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NATIONAL DAM SAFETY PROGRAM. KOENIG DAM (MO 30028), MISSOURI - --ETC(U)
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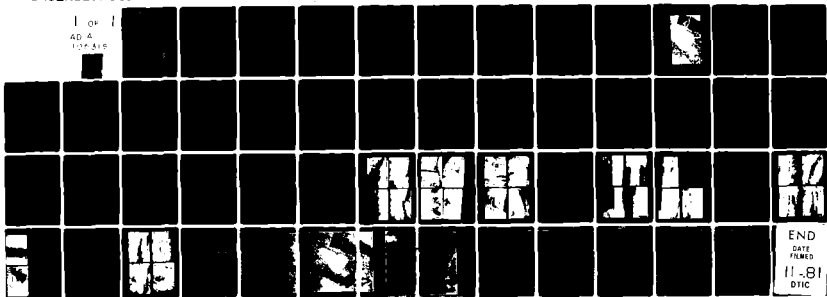
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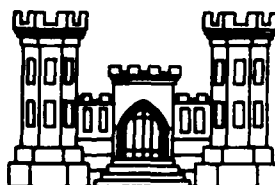
MISSOURI-KANSAS CITY BASIN

KOENIG DAM

ST. CHARLES COUNTY, MISSOURI

MO 30028

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



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

FOR: STATE OF MISSOURI

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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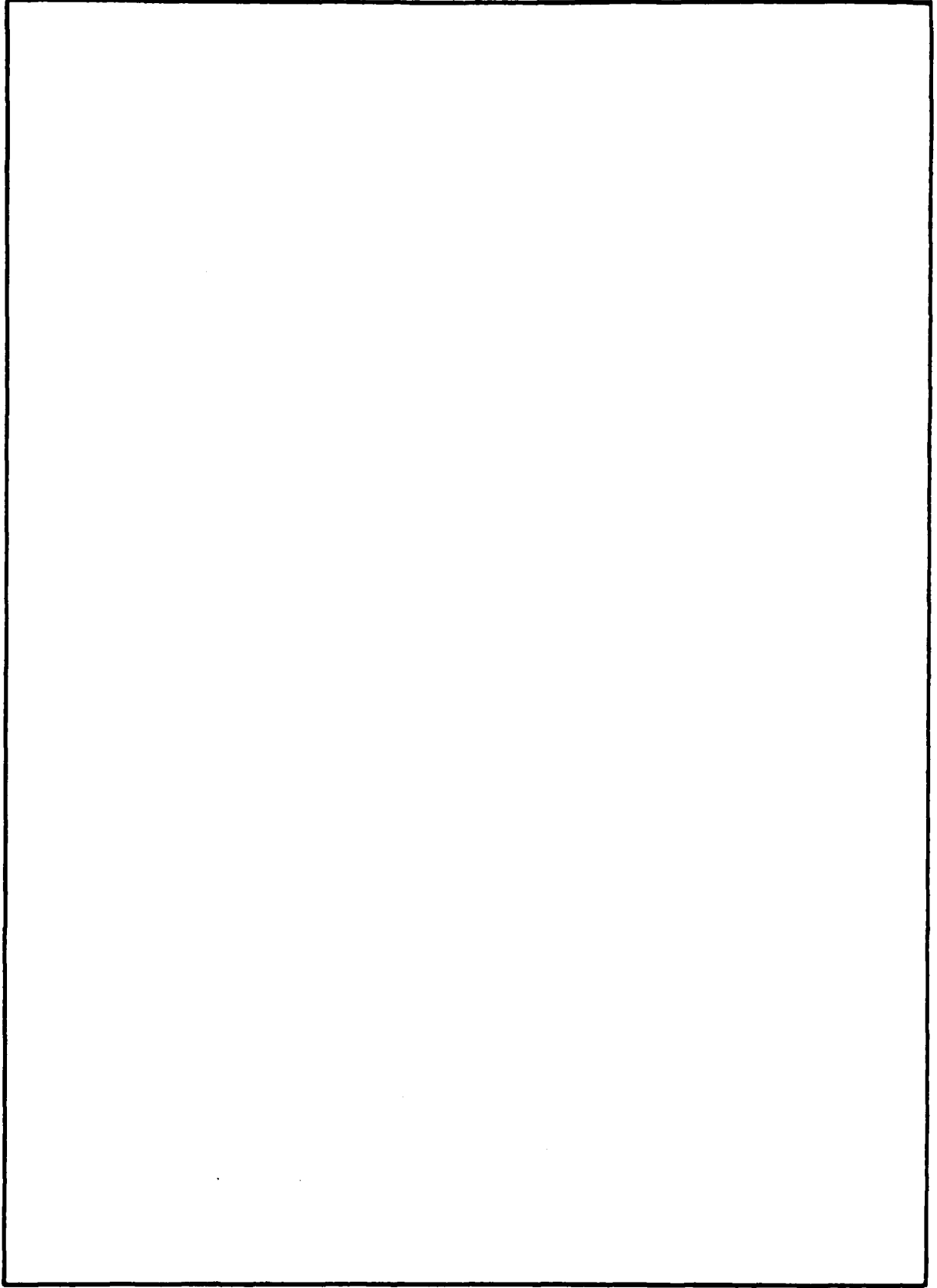
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DEPARTMENT OF THE ARMY
 ST. LOUIS DISTRICT, CORPS OF ENGINEERS
 210 NORTH 12TH STREET
 ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Koenig Dam Phase I Inspection Report

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

SIGNED

28 SEP 1978

SUBMITTED BY:

Chief, Engineering Division

Date

SIGNED

29 SEP 1978

APPROVED BY:

Colonel, CE, District Engineer

Date

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
F. STANLEY KOENIG DAM MO. ID NO. 30028

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2	Index of Panorama Photos (P-1 through P-7)
3	Index of Spillway Photos (S-1 through S-6)
4	Index of Valley Below Dam Photos (V-1 through V-4)

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	F. Stanley Koenig
State Located	Missouri
County Located	St. Charles County
Stream	Unnamed tributary to Crow Creek
Date of Inspection	3 September 1978

The F. Stanley Koenig Dam was inspected by an interdisciplinary team of engineers from Reitz & Jens, Inc., under contract with the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. The estimated drainage zone from failure of the dam could extend approximately two miles downstream.

Failure would threaten the lives and property of eight families and cause appreciable damage to two County roads, one state highway bridge and one railroad bridge.

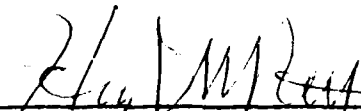
Our inspection and evaluation indicates that the spillway meets the criteria set forth in the guidelines for a dam having the above size and hazard potential. The principal spillway will pass a one-half Probable Maximum Flood (PMF) without overtopping the dam. The probable maximum flood (PMF) is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The dam will begin to be overtopped by a flood having a discharge (peak and volume) equal to 80% of the PMF.

Our inspection and evaluation indicates heavy tree growth on both faces of the dam which could lead to conditions causing rupture of the dam.

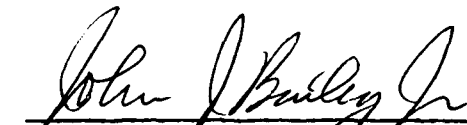
Other deficiencies were inadequate erosion protection of the upstream slope of the dam and spillway and lack of knowledge of the location and condition of a pipe reported to be under or through the dam.

Another deficiency was the lack of seepage or stability analysis records.

We recommend that the owner take action to correct or control the deficiencies described. A detailed report discussing each of these deficiencies was prepared and submitted to the owner and to the Governor of Missouri.



HENRY M. REITZ, President
Reitz & Jens, Inc.



JOHN J. BAILEY, JR., Vice President
Chief Engineer
Reitz & Jens, Inc.



OVERVIEW-MO.30028

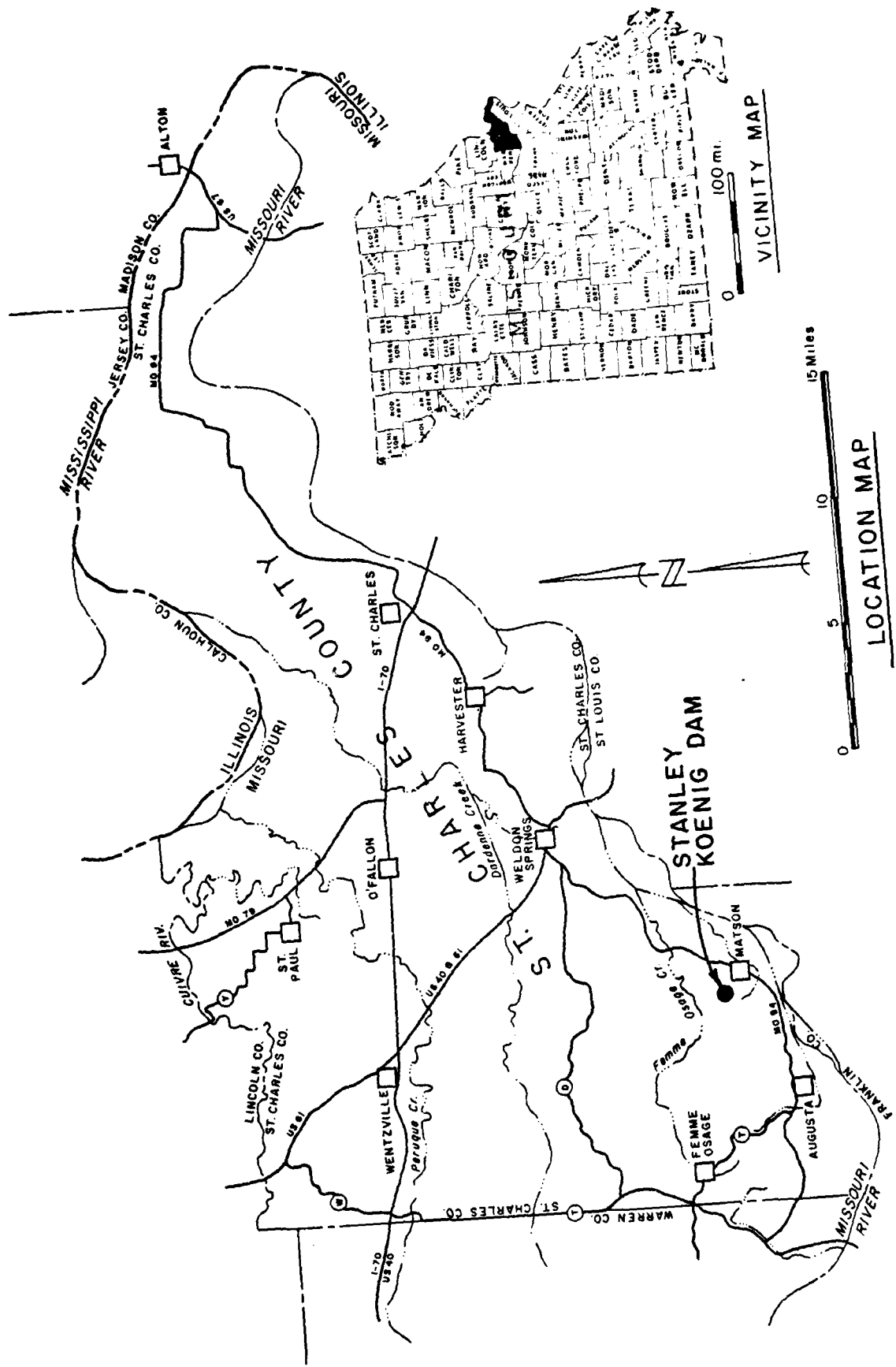


PLATE 3

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer, contracted with Reitz & Jens, Inc. (Contract DACW43-78-C-0162) for a safety inspection of the L. Stanley Koenig Dam.

b. Purpose of Inspection The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

(1) The dam is an earth structure built in the upper end of a "draw" in the hilly ground along the Missouri River on the fringes of the loess blown in from the river bottom. Soils over the lower portion of the valley above the dam, covering about 15% of the drainage area, are Winfield Silt Loam and Winfield Silt Loam and Silty Clay Loam, Hydrologic Soil Group "C", according to the SCS-USDA 1955 Soils Map. About one-third of this area is cultivated and the remainder is in pasture. Except for a minute area of Weldon Silt Loam along the top of the narrow ridges, the remainder of the watershed consists of steep, stony land with shallow, stony, silty clay loam soils over partially weathered limestone and chert. Most of this area is hardwood forest. There is a small impoundment in the upper reaches of the watershed. This has a water surface of about two acres and receives runoff from about 35% of the drainage area above Koenig dam.

Topography in the vicinity of the dam is shown on Plate 2.

(2) A spillway was cut into the earth slope on the northeast end of the dam. At some time, a concrete sill was constructed across the spillway channel about 20 feet downstream from the centerline of the dam apparently to control erosion of the spillway bottom.

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

b. Location The dam is located about one mile northwest of the Village of Matson in a U.S. Survey and the fractional NW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 33, T45N, R2E, in the southwestern part of St. Charles County as shown on Plate 2. The dam and lake behind it are shown on the Missouri, St. Charles-Franklin County-Labadie USGS Quadrangle Sheet, 1972 Edition. A portion of this sheet is reproduced on Plate 2. The lake is also shown on the Augusta, Missouri 15-Minute USGS Quadrangle Sheet, 1948 Edition. (See Location & Vicinity Maps, Plate 3).

c. Size Classification Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the Small Size Category.

d. Hazard Classification Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification.

e. Ownership The dam is owned by Mr. F. Stanley Koenig, P.O. Box 65, Defiance, Mo., 63341.

f. Purpose of Dam The dam forms an 8.8-acre water supply and recreational lake.

g. Design and Construction History The inspection team was unable to find any design data on this dam. It was reported by local residents that the dam was constructed by the Missouri-Kansas-Texas Railroad a few years before 1910. (See paragraph 3.1a below.)

h. Normal Operating Procedure Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation. The maximum water depth ever experienced at the spillway was unknown.

1.3 PERTINENT DATA

a. Drainage Area - 142 acres.

b. Discharge at Damsite

(1) All discharge at the damsite is through an uncontrolled spillway with the possible exception discussed in paragraph 3.1c.

(2) Estimated experienced maximum flood at damsite - unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation - 1300 cfs.

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

(1) Top of Dam - 535.1 to 536.8+ (see Plate 2).

(2) Spillway crest - 530.3.

(3) Streambed at centerline of dam - 500.0.

(4) Maximum tailwater - unknown.

d. Reservoir Length of maximum pool - 1120+ feet.

e. Storage Top of dam - 123 Acre-feet.
Spillway Crest - 76 Acre-feet.

f. Reservoir Surface

- (1) Top of dam - 10.9 Acres.
- (2) Spillway crest - 8.9 Acres.

g. Dam

- (1) Type - earth embankment.
- (2) Length - 730 feet.
- (3) Height - 36.8 feet maximum.
- (4) Top width - 12-15 feet (varies).
- (5) Side Slopes -
 - (a) Downstream - 1V on 2.0H (determined from surveyed sections at 4+75 and 6+11, Plate 2).
 - (b) Upstream - 1V on 2.5H to lake surface; below lake unknown.
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout curtain - unknown

h. Diversion and Regulating Tunnel None

i. Spillway - The spillway is an uncontrolled earth channel cut into the east abutment of the dam. The crest is at the centerline of the dam at elevation 530.3. The bottom width is about 25 feet. Side slopes are about 1V to 3H on the dam side and 1V to 6H on the abutment side of the spillway. There is a concrete sill across the bottom of the spillway channel about 20 feet downstream from the centerline of the dam. This is the control section for higher discharges. Here the bottom width is 16 feet, the flowline is about 0.5 feet lower and the side slopes are the same as at the spillway crest. The spillway channel flowline has an abrupt drop of about 2 feet immediately below the concrete sill.

j. Regulating Outlets - None found (see paragraph 3.1c).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were found to be readily available.

2.2 CONSTRUCTION

The dam was constructed prior to 1910 according to reports of local residents. No construction data are available.

2.3 OPERATION

Lake levels remain stable during average precipitation of 38 inches per year. Except for the reputed presence of a water supply line and valve which the owner is unable to locate, no facilities requiring operation exist. No records of operation have been kept.

2.4 EVALUATION

a. Availability Engineering data were not available.

b. Adequacy Engineering data not being available, no detailed assessment of the design, construction and operation could be made.

Even so, a defensible evaluation of the structure could be made, based on the survey measurements; the observations of the inspection team and by giving due consideration to the age and general condition of the structure, its size and the materials used to built it. Seepage and stability analyses are not on record.

The owner should have an engineer experienced in the design of dams perform detailed seepage and stability analyses.

c. Validity This report is primarily for safety through maintenance and operation and the conclusions and evaluation for this Phase I Inspection are considered to be adequate for the definitive statement to this report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General A visual inspection of the Koenig dam was made on 3 September 1978. This followed 3 days of field measurements by a survey party on 16, 17 and 18 August 1978. The training and experience of personnel in these two inspections included hydrologic/hydraulic engineering, soils and materials engineering, structural engineering and surveying.

This is an old dam and reservoir. The story prevalent in the area is that this was built by the Missouri-Kansas-Texas Railroad early in the century to supply a water tower for steam locomotives at the Matson siding. The distance from the dam to the railroad is about 4000 feet. Sufficient head is available at the reservoir to make such a gravity supply possible. It is purported that an underground pipe carried water from the reservoir to the railroad. Neither the owner nor the inspection team were able to locate either the pipe or a supposed valve at the end of the pipe in the reservoir. The exact date of original construction or any modification since then for this dam or reservoir is not known.

b. Dam The top of the dam is a roadway (photo D-3) that has easy access on the west end. At the east end, where the road crosses the spillway, there is a marked drop which discourages vehicular traffic. Vehicular access to the east end is possible by driving just below the toe of the dam. Therefore, the roadway on top of the dam is really not important to any movement of vehicles in the area. For the 700+ foot length of the dam, the road across the top is covered by an almost continuous arch of trees (D-3, D-8, D-9, D-12) growing on both the reservoir and downstream side of the dam (D-1, D-2, D-4, D-7). The inspection team estimated that some are at least 40 years old (D-5, D-6, D-9, D-10). It appears these trees volunteered (were not planted). There is a mixture of types from red cedars as the slowest growing to deciduous trees common to this area. The thick growth of trees has discouraged underbrush growth.

The profile of top of dam is relatively irregular. Visibly, the center 175 feet (Station 3+50 to 5+25) is lower than points either immediately to east or west; the greatest amount of measurement is about 2 feet. The elevations at both ends of the dam are about the same as the center; however, the slopes from the higher grades adjacent to the center to the end are more gradual. The impression is that the center portion, where the embankment height is greatest, has settled. The tree cover on all portions is of relatively uniform density except on the reservoir side opposite the lower (center) portion. Here, the trees have been thinned so that standing in the center of the dam, one can see the lake over about a 15-degree sector without the lake being partially obscured by foliage.

Detailed inspection was made of the faces of the dam and the strip contiguous with the toe of the slope on the downstream face (D-4, D-7, D-11). No signs of through seepage or underseepage along the contact at the base of the dam were observed. It is possible that in the center part of the dam downstream, a berm approximately 20 feet wide with maximum height of about 4 feet, was built; however, the grades within this area of the possible berm are such that they could well be natural material. There was no sign of water at

any portion of this possible berm. The only place water was seen (V-1, V-3) was at the low point of the draw that started downstream from the obvious toe of the dam, approximately 40 feet. The source of this water is considered to be underseepage from the reservoir moving along joints or bedding planes or rock strata at depth.

Detailed visual inspection of the embankment did not find any signs of tilting, lateral displacement or cracking in the embankment. Both the upstream and downstream slopes of the dam appeared stable.

c. Appurtenant Structures No pipe spillway was found. The owners of the property reported they have heard there is a pipe from the reservoir to the railroad. However, even if there were, for the length involved, it could not be considered as effectively being any type spillway. It could, however, during long dry periods cause appreciable loss of water from the lake if nothing restricted the flow from the lake to the railroad area. It is the owner's belief that a purported valve at the upper end of this pipe in the reservoir is open.

The spillway for the dam is on the east end (S-1, S-2, S-6). It is an uncontrolled earth channel excavated in virgin material. No rock is visible in the portion of the spillway that controls discharge. Its alignment directs water onto undisturbed material well out from the face of the dam.

Facing downstream to the right of the channel coming off the spillway there is a combination of natural berm and man-placed material (V-2) that will fairly effectively keep the spillway discharge from spreading rather quickly to the right, toward the low point downstream from the dam.

Grades suggest that under very high rates of flow, after water has passed the dam, a portion of the spillway discharge could flow westwardly toward the toe of the dam; however, the greater portion would still be in the indicated spillway alignment.

In the spillway, downstream from the centerline of the dam, a channel has been eroded as a result of water going over the spillway. In the bottom of this channel, some distance from the dam, rock ledges are visible. At the upper end of this channel, a concrete sill limited both in lateral extent and thickness (S-4, S-5) has been placed to prevent upslope erosion at the head of this gully.

d. Reservoir Area No wave-wash, excessive erosion or slides were observed along the shore of the reservoir.

e. Downstream Channel More than 100 yards downstream from the dam is a swampy and/or shallow retention pond area into which both the gully from the spillway discharges at a relatively steep gradient as well as the water that comes down the thalweg of the natural valley on a generally flat gradient. Except for this and except as described in paragraph 3.1c above, the downstream channel is in good condition.

3.2 EVALUATION

None of the conditions observed is significant enough to indicate the need for immediate remedial action.

a. Dam A serious potential of failure exists because of the heavy tree growth on both slopes of the dam. Trees provide shelter and habitat for rodents whose burrowing activity might cause detrimental seepage. Furthermore, as the trees mature and die, seepage through the embankment may occur as the roots decay. The tree growth should be removed; then turf established. The upstream slope of the dam consists of fine-grained soil. This should be protected against wave-wash with an armor-coat of stone or broken concrete rip rap.

A recommendation of removal of the tree growth for this specific dam must recognize the probability of questions as to why trees must be completely removed. Those questioning would be aware of the magnitude of the storm event the spillway can handle with a 5-foot rise in the water surface, the vertical difference of 30 feet below sill of spillway and downstream toe of dam, the potential for detention storage in the valley below the dam which would attenuate flow rates from a possible rupture failure of the dam before reaching the first house or public road down-valley. The age of the dam while psychologically important, should not be considered technically applicable.

b. Spillway It appears to the inspection team that inadequate attention has been given to maintenance of the spillway, specifically with regard to removal of weeds and brush, repair and restoration of the cracked concrete sill and removal of irregularities in the channel upstream of the sill. All of these items could contribute to erosion and degradation of the spillway channel. All discharge from the lake passes over this spillway. An erosive resistant and more adequate sill is needed to insure proper functioning of the spillway. The downstream spillway berm on the dam side will begin to be overtopped by the one-half PMF. This berm should be raised to prevent this and armored to protect it from erosion.

c. Possible Outlet Pipe The pipe reputed to be under the dam could corrode and leak, allowing soil to migrate from within the dam embankment. Eventually, if such leakage were to occur, sloughing and/or sliding of the embankment or seepage through the dam could result. If such a pipe exists it should be located and its position marked to facilitate periodic checks of its soundness and the condition of the surrounding embankment.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam; therefore, no regulating procedures exist. The pool is controlled by rainfall, runoff, evaporation, and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Based on the tree growth on the dam and the visual observation of the inspection team, little if any maintenance has been performed on the dam on a regular basis for many years.

4.3 MAINTENANCE OF OPERATING FACILITIES

No known operating facilities exist at this dam. It was reported to the inspection team that a water supply pipe is under the dam. There is supposed to be a valve on the upper end of this pipe. The owner does not know the location of the pipe or valve and therefore, has not been able to open or close the valve.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

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

4.5 EVALUATION

If the uncontrolled vegetation on the downstream slope is allowed to continue, a serious potential of failure may develop.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data No design data are available.

b. Experience Data The drainage area is developed from USGS Labadie, Missouri Quadrangle. Also available are 1"=2000' aerial stereo pairs taken 9 April 1977 by Surdex Corp. Lake area is measured on a 1"=200' enlargement of a portion of one of these photographs and shown on Plate 1. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations

(1) The spillway channel, concrete sill in the spillway and the gully downstream of the spillway are described in paragraphs 3.1c and 3.2b.

(2) No drawdown facilities are available to evacuate the pool.

(3) The spillway and exit channel are located at the east abutment of the dam.

(4) Maximum spillway releases may endanger the integrity of the dam. (see paragraph 3.2b).

d. Overtopping Potential Hydrologic and hydraulic calculations are reproduced in Appendix A. The spillway is large enough to pass the minimum required flood of one-half the probable maximum without overtopping. 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. A free-board of one foot at the lowest part of the dam crest at Station 4+50 will exist at the peak outflow for one-half the PMF. The downstream spillway berm on the dam side will begin to be overtopped by the one-half PMF. The dam will begin to be overtopped by an 80% PMF. The PMF will overtop the dam to a maximum depth of 0.8 foot. This will vary to zero across the sloping top of dam. A width of 350 feet will be subject to some overtopping flow. Maximum rate of flow over the top of the dam will be 300 cfs. Duration of overtopping will be 15 minutes.

Failure of the small upstream water impoundment described in paragraph 1.2a(1) would not have a significant impact on the hydrologic or hydraulic analysis.

The effect from rupture of the dam could extend approximately two miles downstream of the dam. Within the damage zone are eight houses, two county roads, one state highway bridge and one railroad bridge.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

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

b. Design and Construction Data No design or construction data relating to the structural stability of the dam were found.

c. Operating Records The owners cannot find the reported valve on the reputed water supply pipe. They believe this valve exists and it is open. Other than this possibility, no appurtenant structures requiring operation exist at this dam.

d. Post Construction Changes No post construction changes, other than those referenced to in paragraph a above, exist which will affect the structural stability of the dam.

e. Seismic Stability Considering the seismic Zone (2) in which this dam is located, an earthquake of this magnitude is not expected to cause a structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety The spillway is adequate to pass the required one-half Probable Maximum Flood (PMF). Several items were noted during the visual inspection by the inspection team which should be corrected or controlled. The heavy growth of trees on the upstream and downstream slopes of the dam is a safety deficiency. An armor-coat to protect the reservoir slope of the dam against wave-wash is needed. Erosion protection for the spillway is deficient.

The pipe reputed to be under the dam could corrode and leak allowing soil to migrate from within the dam embankment. Seepage and stability analyses are not on record; this is a deficiency which should be rectified.

b. Adequacy of Information Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers these data sufficient to support the conclusions herein.

c. Urgency The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the safety deficiencies listed in paragraph a are not corrected in the near future, they will continue to deteriorate and lead to a serious potential of failure.

d. Necessity for Phase II Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability This dam is located in Seismic Zone 2. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives

(1) The owner should retain an experienced engineer to make annual inspections of seepage and general condition of the dam; or the owner should remove tree growth on both faces of the dam, grub stumps and roots, dispose of debris off the dam, recompact disturbed areas, fertilize, seed and mulch downstream slope to establish turf, and place rip rap slope protection on the upstream slope of the dam under the guidance and observation of an experienced engineer.

(2) The spillway channel should be protected against erosion or an adequate sill should be installed. All work should be done under the guidance and observation of an experienced engineer.

(3) The purported pipe under the dam should be located and inspected for corrosion and watertightness, if it exists. The inspection team is of the opinion that a thorough inspection using an electronic metal detector would be adequate to locate such a pipe. A traverse should be made across the valley bottom and slopes below the dam by an experienced technician using equipment suitable for this purpose.

b. Perform Seepage and Stability Analyses The owner should have seepage and stability analyses performed by an engineer experienced in the design and construction of dams.

c. O&M Maintenance and Procedures

(1) After removal of existing tree growth, vegetation on the dam should be periodically cut.

(2) If the pipe through the dam exists, its location should be permanently marked or recorded so it can be found during future inspections. If a search, as recommended in paragraph 7.2a(1) fails to locate it, a report describing the procedure should be on record.

(3) Maintain an erosive-resistant sill in the control section of the spillway and remove the humps and irregularities in the spillway channel.

(4) The owner should keep a record of all future repairs and maintenance.

(5) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams. Records should be kept of these inspections and major maintenance.

APPENDIX A
HYDROLOGIC COMPUTATIONS

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation for those dams in the high hazard potential category is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33". Reduction factors have not been applied. A 24-hour storm duration is assumed with the 24-hour rainfall depths distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use and antecedent moisture conditions.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the spillway, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-area curve. The hydraulic capacity of the spillway is defined by an elevation-discharge curve. The hydraulic capacity of the sloping top of dam is defined by a triangular broad-crested weir equation.

3. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

4. The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed on Plate A1. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. The discharge in the spillway was calculated using critical depth at the control section near where the dam centerline crosses the spillway channels, allowing 0.2 velocity head for non-uniform velocity distribution, velocity transition losses and friction in the short approach channel. At spillway flows above 500 or 600 cfs the control section moves about 20 feet downstream where the channel is lower, but not as wide as upstream.

6. The average longitudinal slope of top of dam was determined by plotting length of crest subject to overflow for incremental increases in lake elevation above the lowest crest elevation. The "Z" value thus obtained (increase in lineal feet of crest subject to overflow per foot of rise in the lake) was then used in the triangular broad-crested weir equation: $Q = C*0.4*Z*H^{**2.5}$.

 FLOOD HYDROGRAPH PACKAGE (HFC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 3 AUG 78

1 A ***** ID # 30028 STANLEY KOENIG DAM ** ADD 430 FOR USGS FLEV **
 2 A ***** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****
 3 A ***** REITZ & JENS, INC. - AUGUST 1978 *****
 4 R 28R 0 5 -0 -0 -0 -0 -4
 5 1 5
 6 J 1 5 1
 7 J1 .50 .75 .80 .85 1.0
 8 K 0 1 3 1
 9 I ***** INFLOW HYDROGRAPH - SCS METHOD ***** 1
 10 M 1 0.222
 11 P 1 24.8 101 120 130 -1 -91 0.0R
 12 T
 13 W2 0.17
 14 X -0.10 2.0
 15 K 1 05
 16 I ***** RESERVOIR ROUTING - RATING CURVE SUPPLIED - SLOPING DAM *****
 17 Y 1
 18 Y1 1
 19 Y4 100.3 100.5 101.0 101.5 102.0 102.5 103.0 103.5 104.0 104.5
 20 Y4 105.0 105.5 106.0 107.0 108.5
 21 Y5 0 4.0 25 100 180 310 445 600 770 965
 22 Y5 1270 1415 1670 2250 3230
 23 \$A 0.00 8.77 13.10 27.55
 24 \$E 75 100 110 130
 25 \$S 100.3
 26 \$D 105.1 3.0 2.5 180
 27 K 99

 FLOOD HYDROGRAPH PACKAGE (HFC-1)
 DAM SAFETY VFRSION JULY 1978
 LAST MODIFICATION 3 AUG 78

RUN DATE 09/13/78.
 TIME 16.07.24.

***** ID # 3002R STANLEY KOENIG DAM ** ADD 430 FOR USGS ELEV **
 ***** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****
 ***** REITZ & JENS, INC. - AUGUST 1978 *****

JOB SPECIFICATION											
NQ	MHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN		
288	0	5	-0	-0	-0	-0	-0	-4	-0		
		JOPER	NWT	LROPT	TRACE						
		5	-0	-0	-0						

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 5 LRTIO= 1
 RTIO= .50 .75 .80 .85 1.00

***** SUR-AREA RUNOFF COMPUTATION *****

***** INFLOW HYDROGRAPH - SCS METHOD *****
 ISTAQ ICOMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO
 1 0 -0 -0 1 3 1 -0 -0

HYDROGRAPH DATA											
IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL		
1	2	.22	-0.00	.22	1.00	-0.000	-0	1	-0		

PRECIP DATA			
SPFE	PMS	RK	R24
-0.00	24.80	101.00	130.00
		R48	R72
		-0.00	-0.00

LOSS DATA											
LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRTK	RTIOK	STRTL	CNSTL	ALSMX	RTIMP	
-0	-0.00	-0.00	1.00	-0.00	1.00	-1.00	-91.00	-0.00	-0.00	.08	

CURVE NO = -91.00 WETNESS = -1.00 EFFECT CN = 91.00

UNIT HYDROGRAPH DATA
 TC= -0.00 LAG= .17

RECESSION DATA
 STRTQ= -0.00 ORCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAG= .17 VOL= 1.00
 154. 466. 479. 300. 150. 43. 22. 12. 6.
 4. 1.

MO.DA HR.MN PERIOD RAIN EXCS LOSS MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP 0

1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.00	132.
1.01	.10	2	.01	.00	.01	1.	1.01	12.10	146	.21	.20	.00	197.
1.01	.15	3	.01	.00	.01	1.	1.01	12.15	147	.21	.20	.00	264.
1.01	.20	4	.01	.00	.01	2.	1.01	12.20	148	.21	.21	.00	307.
1.01	.25	5	.01	.00	.01	2.	1.01	12.25	149	.21	.21	.00	328.
1.01	.30	6	.01	.00	.01	2.	1.01	12.30	150	.21	.21	.00	340.
1.01	.35	7	.01	.00	.01	2.	1.01	12.35	151	.21	.21	.00	346.
1.01	.40	8	.01	.00	.01	2.	1.01	12.40	152	.21	.21	.00	350.
1.01	.45	9	.01	.00	.01	2.	1.01	12.45	153	.21	.21	.00	352.
1.01	.50	10	.01	.00	.01	2.	1.01	12.50	154	.21	.21	.00	353.
1.01	.55	11	.01	.00	.01	2.	1.01	12.55	155	.21	.21	.00	354.
1.01	1.00	12	.01	.00	.01	2.	1.01	13.00	156	.21	.21	.00	354.
1.01	1.05	13	.01	.00	.01	2.	1.01	13.05	157	.25	.25	.00	361.
1.01	1.10	14	.01	.00	.01	2.	1.01	13.10	158	.25	.25	.00	380.
1.01	1.15	15	.01	.00	.01	2.	1.01	13.15	159	.25	.25	.00	400.
1.01	1.20	16	.01	.00	.01	2.	1.01	13.20	160	.25	.25	.00	413.
1.01	1.25	17	.01	.00	.01	2.	1.01	13.25	161	.25	.25	.00	419.
1.01	1.30	18	.01	.00	.01	3.	1.01	13.30	162	.25	.25	.00	423.
1.01	1.35	19	.01	.00	.01	3.	1.01	13.35	163	.25	.25	.00	425.
1.01	1.40	20	.01	.00	.01	4.	1.01	13.40	164	.25	.25	.00	426.
1.01	1.45	21	.01	.00	.01	4.	1.01	13.45	165	.25	.25	.00	426.
1.01	1.50	22	.01	.00	.01	5.	1.01	13.50	166	.25	.25	.00	427.
1.01	1.55	23	.01	.00	.01	5.	1.01	13.55	167	.25	.25	.00	427.
1.01	2.00	24	.01	.00	.01	5.	1.01	14.00	168	.25	.25	.00	427.
1.01	2.05	25	.01	.00	.01	6.	1.01	14.05	169	.31	.31	.00	437.
1.01	2.10	26	.01	.00	.01	6.	1.01	14.10	170	.31	.31	.00	466.
1.01	2.15	27	.01	.00	.01	7.	1.01	14.15	171	.31	.31	.00	496.
1.01	2.20	28	.01	.00	.01	7.	1.01	14.20	172	.31	.31	.00	515.
1.01	2.25	29	.01	.00	.01	8.	1.01	14.25	173	.31	.31	.00	525.
1.01	2.30	30	.01	.01	.01	8.	1.01	14.30	174	.31	.31	.00	530.
1.01	2.35	31	.01	.01	.01	8.	1.01	14.35	175	.31	.31	.00	532.
1.01	2.40	32	.01	.01	.01	9.	1.01	14.40	176	.31	.31	.00	534.
1.01	2.45	33	.01	.01	.01	9.	1.01	14.45	177	.31	.31	.00	535.
1.01	2.50	34	.01	.01	.01	9.	1.01	14.50	178	.31	.31	.00	535.
1.01	2.55	35	.01	.01	.01	10.	1.01	14.55	179	.31	.31	.00	536.
1.01	3.00	36	.01	.01	.01	10.	1.01	15.00	180	.31	.31	.00	536.
1.01	3.05	37	.01	.01	.01	10.	1.01	15.05	181	.19	.19	.00	517.
1.01	3.10	38	.01	.01	.01	11.	1.01	15.10	182	.38	.38	.00	489.
1.01	3.15	39	.01	.01	.01	11.	1.01	15.15	183	.38	.38	.00	519.
1.01	3.20	40	.01	.01	.01	11.	1.01	15.20	184	.57	.57	.00	603.
1.01	3.25	41	.01	.01	.01	11.	1.01	15.25	185	.67	.66	.00	744.
1.01	3.30	42	.01	.01	.01	12.	1.01	15.30	186	1.62	1.61	.00	1045.
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1.01	3.40	44	.01	.01	.01	12.	1.01	15.40	188	1.05	1.05	.00	2517.
1.01	3.45	45	.01	.01	.01	12.	1.01	15.45	189	.67	.67	.00	2524.
1.01	3.50	46	.01	.01	.01	13.	1.01	15.50	190	.57	.57	.00	2034.
1.01	3.55	47	.01	.01	.01	13.	1.01	15.55	191	.38	.38	.00	1936.
1.01	4.00	48	.01	.01	.01	13.	1.01	16.00	192	.38	.38	.00	1174.
1.01	4.05	49	.01	.01	.01	13.	1.01	16.05	193	.29	.29	.00	922.
1.01	4.10	50	.01	.01	.01	13.	1.01	16.10	194	.29	.29	.00	746.
1.01	4.15	51	.01	.01	.01	14.	1.01	16.15	195	.29	.29	.00	634.
1.01	4.20	52	.01	.01	.01	14.	1.01	16.20	196	.29	.29	.00	571.
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1.01	4.30	54	.01	.01	.01	14.	1.01	16.30	198	.29	.29	.00	519.
1.01	4.35	55	.01	.01	.01	14.	1.01	16.35	199	.29	.29	.00	509.
1.01	4.40	56	.01	.01	.01	14.	1.01	16.40	200	.29	.29	.00	505.
1.01	4.45	57	.01	.01	.01	15.	1.01	16.45	201	.29	.29	.00	503.
1.01	4.50	58	.01	.01	.00	15.	1.01	16.50	202	.29	.29	.00	502.
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1.01	5.00	60	.01	.00	.00	15.	1.01	17.00	204	.29	.29	.00	502.
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1.01	6.15	75	.07	.05	.02	59.	1.01	18.15	219	.02	.02	.00	238.
1.01	6.20	76	.07	.05	.01	72.	1.01	18.20	220	.02	.02	.00	222.
1.01	6.25	77	.07	.05	.01	79.	1.01	18.25	221	.02	.02	.00	207.
1.01	6.30	78	.07	.05	.01	84.	1.01	18.30	222	.02	.02	.00	193.
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1.01	7.10	86	.07	.06	.01	96.	1.01	19.10	230	.02	.02	.00	111.
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1.01	7.35	91	.07	.06	.01	100.	1.01	19.35	235	.02	.02	.00	78.
1.01	7.40	92	.07	.06	.01	100.	1.01	19.40	236	.02	.02	.00	73.
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1.01	7.50	94	.07	.06	.01	101.	1.01	19.50	238	.02	.02	.00	64.
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1.01	8.20	100	.07	.06	.00	104.	1.01	20.20	244	.02	.02	.00	42.
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1.01	10.35	127	.07	.06	.00	109.	1.01	22.35	271	.02	.02	.00	35.
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1.01	11.40	140	.07	.06	.00	110.	1.01	23.40	284	.02	.02	.00	35.
1.01	11.45	141	.07	.06	.00	110.	1.01	23.45	285	.02	.02	.00	35.
1.01	11.50	142	.07	.06	.00	110.	1.01	23.50	286	.02	.02	.00	35.
1.01	11.55	143	.07	.06	.00	110.	1.01	23.55	287	.02	.02	.00	35.
1.01	12.00	144	.07	.06	.00	110.	1.02	0.00	288	.02	.02	.00	35.

SUM 32.24 31.18 1.06 55247.
 (819.) (792.) (27.) (1564.42)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
2524.	590.	192.	192.	55247.
71.	17.	5.	5.	1564.
	24.72	32.15	32.15	32.15
	627.99	816.67	816.67	816.67
	293.	380.	380.	380.
	361.	469.	469.	469.

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	DURATION OVER TOP	TIME OF FAILURE
	OUTFLOW	100.30	100.30	105.10	HOURS	HOURS
		76.	76.	123.		
		0.	0.	1299.		
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	104.02	0.00	112.	776.	15.92	0.00
.75	105.04	0.00	122.	1283.	15.92	0.00
.80	105.26	.16	125.	1351.	15.92	0.00
.85	105.45	.35	127.	1442.	15.92	0.00
1.00	105.89	.79	132.	1920.	15.83	0.00

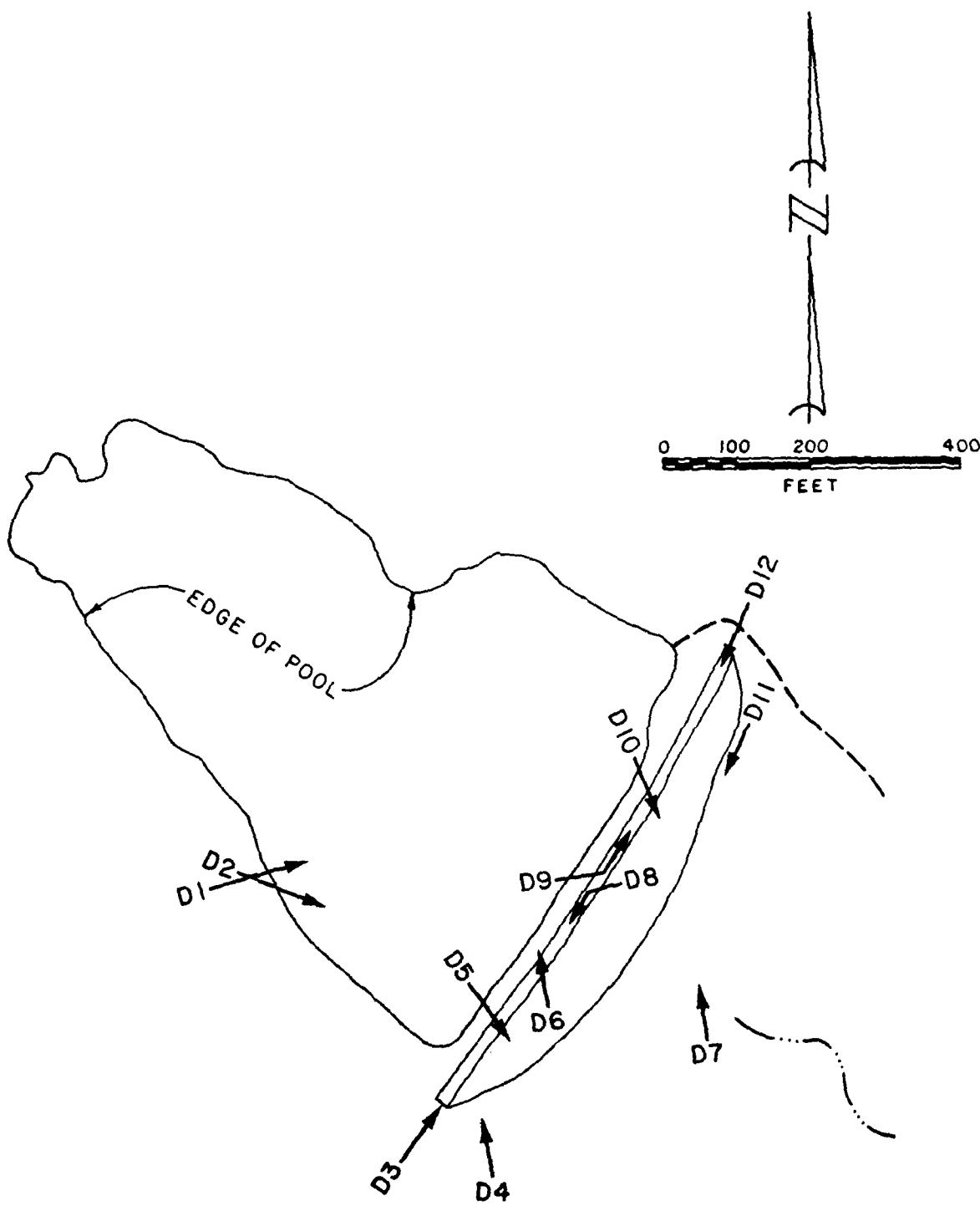


PHOTO INDEX I
FOR
DAM

KOENIG DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

PREPARED BY
REITZ & JENS, INC.



DAM



D8





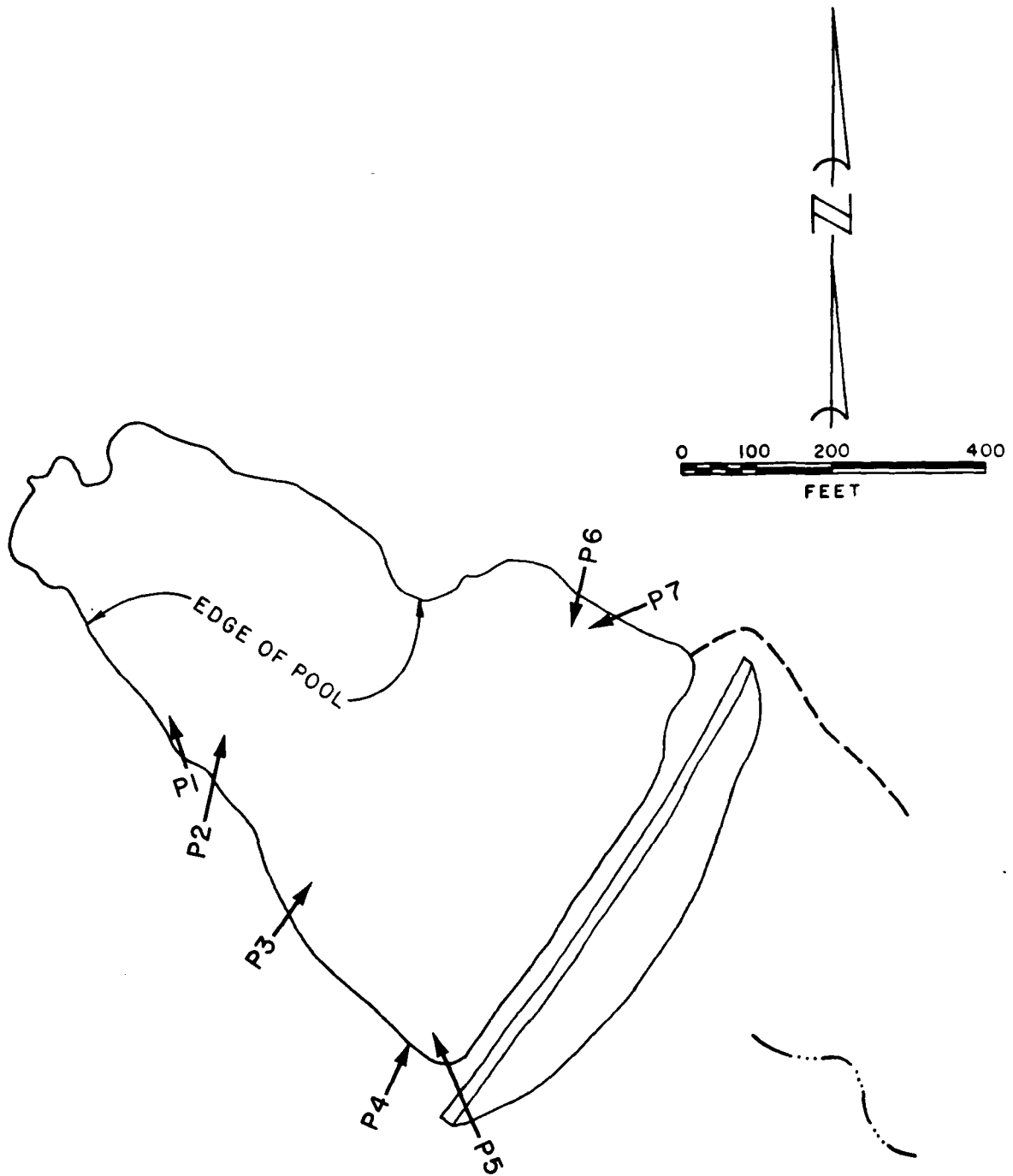
D12



D11



DAM



PREPARED BY
REITZ & JENS, INC.

PHOTO INDEX 2
FOR
PANORAMA
KOENIG DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

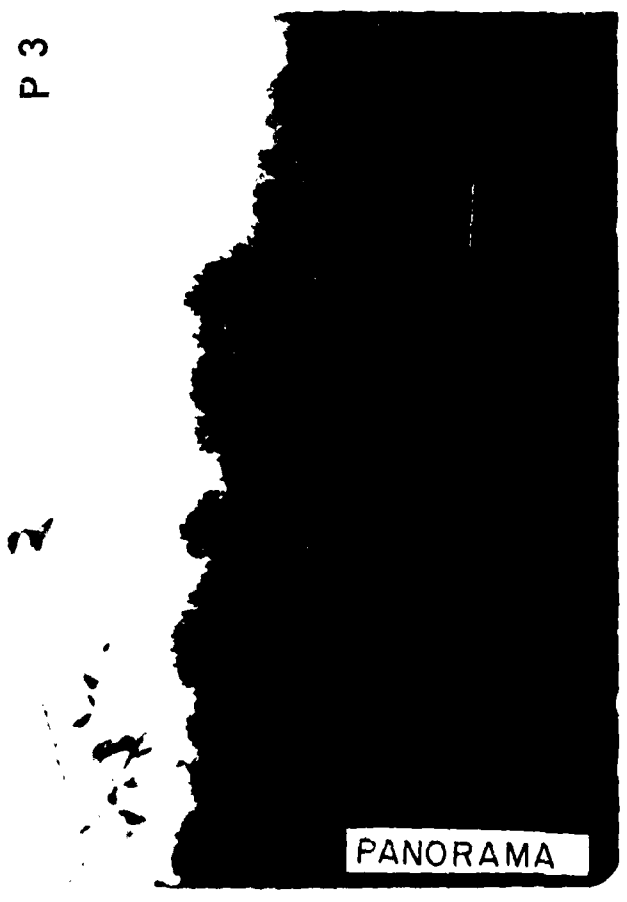
20 11/12



P1

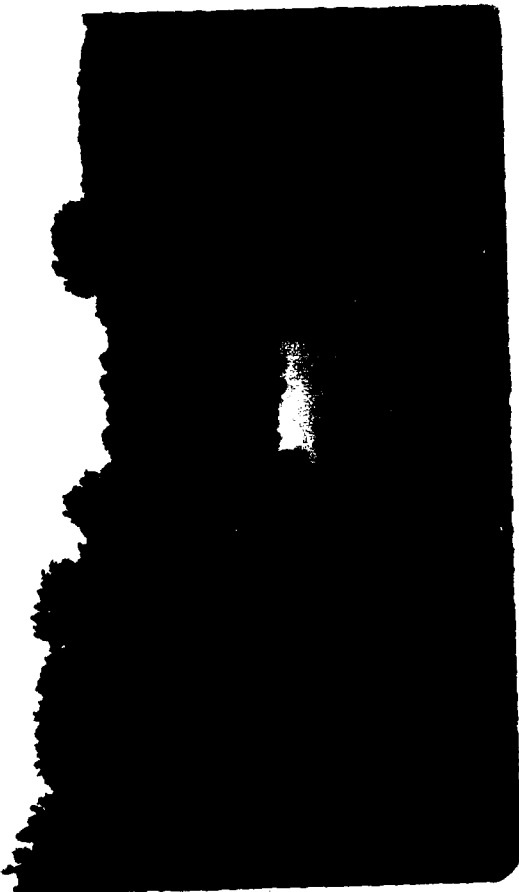


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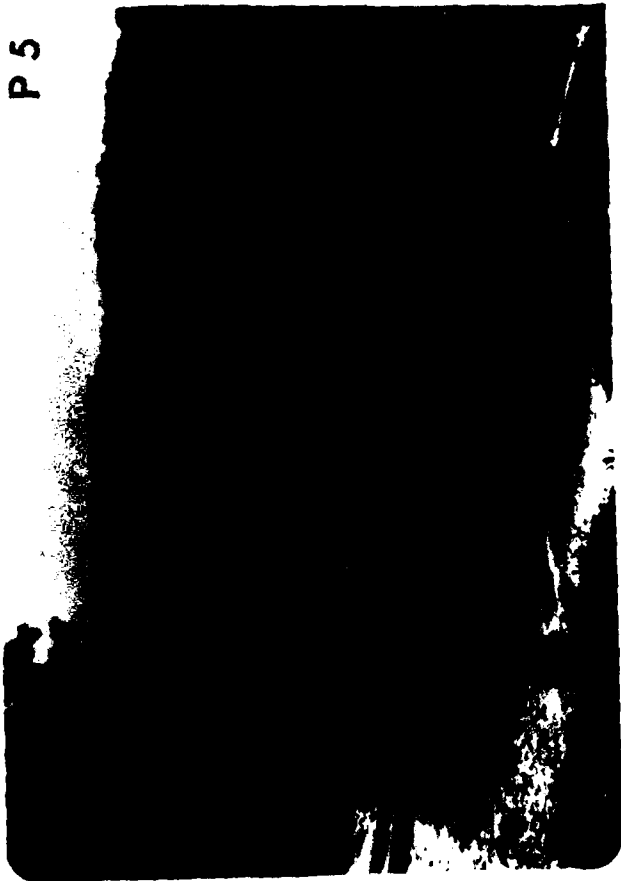


PANORAMA

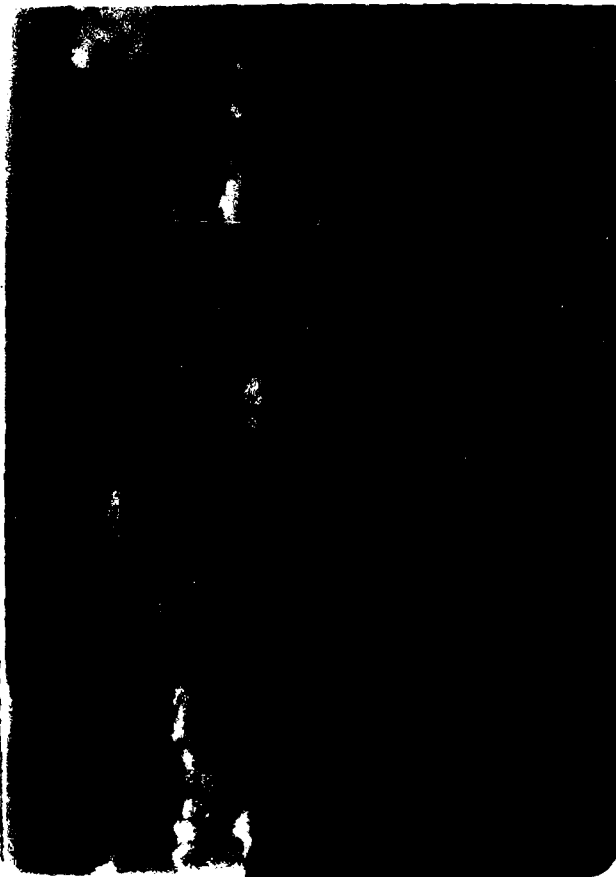
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P5



B



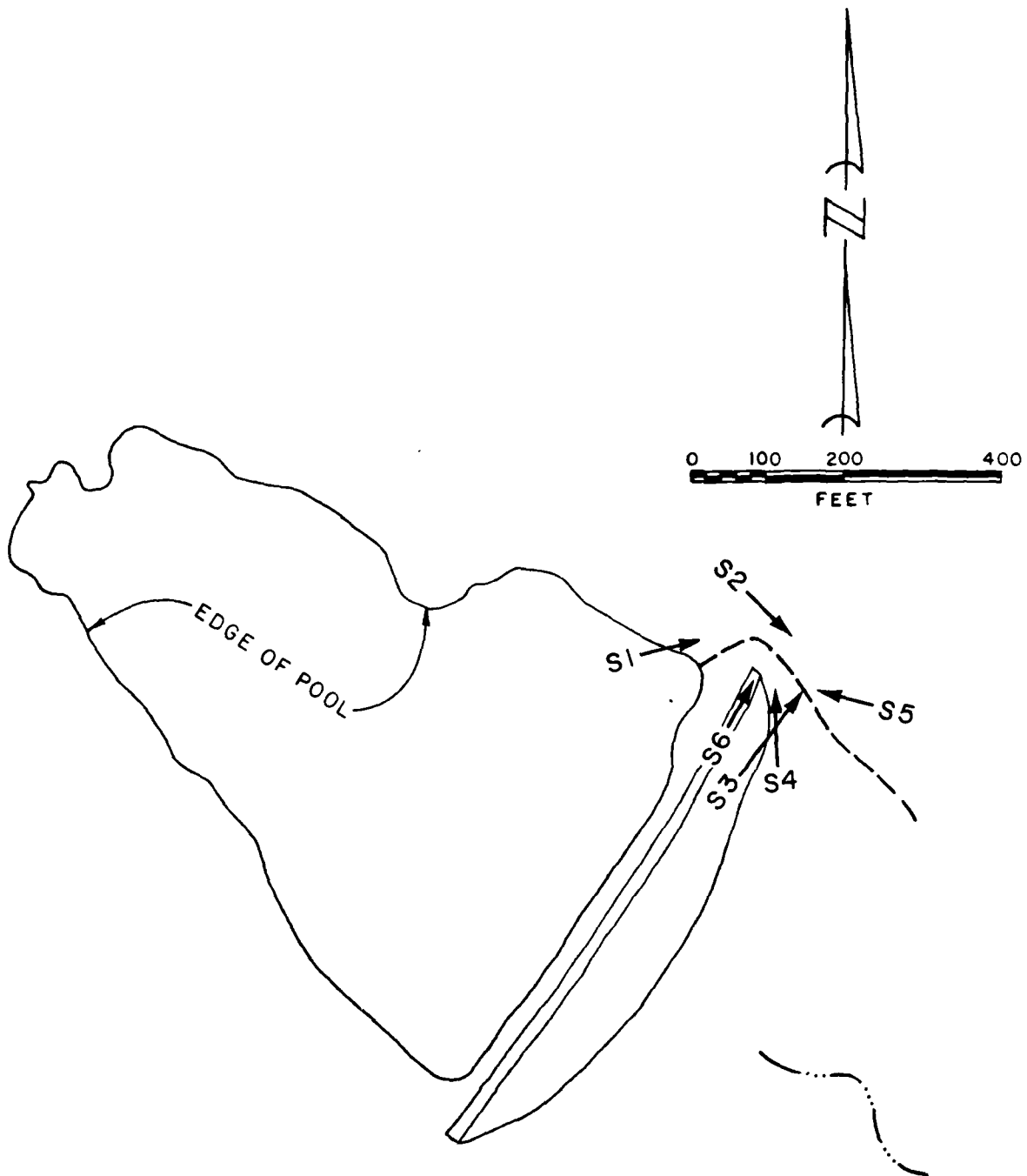


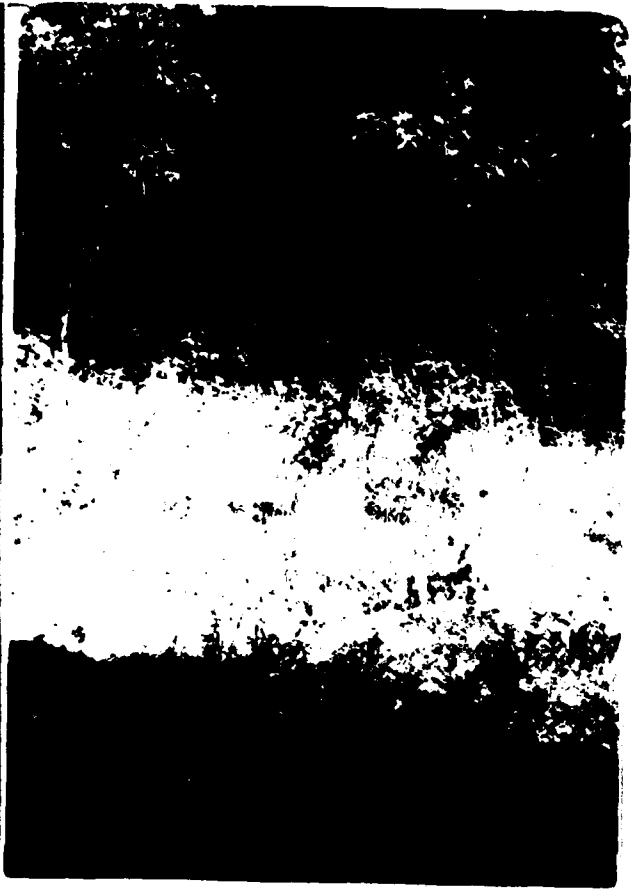
PHOTO INDEX 3
FOR
SPILLWAYS

KOENIG DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

PREPARED BY
REITZ & JENS, INC.



SPILLWAYS



3/6 B

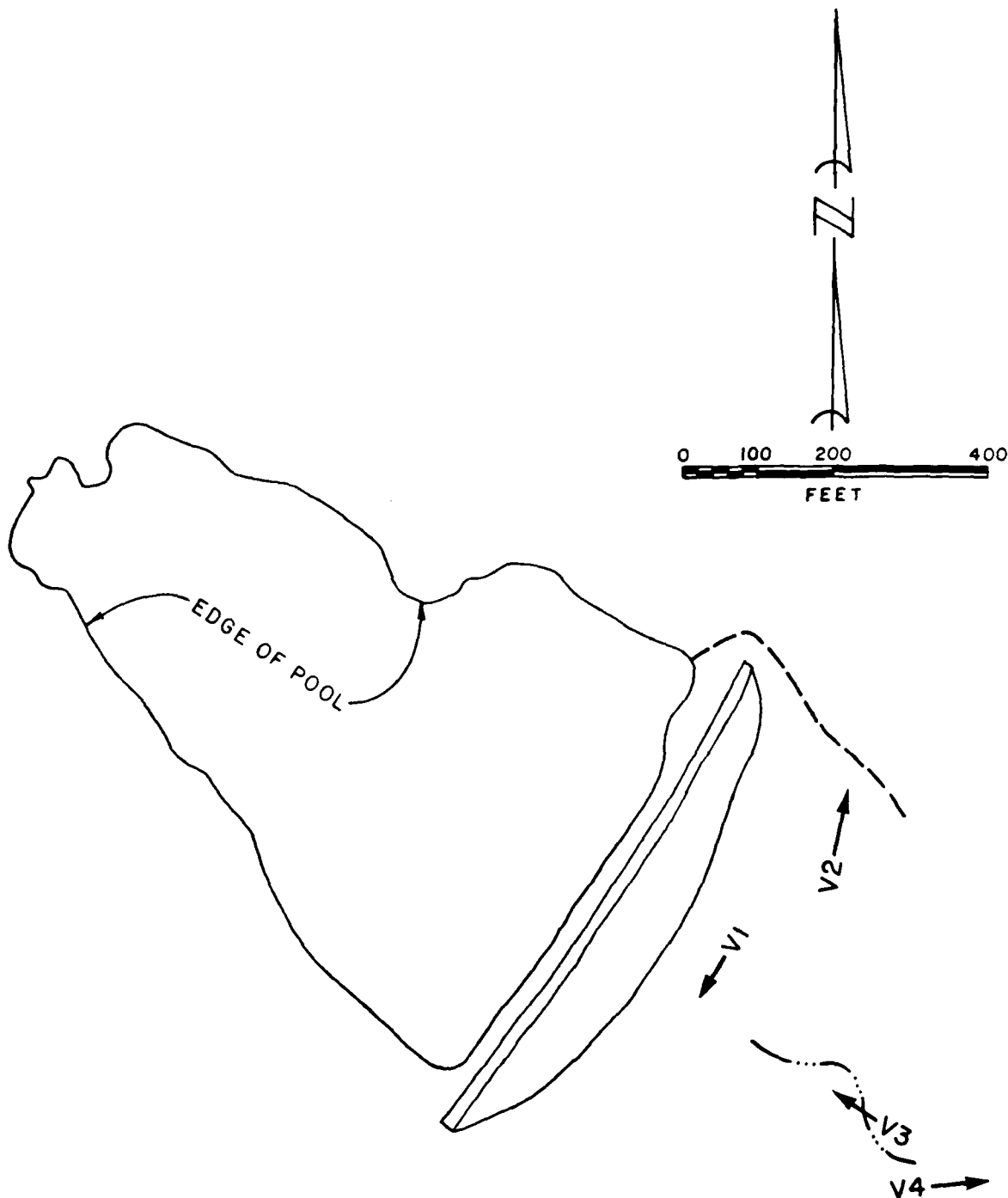
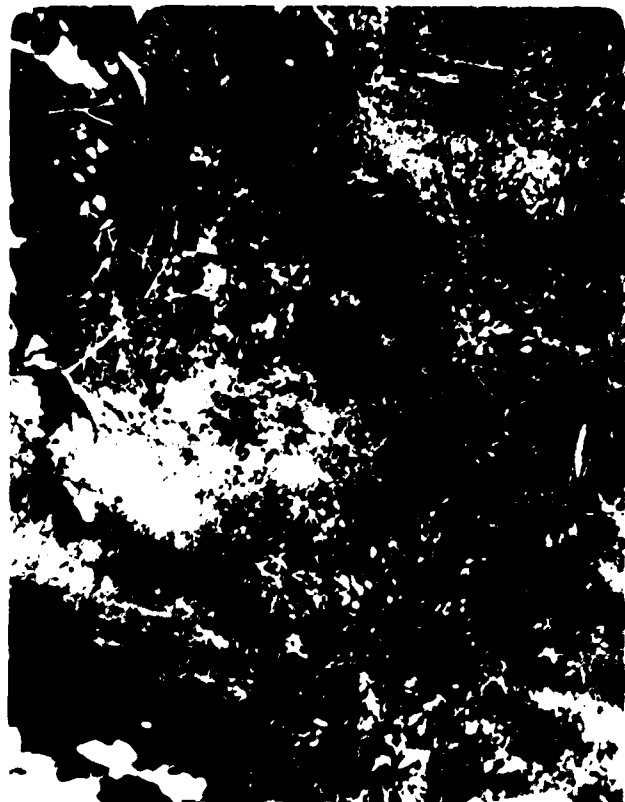


PHOTO INDEX 4
FOR
VALLEY BELOW DAM

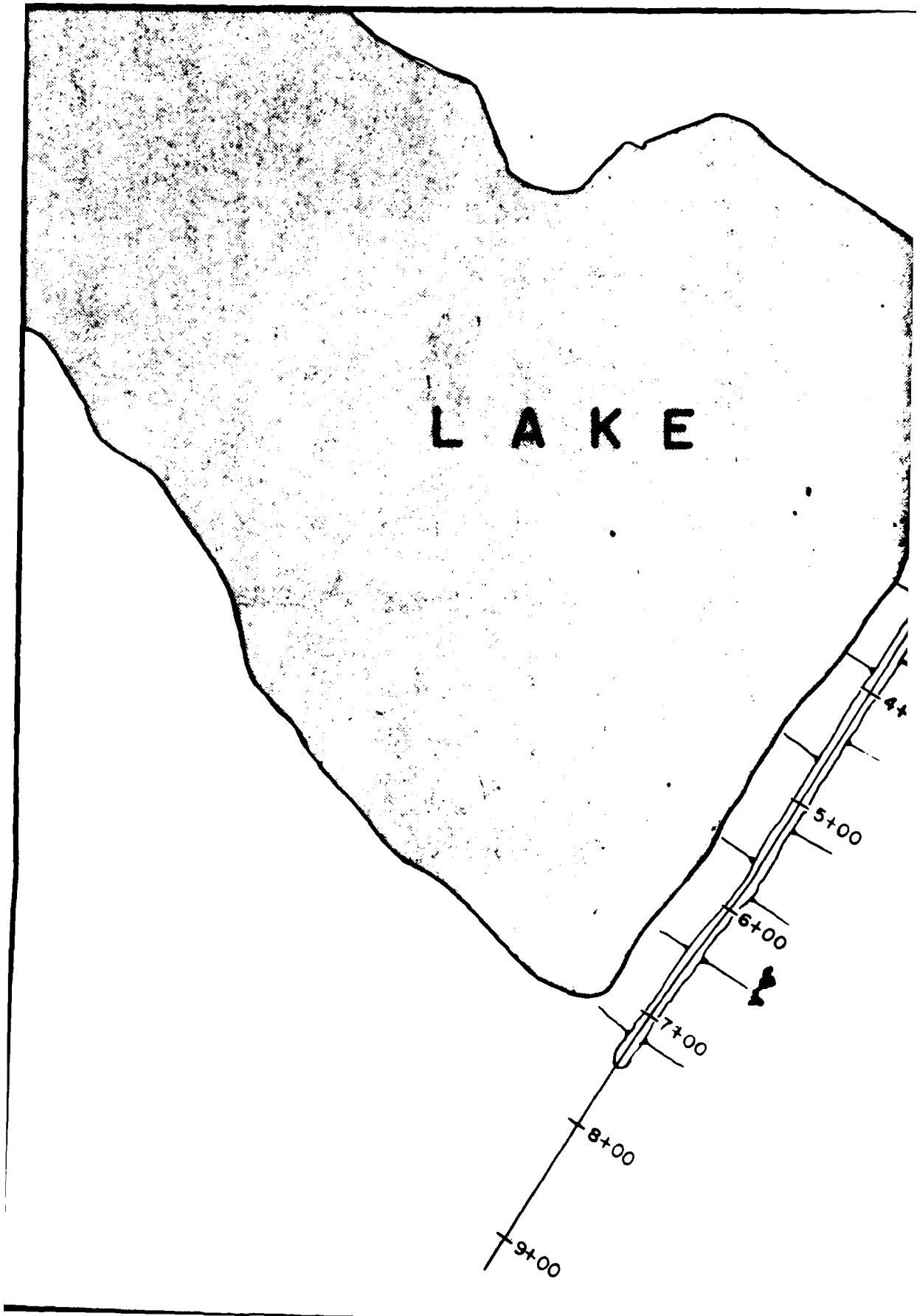
KOENIG DAM
ST. CHARLES COUNTY, MO.

SEPTEMBER 1978

PREPARED BY
REITZ & JENS, INC.



VALLEY BELOW DAM



LAKE

4+

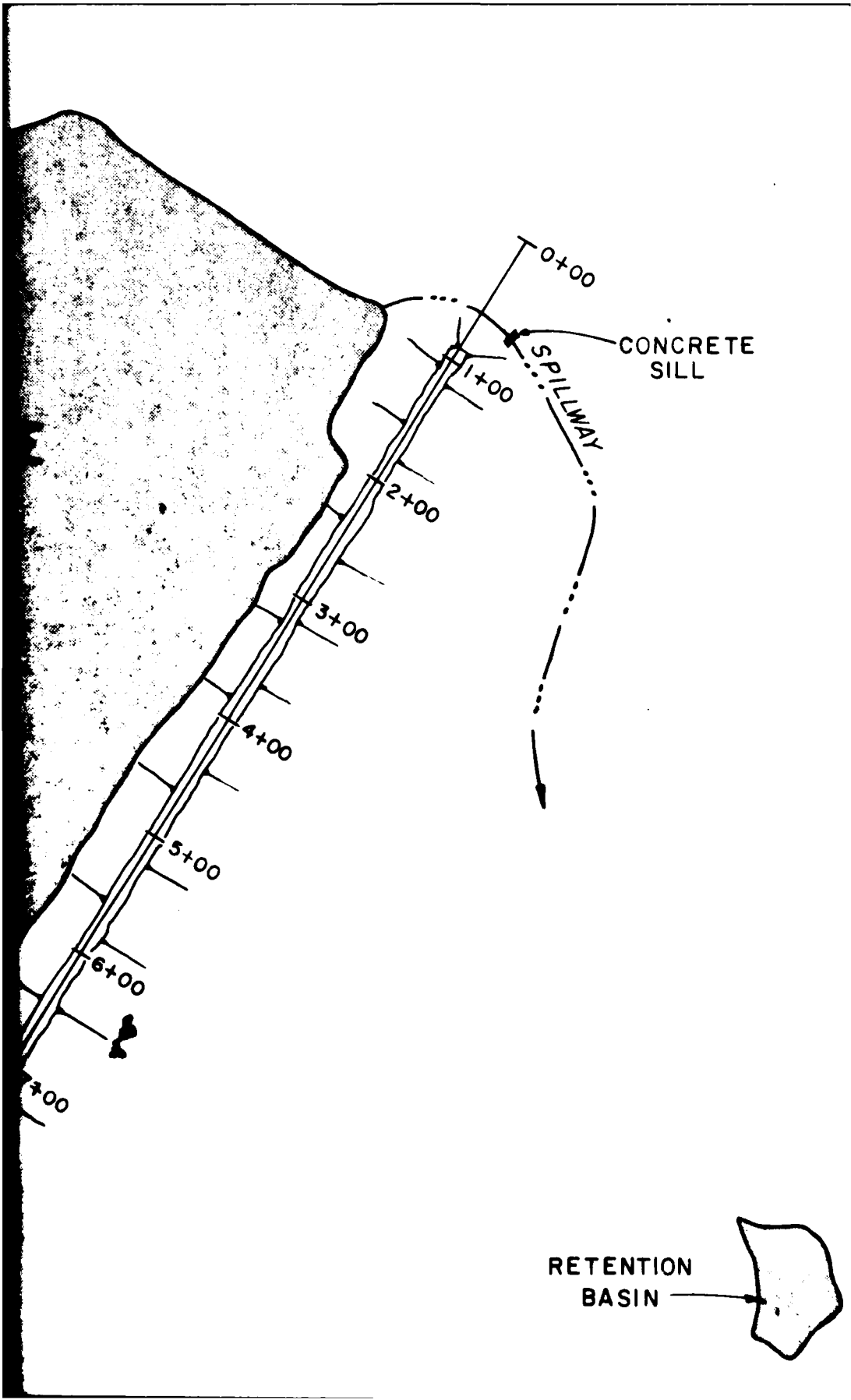
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6+00

7+00

8+00

9+00



3

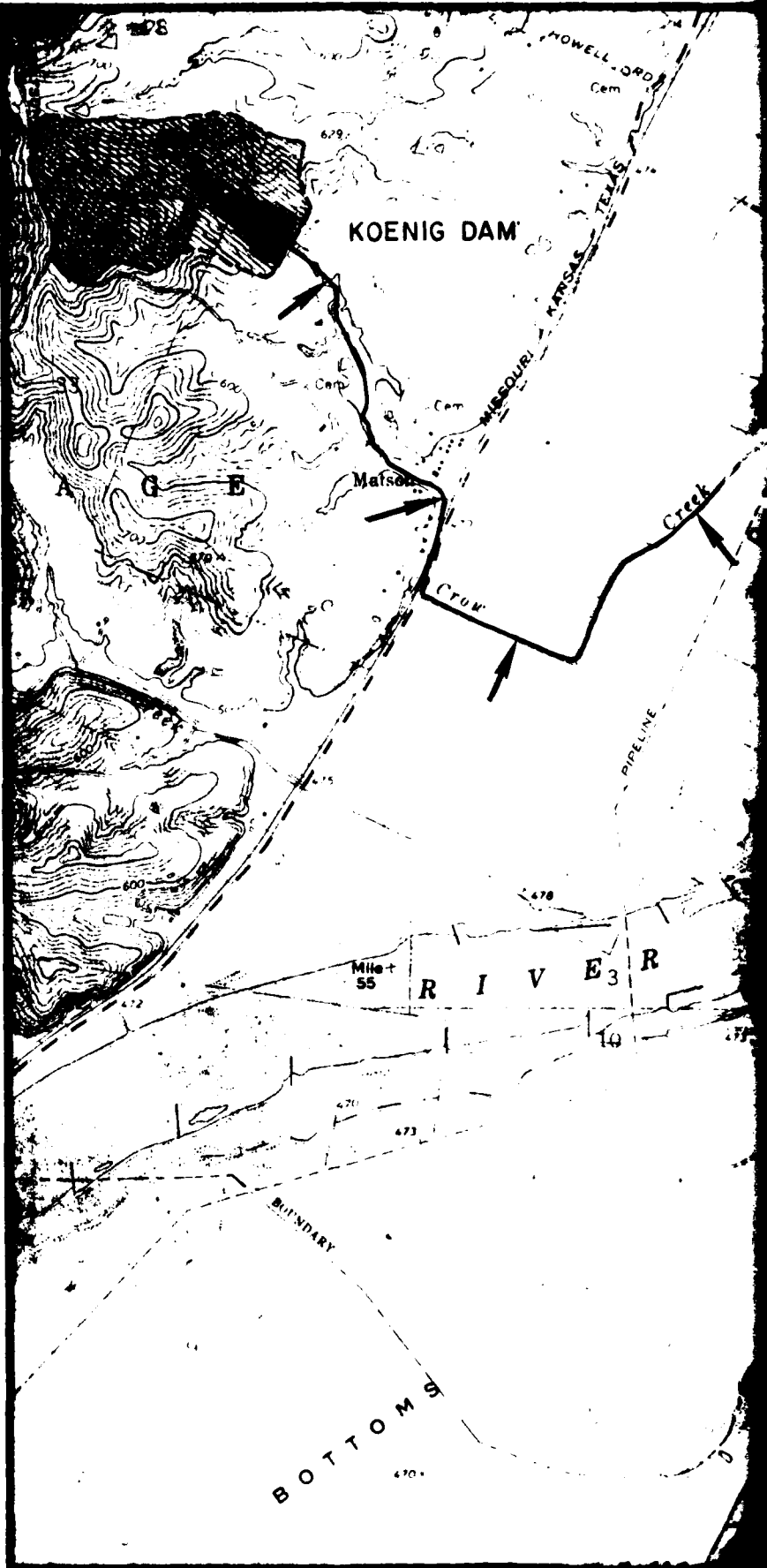
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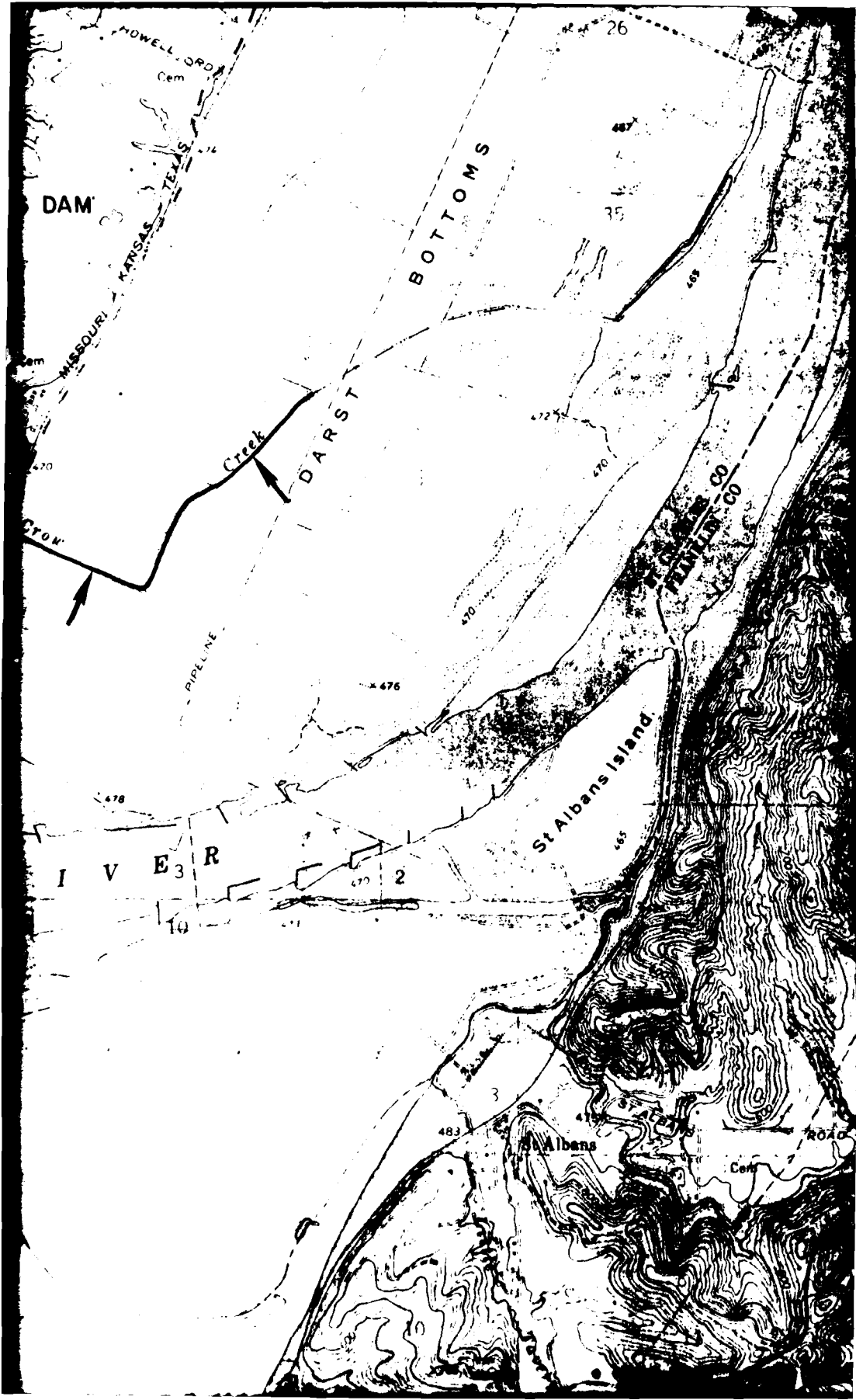
PLAN OF LAKE

0 100 200 400 FT

4



WATERSHED AND OUT

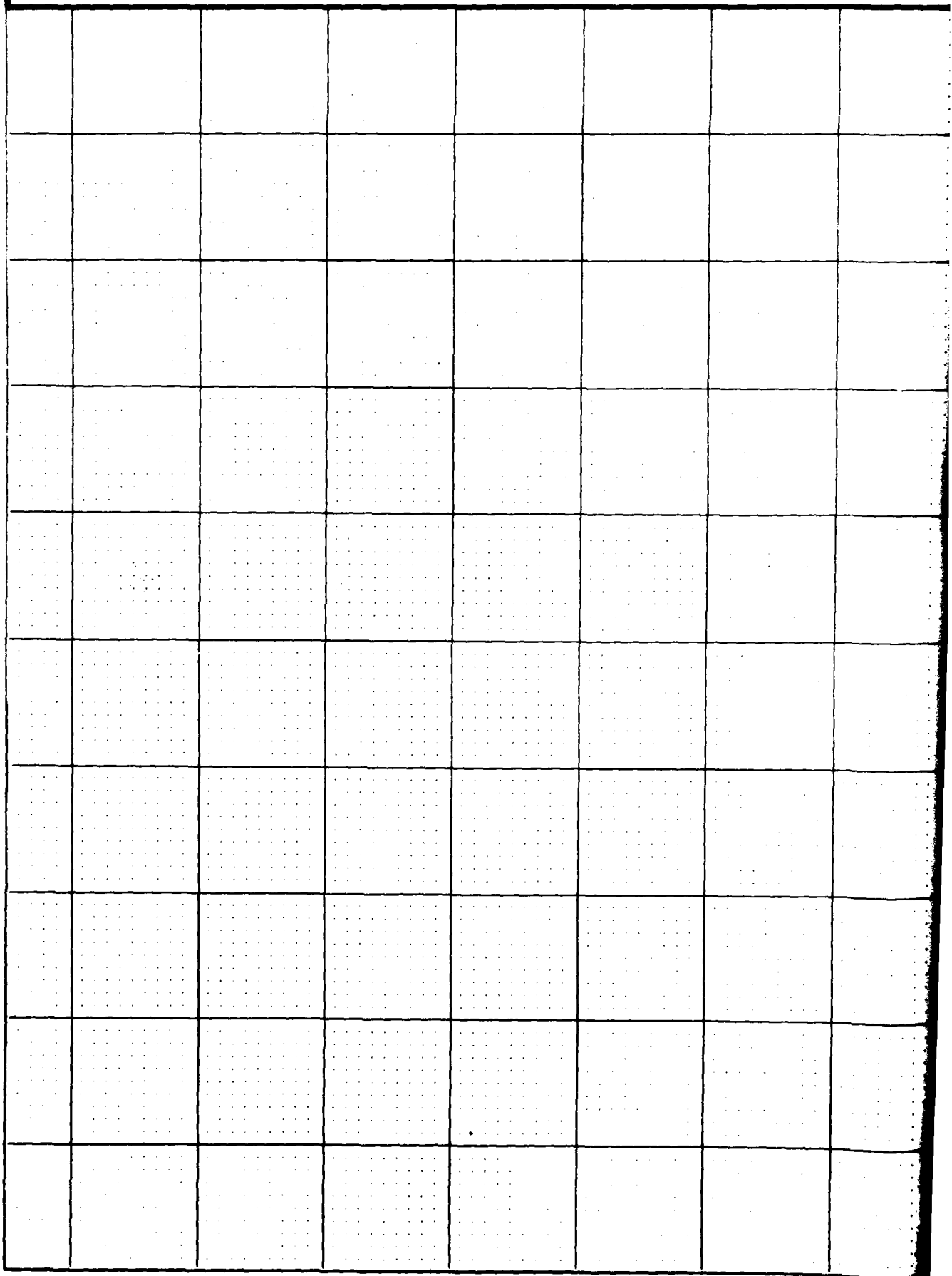


PLAN OF DAM AND SPILLWAY

0 50 100 200 300 FT.



ORIGINAL SURVEY	SURVEYED _____	BY _____	DATE _____
	PLOTTED _____		
NOTE BOOK NO. _____	TEMPLATE _____	AREAS CHECKED _____	
	AREAS _____		



6

AND SPILLWAY

200

300 FT.

110

WATER
LEVEL
16 AUG 1977

90

70

0

110

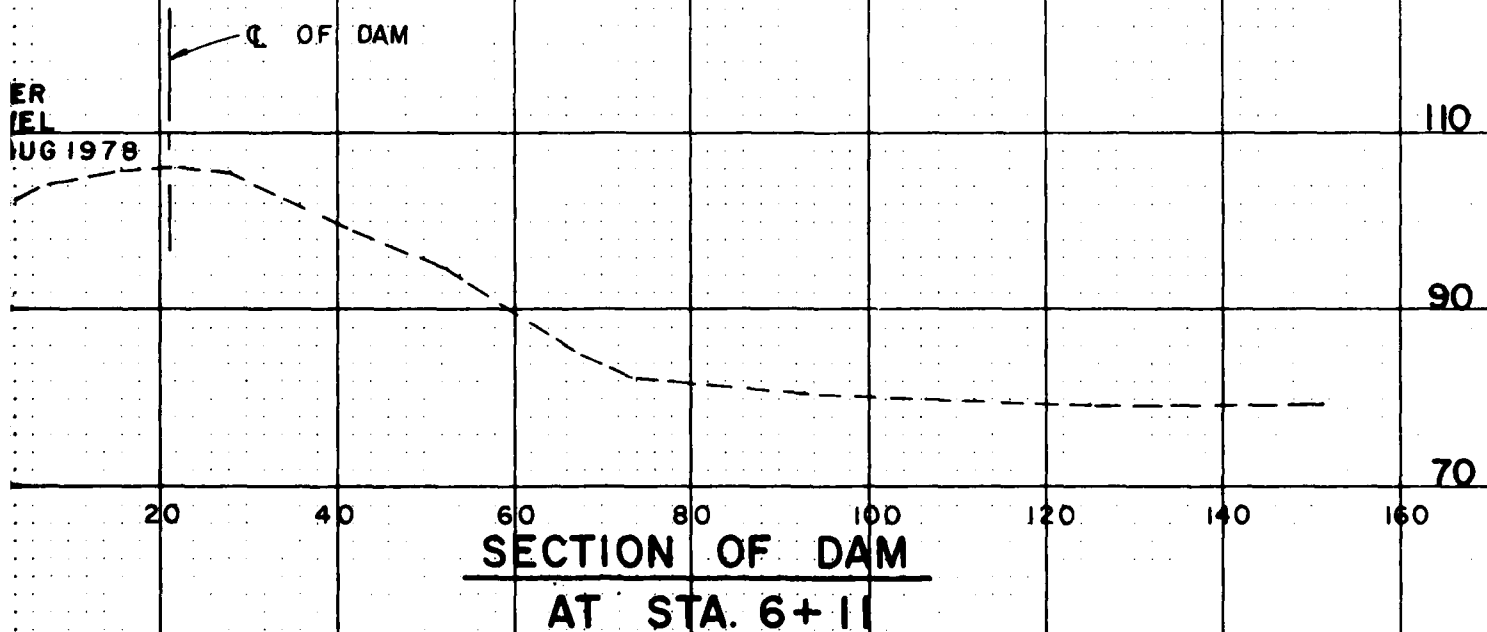
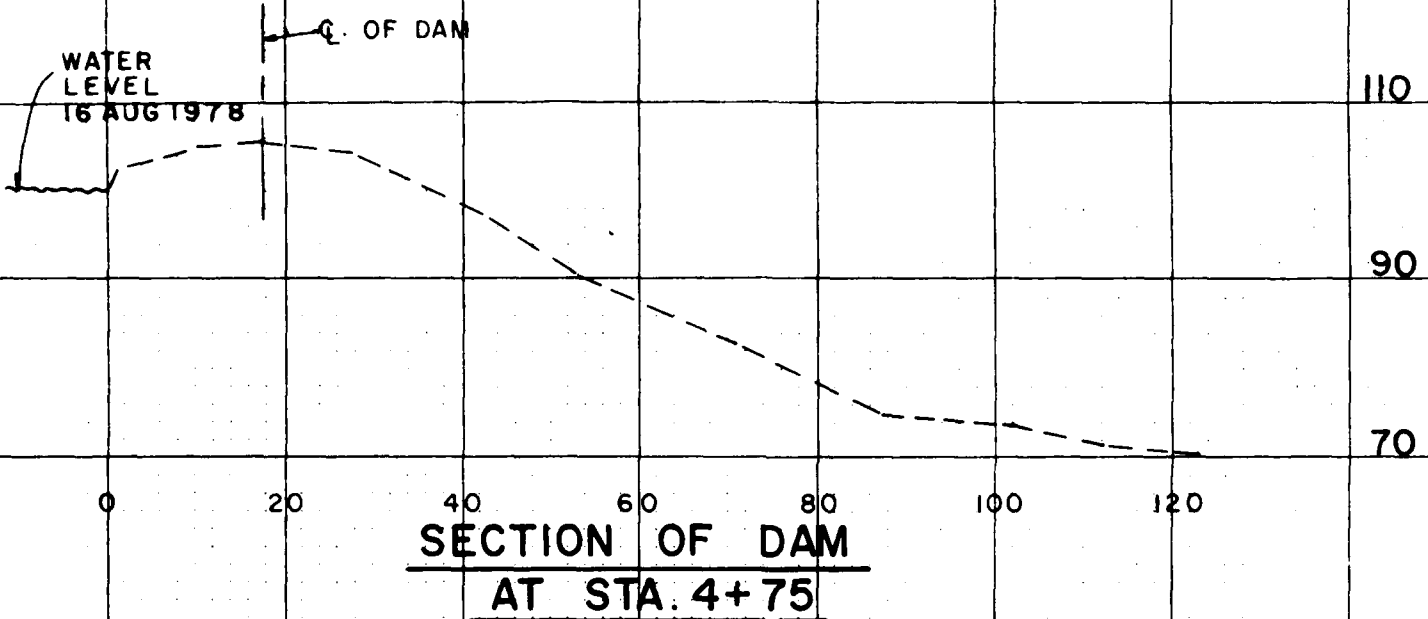
WATER
LEVEL
16 AUG 1978

90

70

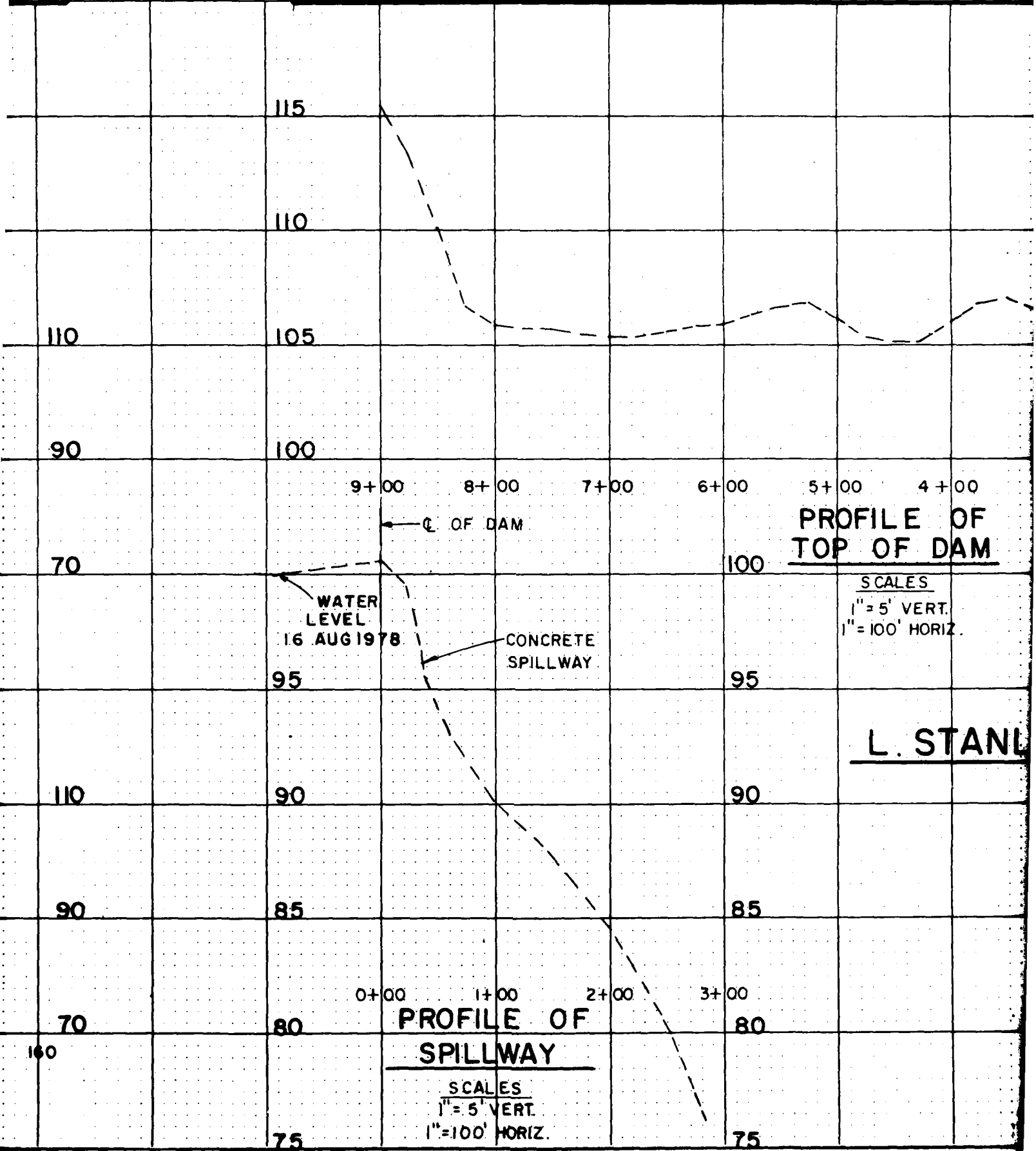
C

0 100 200 400 FT.



WATERSHED AND OUTFLOW CHANN

0 1000 2000 4000 6000 FT.



**PROFILE OF
TOP OF DAM**

SCALES
1" = 5' VERT.
1" = 100' HORIZ.

L. STANL

**PROFILE OF
SPILLWAY**

SCALES
1" = 5' VERT.
1" = 100' HORIZ.

115

110

110

105

90

100

9+00 8+00 7+00 6+00 5+00 4+00

← Q. OF DAM

70

100

WATER LEVEL
16 AUG 1978

CONCRETE
SPILLWAY

95

95

110

90

90

90

85

85

70

80

0+00 1+00 2+00 3+00

160

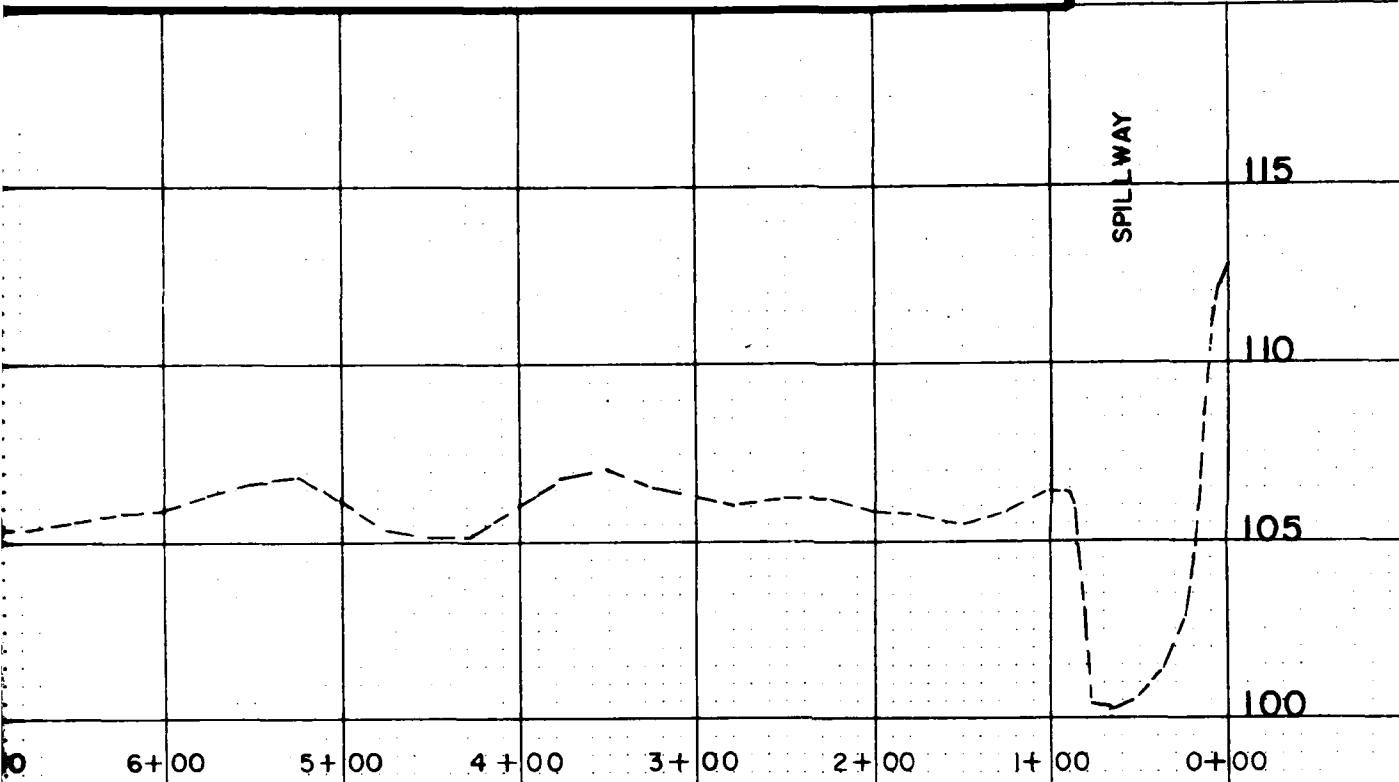
80

75

75

SHED AND OUTFLOW CHANNEL

1000 2000 4000 6000 FT.



PROFILE OF TOP OF DAM

SCALES
1" = 5' VERT.
1" = 100' HORIZ.

L. STANLEY KOENIG DAM

ADD 430' TO ELEVATIONS SHOWN
TO OBTAIN APPROX. USGS DATUM

PHASE I - INSPECTION
COUNTY I.D. NO. 183
ST. CHARLES COUNTY, MISSOURI

INVENTORY NO. I. D. 30028

FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS

REITZ & JENS, INC.
CONSULTING ENGINEERS

ST. LOUIS, MISSOURI
SEPTEMBER 1978

