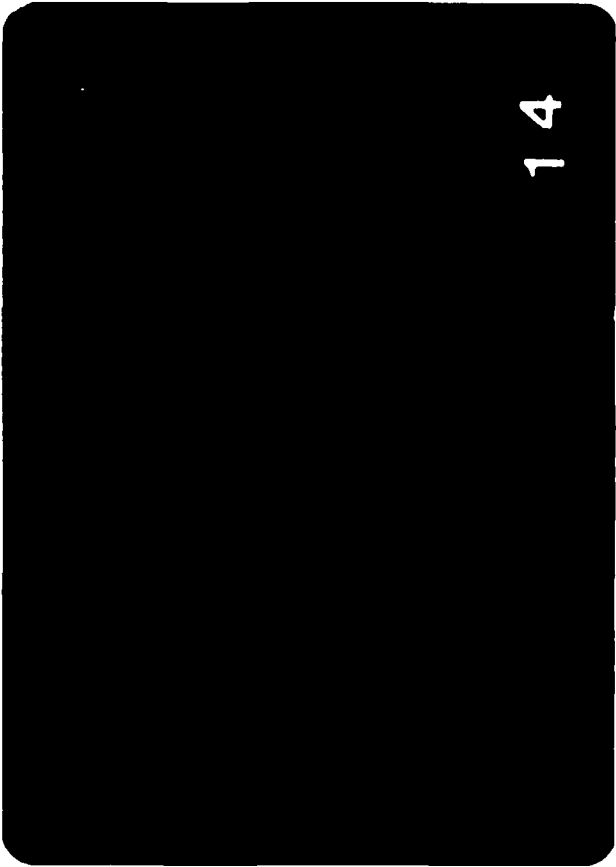
INDEX TO PHOTOGRAPHS

<u>Photo No.</u>	
1.	Aerial - Lake and Dam, Looking North
2.	Aerial - Lake and Dam, Looking Northeast
3.	Aerial - Lake and Dam, Looking Southeast
4.	Aerial - Downstream Face, Looking South
5.	Aerial - Lake and Dam, Looking West
6.	Downstream Face - Looking Southeast from Abutment
7.	Reservoir - Looking South
8.	Crest of Dam - Looking Southeast
9.	Upstream Face - Looking West
10.	Primary Spillway Inlet and Trash Rack
11.	Primary Spillway Inlet
12.	Primary Spillway Outlet
13.	Primary Spillway Outlet - Looking at Embankment
14.	Draindown Pipe Inlet
15.	Draindown Pipe Outlet at Toe of Dam
16.	Downstream Face and Toe - Looking East
17.	Downstream Face - Looking East
18.	Concrete Spillway, Note Undermining at End
19.	Concrete Spillway
20.	Emergency Spillway Discharge Channel
21.	Emergency Spillway Discharge Channel
22.	Seepage Area at Toe just West of Draindown Pipe Outlet
23.	Draindown Pipe Outlet

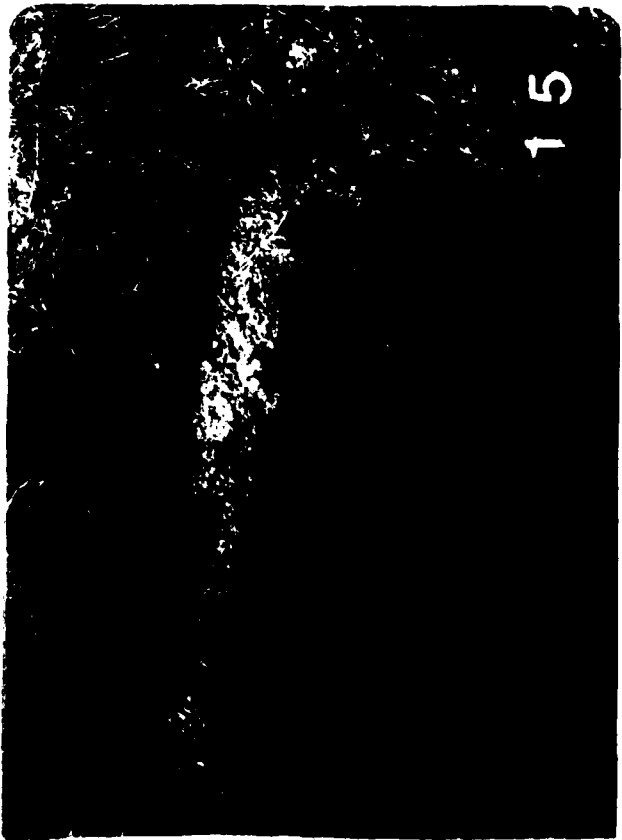




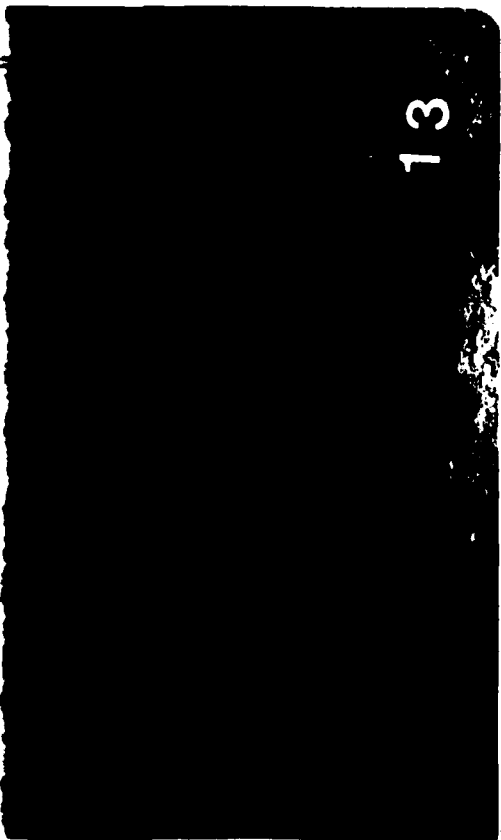




14



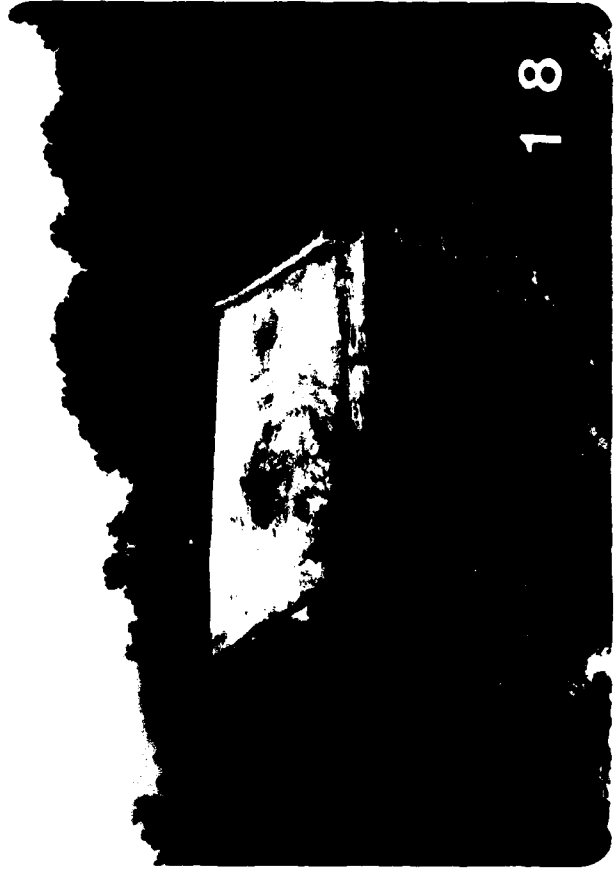
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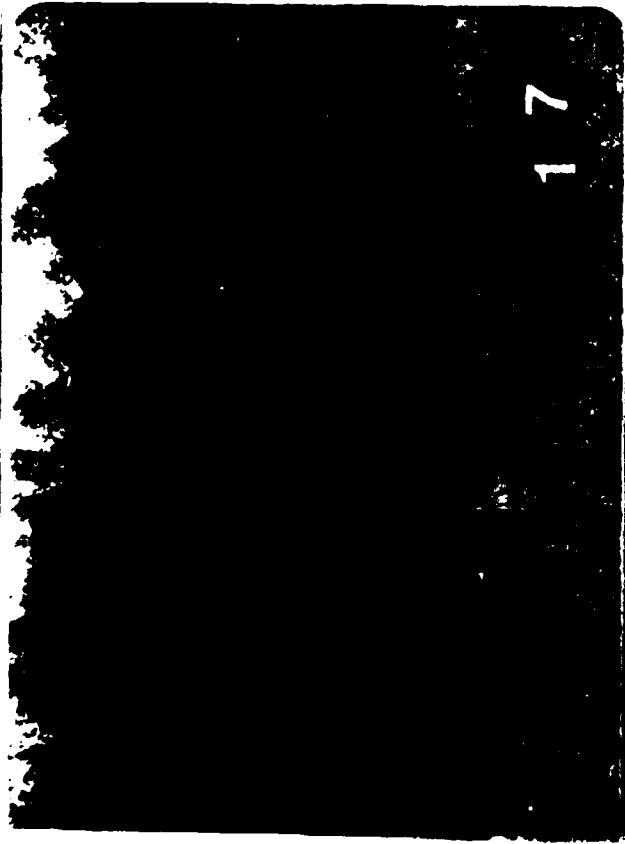
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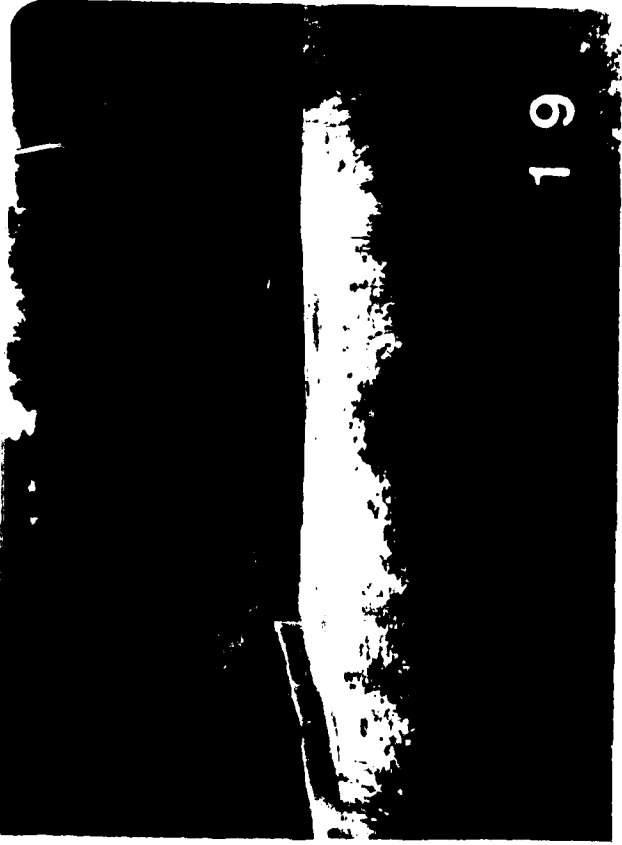
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18



17



19

