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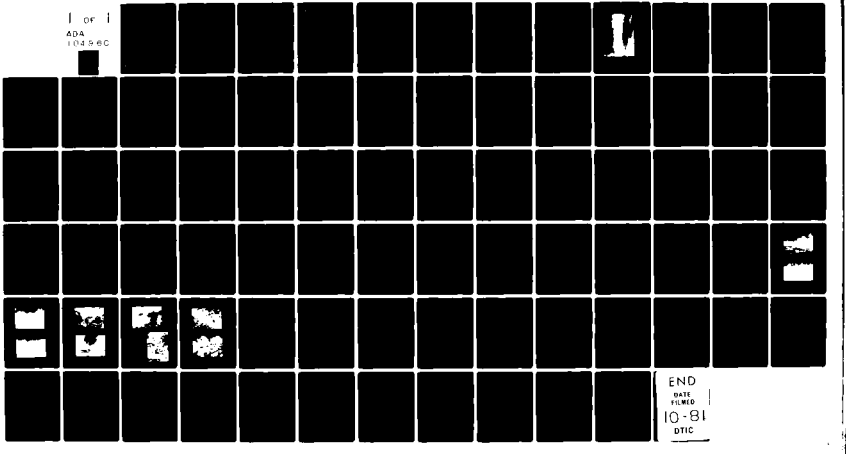

LEVEL II

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MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

LITTLE LAKE DAM
JEFFERSON COUNTY, MISSOURI
MO. 30456

PHASE I 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

JULY 1981

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Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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

REPLY TO ATTENTION OF

SUBJECT: Little Lake Dam (Mo. 30456) Phase I Inspection Report

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

The owner should initiate immediate action to provide an erosion-free spillway so that the full existing spillway capacity could be utilized. An erosion-free spillway will pass flows greater than 50 percent of the Probable Maximum Flood.

Non-implementation of this recommendation will result in an unsafe, emergency classificaton, due to degradation of the spillway which could cause dam failure by floods exceeding 3 percent of the Probable Maximum Flood.

SUBMITTED BY: SIGNED
Chief, Engineering Division
23 JUL 1981
Date

APPROVED BY: SIGNED
Colonel, CE, Commanding
23 JUL 1981
Date

LITTLE LAKE DAM
JEFFERSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30456

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
PRC CONSOER TOWNSEND, INC.
ST. LOUIS, MISSOURI
AND
PRC ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

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

JULY 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Little Lake Dam,
Missouri Inventory No. 30456
State Located: Missouri
County Located: Jefferson
Stream: Unnamed tributary of Joachim Creek
Date of Inspection: May 8, 1981

Assessment of General Condition

Little Lake Dam was inspected by the engineering firms of PRC Consoer Townsend, Inc. of St. Louis, Missouri, and PRC Engineering Consultants, Inc. of Englewood, Colorado, (A Joint Venture) in accordance with the U.S. Army Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams" and additional guidelines furnished by the St. Louis District of the Corps of Engineers. Based upon the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Located within the estimated damage zone of less than one mile downstream of the dam are one downstream reservoir (Sunrise Lake, Mo. 31190) and at least four dwellings located at the upper end of Sunrise Lake, which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Little Lake Dam is in the small size classification since it has a maximum reservoir impoundment of 57 acre-feet and is approximately 25 feet high.

The inspection and evaluation indicate that the spillway capacity of Little Lake Dam will meet the criteria set forth in the guidelines for a dam having the above size and hazard potential if an erosion-free spillway is provided at this damsite, as further described below. Little Lake Dam being a small size dam with a high hazard potential is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping the dam. Considering the small number of dwellings downstream of the dam and the small storage capacity of the reservoir, one-half of the Probable Maximum Flood is considered the appropriate spillway design flood for Little Lake Dam. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. It was determined that the reservoir/spillway system can accommodate approximately 55 percent of the Probable Maximum Flood without overtopping the dam and will also accommodate the one-percent chance flood (100-year flood) without overtopping the dam; however, this is based upon the present spillway being replaced by a more stable and erosion-free spillway. Further evaluation showed that the spillway, in its present condition, can safely pass only three percent of the Probable Maximum Flood. Floods exceeding three percent of the Probable Maximum Flood will cause further degradation of the spillway channel, which could cause a dam failure.

The overall condition of the dam appears to be poor due to the seepage at the damsite and the severe erosion in the spillway channel. Both of these conditions jeopardize the safety of the dam and will require prompt attention. Other deficiencies noted by the inspection team, which will require remedial measures, included: the trees and brush on the embankment; a need for periodical maintenance of the grass cover; and a lack of a maintenance schedule. There also exists a need for periodic inspection by a qualified engineer. The lack of seepage and stability analyses on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above. Replacement of the present spillway with a more stable and erosion-free spillway and further investigation of the seepage warrant prompt attention and should be pursued on a high priority basis. All other remedial measures should be undertaken within a reasonable period of time.

Walter G. Shifrin, P.E.

Overview of Little Lake Dam

NATIONAL DAM SAFETY PROGRAM

LITTLE LAKE DAM, I.D. No. 30456

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LITTLE LAKE DAM, Missouri Inv. No. 30456

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Little Lake Dam was carried out under Contract DACW 43-81-C-0063 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of PRC Consoer Townsend, Inc. of St. Louis, Missouri, and PRC Engineering Consultants, Inc. of Englewood, Colorado, (A Joint Venture).

b. Purpose of Inspection

The visual inspection of Little Lake Dam was made on May 8, 1981. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project, presents a summary of visual observations made during the field inspection, presents an assessment of hydrologic and hydraulic conditions at the site and of the structural adequacy

of the various project features, and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing and detailed analyses were not within the scope of this study. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that in this report reference to left or right abutments is viewed as looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the west abutment or side, and right to the south abutment or side.

d. Evaluation Criteria

The inspection and evaluation of the dam is performed in accordance with the U.S. Army Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams" and additional guidelines furnished by the St. Louis District office of the Corps of Engineers for Phase I Dam Inspection.

1.2 Description of the Project

a. Description of Dam and Appurtenances

The following description is based upon observations and measurements made during the visual inspection and conversations with Mr. Paul N. Shy. Mr. Shy designed and constructed the dam. No design or "as-built" drawings for the dam or spillway were available.

The dam is a homogeneous, rolled, earthfill structure placed between earth abutments with a 12-foot-wide core trench excavated to solid bedrock, according to Mr. Shy. A plan and elevation of the dam are shown on Plate 3 and Photos 1 and 2 show views

of the dam. The axis of the dam consists of two straight segments, which intersect at a point 137 feet from the left end of the dam. The two segments are angled at approximately 85 degrees to each other. The right portion of the embankment has a bearing of approximately N 15° W and an axis length of 283 feet from the spillway to the point of intersection of the two axes. The left portion has a bearing of approximately S 80° W and an axis length of 137 feet from the intersection of the two axes to the left abutment. The top of dam has a total length of 420 feet between the left abutment and the spillway. The minimum elevation of the top of dam was found to be 784.7 feet above mean sea level (M.S.L.) at the spillway. From the spillway, the top of dam slopes upward and downward in varying degrees to the left abutment contact. The left end of the dam was determined to be about 0.9 feet higher than the right end. The embankment has a top width of 11 feet and a maximum structural height of approximately 25 feet. The downstream and upstream slopes were measured to be 1 vertical to 1.5 horizontal (1V to 1.5H). The upstream slope angle was measured from the top of the dam to the water surface on the day of the inspection.

There is only one spillway at this damsite, which consists of an earth-lined open channel cut into the right abutment. The inlet of the spillway is defined by a two-foot drop into an eroded channel (see Photo 4). The crest elevation of the inlet is assumed to be at 778.0 feet above M.S.L. The channel deepens and the top width widens as it proceeds towards the control section of the spillway. At the control section, the spillway is V-shaped and is in line with the axis of the dam (see Photos 5 and 6). Here the spillway is 10.6 feet deep with 1V to 1H side slopes. The invert of the control section is lined with weathered bedrock and has an elevation of 774.1 feet above M.S.L. As the channel proceeds past the dam axis, a bottom width of six to ten feet and near vertical side slopes are attained (see Photo 7). The spillway channel wraps around the dam embankment until it roughly parallels the dam axis. Flow from the spillway intersects the downstream channel about 50 feet downstream of the dam toe.

No low-level outlet or outlet works are provided at this dam.

b. Location

Little Lake Dam is located in Jefferson County in the State of Missouri on an unnamed tributary of Joachim Creek. The location of the dam on the 7.5 minute series of the U.S. Geological Survey maps is found in the northwest quarter of Section 1 of Township 38 North, Range 4 East, of the Vineland, Missouri Quadrangle Sheet (Advance Print, see Plate 2). The dam is located approximately 6.5 miles southeast of De Soto (see Plate 1).

c. Size Classification

The maximum reservoir impoundment of Little Lake Dam is 57 acre-feet. This is less than 1,000 acre-feet but more than 50 acre-feet, which would classify it as a "small" size dam. The maximum height of the dam is approximately 25 feet, which would also classify the dam as a "small" size dam. The size classification is determined by either the storage or height, whichever gives the larger size category. Therefore, the size classification is determined to fall within the "small" category, according to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineer.

d. Hazard Classification

The dam has been classified as having a "high" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. From a visual inspection of the downstream area, our findings concur with this classification. Located within the estimated damage zone, which extends less than one mile downstream of the dam, are one downstream reservoir (Sunrise Lake,

Mo. 31190) and at least four dwellings located at the upper end of Sunrise Lake (see Photo 10).

e. Ownership

Little Lake Dam is privately owned by Mr. Paul N. Shy. The mailing address is Mr. Paul N. Shy, Route 3, De Soto, Missouri, 63020.

f. Purpose of Dam

The purpose of the dam is to impound water for recreational use as a private lake.

g. Design and Construction History

According to Mr. Shy, the dam was designed and constructed by his own construction company during 1960 and 1961. No drawings or specifications pertaining to the design or construction of the dam were available.

The following information, which pertains to the construction of the dam, was obtained from Mr. Shy. The dam was constructed using rubber-tired scrapers and bulldozers. The embankment material was placed on the fill in thin layers and compaction of the material was achieved by the activity of the earthmoving equipment; however, no compaction control was employed. Material used for the homogeneous embankment was a fine clay borrowed from the reservoir area. A 12-foot-wide core trench was excavated along the axis of the dam to solid bedrock.

According to Mr. Robert Sells, the president of the Lake Land Retreat Property Owners Association which owns two downstream dams (Clear Lake Dam (Mo. 30437) and Sunrise Lake Dam (Mo. 31190)), the spillway at Little Lake Dam was never completed for it was originally intended to be a concrete structure.

h. Normal Operational Procedures

Normal operational procedure is to allow the reservoir to remain as full as possible. The water level is controlled by rainfall, runoff, evaporation and the elevation of the spillway inlet. Due to seepage problems at the damsite, as described in Section 3.1b, the reservoir has not been able to maintain a normal water surface level. The water level was 3.9 feet below the elevation of the spillway inlet on the day of the inspection.

1.3 Pertinent Data

a. Drainage Area (square miles):. 0.19

b. Discharge at Damsite

Estimated experienced maximum flood (cfs): 130

Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs): 737

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

Top of dam (minimum):. 784.7

Spillway crest:. . . . . 778.0 (inlet, assumed)*

Normal Pool: 778.0

Maximum Experienced Pool:. 779.5

Observed Pool: 774.1

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):. 700

e. Storage (Acre-Feet)

Top of dam (minimum):. 57

Spillway crest:. 24

Normal Pool: 24

Maximum Experienced Pool:. 30

Observed Pool: 12

f. Reservoir Surfaces (Acres)

Top of dam (minimum):. 6.0

Spillway crest:. 4.0

Normal Pool: 4.0

Maximum Experienced Pool:. 4.5

Observed Pool: 3.0

g. Dam

Type:	Rolled, Earthfill
Length:	420 feet
Structural Height:	25± feet
Hydraulic Height**:	24.35 feet
Top width:	11 feet
Side slopes:	
Downstream.	1V to 1.5H (measured)
Upstream.	1V to 1.5H (above the elevation of the water surface on the day of the inspection)
Zoning:	Homogeneous
Impervious core:	None
Cutoff:	A core trench excavated to bedrock, according to Mr. Shy
Grout curtain:	None
Volume:	12,200 cu.yds. (estimated)

h. Diversion and Regulating Tunnel. . . . .None

i. Spillway

Type:	Earth-lined open channel, uncontrolled.
Location:	Cut into right abutment
Length of crest:	0 feet (at the control section)
Crest Elevation (feet above M.S.L.):	
At inlet.	778.0
At control section.	774.1

j. Regulating Outlets . . None

* The elevation of the spillway inlet was estimated from the U.S.G.S. Vineland, Missouri Quadrangle topographic map (Advance Print). This elevation is, therefore, referred to as an assumed

elevation. The elevations of other features of the dam are obtained by using this elevation and field measurements.

** The hydraulic height of the dam is the vertical distance from the lowest point on the downstream toe to the top of dam or the maximum water surface, if below the top of dam.

SECTION 2: ENGINEERING DATA

2.1 Design

No design drawings or data are available for Little Lake Dam.

2.2 Construction

No documented construction records or data are available relative to the construction of the dam, other than the construction history given in Section 1.2g.

2.3 Operation

No documented operational records or data are available for the dam.

2.4 Evaluation

a. Availability

The availability of engineering data consists only of the State Geological Maps, a general soil map of the State of Missouri published by the Soil Conservation Service, and U.S.G.S. Quadrangle Sheets.

b. Adequacy

The lack of engineering data did not allow for a definitive review and evaluation. The conclusions presented in this report are based on field measurements, past performance and present condition of the dam. The available data including the field measurements taken by the field inspection team are considered

adequate to evaluate the hydraulic and hydrologic capabilities of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity

No valid engineering data pertaining to the design or construction of the dam were available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Little Lake Dam was made on May 8, 1981. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Mark Haynes, P.E.	PRC Engineering Consultants, Inc.	Soils
Jerry Kenny	PRC Engineering Consultants, Inc.	Hydraulics and Hydrology
James Nettum, P.E.	PRC Engineering Consultants, Inc.	Civil-Structural and Mechanical
Razi Quraishi, R.P.G.	PRC Engineering Consultants, Inc.	Geology
Rupp Reitz	PRC Consoer Townsend, Inc.	Civil-Structural

Specific observations are discussed below.

b. Dam

The overall condition of the dam appears to be poor due to the observed items of concern, which are described below.

The entire embankment, except for the upstream slope below the normal water surface, is covered by a dense unmaintained vegetative growth ranging from tall grass to large trees (see Photos 1 and 2). A comprehensive inspection of the dam was hampered due to the vegetative cover; however, no bulges, depressions or cracks indicative of an instability of the embankment or foundation were apparent on the dam.

The upstream slope has no riprap protection; however, no erosion due to wave action was observed. No erosion due to surface runoff was seen on either the upstream or downstream slopes. According to Mr. Shy, the dam has never been overtopped and no evidence indicating the contrary was observed.

An area of moist, boggy ground and cattails was observed in the downstream channel near the dam (see Photo 3). The area extends from the toe of the dam to approximately 100 feet downstream. No measurable flow of water was observed in the area. However, the cattails would indicate that moisture is generally present in the area. According to Mr. Tom Burroughs, a local resident, the reservoir has not been able to maintain a constant level due to seepage. Nevertheless, it is unknown whether the source of the moisture in this area is due to seepage through the embankment or through the foundation. It appears that an attempt was made to stop the seepage. Two, one-inch-diameter, plastic, grout pipes were observed on the top of the dam; however, the pipes appeared to have been unused. No evidence of seepage was observed on the embankment. No detrimental effects due to the seepage were observed on the embankment.

The left abutment is at approximately same elevation as the top of dam. No instabilities, seepage or erosion were apparent on the left abutment. The right abutment from the right side of the spillway slopes gently upward. The severe erosion in the spillway channel, as described in section 3.1d, has left the right abutment in a very unstable condition in the vicinity of the dam. No seepage was apparent on the right abutment.

According to Mr. Shy, there has been some muskrat activity in the reservoir in the past; however, the muskrats are annually trapped. No evidence of burrowing animals was apparent on either the embankment or the abutments.

c. Project Geology and Soils

(1) Project Geology

The damsite is located on an unnamed tributary of Joachim Creek in the Salem Plateau section of the Ozark Plateaus Physiographic Province. Deep dissection of topography by major streams is one of the important characteristics of the Salem Plateau section. There is a wide distribution of dolomites and limestones in the Salem Plateau. Cuestaform topography is exhibited in this plateau section consisting of two major escarpments, namely the Crystal Escarpment and Burlington Escarpment. Deep dissection in dolomites and limestones is a major factor in the development of many springs in this area. A major component of surface discharge of water to the regional drainage is contributed by these springs.

The topography in the vicinity of the damsite is hilly with V-shaped valleys. Elevations of the ground surface range from 900.0 feet above M.S.L. nearly 0.6 miles southwest of the damsite to 778.0 feet above M.S.L. at the damsite. The reservoir slopes are generally from 15 to 25 degrees from horizontal and appeared to be stable. The area near the damsite is covered with residual soil deposits consisting of a reddish-brown and orangey-brown mottled,

moderately plastic, silty clay with some fine sand and occasional rock fragments less than 1/4 inch in size.

The regional bedrock geology beneath the residual soil deposits in the damsite area as shown on the Geologic Map of Missouri (1979) (see Plate 5) are of the Ordovician age rocks consisting of Decorah Formation, St. Peter Sandstone, Powell Dolomite, Cotter Dolomite, Roubidoux Formation, and Gasconade Dolomite; and the Cambrian age rocks consisting of Eminence Dolomite, Potosi Dolomite, Lamotte Sandstone, and Franconia and Bonneterre Formations. The predominent bedrock underlying the residual soil deposits in the vicinity of the damsite are the Ordovician age rocks consisting of Powell Dolomite and Roubidoux Formation.

Outcroppings of Ordovician Powell Dolomite (light brownish-gray, fine grained, moderately hard, thinly to moderately bedded, slightly to moderately weathered dolomite) are exposed in the discharge channel of the spillway (see Photo 8). Intense solution activity, high intensity weathering, and secondary sedimentary internal structures (such as spherulites and concretions) were observed in the rock outcroppings.

No active faults have been identified at the damsite. The closest geologic fault to the damsite is the Ste. Genevieve fault system nearly 0.5 miles northeast of the damsite. The Ste. Genevieve fault had its last movement in the post - Pennsylvanian time and consists of several fault sets that were formed at the same geologic time. Reconnaissance geologic evidence (a possible shear zone in the highly weathered dolomite foundation bedrock, see Photo 9) suggests that there is a possibility that one of these fault sets crosses the dam reservoir, which could be the cause of the leakage at this damsite.

No boring logs or construction reports are available that would indicate foundation conditions encountered during construction. Based on the visual inspection and conversations with Mr. Shy, the embankment probably rests on moderately to highly weathered Powell Dolomite with the core trench excavated to the bedrock. The spillway on the right abutment is cut into the residual soils and has eroded to the dolomite bedrock.

(2) Project Soils

According to the "Missouri General Soil Map and Soil Association Description" published by the Soil Conservation Service, the materials in the general area of the dam belong to the soil series of Union-Goss-Gasconade-Peridge in the Ozark Border Association. The soils are basically formed from loess deposits and weathered bedrock. These soils vary from a slowly permeable silty clay to moderately permeable silt loam.

Material removed from the embankment slopes was a reddish-brown, moderately plastic, silty clay with traces of fine to medium sand. Based upon the Unified Soil Classification System, the soil would be classified as a CL. This is an impervious soil type, which generally has the following characteristics: a coefficient of permeability less than one foot per year, medium shear strength, and a high resistance to piping. This soil type also has a high resistance to erosion under low velocity flow; however, excessive erosion can occur during the high velocity flows that can be expected when the dam is overtopped.

d. Appurtenant Structures

(1) Spillway

It appears that very little, if any, structural work has ever been done on the spillway. In essence, the spillway is merely an erosion gully cut into the right abutment. The side slopes are unprotected and are severly eroded on both the abutment and embankment sides (see Photos 4 through 7). The channel invert has an irregular slope and appeared stable only where bedrock was found. The low reservoir level due to leakage, which increases the storage capacity of the reservoir, has probably prevented even more damage from occurring in the spillway area.

(2) Outlet Works

No low-level outlet or outlet works are provided for this dam.

e. *Reservoir Area*

The reservoir water surface elevation at the time of the inspection was 774.1 feet above M.S.L. Although the reservoir has not been able to maintain a constant water surface level due to the seepage, the normal water surface elevation was taken to be 778.0 feet above M.S.L., which is the elevation of the spillway inlet. At the normal water surface level, the reservoir has a surface area of four acres.

The rim appeared to be stable with no erosional or stability problems observed (see Photo 4). The land around the reservoir slopes gently upward from the reservoir rim and is mostly wooded with grass-covered slopes. No homes are built around the reservoir rim. No evidence of excessive siltation was observed in the reservoir on the day of the inspection.

f. Downstream Channel

The downstream channel near the damsite is the natural streambed, which is not well defined and obstructed with trees and brush. Discharges through the spillway travel approximately 1,000 feet downstream of the dam before entering a reservoir of a downstream dam (Sunrise Lake Dam, Mo. 31190).

3.2 Evaluation

The following conditions were noted during the visual inspection, which warrant further and prompt attention.

Due to the low reservoir level, no measurable flow of seepage was observed; however, evidence observed downstream of the dam indicates that seepage is a problem at this damsite. The seepage could have a detrimental effect on the structural stability of the dam. With time, this condition can only worsen. Under higher reservoir heads, it is possible that the flow rate of the seepage could increase. This could cause piping of embankment material, which could lead to the eventual failure of the embankment.

The eroded condition of the spillway and the lack of proper erosion protection in the spillway present a real and imminent hazard to the safety of the dam.

The following condition was observed which could adversely affect the dam in the future and will require maintenance within a reasonable period of time.

The unmaintained vegetative cover and trees on the embankment pose a potential danger to the safety of the dam. Depending upon the extent of the root system, the roots of large trees present possible paths for piping through the embankment. The root systems can also do damage to the embankment from being

uprooted by a storm. And, a heavy unmaintained growth of vegetation on the embankment hinders a comprehensive inspection of the dam, which could allow potential problems to go undetected.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

There are no specific operational procedures which are followed at this damsite. The water level in the reservoir is allowed to remain as high as possible. The water surface elevation is controlled by rainfall, runoff, evaporation and the elevation of the spillway inlet. At the present time, the reservoir does not maintain a constant water surface level due to the seepage.

4.2 Maintenance of Dam

The dam appears to be neglected and the maintenance is inadequate. The entire embankment, except for the upstream slope below the normal water surface, is covered with a dense, unmaintained vegetative growth of tall grass, brush, and trees. The spillway channel at the right abutment is severely eroded.

4.3 Maintenance of Operating Facilities

There are no operating facilities associated with this dam.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any warning system in use at the damsite, such as an electrical warning system or a manual notification plan.

4.5 Evaluation

The dam appears to be neglected and the maintenance is inadequate at this time. The remedial measures listed in Section 7 shoulo be undertaken within a reasonable period of time to improve the condition of the dam.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

No hydrologic and hydraulic design data are available for Little Lake Dam. The sizes of physical features utilized to develop the stage-outflow relation for the spillway and overtopping of the dam were prepared from field notes and sketches prepared during the field inspection. The reservoir elevation-area data were based on the U.S.G.S. Vineland, Missouri Quadrangle topographic map (Advance Print, 7.5 minute series). The spillway and overtop release rates and the reservoir elevation-area data are presented in Appendix B.

The hydrologic soil group of the watershed was determined from information available in the U.S.D.A. Soil Conservation Service publication "Missouri General Soil Map and Soil Association Descriptions", 1979. The Probable Maximum Precipitation (PMP) used to determine the Probable Maximum Flood (PMF) was determined by using the U.S. Weather Bureau publication "Hydrometeorological Report No. 33" (April 1956). The 100-year and the 10-year floods were derived from the 100-year and the 10-year rainfalls, respectively, of Ste. Genevieve, Missouri.

b. Experience Data

Records of reservoir stage or spillway discharge are not maintained for this site. However, according to Mr. Shy, the maximum reservoir level was approximately 18 inches above the normal water surface elevation.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1d and evaluated in Section 3.2.

d. Overtopping Potential

The Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. One-half of the PMF, which is considered to be the appropriate spillway design flood for this dam, can be accommodated by the spillway/reservoir system without overtopping the dam. The peak inflows of the PMF and one-half of the PMF are 2,632 cfs and 1,316 cfs, respectively. The peak outflow discharges for the PMF and one-half of the PMF are 2,268 cfs and 642 cfs, respectively. The maximum capacity of the spillway just before overtopping the dam is 737 cfs. The PMF overtopped the dam by 2.05 feet with a total duration of flow over the dam of 45 minutes. The maximum water surface elevation during the one-half PMF was determined to be 784.15 feet above M.S.L. The spillway/reservoir system of Little Lake Dam is capable of accommodating a flood equal to approximately 55 percent of the PMF just before overtopping the dam and will also accommodate the one-percent chance flood (100-year flood) without overtopping the dam. However, the earth-cut spillway channel has no vegetative cover and is severely eroded. Further erosion in the spillway channel will have an adverse effect on the safety of the dam since the embankment forms a portion of the left side of the channel. The maximum velocity of flow in the spillway channel during one-half the PMF and the PMF will be about 11 and 13 feet per second (fps), respectively; high velocity flows such as these will cause further erosion in the spillway channel, which could cause an eventual dam failure. A velocity of seven fps through the spillway channel is considered to be the maximum permissible velocity for which further degradation of the spillway channel will not occur. Based upon this permissible velocity, the spillway/reservoir system will safely pass only three percent of the PMF.

The surface soils on the embankment consist of a silty clay. The top and downstream slope of the dam are covered by a dense growth of grass, brush, and trees. The dam will be overtopped by over two feet during the occurrence of the PMF, which can cause severe erosion to the embankment due to the high velocity of flow on its downstream slope and could lead to the eventual failure of the dam.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends less than one mile downstream of the dam. Located within the damage zone are one downstream reservoir (Sunrise Lake, Mo. 31190) and at least four dwellings located at the upper end of Sunrise Lake.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no major signs of settlement or distress observed on the embankment or foundation during the visual inspection. The stability of the dam does not appear to be in jeopardy at this time; however, the steep angle of the embankment slopes (1V to 1.5H) is generally not the recommended slope angle for an earthfill dam from a structural stability standpoint. Nevertheless, no structural defects were apparent on the dam embankment. The seepage at this damsite could be detrimental to the stability of the embankment, but it does not appear to constitute an unsafe condition at this time. In the absence of seepage and stability analyses, no quantitative evaluation of the structural stability can be made.

The stability of the spillway, which is an open cut into the right abutment, is poor because the earthen channel is being progressively eroded. The spillway is unobstructed and should be able to function; however, continued use of the channel will cause further erosion which will be a threat to the integrity of the dam.

b. Design and Construction Data

No design computations pertaining to the embankment were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters were available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction were available for use in a stability analysis.

c. Operating Records

No documented operating records are available relating to the stability of the dam or appurtenant structures; however, the reservoir does not maintain a relatively constant water surface level due to the seepage problem at this damsite. The water level on the day of inspection was 3.9 feet below the normal pool elevation.

d. Post Construction Changes

The only known modification to the dam since its construction was the apparent attempt to stop the seepage, as described in Section 3.1b. This attempt could have had a positive effect on the structural stability of the dam; however, the attempt was not completed.

e. Seismic Stability

The dam is located in Seismic Zone 2, as defined in the "Recommended Guidelines for Safety Inspection of Dams" prepared by the Corps of Engineers (see Plate 8). Seismic Zone 2 is characterized by a moderate earthquake hazard. An earthquake of the magnitude that would be expected in Seismic Zone 2 should not cause significant distress to a well designed and constructed earth dam. Available literature indicates that no active faults exist near the vicinity of the damsite. The maximum recorded historic magnitude earthquake in the immediate vicinity of the damsite was the July 21, 1967 event of magnitude 4.4 located at a distance of approximately 36 miles southeast of the damsite. This event cannot be correlated with known tectonic structure and is considered to probably be related to the release of accumulated residual strain along a buried pre-Quaternary fault. The attenuation of this event to the damsite would produce a peak ground acceleration of less than 0.05g which would not produce a significant seismic impact on the dam.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and the visual inspection. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based upon observations of field conditions at the time of the inspection along with data available to the inspection team.

It is also important to realize that the condition of a dam depends upon numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway/reservoir system for Little Lake Dam will accommodate about 55 percent of the PMF without overtopping the dam. The one-half of the PMF is considered to be the appropriate spillway design flood for this dam. The spillway capacity of Little Lake Dam is found to be adequate; however, for the spillway to safely pass 55 percent of the PMF, the present spillway will have to be replaced by a more stable and erosion-free spillway. The spillway, in its present condition, will safely pass only three percent of the PMF before further degradation of the spillway will occur, which could cause a dam failure.

The overall condition of the dam appears to be poor due to the severe erosion in the spillway channel and the seepage. Both of these conditions jeopardize the safety of the dam and do warrant prompt attention. A quantitative evaluation of the safety of the embankment could not be made in view of the absence of seepage and stability analyses. The present embankment, however, appears to have performed satisfactorily without failure since its construction. The dam has never been overtopped, according to Mr. Shy, and no evidence indicating the contrary was observed. The safety of the dam can only be improved if the deficiencies described in Section 3.2 are properly corrected as described in Section 7.2b.

b. Adequacy of Information

The conclusions presented in this report are based upon field measurements, past performance and the present condition of the dam. Documented information on the design hydrology, hydraulic design, operation, and maintenance of the dam was not 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.

c. Urgency

The item in paragraph 7.2a, regarding the replacement of the present spillway with a more stable and erosion-free spillway, and the first item in paragraph 7.2b, pertaining to the further investigation of the seepage, warrant prompt attention and should be pursued on a high priority basis. The remaining remedial measures recommended in Paragraph 7.2b should be accomplished within a reasonable period of time.

d. Necessity for Phase II Inspection

Based upon results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Recommendation

The present eroded spillway condition should be replaced by a more stable arrangement that is properly protected from future erosion.

b. O & M Procedures

1. Further investigation of the seepage at this damsite should be undertaken to determine the seriousness of the condition. The investigation should be carried out under the direction of a qualified professional engineer and repairs made as required.

2. The trees and brush on the embankment should be removed and regrowth prevented. The grass cover on the embankment, especially on the downstream slope, should be periodically maintained. The grass cover should be retained on the downstream slope to protect it from erosion due to surface runoff and to prevent excessive erosion in the event the dam is overtopped. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earth dams. Indiscriminate clearing could jeopardize the safety of the dam.

3. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

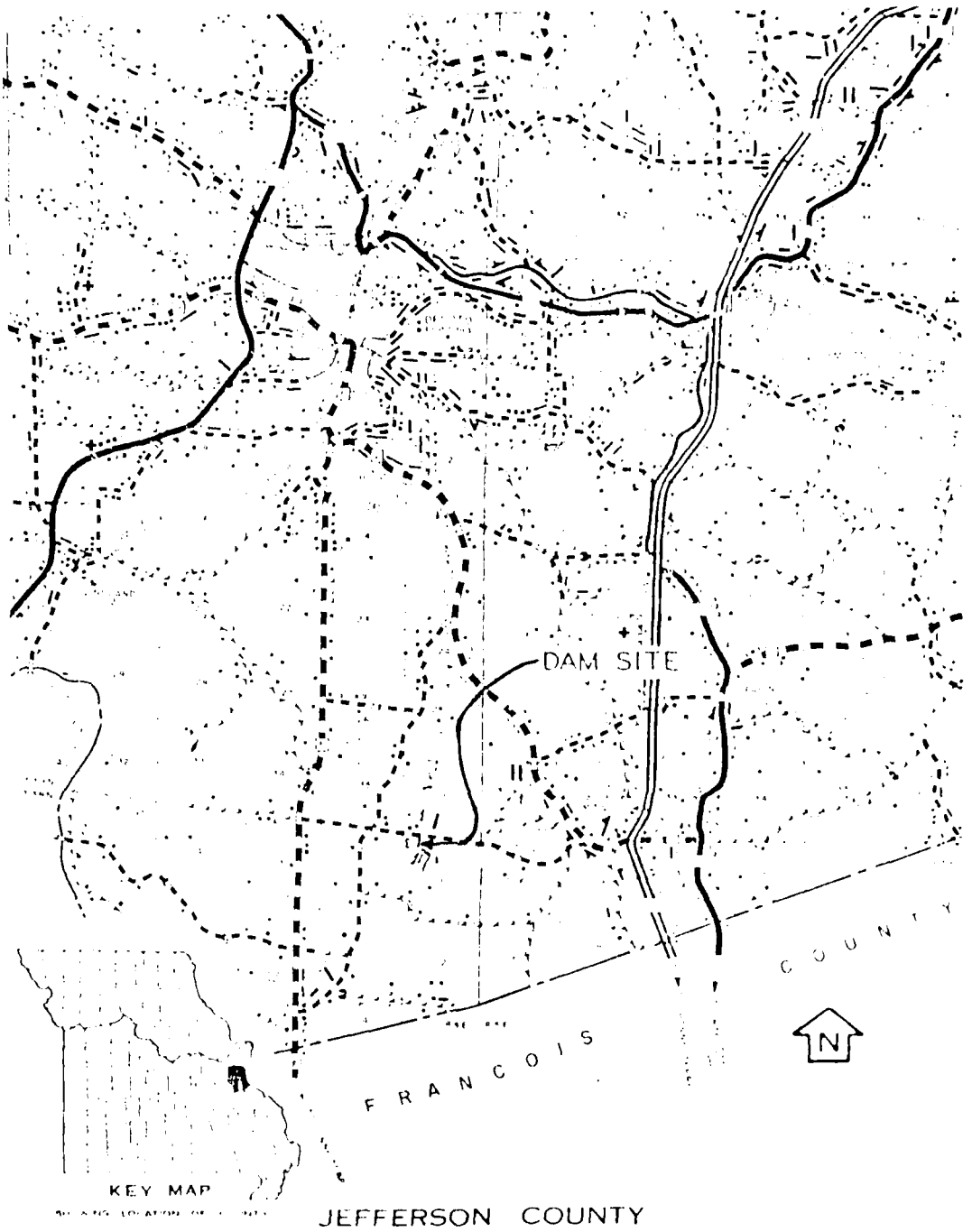
4. The owner should initiate the following programs:

   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earth dams.

(b) Set up a maintenance schedule and log all repairs and maintenance.

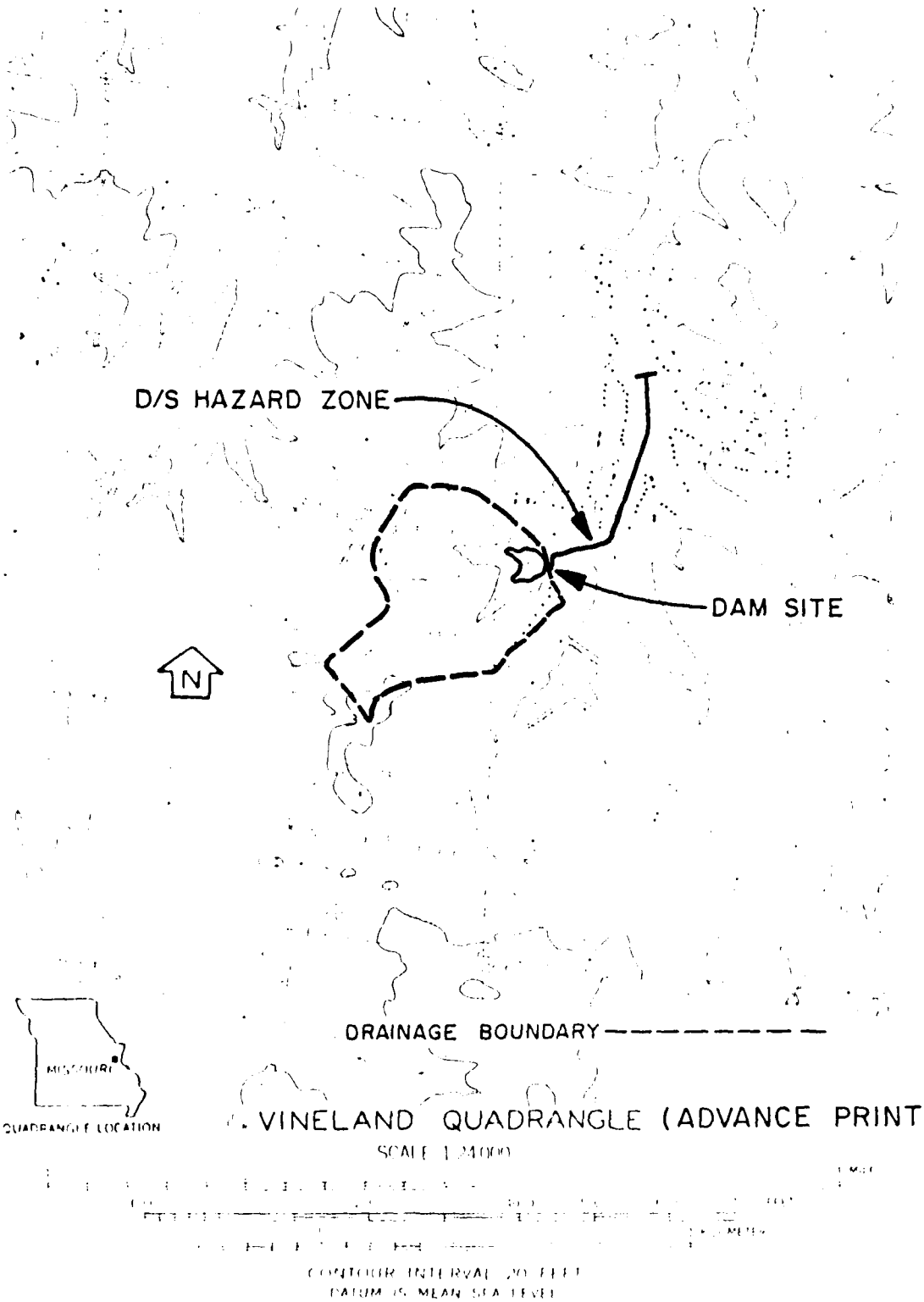
PLATES

PLATE I



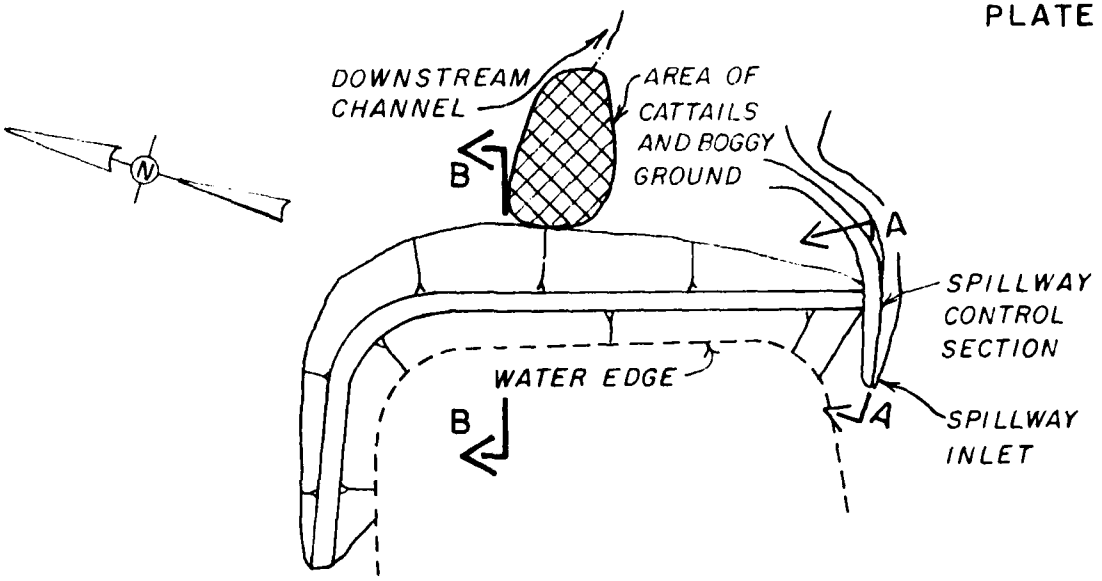
LITTLE LAKE DAM (MO. 30456)
LOCATION MAP

PLATE 2



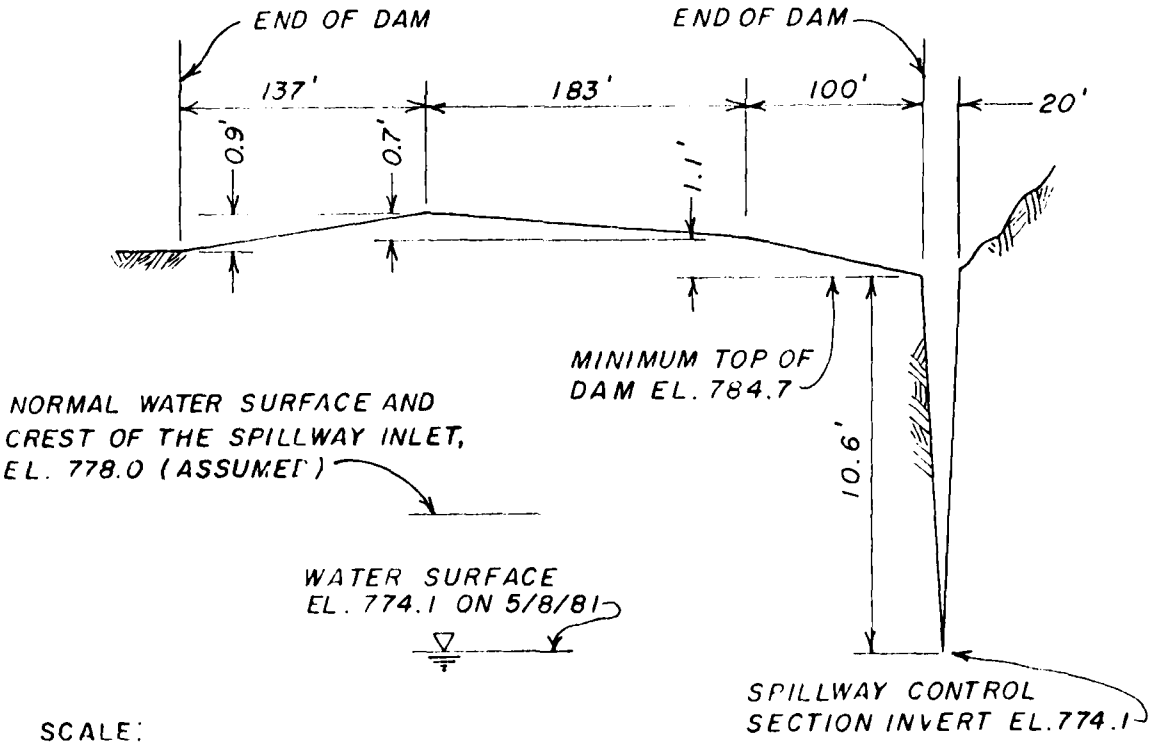
LITTLE LAKE DAM (MO. 30456)
DRAINAGE BASIN AND
DOWNSTREAM HAZARD ZONE

PLATE 3



PLAN

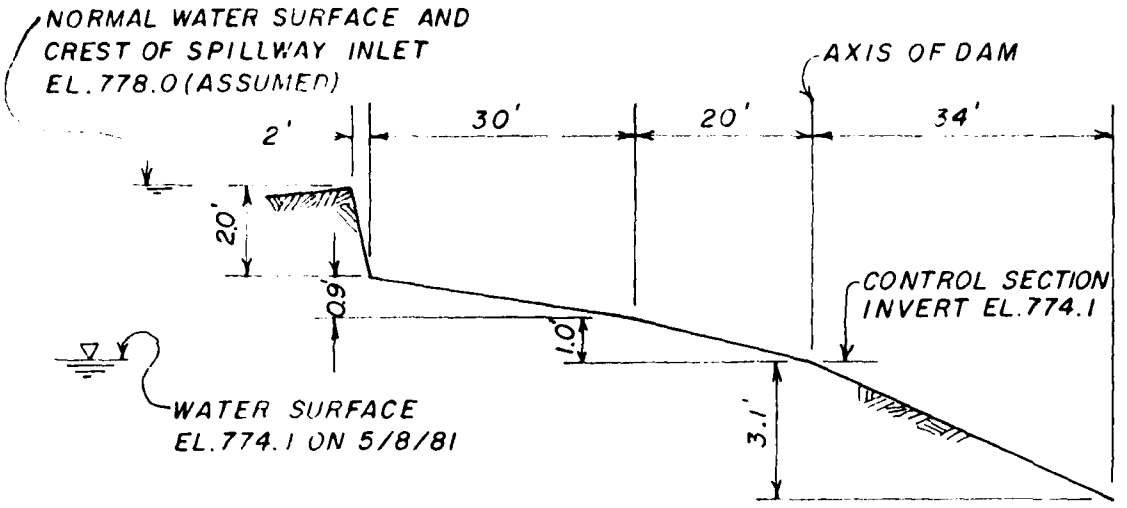
SCALE:
HORIZ. 1"=100'



SCALE:
HORIZ: 1"=100'
VERT. 1"= 5'

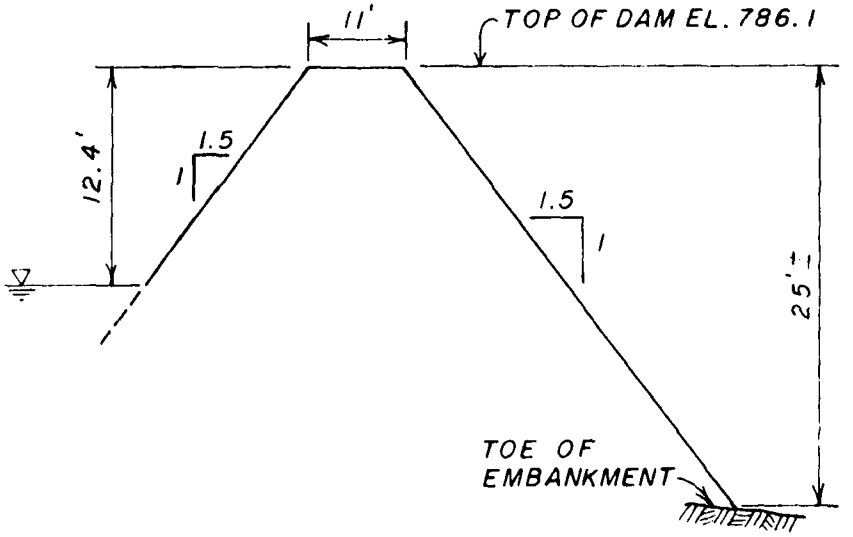
ELEVATION

LITTLE LAKE DAM (MO. 30456)
PLAN AND ELEVATION
(SHEET 1 OF 2)



SCALE:
HORIZ. 1" = 20'
VERT. 1" = 4'

SECTION A-A
(SPILLWAY PROFILE)

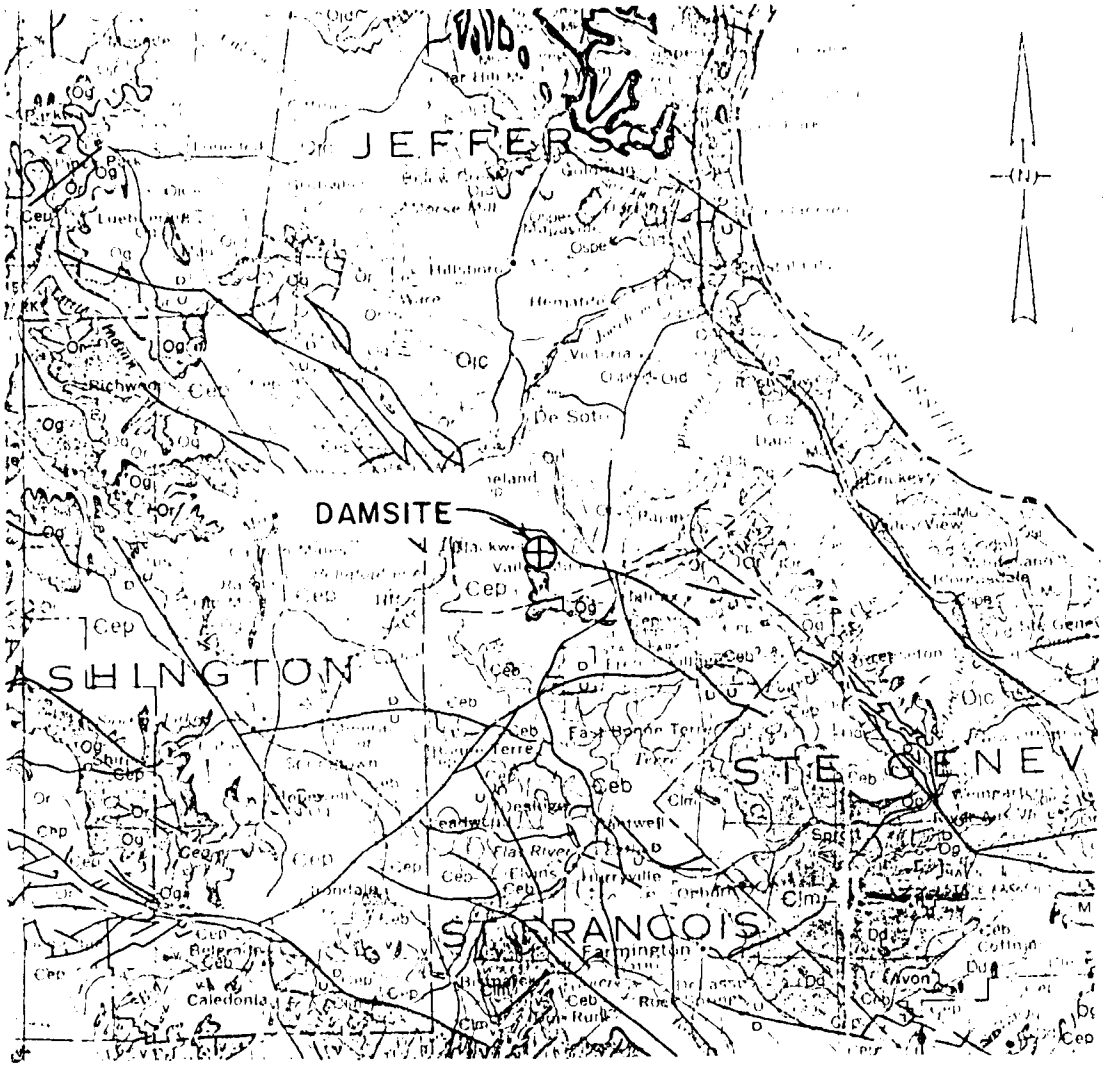


SCALE:
HORIZ. 1" = 20'
VERT. 1" = 10'

SECTION B-B
(MAXIMUM SECTION)

LITTLE LAKE DAM (MO.30456)
SPILLWAY PROFILE AND MAXIMUM SECTION
(SHEET 2 OF 2)

PLATE 5



SCALE

0 10 20 30 40 Miles

⊕ LOCATION OF DAM

NOTE: LEGEND FOR THIS MAP IS ON PLATES 6 AND 7

REFERENCE:

GEOLOGIC MAP OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
KENNETH H. ANDERSON, 1979

REGIONAL GEOLOGICAL MAP OF LITTLE LAKE DAM

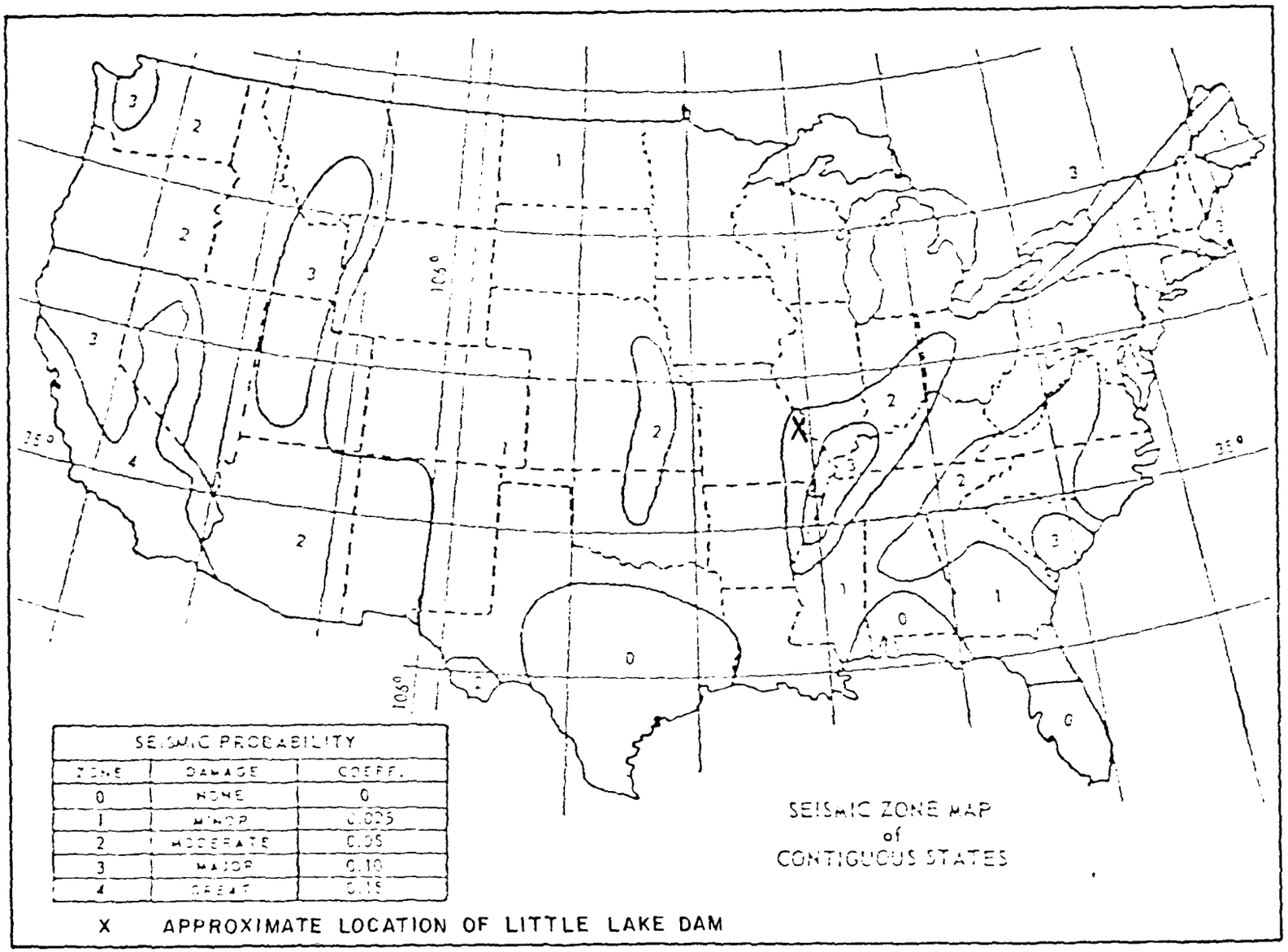
LEGEND

PERIOD	SYMBOL	DESCRIPTION
QUATERNARY	Qal	ALLUVIUM: SAND, SILT, GRAVEL
MISSISSIPPIAN	Mo	KEOKUK – BURLINGTON FORMATION: CHERTY GRAYISH BROWN SANDY LIMESTONE
	Mk	UNDIFFERENTIATED CHOUTEAU GROUP: LIMESTONE
	Mk	HANNIBAL FORMATION: SHALE AND SILTSTONE
DEVONIAN	Dd	DIATREMES, KIMBERLITES, CARBONATITES
ORDOVICIAN	Omk	MAQUOKETA SHALE, KIMMSWICK LIMESTONE
	Odp	DECORAH FORMATION: GREEN TO GRAY CALCAREOUS SHALE WITH THIN FOSSILIFEROUS LIMESTONE
	Ospe	ST. PETER SANDSTONE, EVERTON FORMATION
	Ojd	JOACHIM DOLOMITE
	Ojc	POWELL DOLOMITE, COTTER DOLOMITE
	Or	ROUBIDOUX FORMATION: INTERBEDS OF CHERTY LIMESTONE AND SANDSTONE
	Og	GASCONADE DOLOMITE

LITTLE LAKE DAM
PLATE 7
SHEET 2 OF 2

LEGEND

PERIOD	SYMBOL	DESCRIPTION
CAMBRIAN	$\mathcal{C}ep$	EMINENCE DOLOMITE, POTOSI DOLOMITE
	$\mathcal{C}eb$	FRANCONIA AND BONNETERRE FORMATION: INTERBEDDED LIMESTONE, CHERTY LIMESTONE, DOLOMITE AND SILTSTONE
	$\mathcal{C}lm$	LAMOTTE SANDSTONE
PRECAMBRIAN	i	ST. FRANCOIS MOUNTAINS INTRUSIVE
	V	ST. FRANCOIS MOUNTAINS VOLCANIC
	U / D	NORMAL FAULT
	U / D	INFERRED FAULT
	U =	UPTHROWN SIDE; D = DOWNTHROWN SIDE



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

X APPROXIMATE LOCATION OF LITTLE LAKE DAM

PLATE 8

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

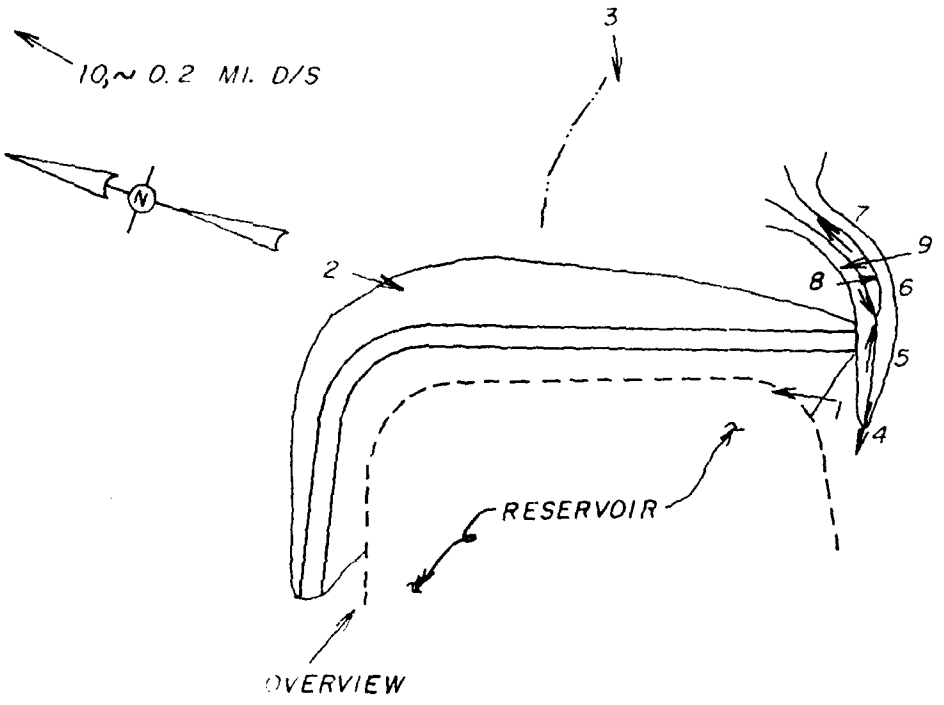


PHOTO INDEX
FOR
LITTLE LAKE DAM

Photo 1 - View of the upstream slope from the right abutment.

Photo 2 - View of the downstream slope near the maximum section looking towards the right abutment.

Photo 3 - View of the downstream channel area looking upstream towards the dam. Note the cattails in the center of the Photo.

Photo 4 - View of the spillway inlet looking towards the reservoir. Note the reservoir and rim in the background.

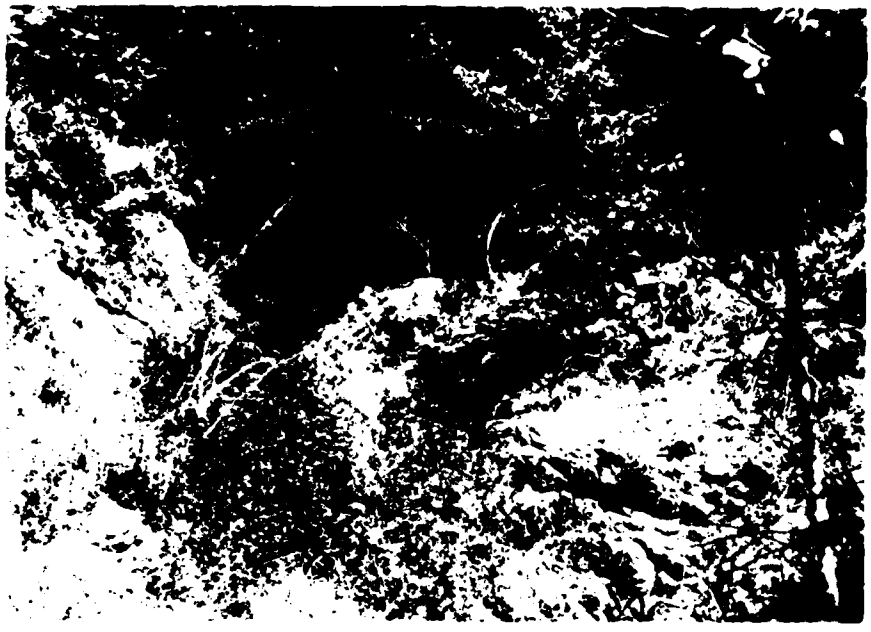


Photo 5 - View of the spillway control section looking downstream.

Photo 6 - View of the spillway control section looking upstream.

Photo 7 - View of the spillway channel looking downstream.

Photo 8 - Close-up view of an outcropping of weathered dolomite bedrock in the discharge channel of the spillway.

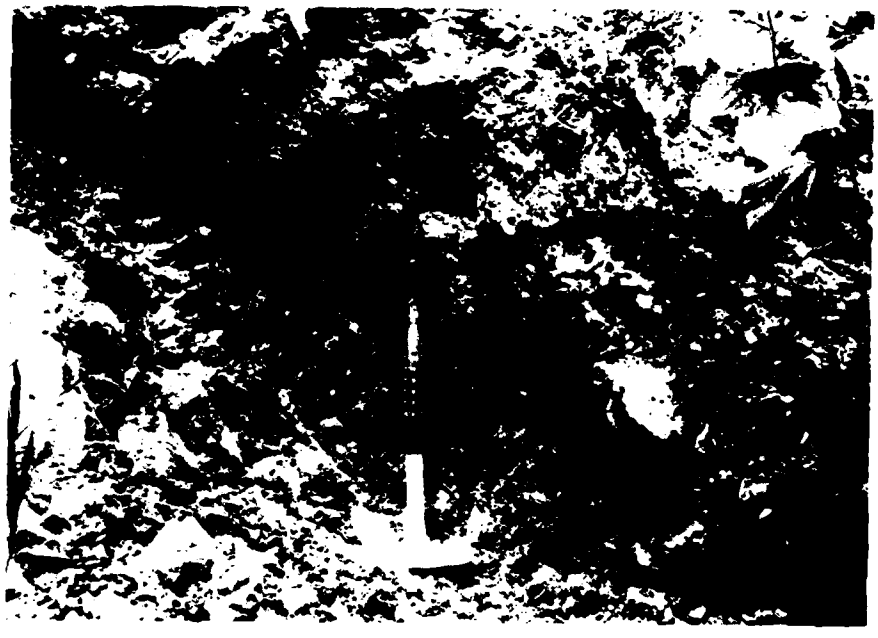


Photo 9 - Close-up view of a possible shear zone in the highly weathered dolomite bedrock in the spillway discharge channel.

Photo 10 - View of dwellings in the downstream hazard zone at the upper end of Sunrise Lake.

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

LITTLE LAKE DAM

HYDROLOGIC AND HYDRAULIC DATA, ASSUMPTIONS AND METHODOLOGY

1. SCS Unit Hydrograph procedures and the HEC-1DB computer program are used to develop the inflow hydrographs. The hydrologic inputs are *as follows:*

   (a) 24-hour Probable Maximum Precipitation from Hydrometeorological Report No. 33, and 24-hour 100-year rainfall and 24-hour 10-year rainfall of Ste. Genevieve, Missouri.

   (b) Drainage area = 0.19 square miles.

   (c) Lag time = 0.12 hours.

   (d) Hydrologic Soil Group:
   Soil Group "C".

   (e) Runoff curve number:
   CN = 73 for AMC II and CN = 87 for AMC III.

2. Flow rates through the spillway are based on HEC-2 generated profiles assuming critical depth in the channel downstream of the control section and a Manning's n = 0.05. Flow rates over the dam are based on critical depth assumption, in accordance with the procedures used in the HEC-1 computer program.

3. The spillway and the dam overtop rating curves are hand calculated and combined as shown on pages B-5 and B-6. This combined rating curve is input into HEC-1DB on the Y4 and Y5 cards. The $L and $V cards are, therefore, not used.

4. Floods are routed through Little Lake to determine the capability of the spillway.

5. An effective top of dam analysis was also performed for this dam. A permissible velocity of flow through the spillway of seven feet per second (fps) was used. This velocity was obtained by using a weighted average between the velocities of three fps for silty clay and ten fps for poor sedimentary bedrock. The summaries of the input data and the output from the HEC-1 computer program for the percentage of the PMF the spillway will pass are shown on pages B-18 through B-20.

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF 1

DAM NAME: Little Lake (Mo 30456) — JOB NO. 1283

UNIT HYDROGRAPH PARAMETERS — BY JFK DATE 5/12/81

1) DRAINAGE AREA, $A = 0.19$ sq. mi $= (124.0$ acres$)$

2) LENGTH OF STREAM, $L = (1.4$ " $\times 2000' = 2800') = 0.53$ mi.

3) ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM,

$H_1 = 890$

4) ELEVATION OF RESERVOIR AT SPILLWAY CREST, $H_2 = 778$

5) ELEVATION OF CHANNEL BED AT $0.85L$, $E_{85} = 870$

6) ELEVATION OF CHANNEL BED AT $0.10L$, $E_{10} = 790$

7) AVERAGE SLOPE OF THE CHANNEL, $S_{AVG} = (E_{85} - E_{10})/0.75L = 0.038$

8) TIME OF CONCENTRATION:

A) BY KIRPICH'S EQUATION,

$t_c = [(11.9 \times L^3)/(H_1 - H_2)]^{0.385} = [11.9 * 0.53^3/(112)]^{0.385} = 0.20$ hr

B) BY VELOCITY ESTIMATE,

SLOPE = 3.8% $\Rightarrow$ AVG. VELOCITY = 3 fps

$t_c = L/V = 2800'/3$ fps $*$ hr/3600s $= 0.26$ hr.

USE $t_c = 0.20$ hr.

9) LAG TIME, $t_l = 0.6\, t_c = 0.12$ hr.

10) UNIT DURATION, $D \leq t_l/3 = 0.03$ hr. < 0.083 hr.

USE $D = 0.083$ hr.

11) TIME TO PEAK, $T_p = D/2 + t_l = 0.16$ hr

12) PEAK DISCHARGE,

$q_p = (484 \times A)/T_p = 484 * 0.19/0.16 = 575$ cfs

ECI-4 PRC ENGINEERING CONSULTANTS, INC.

Dam Safety Inspection - Missouri — SHEET NO. ____ OF ____

Little Lake Dam (Mo. 30456) — JOB NO. 1283

Reservoir Elevation - Area Data — BY JFK DATE 5/20/81

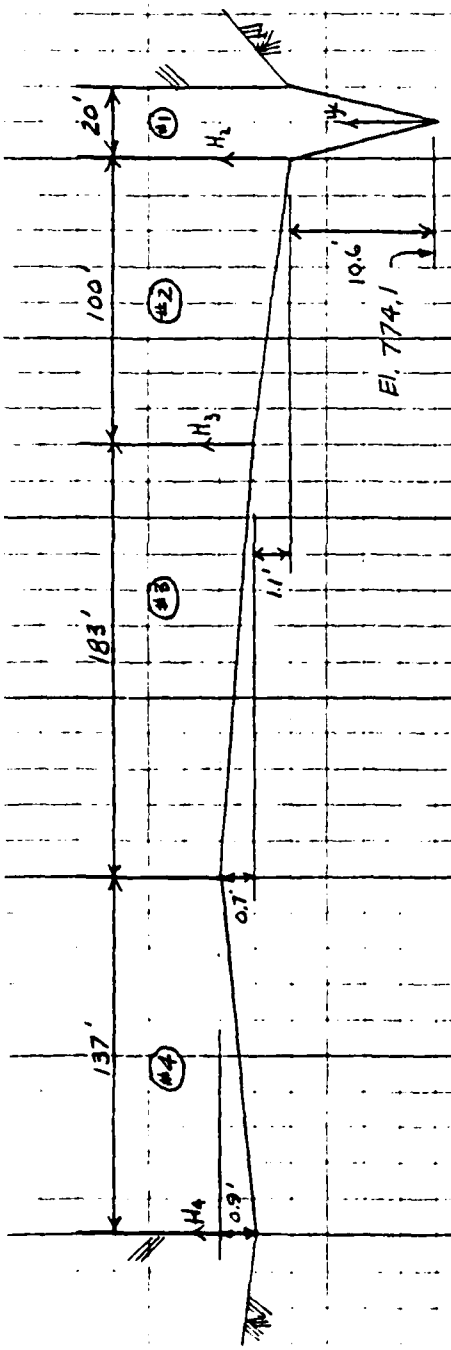
Elevation (ft, MSL)	Area (acres)	Remarks
765	0	Estimated streambed U/S at dam
770	1.5	Interpolated
778	4.0	Spillway Entrance Elevation (assumed)
780	4.5	Measured on USGS 7.5' Quad
784.7	6.0	Minimum Top of Dam
790	8.5	Interpolated
800	15.0	Measured on USGS 7.5' Quad

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Dam Safety Inspection - Missouri — SHEET NO. 1 OF 2

Little Lake Dam (Mo. 30456) — JOB NO. 1283

Spillway and Overtop Rating Curve — BY JFK DATE 5/21/81



NOTE: HEC-2 was used to determine the W.S.EL. in the reservoir (See HEC-2 printout SECNO 5) corresponding to the discharges in the control section shown above (See HEC-2 printout SECNO 2).

Section #1: for $0 < y_c \leq 10.6$

$A_1 = 0.9 y_c^2$

$T_1 = 1.9\, y_c$

for $10.6 < y_c$

$A_1 = 20.0\, y_c - 106.0$

$T_1 = 20.0$

; H_1 = W.S.EL. - 785.8

Section #2: for $0 < y_2 \leq 1.1$

$y_2 = 4/5\, H_2$

$A_2 = 45.5\, y_2^2$

$T_2 = 90.9\, y_2$

for $1.1 < y_2$

$y_2 = 2/3\,(H_2 + 0.3)$

$A_2 = 100.0\, y_2 - 55.0$

$T_2 = 100.0$

; H_2 = W.S.EL. - 784.7

Section #3: for $0 < y_3 \leq 0.7$

$y_3 = 4/5\, H_3$

$A_3 = 130.7\, y_3^2$

$T_3 = 261.4\, y_3$

for $0.7 < y_3$

$y_3 = 2/3\,(H_3 + 0.2)$

$A_3 = 183.0\, y_3 - 64.1$

$T_3 = 183.0$

; H_3 = W.S.EL. - 785.6

Section #4: for $0 < y_4 \leq 0.9$

$y_4 = 4/5\, H_4$

$A_4 = 76.1\, y_4^2$

$T_4 = 152.2\, y_4$

for $0.9 < y_4$

$y_4 = 2/3\,(H_4 + 0.2)$

$A_4 = 137.0\, y_4 - 61.7$

$T_4 = 137.0$

; H_4 = W.S.EL. - 785.6

* critical depth assumed ; $Q = \sqrt{A^3 g / T}$

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Dam Safety Inspection - Missouri — SHEET NO. 2 OF 2

Little Lake Dam (Mo. 30456) — JOB NO. 1283

Spillway and Overtop Rating Curve — BY JFK DATE 5/21/81

← Refer to HEC-2 Printout →

Section No. 2					Sec. No. 5						
y_c	A_c	T_c	V_c	Q_c	W.S.EL.	H_2	y_2	A_2	T_2	Q_2	Q_c+Q_2
0	0	0	0	0	778.0						0
2.8	7.4	5.3	6.8	50	778.5						50
3.7	12.8	7.0	7.8	100	779.1						100
4.9	22.4	9.2	8.9	200	780.5						200
5.7	30.8	10.8	9.7	300	781.6						300
6.4	38.9	12.1	10.3	400	782.5						400
7.0	46.4	13.2	10.8	500	783.2						500
7.6	54.4	14.3	11.0	600	783.9						600
8.1	61.3	15.2	11.4	700	784.5	0	0	0	0	0	700
8.5	68.2	16.0	11.7	800	785.1	0.4	0.3	4.7	29.1	10.6	811
8.9	74.8	16.8	12.0	900	785.6	0.9	0.7	23.7	65.5	80.2	980
9.3	81.2	17.5	12.3	1000	786.1	1.4	1.1	56.7	100.0	242.1	1242
9.6	87.6	18.2	12.6	1100	786.5	1.8	1.4	83.3	100.0	431.7	1532
10.0	94.0	18.8	12.8	1200	787.0	2.3	1.7	116.7	100.0	715.1	1915
10.3	100.3	19.5	13.0	1300	787.4	2.7	2.0	143.3	100.0	973.8	2274

W.S. EL.	H_3	y_3	A_3	T_3	Q_3	H_4	y_4	A_4	T_4	Q_4	Q_{TOTAL}
778.0											0
778.5											50
779.1											100
780.5											200
781.6											300
782.5											400
783.2											500
783.9											600
784.5											700
785.1											811
785.6	0	0	0	0	0	0	0	0	0	0	980
786.1	0.3	0.2	7.5	62.7	14.8	0.5	0.4	12.2	60.9	30.9	1288
786.5	0.7	0.6	41.0	141.4	123.1	0.9	0.7	39.5	109.6	134.3	1789
787.0	1.2	0.9	103.7	183.0	443.0	1.4	1.1	86.8	137.0	391.8	2750
787.4	1.6	1.2	152.5	183.0	790.0	1.8	1.4	123.3	137.0	663.8	3728

HEC-2 INPUT AND SUMMARY TABLE

```
**********************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRI 1980
  ERROR CORR -  01.02.03.04
  MODIFICATION -  50.51.52.53.54
**********************************************

T1       DAM SAFETY INSPECTION - MISSOURI
T2       SPILLWAY RATING CURVE
T3       LITTLE LAKE DAM (MO. 30456)

J1  ICHECK     INQ        NINV       IDIR       STRT       METRIC     HVINS      Q          WSEL       FQ
       -1.        2.         0.         0.  -1.000000       0.00       0.0        0.       775.000    0.000
J2  NPROF      IPLOT      PRFVS      XSECV      XSECH      FN         ALLOC      IBW        CHNIM      ITHACE
     1.000      2.000     -1.000      0.000      0.200      0.000      0.000      0.000      0.000      0.000
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
    18.000      1.000     25.000      4.000     26.000     10.000     45.000      5.000      9.000     17.000
J4  LPRNT      NUMSEC                        ********REQUESTED SECTION NUMBERS********
    -10.000    -10.000     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
J5  IDLEG      ICOPY
     1.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

NC      .050       .050       .050       .100       .300      0.000      0.000      0.000      0.000      0.000
NT    14.000     50.000    100.000    200.000    500.000    400.000    500.000    600.000    700.000    800.000
NT   900.000   1000.000   1100.000   1200.000   1300.000      0.000      0.000      0.000      0.000      0.000

X1     1.000      4.000      5.000     25.000      0.000      0.000      0.000      0.000      0.000      0.000
GR   781.000      0.000    771.000     10.000    771.000     15.000    781.000     25.000      0.000      0.000

X1     2.000      3.000      0.000     20.000     35.000     35.000     35.000      0.000      0.000      0.000
GR   784.700      0.000    774.100     10.300    784.700     20.000      0.000      0.000      0.000      0.000

X1     3.000      6.000      0.000     50.000     20.000     20.000     20.000      0.000      0.000      0.000
GR   784.700      0.000    782.700     20.000    779.700     25.000    775.100     35.000    779.700     45.000
GW   784.700     50.000      0.000      0.000      0.000      1.110      0.000      0.000      0.000      0.000

X1     4.000      8.000      0.000    150.000     30.000     30.000     30.000      0.000      0.000      0.000
GR   784.700      0.000    778.000     80.000    778.000     80.000    776.000     90.100    776.000    100.000
GW   778.000    102.100    778.000    110.000    784.700    150.000      0.000      0.000      0.000      0.000
```

XS	5.000	0.000	0.000	140.000	2.000	2.000	2.000	0.000	0.000	0.000
XR	789.700	0.000	778.000	56.000	778.000	120.000	789.700	140.000	0.000	0.000
FJ	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

IHLEG = 1. THEREFORE FRICTION LOSS (HL) IS CALCULATED AS A FUNCTION OF PROFILE TYPE, WHICH CAN VARY FROM REACH TO REACH. SEE DOCUMENTATION FOR DETAILS.

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED APRI 1980
  ERROR CORR - 01,02,03,04
  MODIFICATION - 50,51,52,53,54
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

LITTLE LAKE DAM (NO. 30

SUMMARY PRINTOUT

	SECNO	DEPTH	AREA	TOPWID	VCH	AV	Q	EG	10K*S	K*XNCH
*	1.000	1.32	8.37	7.65	5.97	.55	50.00	772.88	427.74	50.00
*	1.000	2.01	14.65	9.01	7.12	.79	100.00	773.79	397.32	50.00
*	1.000	2.98	23.80	10.98	8.40	1.10	200.00	775.08	372.94	50.00
*	1.000	3.72	32.47	12.45	9.24	1.33	300.00	776.05	361.34	50.00
*	1.000	4.35	40.65	13.70	9.84	1.50	400.00	776.85	350.97	50.00
*	1.000	4.89	48.31	14.77	10.35	1.66	500.00	777.55	345.02	50.00
*	1.000	5.36	55.83	15.76	10.75	1.79	600.00	778.17	337.37	50.00
*	1.000	5.84	63.32	16.68	11.06	1.90	700.00	778.74	329.19	50.00
*	1.000	6.22	69.83	17.44	11.46	2.04	800.00	779.26	330.20	50.00
*	1.000	6.61	76.65	18.21	11.74	2.14	900.00	779.75	325.97	50.00
*	1.000	6.97	83.45	18.94	11.96	2.23	1000.00	780.20	320.93	50.00
*	1.000	7.32	90.22	19.64	12.19	2.31	1100.00	780.63	315.56	50.00
*	1.000	7.66	96.90	20.31	12.38	2.38	1200.00	781.04	310.56	50.00
*	1.000	7.92	102.39	20.85	12.70	2.50	1300.00	781.43	314.87	50.00
*	2.000	2.90	7.41	5.29	6.75	.71	50.00	777.61	542.79	50.00
*	2.000	3.68	12.79	6.95	7.82	.95	100.00	778.73	506.50	50.00
*	2.000	4.87	22.59	9.19	8.93	1.24	200.00	780.21	455.27	50.00
*	2.000	5.72	30.83	10.79	9.73	1.47	300.00	781.29	436.50	50.00
*	2.000	6.41	38.78	12.16	10.31	1.65	400.00	782.16	420.84	50.00
*	2.000	7.01	46.39	13.23	10.78	1.80	500.00	782.92	408.00	50.00
*	2.000	7.59	54.35	14.32	11.04	1.89	600.00	783.58	385.13	50.00
*	2.000	8.06	61.33	15.21	11.41	2.02	700.00	784.19	379.78	50.00
*	2.000	8.52	68.16	16.04	11.74	2.14	800.00	784.74	374.33	50.00
*	2.000	8.98	74.77	16.80	12.04	2.25	900.00	785.25	370.09	50.00
*	2.000	9.28	81.22	17.51	12.31	2.35	1000.00	785.73	366.36	50.00
*	2.000	9.63	87.55	18.18	12.56	2.45	1100.00	786.18	362.99	50.00
*	2.000	9.98	93.95	18.83	12.77	2.53	1200.00	786.61	357.85	50.00
*	2.000	10.51	100.32	19.46	12.96	2.61	1300.00	787.02	352.54	50.00

SECNO	DEPTH	AREA	TOPWID	VCH	HV	Q	EG	10KAS	K*XNCH
3.300	2.71	15.88	11.75	3.15	.15	50.00	777.96	85.31	50.00
3.600	3.76	30.67	16.33	3.26	.17	100.00	779.02	59.05	50.00
3.900	5.19	56.10	21.55	3.44	.18	200.00	780.47	41.20	50.00
4.200	6.24	82.36	24.37	3.64	.21	300.00	781.54	34.83	50.00
4.500	7.11	104.46	26.68	3.83	.23	400.00	782.42	32.05	50.00
4.800	7.85	125.34	30.75	3.99	.25	500.00	783.19	32.82	50.00
5.100	8.52	148.45	36.13	4.04	.25	600.00	783.88	35.05	50.00
5.400	9.14	174.62	44.90	4.02	.25	700.00	784.49	34.46	50.00
5.700	9.70	203.88	50.00	3.98	.25	800.00	785.05	32.09	50.00
6.000	10.21	226.47	50.00	3.97	.25	900.00	785.56	27.90	50.00
6.300	10.69	250.43	50.00	3.99	.25	1000.00	786.04	25.20	50.00
6.600	11.14	272.96	50.00	4.03	.25	1100.00	786.49	23.36	50.00
6.900	11.56	294.21	50.00	4.08	.26	1200.00	786.92	22.08	50.00
7.200	11.97	314.36	50.00	4.14	.27	1300.00	787.33	21.16	50.00
4.600	2.11	27.29	31.59	1.83	.05	50.00	778.16	49.52	50.00
4.900	3.08	64.60	46.02	1.54	.04	100.00	779.12	18.32	50.00
5.200	4.49	145.16	67.21	1.38	.03	200.00	780.52	8.03	50.00
5.500	5.56	225.47	83.15	1.33	.03	300.00	781.59	5.50	50.00
5.800	6.44	309.44	96.29	1.31	.03	400.00	782.47	4.36	50.00
6.100	7.21	382.75	107.75	1.31	.03	500.00	783.24	3.68	50.00
6.400	7.89	457.49	117.90	1.31	.03	600.00	783.92	3.25	50.00
6.700	8.51	534.51	127.04	1.31	.03	700.00	784.53	2.95	50.00
7.000	9.08	606.29	130.00	1.32	.03	800.00	785.08	2.63	50.00
7.300	9.66	672.29	130.00	1.34	.03	900.00	785.59	2.38	50.00
7.600	10.24	734.56	130.00	1.36	.03	1000.00	786.07	2.21	50.00
7.900	10.80	793.52	130.00	1.39	.03	1100.00	786.53	2.08	50.00
8.200	11.35	849.38	130.00	1.41	.03	1200.00	786.96	1.99	50.00
8.500	11.89	902.59	130.00	1.44	.03	1300.00	787.37	1.93	50.00
5.000	.56	15.16	45.31	3.30	.17	50.00	778.52	531.21	50.00
5.300	1.67	51.90	56.12	1.93	.06	100.00	779.13	46.90	50.00
5.600	2.60	146.52	77.29	1.36	.03	200.00	780.52	9.07	50.00
5.900	3.37	237.47	93.21	1.26	.02	300.00	781.59	5.25	50.00
6.200	4.05	325.24	106.34	1.23	.02	400.00	782.47	3.90	50.00
6.500	4.71	411.27	117.80	1.22	.02	500.00	783.24	3.20	50.00
6.800	5.39	494.67	127.95	1.21	.02	600.00	783.92	2.78	50.00
7.100	6.01	576.00	137.09	1.22	.02	700.00	784.53	2.50	50.00
7.400	7.00	653.33	140.00	1.22	.02	800.00	785.08	2.22	50.00
7.700	7.57	724.34	140.00	1.24	.02	900.00	785.59	2.01	50.00
8.000	8.04	791.36	140.00	1.26	.02	1000.00	786.07	1.86	50.00
8.300	8.52	854.85	140.00	1.29	.03	1100.00	786.53	1.76	50.00
8.600	8.93	914.97	140.00	1.31	.03	1200.00	786.96	1.68	50.00
8.900	9.34	972.27	140.00	1.34	.03	1300.00	787.37	1.62	50.00

SUMMARY OF PMF AND ONE-HALF PMF ROUTING

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
  LAST MODIFICATION  21 APR 80
**********
    1          A1        DAM SAFETY INSPECTION - MISSOURI
    2          A2           LITTLE LAKE DAM (MO.30456)
    3          A3           PMF AND ONE-HALF PMF
    4          B    300       0       5       0       0       0       0       0       0       0       0
    5          B1     5
    6          J      1       2       1
    7          J1     1      .5
    8          K            LTTLLK                                                  1
    9          K1         RUNOFF CALCULATION FOR LITTLE LAKE DAM DRAINAGE AREA
   10          M      1       2      .19             .19       1                                 1
   11          P             26      100     120     130
   12          T                                                       -1      -87
   13          H2            .12
   14          X                     1
   15          K      1    LTTLLK                                      1
   16          K1         ROUTE HYDROGRAPH THROUGH LITTLE LAKE
   17          Y                                     1       1
   18          Y1     1                                              -778      -1
   19          Y4   778     778.5   779.1   781.5   781.6   782.5   783.2   783.9   784.5   785.1
   20          Y4 785.6     786.1   786.5   787.0   787.4
   21          Y5     0       50     100     200     300     400     500     600     700     811
   22          Y5   980     1288    1789    2750    3728
   23          SA     0      1.5       4     4.5       6     8.5      15
   24          SE   765      770     778     780   784.7     790     800
   25          SS   778
   26          SD 784.7
   27          X     99
```

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	778.00	778.00	784.70
STORAGE	24.	24.	57.
OUTFLOW	0.	0.	737.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	786.75	2.05	70.	2268.	.75	15.75	0.00
.50	784.15	0.00	54.	642.	0.00	15.92	0.00

PERCENT OF PMF ROUTING
EQUAL TO SPILLWAY CAPACITY

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
    1                 A1        DAM SAFETY INSPECTION - MISSOURI
    2                 A2           LITTLE LAKE DAM (MO.30456)
    3                 A3           PERCENT PMF
    4                 B     300       0        5        0        0        0        0        0       -4        0
    5                 B1      5
    6                 J       1       4        1
    7                 J1     .5     .53      .55      .58
    8                 K          LTTLLK                                                  1
    9                 K1         RUNOFF CALCULATION FOR LITTLE LAKE DAM DRAINAGE AREA
   10                 M       1       2      .19              .19        1                                 1
   11                 P              26      100      120     130
   12                 T                                                               -1      -87
   13                 J2             .12
   14                 X                       1
   15                 K       1   LTTLLK                                              1
   16                 K1         ROUTE HYDROGRAPH THROUGH LITTLE LAKE
   17                 Y                                1        1
   18                 Y1      1                                                    -778       -1
   19                 Y4    778    778.5    779.1    780.5    781.6    782.5    783.2    783.9    784.5    785.1
   20                 Y4  785.6    786.1    786.5    787.0    787.4
   21                 Y5      0       50      100      200      300      400      500      600      700      811
   22                 Y5    980     1288     1789     2750     3728
   23                 $A      0      1.5        4      4.5        6      8.5       15
   24                 $E    765      770      778      780    784.7      790      800
   25                 $$    778
   26                 $D  784.7
   27                 K      99
```

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	778.00	778.30	784.70
STORAGE	24.	24.	57.
OUTFLOW	0.	0.	737.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	784.15	0.00	54.	642.	0.00	15.92	0.00
.53	784.43	0.00	55.	688.	0.00	15.83	0.00
.55	784.61	0.00	56.	720.	0.00	15.83	0.00
.58	784.88	.18	58.	770.	.17	15.83	0.00

PERCENT OF PMF ROUTING
EQUAL TO SPILLWAY CAPACITY
FOR EFFECTIVE TOP OF
DAM ANALYSIS

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**********
LOOD HYDROGRAPH PACKAGE (HEC-1)
AM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  11 APR 80
**********
    1          A1       DAM SAFETY INSPECTION - MISSOURI
    2          A2          LITTLE LAKE DAM (MO.30457)
    3          A3          PERCENT PMF
    4          B    300       0       5       0       0       0       0       0      -4       0
    5          B1     5
    6          J      1       5       1
    7          J1   .01     .02     .03     .04     .05
    8          K             LTTLLK                                          1
    9          K1          RUNOFF CALCULATION FOR LITTLE LAKE DAM DRAINAGE AREA
   10          B      1       2     .19             .19       1                       1
   11          I              26     100     120     139
   12          I                                                      -1      -87
   13          J2           .10
   14          K                     1
   15          K      1     LTTLLK                                          1
   16          K1          ROUTE HYDROGRAPH THROUGH LITTLE LAKE
   17          Y                                     1       1
   18          Y1     1                                                -778      -1
   19          Y4   778     778.5   779.1   780.5   781.6   782.5   783.2   783.9   784.5   785.1
   20          Y4 785.6     786.1   786.5   787.0   787.4
   21          Y5     0       50     100     200     300     400     500     600     700     811
   22          Y5   986     1288    1789    2750    3728
   23          YA     0       1.5       4     4.5       6     8.5      15
   24          YC   765       770     778     780   784.7     790     800
   25          YI   778
   26          YJ 778.5
   27          Z      99
```

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	778.00	778.00	778.50
STORAGE	24.	24.	26.
OUTFLOW	0.	0.	50.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.01	778.13	0.00	24.	13.	0.00	15.83	0.00
.02	778.26	0.00	25.	26.	0.00	15.83	0.00
.03	778.39	0.00	25.	39.	0.00	15.83	0.00
.04	778.52	.02	26.	52.	.17	15.92	0.00
.05	778.65	.15	26.	63.	.58	15.92	0.00