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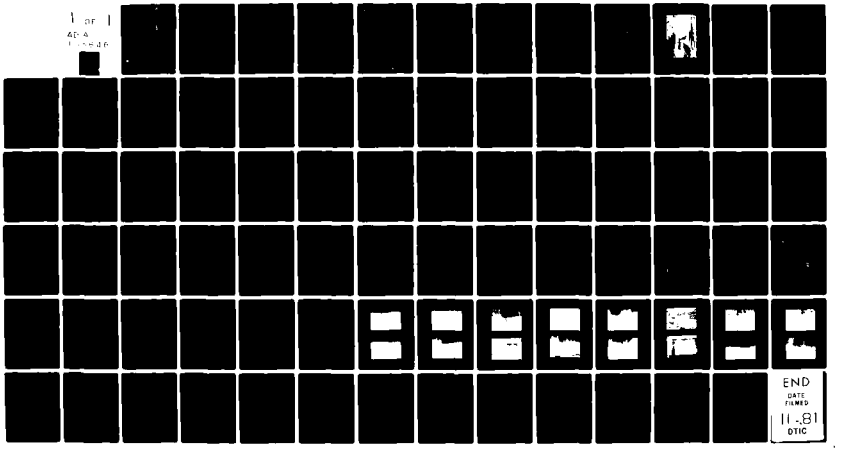

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SIESTA LAKE DAM
JEFFERSON COUNTY, MISSOURI
MO. 31199

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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7. AUTHOR(s) Consoer, Townsend and Associates, Ltd.		8. CONTRACT OR GRANT NUMBER(s) DACW43-81-C-0063
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

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

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

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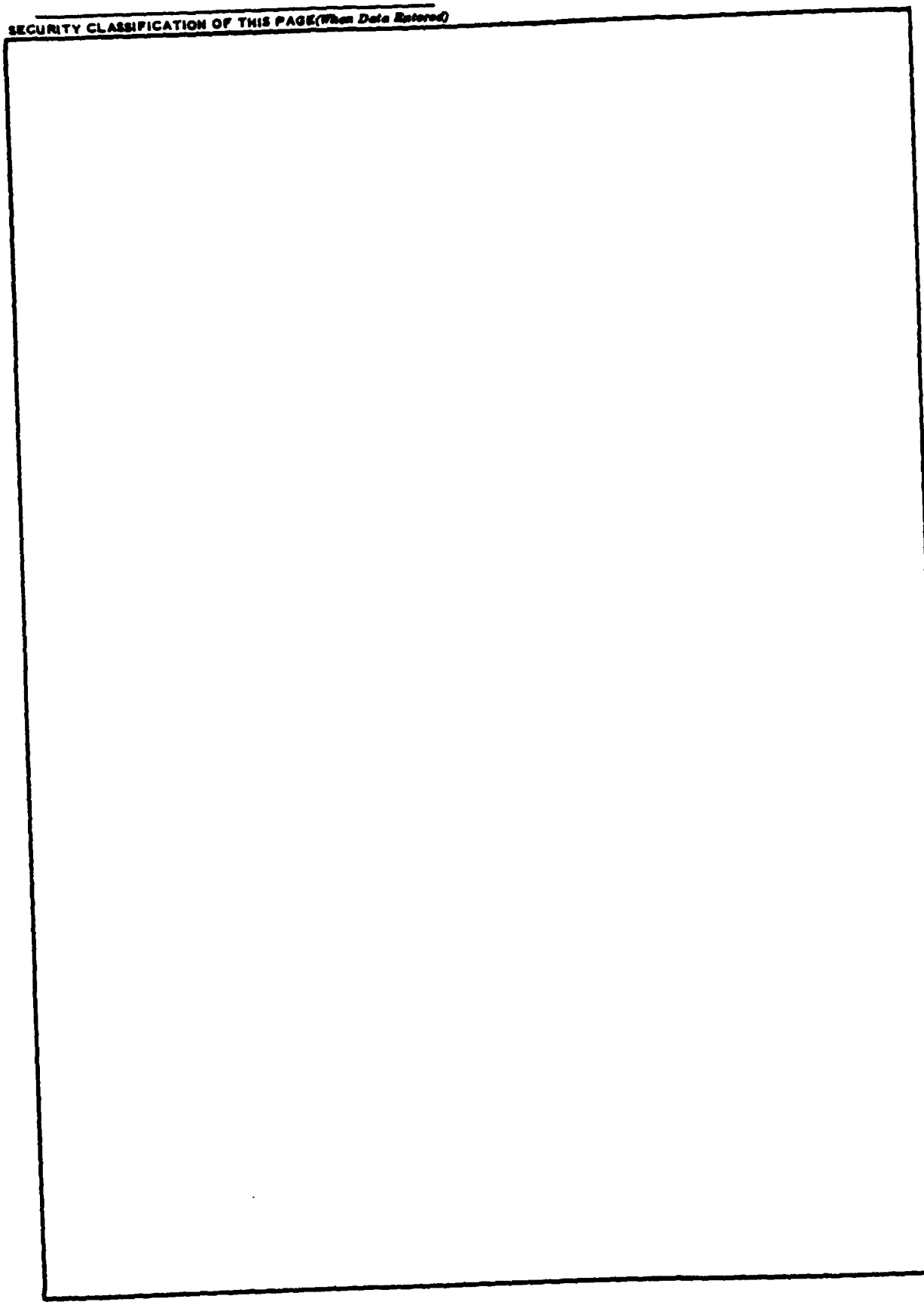

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Siesta Lake Dam (Mo. 31199) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Siesta Lake Dam (Mo. 31199).

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

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

a. The combined capacity of the spillways will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 9 JUL 1981
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 10 JUL 1981
Colonel, CE, Commanding — Date

SIESTA LAKE DAM
JEFFERSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31199

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: Siesta Lake Dam, Missouri Inv. No. 31199
State Located: Missouri
County Located: Jefferson
Stream: Unnamed tributary of Fritz Creek
Date of Inspection: March 4, 1981

Assessment of General Condition

Siesta 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 two miles downstream of the dam are at least four dwellings, two trailers, two state highway crossings (Highways 21 and 110) and a warehouse, which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Siesta Lake Dam is in the small size classification since it is more than 25 feet but less than 40 feet in height and impounds more than 50 acre-feet but less than 1,000 acre-feet of water.

The inspection and evaluation indicates that the spillway system of Siesta Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Siesta 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 (PMF) to the Probable Maximum Flood before overtopping of the dam occurs. Considering the number of inhabited dwellings located in the downstream hazard zone, the PMF is considered the appropriate spillway design flood for Siesta 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 15 percent of the Probable Maximum Flood without overtopping the dam. The evaluation also indicates that the reservoir/spillway system can not accommodate the one-percent chance flood (100-year flood) without overtopping the dam, but can accommodate the ten-percent chance flood (10-year flood).

The overall condition of the dam and the spillways appears to be fair; however, several deficiencies were noted by the inspection team. The deficiencies included: an area of boggy ground observed along the downstream toe of the dam indicating possible seepage through the embankment or foundation; the deteriorated condition of the concrete channel in the principal spillway; the erosion and obstructions observed in both of the spillway discharge channels; the erosion of the upstream slope due to wave action above the riprap; the trees and brush growing on the downstream slope; a need for periodical maintenance of the grass cover on the embankment and in the emergency spillway discharge channel and a lack of a maintenance schedule; and 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.

Walter G. Shifrin, P.E.

Overview of Siesta Lake Dam

NATIONAL DAM SAFETY PROGRAM

SIESTA LAKE DAM, I.D. No. 31199

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SIESTA LAKE DAM, Missouri Inv. No. 31199

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 Siesta 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 Siesta Lake Dam was made on March 4, 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 north 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. Joseph Merten, the owner. No design or "as-built" drawings were available for this dam.

The dam is a homogeneous, rolled, earthfill structure with a core trench excavated into the bedrock, according to Mr. Merten. The alignment of the dam is straight between earth abutments. A plan and elevation of the dam are shown on Plate 3 and Photos 1 through 3 show views of the dam. The top of dam was measured to be 460-feet long between the principal and emergency spillways and has a top width of ten feet. The top of dam was surveyed to be level from the right end of the dam to a point 160 feet to the left. From this point, the top of dam slopes upward with a rise in elevation of 1.2 feet to the left end of the embankment. The minimum elevation of the top of dam was assumed to be 575.0 feet above mean sea level (M.S.L.) at the principal spillway. The embankment has a maximum structural height of 29.5 feet with side slopes of 1 vertical to 1.5 horizontal (1V to 1.5H) on the downstream face and 1V to 1.75H on the upstream face above the water surface.

There are two spillways at this damsite, which are referred to in this report as the principal and emergency spillways. The principal spillway is roughly a parabolic shaped, concrete channel cut into the right abutment (see Photos 4 and 5). The concrete spillway channel has a bottom width of nine feet, a depth of 0.75 feet, and a length of 45 feet with its centerline perpendicular to the axis of the dam. The inlet to the spillway is defined by two vertical concrete headwalls about one-foot tall and eight-inches thick (see Photo 6). The inlet is also the control section of the spillway with a crest width of nine feet and an invert elevation of 752.5 feet above M.S.L. A two-feet tall, welded wire and hardware cloth fishscreen extends across the spillway inlet. The fishscreen is supported by metal pipes set about 18 inches apart in the spillway concrete. The two end pipes are set in the two headwalls. Discharge through the spillway channel drops about five feet into the discharge channel, which has been eroded into the in situ weathered bedrock (see Photos 5 and 8). The discharge channel carries flow down the right abutment and towards the downstream channel. The downstream channel and the spillway discharge channel intersect about 50 feet downstream of the toe of the dam.

The emergency spillway is an earth- and weathered bedrock-lined channel cut into the left abutment (see Photo 9). The inlet and control section of the spillway is a concrete weir placed across the channel and located slightly upstream of the axis of the dam. The weir crest is ten-inches wide and has an elevation of 753.1 feet above M.S.L. The crest of the weir extends 15 feet across the full width of the spillway. A two-feet tall, welded wire fishscreen passes across the top of the weir. The fishscreen is supported by alternating metal fence posts and 1/4-inch diameter reinforcing bars set into the concrete weir. The right end of the weir is protected by one-foot diameter riprap. The channel immediately downstream of the weir is lined with 6- to 18-inch diameter riprap. The outlet channel is grass-lined as it proceeds past the axis of the dam. This changes to in situ weathered bedrock as the gradient of the channel steepens and the alignment swings toward the downstream channel. The channel is earth-lined as it proceeds down the left abutment, along a line approximately parallel with the axis of the dam, towards the downstream channel (see Photo 10).

A low-level outlet is provided to drain the reservoir. Mr. Merten states that a vertical, six-inch diameter, perforated, steel riser pipe is positioned near the upstream heel of the dam embankment. The riser is five-feet tall with the top capped. A six-inch diameter, 160-feet long, steel pipe is welded to the bottom of the riser. This pipe passes under the embankment of the dam approximately 214 feet from the right abutment with an alignment approximately perpendicular to the dam axis. According to Mr. Merten, the outlet pipe was placed in the natural streambed beneath the dam. Drawdown of the reservoir is controlled by a gate valve at the downstream end of the pipe (see Photo 12). The valve is enclosed in a brick masonry housing at the toe of the dam. The valve house top is a loose piece of sheet metal. Discharge through the valve flows out a six-inch diameter, steel outlet pipe. The outlet pipe passes through the housing sending discharge into an earth-lined channel, which becomes part of the downstream channel just downstream of the dam.

b. Location

Siesta Lake Dam is located in Jefferson County in the State of Missouri on an unnamed tributary of Fritz Creek. The dam is located approximately two miles northwest of DeSoto and 4.5 miles south of Hillsboro in the southeast quadrant of Section 28 of Range 4 East, Township 40 North, as shown on the DeSoto, Missouri Quadrangle (7.5 minute series, Advanced Print) sheet (see Plate 2).

c. Size Classification

The reservoir impoundment of Siesta Lake Dam is less than 1,000 acre-feet but more than 50 acre-feet, which would classify it as a "small" size dam. The maximum structural height of the dam is less than 40 feet and greater than 25 feet, which also classifies it 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 two miles downstream of the dam, are at least four dwellings, two trailers, two State highway crossings (Highways 21 and 110), and a warehouse (see Photos 15 and 16).

e. Ownership

Siesta Lake Dam is privately owned by Mr. and Mrs. Joseph Merten. The mailing address is: Mr. and Mrs. Joseph Merten, Route 6, Box 295, DeSoto, Missouri, 63020.

f. Purpose of Dam

The purpose of the dam is to impound water for a commercial, recreational, fishing lake.

g. Design and Construction History

According to Mr. Merten, the dam was built in 1957 by a Mr. Jarret. The compaction of the embankment was achieved by the activity of the earthmoving equipment across the fill. A core trench was excavated into sound bedrock along the axis of the dam. The trench was approximately six-feet wide and three- to four-feet deep. No drawings or specifications used to construct the dam exist.

There have been two modifications made at the damsite since the original construction of the dam. One was the addition of concrete to the principal spillway channel about ten years ago. The plain concrete was added to the spillway channel to arrest erosion of the channel. The other modification was the injection of grout into the foundation bedrock by use of mud jacks to stop leakage through the foundation, according to Mr. Merten. Leakage through the foundation bedrock was detected shortly after the dam was completed.

h. Normal Operational Procedures

Normal procedure is to allow the reservoir to remain as full as possible with the water level being controlled by rainfall, runoff, evaporation and the elevation of the principal spillway crest.

The gate valve for the six-inch diameter low-level outlet is operated during the spring months, according to Mr. Merten. This allows stagnant water to be released so that the reservoir can be recharged with fresh water during spring rainstorms. Mr. Merten also states that the valve is operated to assist the spillways in releasing water during heavy rainstorms.

1.3 Pertinent Data

a. Drainage Area (square miles):. . . 0.33

b. Discharge at Damsite

Estimated experienced maximum flood (cfs): 145

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

Principal Spillway	266
Emergency Spillway	162
Total	428

c. Elevation (Feet above MSL)

Top of dam (minimum):.	575 (assumed)*
Spillway crest:	
Principal Spillway	572.5
Emergency Spillway	573.1
Normal Pool:	572.5
Maximum Experienced Pool:.	574.0
Observed Pool:	569.1

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):.	1400

e. Storage (Acre-Feet)

Top of dam (minimum):.	78
Spillway crest:	
Principal Spillway	58
Emergency Spillway	63
Normal Pool:	58
Maximum Experienced Pool:.	70
Observed Pool:	40

f. Reservoir Surfaces (Acres)

Top of dam (minimum):.	9.0
Spillway crest:	
Principal Spillway	7.0

Emergency Spillway	7.5
Normal Pool:	7.0
Maximum Experienced Pool:	8.5
Observed Pool:	5.5

g. Dam

Type:	Rolled, Earthfill
Length:	460 feet
Structural Height:	29.5 feet
Hydraulic Height**:	29.5 feet
Top width:	10 feet
Side slopes:	
Downstream	1V to 1.5H (measured)
Upstream.	1V to 1.75H (above the water surface)
Zoning:	N.A., Homogeneous
Impervious core:	N.A.
Cutoff:	A trench was excavated into bedrock, according to Mr. Merten.
Grout curtain:	None
Freeboard above normal reservoir level:	2.5 feet (minimum)
Volume:	27,000 cu.yds., according to Mr. Merten

h. Diversion and Regulating Tunnel . . . . None

i. Spillways

Type:	
Principal Spillway	Concrete-lined channel, cut into right abutment, uncontrolled.
Emergency Spillway	Earth-lined channel, cut into left abutment, uncontrolled.

Length of crest:

Principal Spillway	9 feet
Emergency Spillway	15 feet

Crest Elevation (above MSL):

Principal Spillway	572.5
Emergency Spillway	573.1

j. Regulating Outlets

Type:.	Six-inch diameter, low-level outlet
Location:.	214 feet from the right side of the dam.
Length:.	160 feet, according to Mr. Merten
Closure:	Six-inch gate valve
Maximum Capacity:.	Unknown

* No exact elevation is known for the top of dam, therefore, an elevation was estimated from the DeSoto, Missouri, U.S.G.S. Quadrangle sheet. This estimated elevation is referred to as assumed elevation. All other elevations were determined from the assumed top of dam 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

Design drawings or calculations are not available for this dam.

2.2 Construction

The dam was built by a Mr. Jarret in 1957. No construction records or data are available concerning the construction of the dam, other than the construction history given in Section 1.2g.

2.3 Operation

No operational records are available for Siesta Lake Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is poor and consists only of 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. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation, and construction data, but is based primarily on the visual inspection, past performance history, and present

condition 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 documented engineering data pertaining to the design or construction of the dam were available. The information obtained from Mr. Merten, which could be field verified, was found to be accurate.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Siesta Lake Dam was made on March 4, 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
John Lauth, P.E.	PRC Consoer Townsend, Inc.	Civil-Structural
Joseph Merten	Owner	

Specific observations are discussed below.

b. Dam

The overall condition of the dam appears to be fair; however, some items of concern were noted and are discussed below.

The top of dam showed signs of occasional vehicular traffic across the dam; however, no major damage to the dam due to the traffic was apparent. Access to the dam is partially obstructed by the spillway channels at each end of the dam. The top of dam was somewhat irregular; however, the irregularity did not appear to be due to a settlement of the embankment. No major depressions or cracking indicative of an instability were observed. The major variation in the elevation across the top of dam did not appear to be due to an instability of the embankment or foundation. No significant deviation in the horizontal alignment was apparent. The top of dam was adequately protected against surface erosion by a maintained grass cover (see Photo 2). The dam has never been overtopped, according to Mr. Merten, and no evidence indicating the contrary was observed.

The upstream slope, for the most part, appears to be adequately protected against wave erosion by a layer of dumped riprap. The riprap consisted mainly of thinly bedded dolomite, which ranged from angular to round and, for the most part, ranged in size from six to three inches in diameter. Some concrete blocks and boulders up to 4 feet in diameter were also observed on the slope. No deterioration of the riprap was apparent. The riprap extended from the top of dam to well below the normal water surface level. Nevertheless, in some areas on the slope, the riprap did not extend to the top of dam and, consequently, the slope above the riprap has been steepened to near vertical due to wave erosion in these areas. Tree stumps measuring up to six inches in diameter and evidence that some brush has been burnt off the slope were observed. The trees appeared to have been recently cut down. No bulges, depressions or cracks indicative of any movement of the embankment or foundation were apparent.

The downstream slope was covered by a tall, unmaintained grass cover, which appeared to be providing adequate protection against surface runoff. However, due to the heavy grass cover, a comprehensive inspection of the slope was hampered. Several small to medium size trees and bushes were also growing on the slope. No bulges, depressions or cracks indicative of an instability of the slope were apparent. Nevertheless, some shallow surface sloughs, which appeared to be due to the steepness of the slope, were observed. The sloughs did not appear to indicate a major instability of the slope.

An area of moist boggy ground and standing water was observed along the toe of the dam extending from the left side of the dam to about the mid-section of the dam. It was undetermined whether the source of the water was due to recent rainstorms in the area or due to seepage through the embankment or foundation. In one section of this area near the left side of the dam, however, cattails were observed growing, which would indicate that moisture is generally present in this area. Nevertheless, no measurable flow of seepage was observed in the above mentioned area, on the embankment or downstream of the toe.

Both abutments slope gently upward from the dam. No instabilities, seepage or erosion, which were felt to be detrimental to the safety of the dam, were observed on either abutment, except for the erosion observed in both of the spillway discharge channels (see Section 3.1d).

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 the Fritz 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.

The topography in the vicinity of the damsite is rolling to hilly with U- to V-shaped valleys. Elevations of the ground surface range from 838 feet above M.S.L. nearly two miles west of the damsite to 560 feet above M.S.L. at the damsite. The reservoir slopes are generally from 4- to 10-degrees from horizontal. The reservoir slopes are stable and the reservoir appears to be watertight. The area near the damsite is covered with residual soil deposits consisting of a reddish-brown to orangey-brown, moderately plastic, silty clay with occasional 1/4- to 1-inch rock fragments.

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 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, 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, Roubidoux Formation, Gasconade Dolomite and St. Peter Sandstone.

Outcroppings of Ordovician Powell Dolomite (light, brownish-gray, fine to medium grained, very hard, thinly bedded dolomite) are exposed at the right abutment and in the discharge channels of the principal and the emergency spillways (see Photos 8 and 11).

No faults have been identified at the damsite. The closest trace of a fault to the damsite is the Ste. Genevieve fault system nearly three miles southwest of the damsite. The Ste. Genevieve fault had its last movement in post-Pennsylvanian time. Thus, the fault system has no effect on the damsite.

No boring logs or construction reports were available that would indicate foundation conditions encountered during construction. Based on the visual inspection and conversations with Mr. Merten, the embankment probably rests on Ordovician Powell Dolomite bedrock with the core trench excavated into the bedrock. The concrete-lined principal spillway was cut into the right abutment and rests on the thinly bedded dolomite bedrock. The emergency spillway was cut into the residual soils of the left abutment, which overlays the dolomite bedrock. The low-level outlet pipe probably partially rests on the dolomite bedrock, while the remaining portion of the pipe rests on the alluvial soils of the valley floor.

(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 cherty limestone. These soils vary from a slowly permeable silty clay to moderately permeable silt loam.

Material removed from the embankment slopes was a light brown, moderately plastic, silty clay with traces of fine sand and rock fragments up to 1/2-inch in diameter. Based upon the Unified Soil Classification System, the soil would probably 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) Principal Spillway

The concrete lining in the spillway channel is between 2- to 4-inches thick and non-reinforced. Mr. Merten said he had a truck load of concrete dumped in the spillway channel. He then troweled the concrete into the present shape of the spillway. The short apron approaching the spillway inlet was broken apart, most likely from mechanical weathering (see Photo 6). The headwalls of the inlet appeared sound; the concrete was not damaged; and there was no erosion evident around the foundations. The spillway was partially obstructed by the presence of the fishscreen; and Mr. Merten stated that he has had to remove debris from the screen to avoid clogging while the spillway was operating. The spillway surface was rough, with trowel marks evident along the entire length. There were numerous cracks in the concrete with grass growing through them (see Photo 4). There was a transverse/longitudinal crack starting three feet from the end of the spillway and encompassing the left third of this portion of the outlet (see Photo 7). This crack is the resultant from the undermining of the spillway outfall. Failure of this portion of the spillway is not imminent, but it is inevitable. The discharge channel of the spillway has been severly eroded, especially at the outlet end of the con-

crete channel (see Photo 8). The channel, for the most part, has been eroded to weathered bedrock. The weathered bedrock of the spillway discharge channel bottom was deteriorating and the earth sides were raw. The discharge channel was also obstructed by trees and debris.

(2) Emergency Spillway

The concrete weir control section of the spillway appeared sound. The weir crest was partially obstructed by the presence of the fishscreen. There was no erosion seen at the ends of the weir, although the left side was not protected by riprap. The ripraped outfall of the weir appeared stable. An erosion gully in the channel, beginning 25 feet downstream of weir, was the only damage observed in the flatter portion of the discharge channel (see Photo 9). More serious erosion was evident where the spillway discharge channel curves toward the downstream channel (see Photo 10). Here the earth side slopes were raw and large scale sloughing of the banks was observed. Brush, trees and several 55-gallon drums were found in the channel.

(3) Low-Level Outlet

The portion of the low-level outlet observed appeared to be in good condition. There was no sign of erosion or piping around the valve house. The masonry house appeared sound. Mr. Merten dumped waste motor oil on the valve the day of the inspection; and, he said he does this periodically to prevent seizure of the valve mechanism. A futile attempt was made by the inspection team on the day of inspection to operate the valve; however, Mr. Merten stated that the valve is operable and that he uses a wooden board as a lever to facilitate the operation of the valve. The outlet channel from the valve house was earth-lined and appeared to be stable.

e. Reservoir Area

The reservoir water surface elevation at the time of the inspection was 569.1 feet above M.S.L. The normal water surface in the reservoir is at 572.5 feet above M.S.L., which is the elevation of the principal spillway crest. The surface area of the reservoir at the normal water level is about seven acres.

The rim appeared to be stable with no major erosional problems observed. The land around the reservoir slopes gently to moderately upward from the rim and is mostly wooded and grass covered (see Photo 14). One house is built upstream of the reservoir. The area around the rim is used mainly for recreational purposes. No evidence of excessive siltation was observed in the reservoir on the day of the inspection.

f. Downstream Channel

The downstream channel near the dam is the natural streambed. The channel is undefined and obstructed with trees and bushes (see Photo 13). Both spillway discharge channels intersect the downstream channel just downstream of the dam and the low-level outlet discharges directly into the channel.

3.2 Evaluation

The visual inspection uncovered nothing of a consequential nature which would require immediate remedial action. However, the following conditions were observed which could adversely affect the dam in the near future.

1. The area of moist boggy ground and standing water along the toe of the dam could affect the structural stability of the dam, however, it was undetermined if the condition was due to seepage or recent rainstorms in the area. Nevertheless, if the moisture was indeed due to seepage and the rate of seepage were to increase, it

is possible that the seepage could transport soil particles. This could cause piping of embankment material, which could lead to an eventual failure of the embankment. No flowing seepage was observed in the area on the day of the inspection.

2. The damage to the concrete of the principal spillway channel does not appear to presently pose a hazard to the dam. But, complete disintegration of the concrete from mechanical weathering, flow through the spillway and undermining of the outfall, is inevitable.

3. The erosion in the principal spillway discharge channel for the most part does not appear to affect the stability of the embankment. However, the degradation of the channel at the spillway outfall, and subsequent undermining does constitute a stability hazard for the principal spillway.

4. The erosion in the emergency spillway is not a current threat to the dam. But, with time, this condition will worsen and the safety of the dam could be jeopardized.

5. The obstruction in both of the spillway discharge channels by trees and debris does not endanger the safety of the dam, but they do have an adverse effect on the safe operation of the spillways.

6. The trees, bushes and unmaintained grass cover observed on the downstream slope 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 growth of vegetation on the embankment hinders a comprehensive inspection of the dam, which could allow potential problems to go undetected. Removal of trees should be under the guidance of an engineer experienced in the design and construction of earth dams. Indiscriminate clearing of trees could jeopardize the safety of the dam.

7. The wave erosion on the upstream slope above the riprap does not appear to affect the stability of the dam in its present condition. However, continual erosion of the slope can only be detrimental to the structural integrity of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Siesta Lake Dam is used to impound water for use as a commercial, recreational, fishing lake. The water level below the principal spillway crest is normally allowed to remain as high as possible. The six-inch diameter, low-level outlet is operated periodically and whenever the need arises as outlined in Section 1.2h.

4.2 Maintenance of Dam

The dam is maintained by the owner, Mr. Merten. Mr. Merten had recently cut several small trees and saplings from the upstream and downstream slopes of the dam; however, several small to medium sized trees still remained on the downstream slope. He also periodically mows the grass on the top of dam and removes debris from the fishscreens at the entrance of the two spillways.

4.3 Maintenance of Operating Facilities

Mr. Merten dumped waste motor oil on the gate valve of the low-level outlet on the day of the inspection. This is done periodically to prevent the valve from seizing. The valve is kept in an operable condition; however, the inspection team was unable to operate the valve on the day of the inspection.

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 maintenance at Siesta Lake Dam appears to be fair at this time; however, the remedial measures described in Section 7 should be undertaken 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 Siesta Lake Dam. The sizes of physical features utilized to develop the stage-outflow relation for the spillways 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. DeSoto, Missouri Quadrangle topographic map (7.5 minute series, Advanced Print). The spillways and overtop release rates and the reservoir elevation-area data are presented in Appendix B.

The hydrologic soil groups 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 rainfall and the 10-year rainfall, respectively, of Sullivan, Missouri.

b. Experience Data

Records of reservoir stage or spillway discharge are not maintained for this site. However, according to Mr. Merten, the maximum reservoir level was approximately 18 inches above the crest of the principal spillway.

c. Visual Observations

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

d. Overtopping Potential

Both the Probable Maximum Flood, and one-half of the Probable Maximum Flood when routed through the reservoir, resulted in overtopping of the dam. The peak inflows for the PMF and one-half of the PMF are 3,880 cfs and 1,920 cfs, respectively. The peak outflow discharges for the PMF and one-half of the PMF are 3,817 and 1,802 cfs, respectively. The maximum capacity of the spillway just before overtopping the dam is 428 cfs. The PMF overtopped the dam by 1.83 feet and one-half of the PMF overtopped the dam by 1.06 feet. The total duration of overflow over the top of dam is 5.58 hours during the occurrence of the PMF and 1.25 hours during one-half of the PMF. The spillway/reservoir system of Siesta Lake Dam is capable of accommodating a flood equal to approximately 15 percent of the PMF just before overtopping the dam. Further evaluation showed that Siesta Lake Dam will be overtopped by about 0.20 feet for a duration of 20 minutes during the occurrence of the one-percent chance flood (100-year flood). The reservoir/spillway system of Siesta Lake Dam, however, will accommodate the ten-percent chance flood (10-year flood) without overtopping the dam.

The surface soils on the embankment and in the emergency spillway channel appear to be a silty clay. The emergency spillway channel and the top of dam have a good cover of grass. The dam will be overtopped by less than 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 maximum velocity of flow in the emergency spillway during the PMF will be about 8.0 ft/sec, which

could also cause excessive erosion in the earth-lined spillway channel due to the high velocity of flow. The principal spillway will also sustain more damage during the occurrence of the PMF, especially at the outlet end of the concrete channel.

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 approximately two miles downstream of the dam. Located within the damage zone are at least four dwellings, two trailers, two state highway crossings (Highways 21 and 110) and a warehouse.

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 angles of the embankment slopes, especially the downstream slope of 1V to 1.5H, are generally not the recommended slope angles for this type of an earthfill dam from a structural stability standpoint. The area of possible seepage along the downstream toe of the dam could be detrimental to the stability of the embankment, but it does not appear to constitute an unsafe condition at this time. It was unknown whether the source of the moisture was due to seepage or recent rainstorms. Nevertheless, if the condition was due to seepage, with time, the condition can only worsen. The wave erosion on the upstream slope does not appear to endanger the structural stability of the embankment in its present condition; however, continual erosion of the slope could be detrimental to the embankment. In the absence of seepage and stability analyses, no quantitative evaluation of the structural stability can be made.

The structural stability of the principal spillway concrete channel appears questionable due to the evident deterioration, the undermining at the outlet end and the lack of reinforcement. Nonetheless, the condition of the spillway does not constitute an unsafe condition at this time. The emergency spillway appeared to be structurally stable with the exception of the erosion present in the discharge channel. Both spillways are partially obstructed by fishscreens located at the control sections. The presence of these fishscreens can only impair the proper operation

of the spillways. The discharge channels of the spillways are also obstructed with trees and debris.

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 operating records are available relating to the stability of the dam or appurtenant structures. The water level on the day of inspection was 3.4 feet below the crest of the principal spillway; however, the reservoir remains close to the normal pool level most of the time.

No evidence was observed that would indicate that the drawing down of the reservoir by the low-level outlet has had any effect on the structural stability of the dam. It is also felt that due to the small size of low-level outlet and the volume of water stored in the reservoir that drawing down the reservoir by means of the outlet should not have any effect on the stability of the dam.

d. Post Construction Changes

The only modifications made at the damsite since the construction of the dam, which would have any effect on the stability of the dam and appurtenant structures, were the addition of concrete to the principal spillway channel and the grouting of the foundation bedrock. Both of these modifications have a positive effect on the stability of the dam and spillway.

e. Seismic Stability

The dam is located in Seismic Zone 2, as defined in the "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers (see Plate 9). 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 January 24, 1902 event of magnitude 5 located at a distance of 37 miles northeast 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 the buried pre-Quaternary fault. The attenuation of this event to the damsite would produce a peak ground acceleration of less than 0.05g which could 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 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 capacity of Siesta Lake Dam is found to be "Seriously Inadequate". The spillway/reservoir system will accommodate about 15 percent of the PMF without overtopping the dam. If the dam is overtopped, the safety of the embankment would be in jeopardy. Due to the susceptibility of the embankment materials to erosion, high velocity flow on the downstream slope could cause excessive erosion and eventually lead to a failure of the dam. The spillways would also receive considerable damage during the occurrence of a PMF.

The overall condition of the dam and spillway appears to be fair; however, some items of concern were noted that will require 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 and appurtenant structures, however, appear to have performed satisfactorily since their construction without failure or evidence of instability except for the erosion at the outlet end of the concrete channel of the principal spillway. The dam has never been overtopped, according to Mr. Merten, and no evidence indicating the contrary was observed. The safety of the dam can only be improved if the deficiencies described in Sections 3.2 and 6.1a are properly corrected as described in Section 7.2b.

b. Adequacy of Information

The conclusions presented in this report are based on field measurements, past performance and present condition of the dam. 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 items recommended in paragraph 7.2a should be pursued on a high priority basis. The 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. Alternatives

There are several options that may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these options are:

1. Increase the capacity of the spillways to pass the PMF, without overtopping the dam. The spillway should also be protected to prevent excessive erosion during the occurrence of the PMF.

2. Increase the height of the dam in order to pass the PMF without overtopping the dam; an investigation should also include studying the effects that increasing the height of the dam would have on the structural stability of the present embankment. The overtopping depth during the occurrence of the PMF, stated in Section 5.1d, is not the required or recommended increase in the height of the dam.

3. A combination of 1 and 2 above.

b. O & M Procedures

1. The area of possible seepage along the downstream toe of the dam should be monitored to detect any flow of water or changes in location of the area. Any changes of the condition of the area should be investigated further by a qualified professional engineer and proper repairs made as

required.

2. Consideration should be given to the replacement of the present concrete of the principal spillway channel with a more stable structure.

3. The erosion in both spillway discharge channels should be repaired and stabilized.

4. The trees, brush, and debris should be removed from both of the spillway discharge channels to allow the spillways to function properly.

5. The trees and brush on the downstream slope should be removed from the embankment and regrowth prevented. The grass cover on the embankment, especially on the downstream slope, and in the emergency spillway channel should be periodically maintained. The grass cover should be retained on the downstream slope and in the spillway channel to protect them from erosion and to prevent excessive erosion in the event the dam is overtopped or during high flows through the spillway. Removal of trees should be under the guidance of an engineer experienced in the design and construction of earth dams. Indiscriminate clearing of trees could jeopardize the safety of the dam.

6. The wave erosion on the upstream slope should be properly repaired and the slope protected from further damage.

7. The fishscreens at the inlets of both spillways should either be continuously cleared of all debris or removed altogether.

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

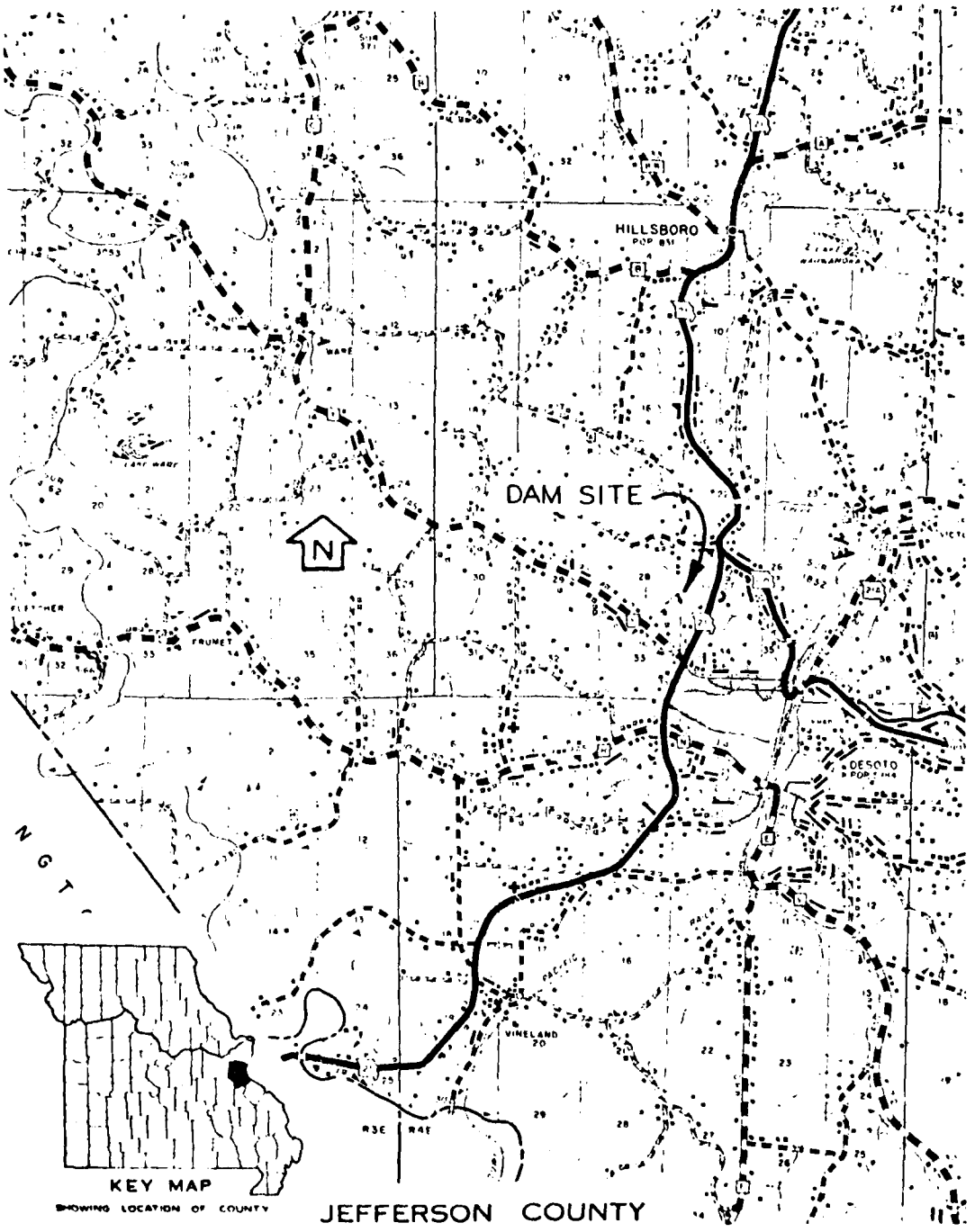
9. The owner should initiate the following programs:

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

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

PLATES

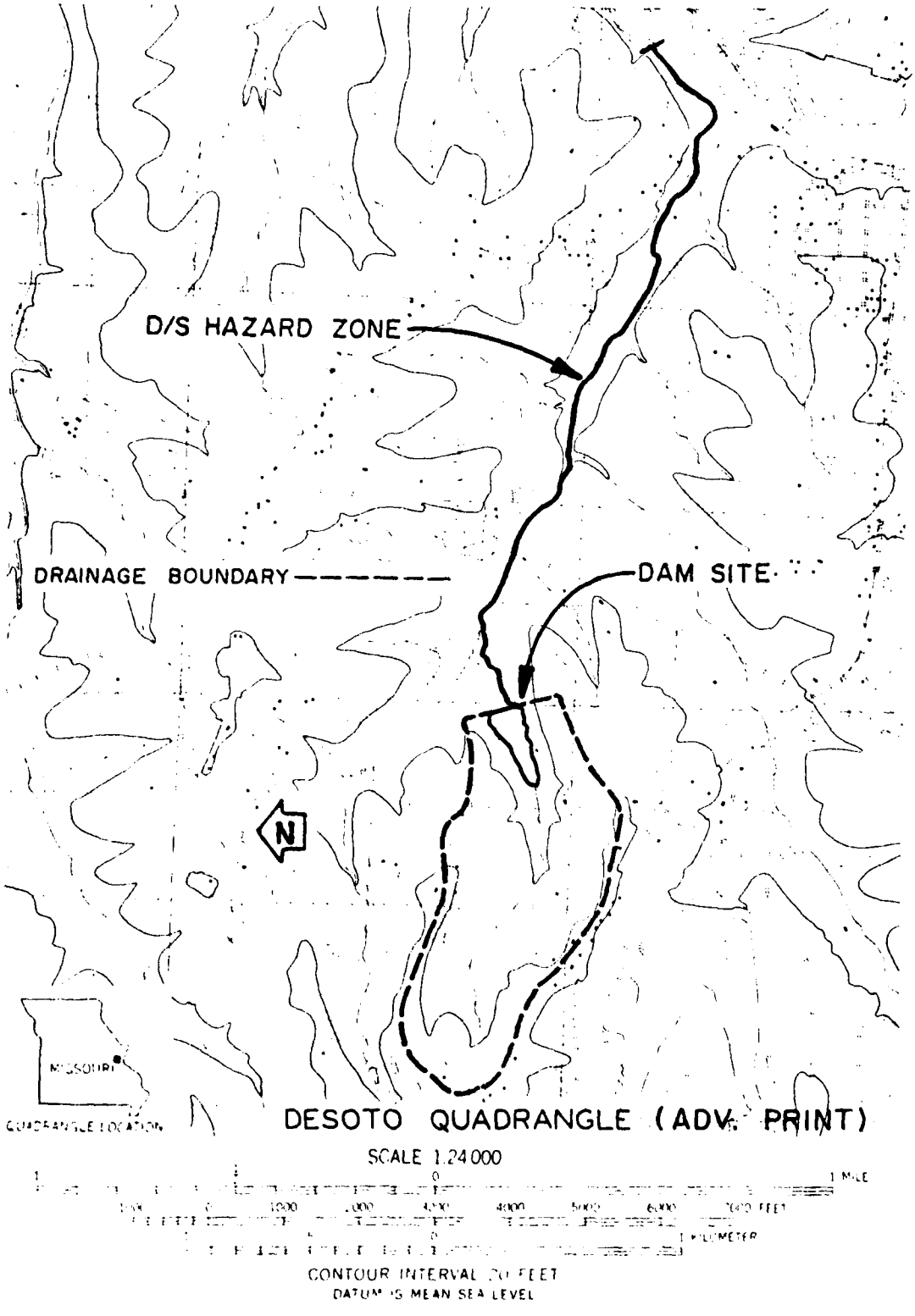
PLATE 1



LOCATION MAP - SIESTA LAKE DAM

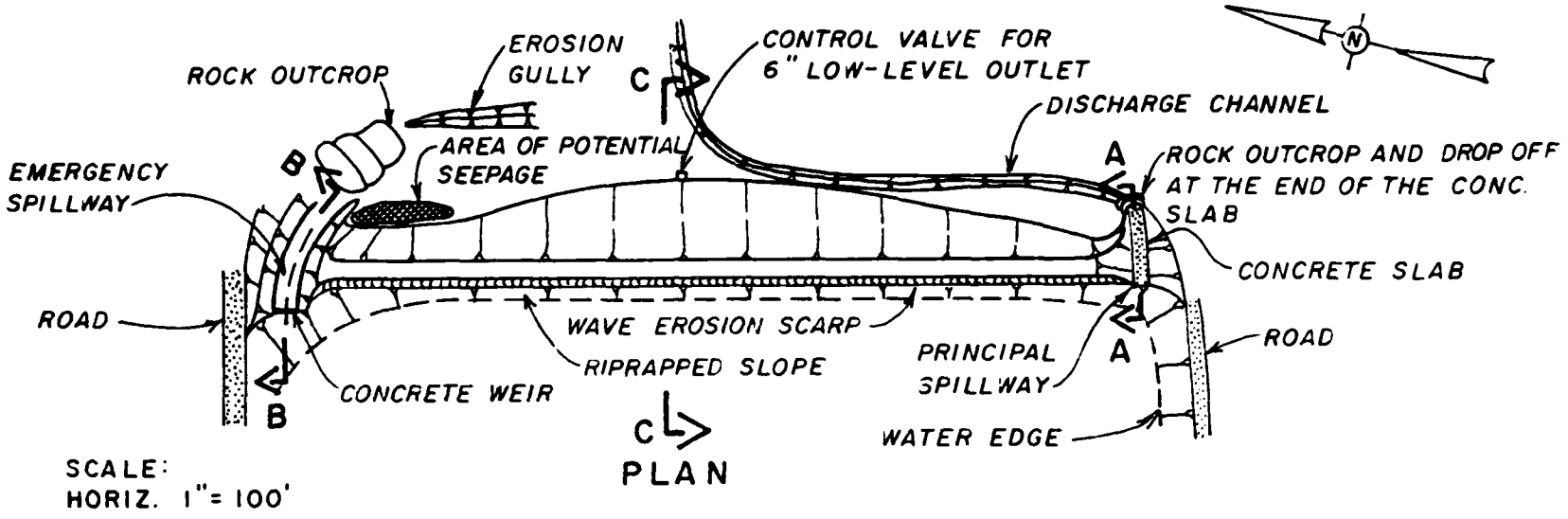
MO. 31199

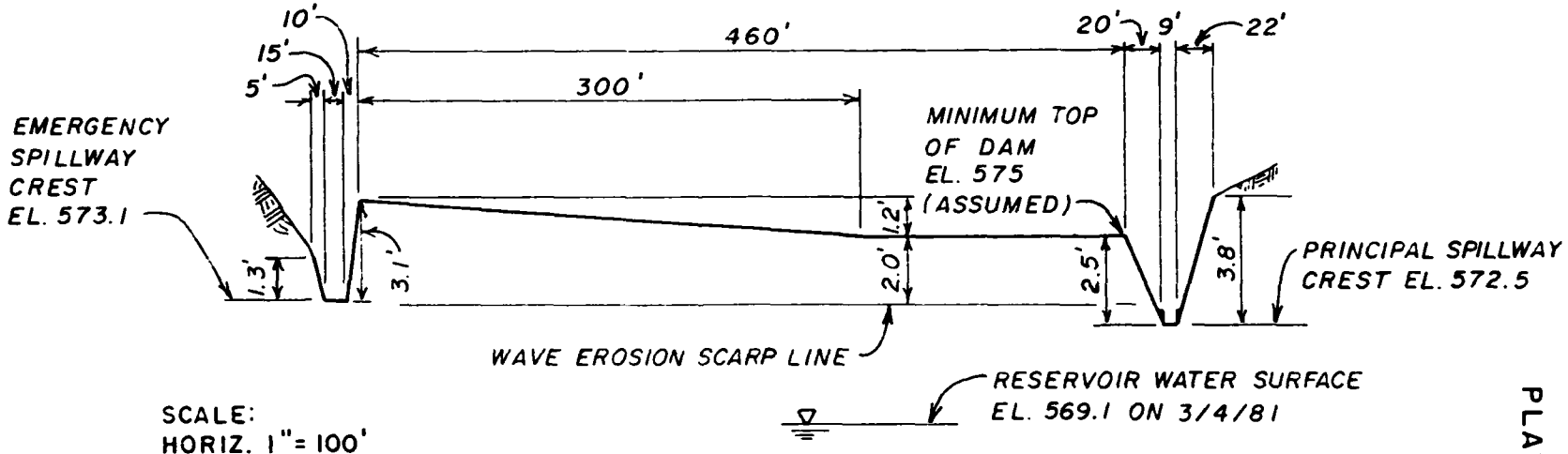
PLATE 2



SIESTA LAKE DAM (MO. 31199)

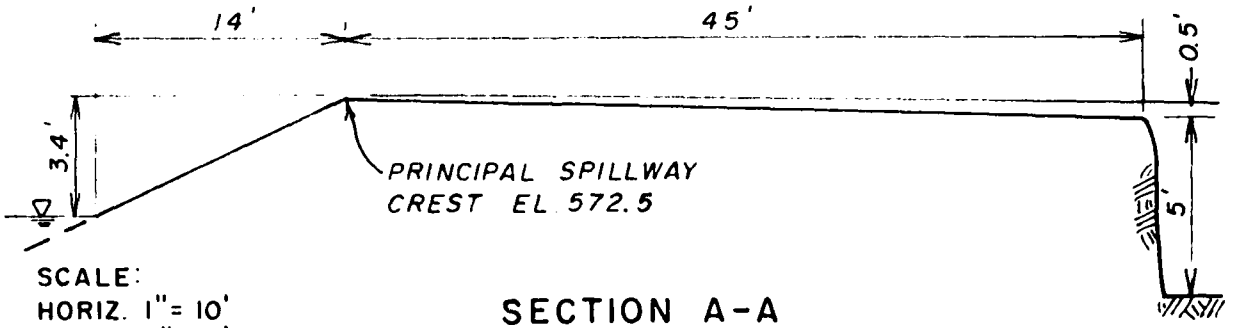
DRAINAGE BASIN AND
DOWNSTREAM HAZARD ZONE





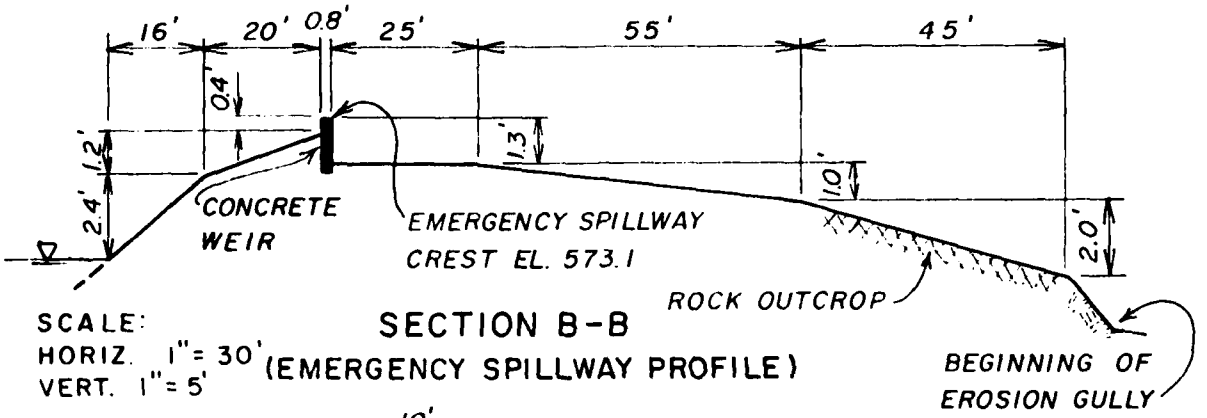
SIESTA LAKE DAM (MO. 31199)
PLAN AND ELEVATION
(SHEET 1 OF 2)

PLATE 3



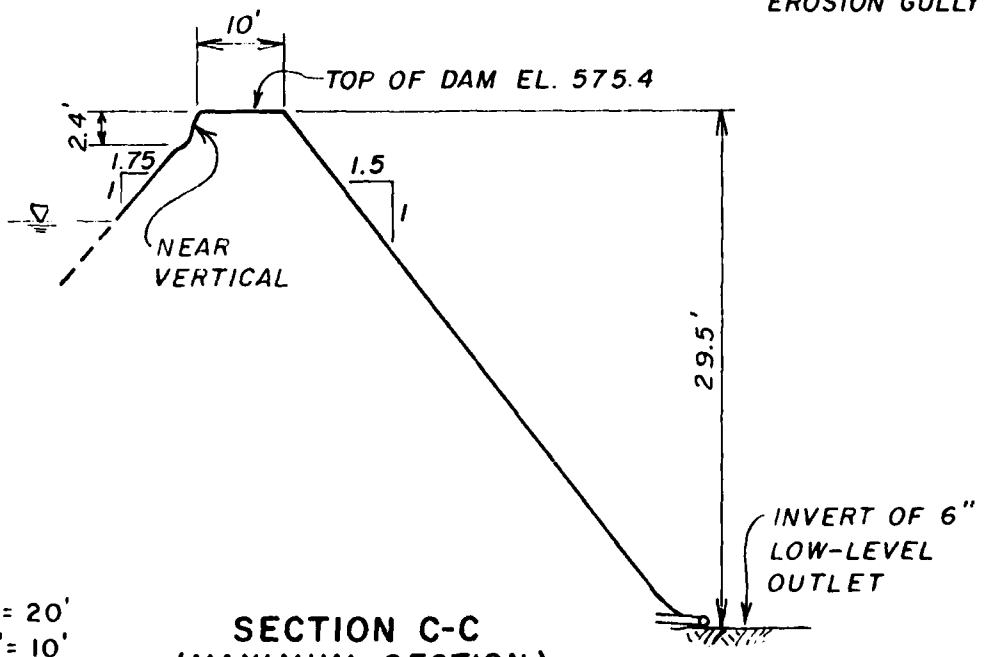
SCALE:
HORIZ. 1" = 10'
VERT. 1" = 5'

SECTION A-A
(PRINCIPAL SPILLWAY PROFILE)



SCALE:
HORIZ. 1" = 30'
VERT. 1" = 5'

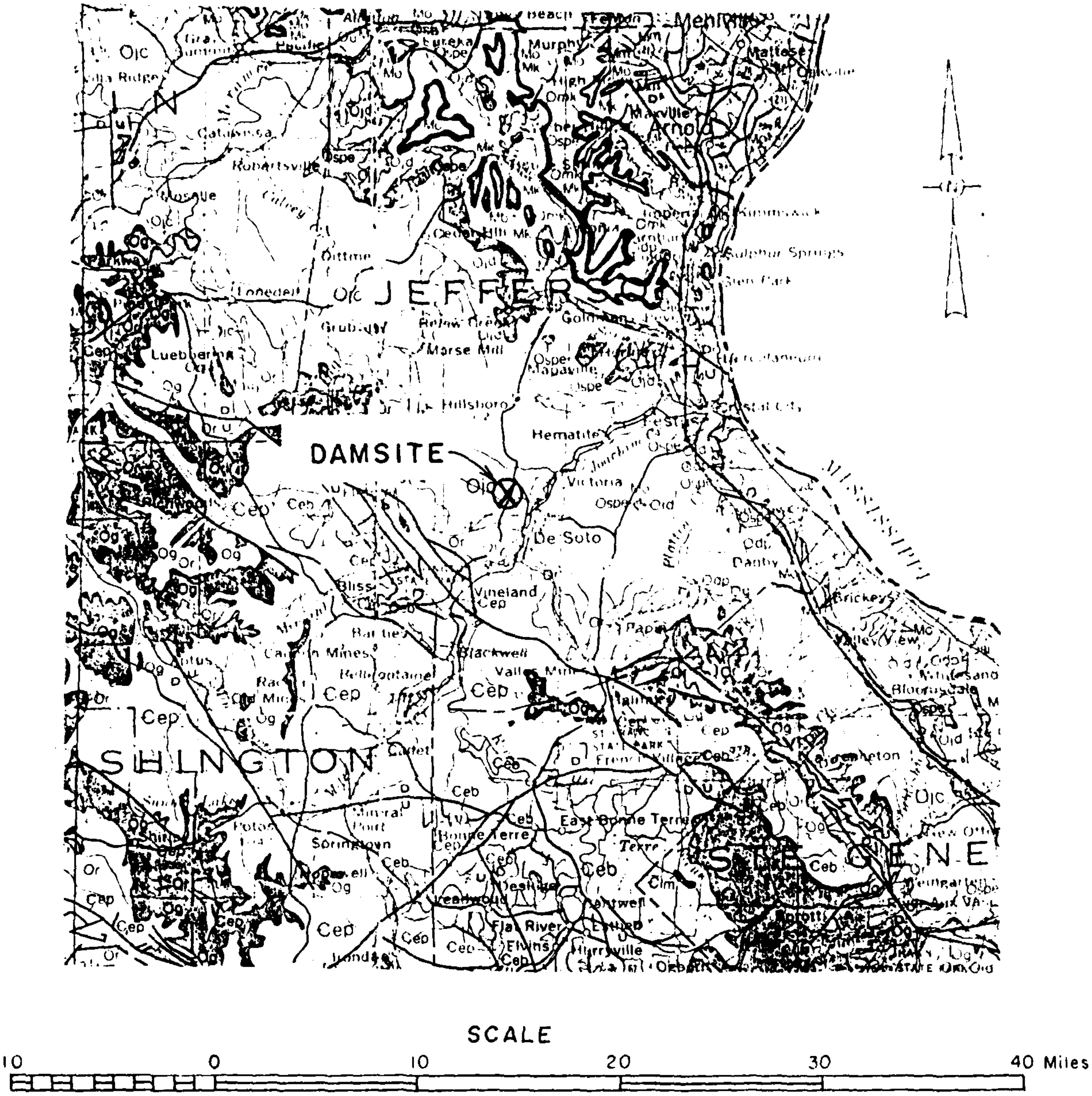
SECTION B-B
(EMERGENCY SPILLWAY PROFILE)



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

SECTION C-C
(MAXIMUM SECTION)

SIESTA LAKE DAM (MO. 31199)
SPILLWAY PROFILES AND MAXIMUM SECTION
(SHEET 2 OF 2)



⊕ LOCATION OF DAM

NOTE: LEGEND FOR THIS MAP IS ON PLATES 6 THROUGH 8

REFERENCE:

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

REGIONAL GEOLOGICAL MAP OF SIESTA LAKE DAM (MO 31199)

LEGEND

PERIOD	SYMBOL	DESCRIPTION
QUATERNARY	Qal	ALLUVIUM: SAND, SILT, GRAVEL
MISSISSIPPIAN	Mm	ST. LOUIS FORMATION: LIMESTONE INTERBEDDED WITH SHALE
	Mm	SALEM FORMATION: LIMESTONE INTERBEDDED WITH SHALE AND SILTSTONE
	Mo	KEOKUK- BURLINGTON FORMATION: CHERTY GRAYISH BROWN SANDY LIMESTONE
	Mk	UNDIFFERENTIATED CHOUTEAU GROUP: LIMESTONE
	Mk	HANNIBAL FORMATION: SHALE AND SILTSTONE

LEGEND

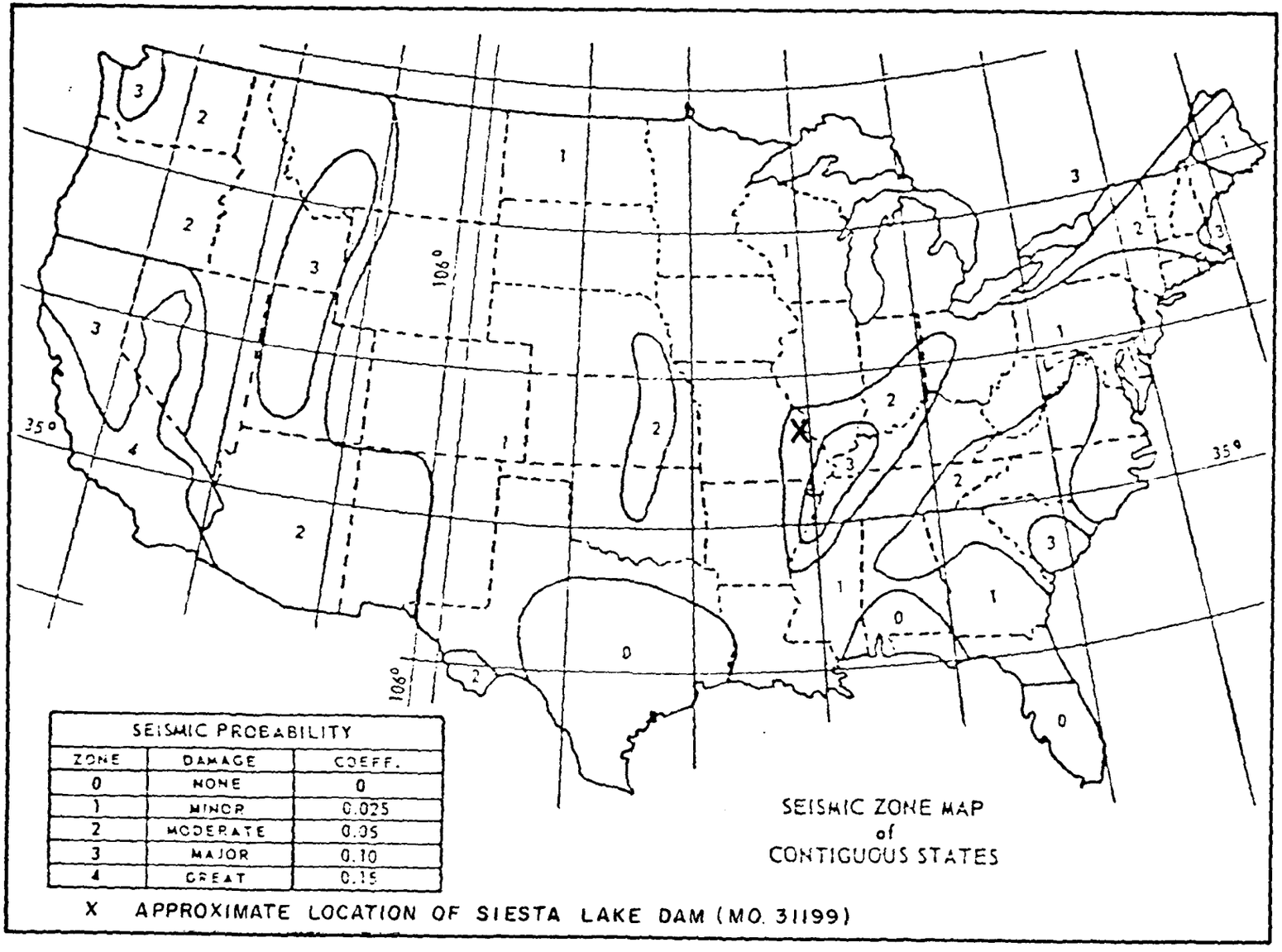
PERIOD	SYMBOL	DESCRIPTION
ORDOVICIAN	Ou	NOIX LIMESTONE
	Omk	MAQUOKETA SHALE, KIMMSWICK LIMESTONE
	Odp	DECORAH FORMATION: GREEN TO GRAY CALCAREOUS SHALE WITH THIN FOSSILIFEROUS LIMESTONE
	Ospe	ST. PETER SANDSTONE, EVERTON FORMATION
	Ojd	JOACHIM DOLOMITE
	Ojc	POWELL DOLOMITE, COTTER DOLOMITE
	Or	ROUBIDOUX FORMATION: INTERBEDS OF CHERTY LIMESTONE AND SANDSTONE
	Og	GASCONADE DOLOMITE

SIESTA LAKE DAM (MO. 31199
PLATE 8
SHEET 3 OF 3

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 SIESTA LAKE DAM (MO. 31199)

PLATE 9

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

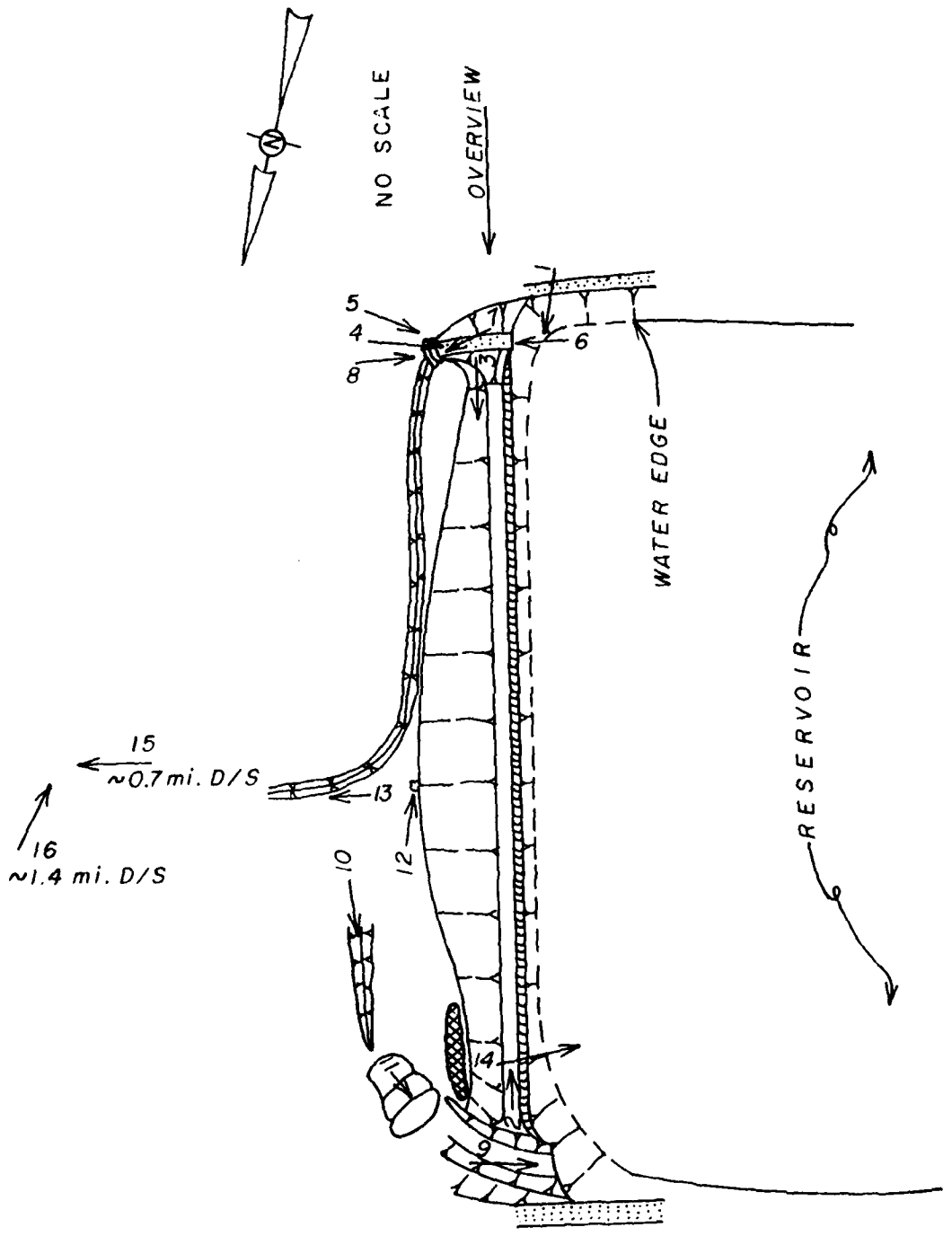


PHOTO INDEX FOR SIESTA LAKE DAM

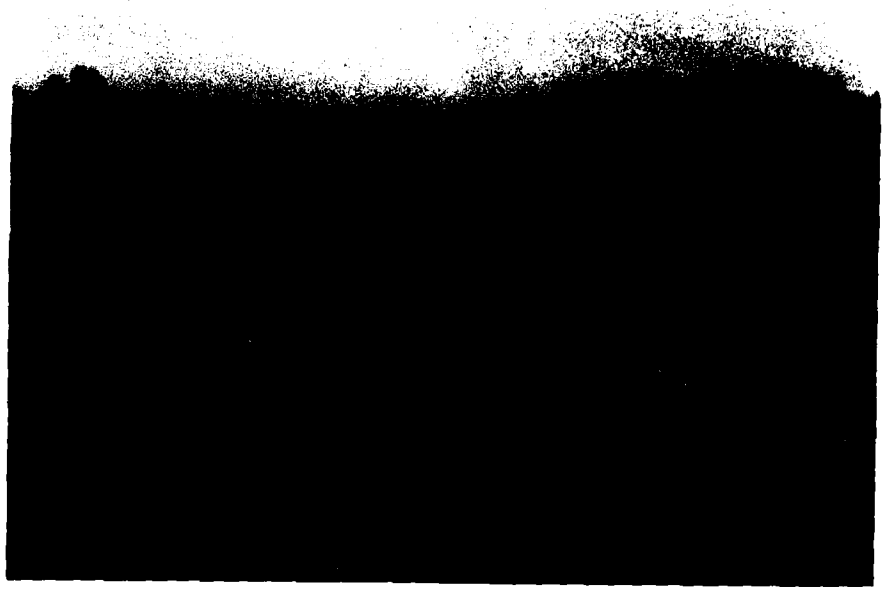


Photo 1 - View of the upstream slope from the right abutment showing the riprap protection.

Photo 2 - View of the top of dam from the left abutment.

Photo 3 - View of the downstream slope from the right abutment.

Photo 4 - Close-up view of the principal spillway channel looking upstream.

Photo 5 - View of the drop-off at the outlet of the principal spillway channel.

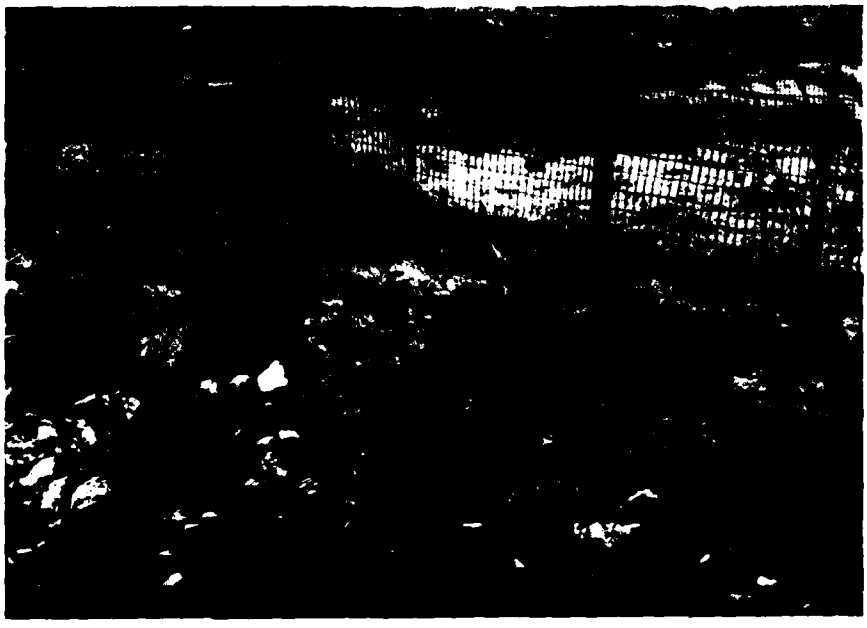


Photo 6 - Close-up view of principal spillway control section, headwall, and fishscreen, looking downstream.

Photo 7 - Close-up view of the cracking of the concrete in the principal spillway channel at the downstream end.

Photo 8 - Close-up view of the thinly bedded dolomite at the drop-off of the principal spillway channel outlet.

Photo 9 - View of the emergency spillway control section weir, looking upstream towards the reservoir.

Photo 10 - View of the emergency spillway discharge channel, looking upstream. Note the rock outcrops in the center of the Photo.

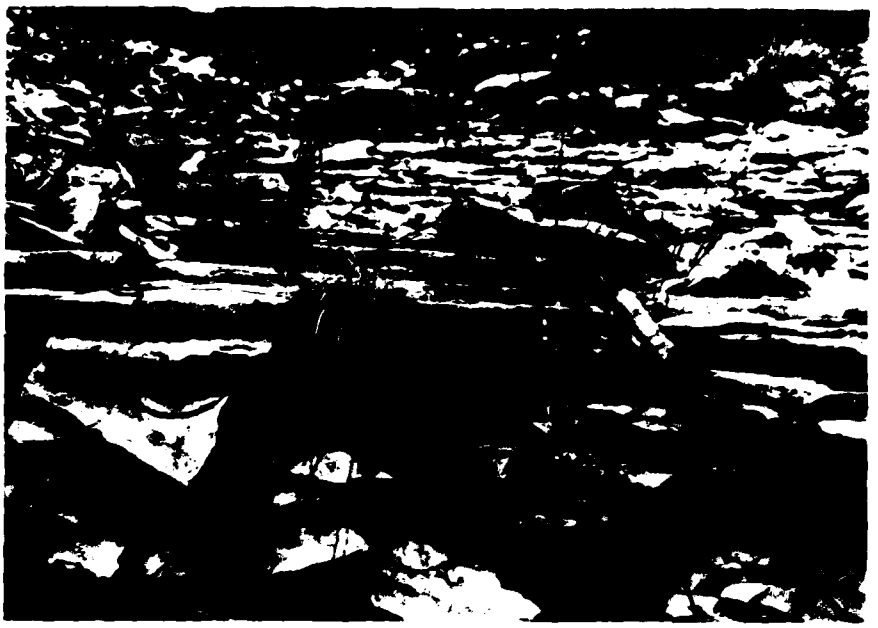


Photo 11 - Close-up view of the thinly bedded dolomite in the emergency spillway discharge channel.

Photo 12 - Close-up view of the low-level outlet control valve, outlet pipe and valve house.

Photo 13 - View of the downstream channel looking downstream from the toe of the dam.

Photo 14 - View of the reservoir and rim.

Photo 15 - View of a dwelling and trailer in the downstream hazard zone with the downstream channel on the right-hand side of the Photo.

Photo 16 - View of dwelling in the downstream hazard zone looking across the downstream channel.

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

SIESTA 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, 24-hour 100-year rainfall and 24-hour 10-year rainfall of Sullivan, Missouri.

   (b) Drainage area = 0.33 square miles.

   (c) Lag time = 0.17 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 spillways are based on critical depth assumption. Flow rates over the dam are based on the broad crested weir equation $Q = CLH^{3/2}$ and critical depth assumption.

3. The principal and emergency spillways and the dam overtop rating curves are hand calculated, in accordance with the procedures used in the HEC-1 computer program, and combined as shown on pages B-4 and B-5. 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 were routed through Siesta Lake to determine the capability of the spillways.

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

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

DAM NAME: SIEETA LAKE DAM (MO. 31199) — JOB NO. 1283

UNIT HYDROGRAPH PARAMETERS — BY AK — DATE 3 FEB 2

1) DRAINAGE AREA, $A = 0.33$ sq. mi = (211 acres)

2) LENGTH OF STREAM, $L = (2.25'' \times 2000' = 4500') = .85$ mi.

3) ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM,

$H_1 = 763'$

4) ELEVATION OF RESERVOIR AT SPILLWAY CREST, $H_2 = 572.5$

5) ELEVATION OF CHANNEL BED AT 0.85L, $E_{85} = 700'$

6) ELEVATION OF CHANNEL BED AT 0.10L, $E_{10} = 580'$

7) AVERAGE SLOPE OF THE CHANNEL, $S_{AVG} = (E_{85} - E_{10})/0.75L = .036$

8) TIME OF CONCENTRATION:

A) BY KIRPICH'S EQUATION,

$t_c = [(11.9 \times L^3)/(H_1 - H_2)]^{0.385} = [11.9 \times (0.85)^3/(190.5)]^{.385} = 0.28$ hrs

B) BY VELOCITY ESTIMATE,

SLOPE = 3.6% $\Rightarrow$ AVG. VELOCITY = 3.0 ft/sec.

$t_c = L/V = 4500\text{ ft}/(3.0\text{ ft/sec}) = 1500\text{ sec} = .42$ hr.

USE $t_c = 0.28$ hr

9) LAG TIME, $t_l = 0.6\, t_c = 0.17$ hr

10) UNIT DURATION, $D \leq t_l/5 = 0.057$ $<$ 0.083 hr.

USE $D = 0.083$ hr.

11) TIME TO PEAK, $T_p = D/2 + t_l = 0.21$ hr.

12) PEAK DISCHARGE,

$q_F = (484 \times A)/T_F = [484\ (0.33)]/0.21 = 760$ cfs

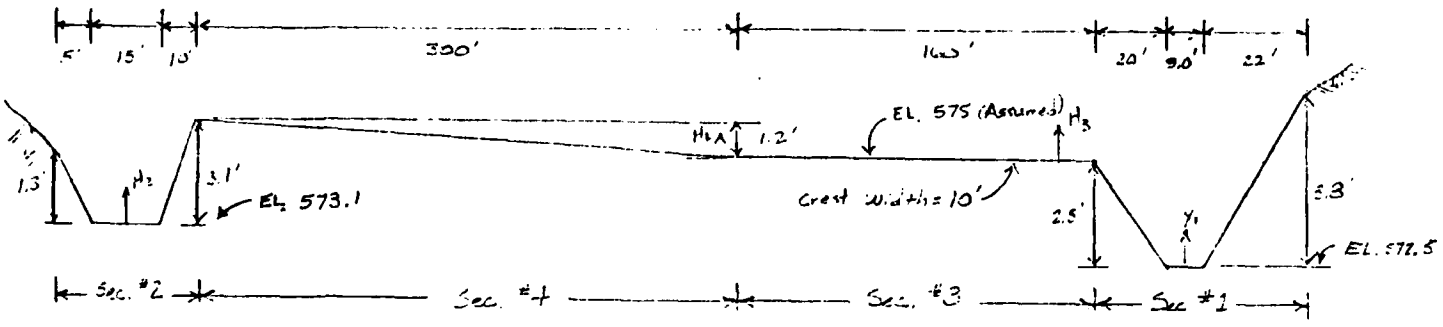
ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Missouri Dam Safety Inspection — SHEET NO. ____ OF ____

Siesta Lake Dam (MO 31199) — JOB NO. 1283

Reservoir Elevation-Area Data — BY JFK DATE 3/26/81

Elevation (ft, NGVD)	Area (ac)	Remarks
550	0	Estimated stream bed elev. U/S of dam
560	2.0	Interpolated
570	5.5	Interpolated
572.5	7.0	Principal Spillway Crest
573.1	7.5	Emergency Spillway Crest
575	9.0	Minimum Top of Dam (Assumed)
580	14.0	Measured on U.S.G.S. 7.5' Quad (DeSoto)
590	24.0	Interpolated
600	30.5	Measured on U.S.G.S. 7.5' Quad (DeSoto)



Section #1*: for; $0 < y_1 < 2.5$ | $2.5 < y_1 < 3.9$ | $y_1 > 3.9$

$A = 9.0y_1 + 6.89y_1^2$ | $A = 25 + 29.0y_1 + 2.89y_1^2$ | $A = 51.0y_1 - 66.8$

$T = 9.0 + 13.79y_1$ | $T = 29.0 + 5.79y_1$ | $T = 51.0$

$W.S.EL. = 572.5 + y_1 + V_1^2/2g$

Section #2*: for; $0 < y_2 < 1.3$ | $1.3 < y_2 < 3.1$ | $y_2 > 3.2$: $y_2 = W.S.EL. - 573.1 - V_2^2/2g$

$A = 15y_1 + 3.54y_2^2$ | $A = 1.61y_2^2 + 30y_2 - 3.23$ | $A = 30y_2 - 18.75$

$T = 15 + 7.07y_2$ | $T = 30 + 3.23y_2$ | $T = 30$

Section #3: $Q = CLH_3^{3/2}$, $H_3 = W.S.EL. - 575$

$Q = C(L-0)H_3^{3/2}$

Section #4*: for; $y_4 \leq 1.2$ | $1.2 < y_4$

$y_4 = 4/5\, H_4$ | $y_4 = 2/3(H_4 + 0.3)$

$A = 125y_4^2$ | $A = 333.3y_4 - 130$

$T = 250y_4$ | $T = 300$

* for Sections #1, #2, and #4: $Q = \sqrt{A^3 g/T}$

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

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

Siesta Lake Dam (I.D. 31197) — JOB NO. 1283

Spillway and Overtop Rating Curve — BY JFK DATE 3/26/81

y_1	A_1	T_1	V_1	Q_1	H_1	W.S.EL.	H_2	y_2	A_2	T_2	V_2	Q_2
0	0	0	0	0	0	572.5						
0.3	3.3	13.1	2.9	9	0.4	572.9	0	0	0	0	0	0
0.5	6.2	15.9	3.6	22	0.7	573.2	0.1	.07	1.1	15.5	1.5	2
0.8	11.6	20.0	4.3	50	1.1	573.6	0.5	.35	5.7	17.5	3.2	18
1.0	15.9	22.8	4.7	73	1.3	573.8	0.7	.48	8.0	18.4	3.7	30
1.3	23.4	26.9	5.3	123	1.7	574.2	1.1	.77	13.6	20.4	4.6	63
1.5	29.0	29.7	5.6	163	2.0	574.5	1.4	.99	18.3	22.0	5.2	95
1.8	38.5	33.8	6.1	233	2.4	574.9	1.8	1.28	25.0	24.1	5.8	145
2.0	45.6	36.6	6.3	289	2.6	575.1	2.0	1.42	28.4	24.6	6.1	173
2.3	57.2	40.7	6.7	384	3.0	575.5	2.4	1.71	35.7	25.5	6.7	239
2.5	65.6	43.5	7.0	457	3.3	575.8	2.7	1.85	39.3	26.0	7.0	274
2.8	78.9	45.2	7.5	591	3.7	576.2	3.1	2.21	48.8	27.1	7.6	372
3.0	88.1	46.4	7.8	689	3.9	576.4	3.3	2.35	52.7	27.6	7.8	413
3.3	102.2	48.1	8.3	846	4.4	574.9	3.8	2.71	62.8	28.7	8.4	527
3.5	112.0	49.3	8.6	958	4.6	577.1	4.0	2.86	67.1	29.2	8.6	577

W. S. EL.	H_3	C	Q_3	H_4	y_4	A_4	T_4	P_4	Q_{TOTAL}
572.5									0
572.9									9
573.2									24
573.6									68
573.8									103
574.2									186
574.5									258
574.9	0	0	0	0	0	0	0	0	378
575.1	0.1	2.92	15	0.1	0.08	0.8	20.	1	478
575.5	0.5	3.02	171	0.5	0.40	20.	100.	51	845
575.8	0.7	3.03	284	0.7	0.56	39.2	140.	118	1133
576.2	1.2	3.04	637	1.2	0.96	115.2	240.	453	2055
576.4	1.4	3.04	806	1.4	1.12	156.8	280.	666	2574
576.9	1.9	3.07	1286	1.9	1.47	260	300.	1374	4033
577.1	2.1	3.03	1503	2.1	1.60	300	300	1702	4727

EC1-4 **PRC ENGINEERING CONSULTANTS, INC.**

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

Secor Lake Dam (MO. 31199) — JOB NO. 283

Check Critical Depth Assumption — BY VFC DATE 3/31/81

Check critical depth assumption in Principal Spillway.

Slope channel = 0.5'/45' = 0.011

$$S = \left[\frac{Qn}{1.49} \frac{1}{A R_h^{2/3}}\right]^2$$

critical slope for; $y_c = 1.5'$
$Q_c = 163$ cfs
$A_c = 29.0$ ft²
$R_h = 29.7'$
$n = 0.025$

$$S_c = \left[163 \frac{(0.025)}{1.49} \frac{1}{29.0} \frac{1}{(29.7)^{2/3}}\right]^2 = 0.0001 < S_{channel} \quad \text{O.K.}$$

In the Emergency Spillway, critical depth will occur at the concrete weir.

SUMMARY OF PMF AND ONE-HALF PMF ROUTING

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1  A1          MISSOURI DAM SAFETY
    2  A2           SIESTA LAKE DAM (MO.31199)
    3  A3            PMF AND 50 PERCENT PMF
    4  B    300       0       5       0       0       0       0       0       0       0
    5  R1     5
    6  J      1       2       1
    7  J1     1      .5
    8  K            SLD DA                                          1
    9  K1         RUNOFF CALCULATION FOR SIESTA LAKE DRAINAGE AREA
   10  M      1       2     .33               .33       1                               1
   11  P            25.7     100     120     130
   12  T                                                    -1      -87
   13  L2           .17
   14  X                     1
   15  K      1   SLD DM                                          1
   16  K1         ROUTE RUNOFF HYDROGRAPH THROUGH RESERVOIR
   17  Y                                     1       1
   18  Y1     1                                             -572.5      -1
   19  Y4 572.5   572.9   573.2   573.6   573.8   574.2   574.5   574.9   575.1   575.5
   20  Y4 575.7   576.2   576.4   576.9   577.1
   21  Y5     0       9      24      68     103     186     258     378     478     845
   22  Y5  1133    2055    2574    4033    4737
   23  $A     0       2     5.5       7     7.5       9      14      24    30.5
   24  $E   550     560     570   572.5   573.1     575     580     590     600
   25  $$ 572.5
   26  $D   575
   27  K     99
```

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	572.50	572.50	575.00
STORAGE	58.	58.	78.
OUTFLOW	0.	0.	428.

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	576.83	1.83	96.	3817.	5.58	15.75	0.00
.50	576.06	1.06	88.	1802.	1.25	15.75	0.00

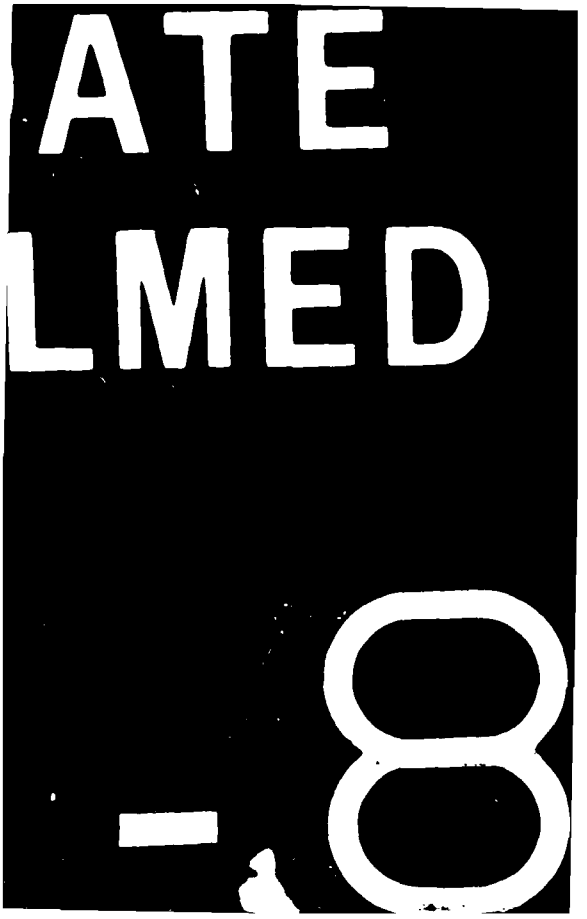
PERCENT OF PMF ROUTING
EQUAL TO SPILLWAY CAPACITY

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                A1              MISSOURI DAM SAFETY
    2                A2               SIESTA LAKE DAM (MO.31199)
    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    .1      .13      .15      .18      .2
    8                K           SLD DA                                                  1
    9                K1          RUNOFF CALCULATION FOR SIESTA LAKE DRAINAGE AREA
   10                M      1        2      .33                .33        1                                 1
   11                P             25.7      100      120      130
   12                T                                                                -1      -87
   13                W2            .17
   14                X                       1
   15                K      1   SLD DM                                                  1
   16                K1          ROUTE RUNOFF HYDROGRAPH THROUGH RESERVOIR
   17                Y                                1        1
   18                Y1     1                                                  -572.5      -1
   19                Y4 572.5    572.9    573.2    573.6    573.8    574.2    574.5    574.9    575.1    575.5
   20                Y4 575.7    576.2    576.4    576.9    577.1
   21                Y5     0        9       24       68      103      186      258      378      478      845
   22                Y5  1133     2055     2574     4033     4737
   23                $A     0        2      5.5        7      7.5        9       14       24     30.5
   24                $E   550      560      570    572.5    573.1      575      580      590      600
   25                $$ 572.5
   26                $D   575
   27                K     99
```

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	572.50	572.50	575.00
STORAGE	58.	58.	78.
OUTFLOW	0.	0.	428.

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
.10	574.34	0.00	73.	220.	0.00	15.92	0.00
.13	574.64	0.00	75.	299.	0.00	15.92	0.00
.15	574.81	0.00	77.	352.	0.00	15.92	0.00
.18	575.05	.05	79.	452.	.17	15.92	0.00
.20	575.16	.16	80.	534.	.25	15.92	0.00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