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NATIONAL DAM SAFETY PROGRAM, STRUCKHOFFS DAM (MO 30100), MISSOUA--ETC(U)

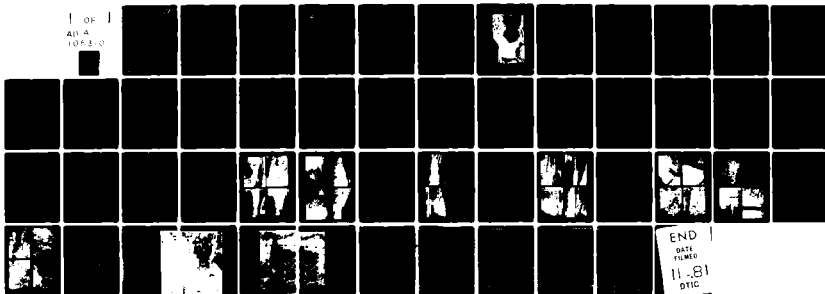
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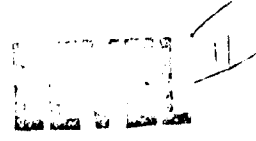
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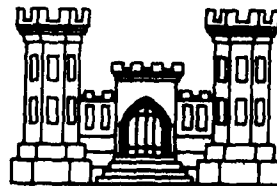
MISSOURI-KANSAS CITY BASIN

STRUCKHOFFS DAM

ST. CHARLES COUNTY, MISSOURI

MO 30100

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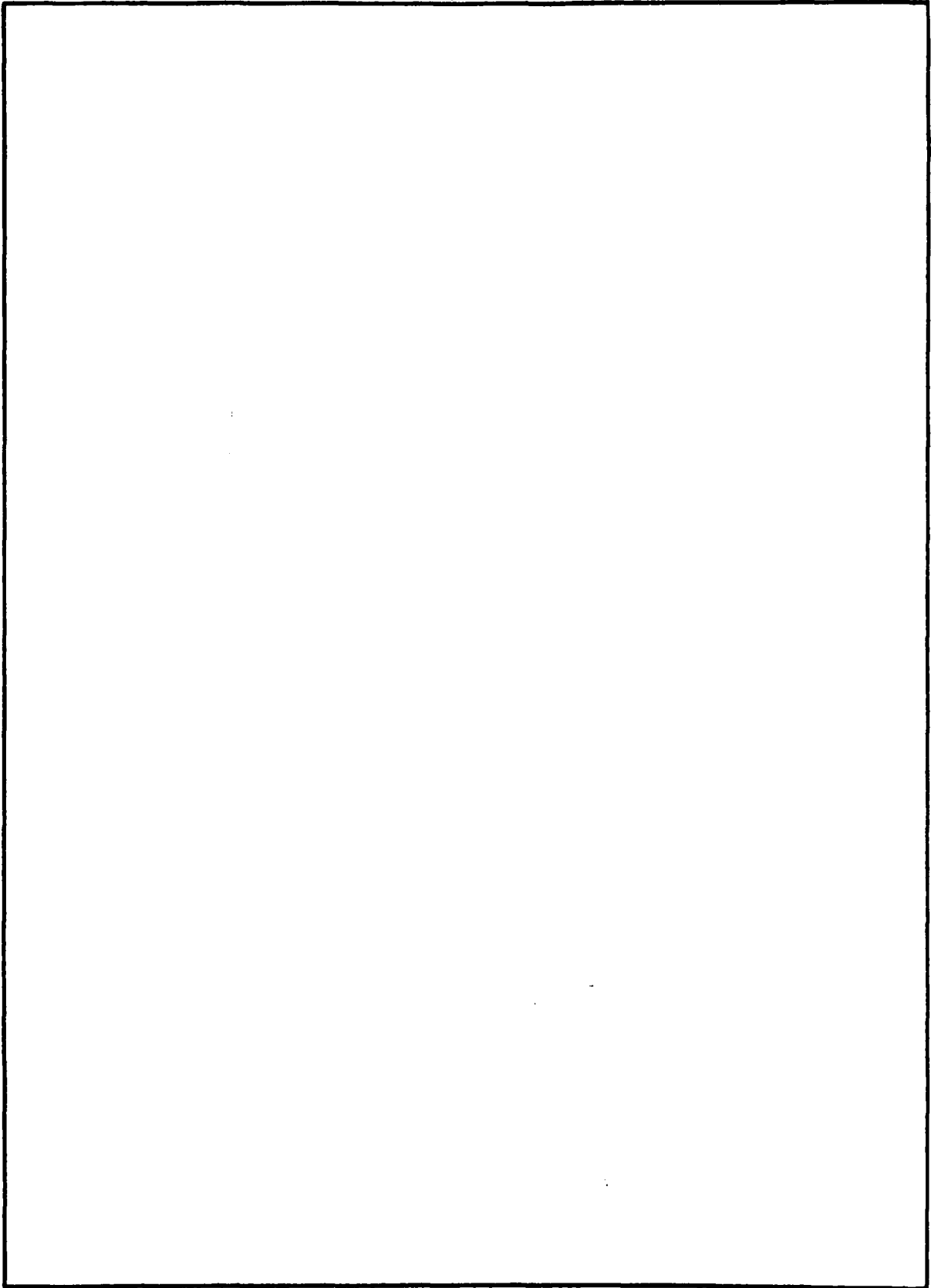
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DEPARTMENT OF THE ARMY
 ST. LOUIS DISTRICT, CORPS OF ENGINEERS
 210 NORTH 12TH STREET
 ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Richard Struckhoff Dam, ID No. 30100, Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Richard Struckhoff dam:

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

The St. Louis District has classified this dam as unsafe, non-emergency because the spillway will not pass 50 percent of the Probable Maximum Flood.

SUBMITTED BY: SIGNED
 Chief, Engineering Division

25 SEP 1978
 Date

APPROVED BY: SIGNED
 Colonel, CE, District Engineer

25 SEP 1978
 Date

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RICHARD STRUCKHOFF DAM
ST. CHARLES COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30100

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: REITZ & JENS, INC. UNDER CONTRACT WITH
ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

SEPTEMBER 1978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Richard Struckhoff Dam
State Located	Missouri
County Located	St. Charles County
Stream	Unnamed tributary to Bigelow Creek
Date of Inspection	22 August 1978

Richard Struckhoff 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 damage zone from failure of the dam extends two miles downstream from the dam.

Failure would threaten the life and property of two families and cause appreciable damage to a county road and the MKT Railroad.

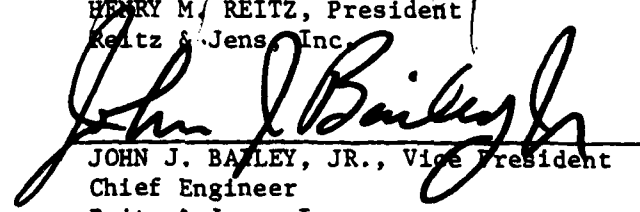
Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The dam will begin to be overtopped by a flood having a discharge (peak and volume) equal to 35% of the PMF. The dam storage and principal spillway will contain a 1% chance flood (100-year flood) without overtopping the emergency spillway. This is a flood that has a 1% chance of being exceeded in any given year.

Another deficiency found was the lack of seepage and stability analysis records.

Other deficiencies observed by the inspection team were tree growth starting on the downstream face and shallow erosion channels on the downstream face and at the toe of the dam on the west slope.

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 lake 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. 30100

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
RICHARD STRUCKHOFF DAM - ID NO. 30100

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1	Overview - Lake and Environs
2	Plan and Profile Sheet (in pocket on back cover)
A-1 (5 sheets)	Hydrologic and Hydraulic Computations (HEC-1 Input and Output)

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1	Index of Dam Photos (D1 through D8)
2	Index of Panorama Photos (P1 through P2)
3	Index of Spillway Photos (S1 through S4)
4	Index of Valley Below Dam Photos (V1 through V7)
5	Index of Seepage Photos (SE1 through SE4)

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 Richard Struckhoff 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 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 a narrow draw in the uplands of the Missouri River Bluffs. Topography adjacent to the valley is rolling to steep. Soils are formed in thick loess deposits over weathered material from the St. Peters Sandstone. Topography in the vicinity of the dam is shown on Plate 2. From 1"=2000' aerial photographs taken in 1977, it appears that about 70% of the watershed is cultivated and about one-half of this area is contoured. A 30-acre portion of the watershed at the northwest extremity is severely eroded.

(2) An 8-inch steel pipe (principal spillway) is provided to bleed off water retained in the lake. Additional spillways (emergency spillways), flat channels excavated in earth, are provided at each abutment.

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

b. Location The dam is located in the southwestern portion of St. Charles County, Mo. in the NW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, T44N, R1E, as shown on Plate 2. The lake formed by the dam is not shown on the Missouri-St. Charles County Washington East Quadrangle Sheet (1972).

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 are 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 This dam is owned by Richard Struckhoff, Route 1, Augusta, Missouri, 63332, who also owns and farms the greater part of the watershed as well as adjoining property.

f. Purpose of the Dam The dam forms an 8-acre recreational and agricultural lake and serves a flood control function for interior drainage of the Hancock Bottoms.

g. Design and Construction History The dam was constructed between 1970 and 1972. Design and construction advice was furnished by the USDA Soil Conservation Service. Contractor's name, design and construction records are not currently available.

h. Normal Operating Procedure Normal rainfall, runoff, transpiration and evaporation all combine to maintain a relatively stable water surface elevation. The principal spillway pipe is capable of discharging water ponded to the level of the emergency spillway in 5 to 6 days. The maximum water depth ever experienced at the spillway is unknown.

1.3 PERTINENT DATA

a. Drainage Area - 157 acres, 70% cultivated (35% terraced) 20% eroded. About 1/2 Menfro silt loam and 1/2 Winfield silt loam soils according to the soil map of St. Charles County, Mo., surveyed in 1937 and published in 1955.

b. Discharge at Dam Site

(1) Discharge at the dam site is through an uncontrolled 8-inch diameter steel pipe. Emergency spillways are provided at the east and west ends of the dam. The elevation of the west spillway is so high, relative to the top of dam, that it provides little usable capacity.

(2) Estimated experienced maximum flood at dam site - unknown.

(3) Estimated ungated spillway capacity at crest of dam elevation 6 cfs in principal spillway; 282 cfs east emergency spillway; 30 cfs west emergency spillway; total 318 cfs.

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

(1) Top of dam - 527.0 to 529+ (see Plate 2).

(2) Spillway crest - 519.4 Principal spillway
524.4 East Emergency Spillway
526.6 West Emergency Spillway

(3) Streambed at centerline of dam - 493 (est.)

(4) Maximum tailwater - unknown.

d. Reservoir Length of maximum pool - 1800 ft.+ (est. from USGS Contour Map).

e. Storage (Acre-feet) Crest of principal spillway - 73 Ac/ft. (est.)
Top of dam - 156 Ac/ft.

f. Reservoir Surface (Acres)

- (1) Top of dam 14.0 Acres (interpolated from USGS)
- (2) Principal Spillway Crest - 8.3 Acres (est.)

g. Dam

- (1) Type - earth embankment
- (2) Length - 400 feet
- (3) Height - 36 feet maximum
- (4) Top width - 13 to 14 ft.
- (5) Side slopes -
 - (a) Downstream - 1V on 2.4H (determined from Stations 2+00 and 3+00, Plate 2.)
 - (b) Upstream - 1V on 3H to water surface - below water surface unknown.
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout Curtain - unknown

h. Diversion and Regulating Tunnel - None

i. Spillways

(1) Principal spillway - smooth steel 8-inch pipe with trashrack through dam approximately 145 feet long at 15%+ average grade. Upper flowline at elevation 519.4; lower flowline elevation 493.7.

(2) East Emergency Spillway - 8-foot flat bottom earth channel with 1V to 6H and 1V to 10H side slopes at control section; crest elevation 524.4+.

(3) West Emergency Spillway - 25-foot flat bottom earth channel with 1V to 8H and 1V to 25H side slopes at control section; crest elevation 526.4+.

j. Regulating Outlets - None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were found to be readily available.

2.2 CONSTRUCTION

The dam was constructed between 1970 and 1972 with advice from the local representatives of the USDA-SCS. No additional construction data are currently available.

2.3 OPERATION

Lake levels remain stable during average precipitation of 38 inches per year. It appears from the condition of the east emergency spillway that water has flowed over it at some time since completion.

2.4 EVALUATION

a. General The inspection team believes the Soil Conservation Service of the U.S. Department of Agriculture furnished design and construction advice for this dam and others in the Bigelow Creek watershed.

During the period of the late 1960's and early 1970's, SCS was implementing a project to minimize problems of interior drainage in the Hancock Bottom generally between Missouri River Miles 61L and 65L. Bigelow Creek flows between the toe of bluff and this bottom. Construction of a series of upland dams, proportioned to contain at least the 100-year runoff, reduced peak flows in the relatively flat lower end of the creek. Crop damage from flooding in the bottom was thereby reduced.

Some confusion was found in SCS records because of incomplete descriptions of each of the dams in which they had some involvement which was further complicated by several of the different ground owners having the same surname. The description by section and name of owner could be any one of several dams. Further, there is considerable similarity between lengths and heights of dams making specific identification of an existing record questionable. (Note: an effort is being made to retrieve copies of original field notes and surveys which would clarify this matter.)

b. Adequacy The engineering data available were inadequate to make a detailed assessment of design, construction and operation. The owner should have an engineer, experienced in the design of dams, perform detailed seepage and stability analyses.

However, for the size of dam, materials used and measurements taken, a satisfactory hydrologic/hydraulic evaluation resulted. Also, for the section and the presence of the primary spillway plus the visual inspection of a dam with reservoir of at least 6 years of age, the generally good condition of the dam, when considered by the experienced engineers, indicated that even though a detailed assessment of the design and construction in an analytical sense was not possible, a defensible evaluation of the dam as a structure, was feasible.

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 Richard Struckhoff dam was made on 22 August 1978. This followed two days of field measurements by a survey party on 25 and 26 July 1978. The training and experience of personnel in these two inspections included hydrologic/hydraulic engineering, soils and materials engineering, surveying and structural engineering. Specific observations are discussed below.

b. Dam The grade of top of dam is relatively uniform for an earth dam. Vehicles infrequently will cross the dam.

Both the downstream and upstream slopes of the dam were covered with healthy growth of low grass. Neither slope had any weed growth as differentiated from grasses. There is marked freedom from shrubs or undergrowth. Several first-year tree seedlings, less than 2 feet high (photo D4) were visible. There was some shallow erosion in a ditch typical of the erosion pattern for the low plasticity soils which had resulted from overland flow off the downstream face of the dam. At one point, entering the erosion pocket at the lower end of the spillway from the east (photo SE2) had also a relatively indistinct "Y" erosion pattern upslope from this entry into the photo number area (photo D4). There is also some erosion at the contact of the toe of dam and virgin soil running up the west slope and the original ground surface (photos V1 and V2). Some water, less than an inch deep, was in the bottom (photo SE1).

No hydrophilic plants were at or above the downstream toe of the dam in any portion.

c. Appurtenant Structures Some trash had accumulated on the rack at the end of the principal spillway which is shown on photo P1. The discharge end of the 8-inch pipe from the principal spillway appeared to be at the original ground surface (photo V3) in the life of the dam, a limited erosion, roughly circular in shape, about 6 feet in lateral dimension and to a depth about 3 feet below the flowline of the pipe, had occurred. Since the bottom of this scour hole is below the downstream channel, water was standing in it.

The east emergency spillway is lower and better defined than the west and it carries the majority of flow when the high intensity storms occur. The east is an earth spillway beyond the end of the dam in virgin soil with grass cover of the same nature as the dam and surrounding fields (photos S3 and S4). While there is a fence with change in direction in this general area, the location of the posts and the heights of the barbed wire strands are such that they will not catch debris which could adversely affect the carrying capacity of this spillway. Water, flowing over this spillway, is confined by a low man-made dike along the west side (photo S4) which directs its flow into a deep, natural channel that is downstream from the dam and beyond another fence line which roughly parallels the dam from the east to the west (photo V4).

At the west end of the dam there is some additional capacity for flows to leave the reservoir before the lake level reaches the top of the dam. This spillway at this location is less well defined (photo S1).

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

e. Downstream Channel 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 or a serious potential failure. Continued annual attention to cutting growth on the slopes of the dam is suggested. The shallow erosion channels that were enumerated and can be observed on the downstream face due to surface runoff should be filled and then turf re-established.

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 spillways, in particular, the 8-inch pipe principal spillway which is capable of evacuating water stored to the elevation of the emergency spillway crest in 5 to 6 days.

4.2 MAINTENANCE OF DAM

Based on the size of weeds and brush growing on the dam it appears that the slope has been cut at intervals sufficient to keep trees and bushes from being established. Some attention should be given to filling the erosion channels on the downstream face of the dam described in paragraph 3.1c.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

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 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 Washington East Missouri Quadrangle. The lake surface area was determined from a 1"=200' enlargement of a 1"=2000' aerial photograph obtained from Surdex Corp. Picture was made 22 March 1977. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations

(1) The 8-inch smooth steel pipe principal spillway and the east and west emergency spillway channels are in good condition. The east emergency spillway channel shows evidence of erosion from flow through it.

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

(3) The principal spillway pipe is located at the west abutment. Spillway releases will not endanger the integrity of the dam.

d. Overtopping Potential The spillways are too small 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 meteorologic and hydrologic conditions that are reasonably possible in the region. The dam will start to be overtopped by a flood equal to 35% of the PMF. The one-half PMF will overtop the dam to a maximum depth of about 0.94 feet. The depth will vary to zero across the dam because of the sloping crest. A width of 140+ feet of dam crest will be subject to some overtopping flow. Maximum rate of flow over the dam crest will be about 135 cubic feet per second. Overtopping flow will have a duration of one hour and 30 minutes. The existing lake and principal spillway will contain a 100-year frequency flood below the crest of the emergency spillway. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, the 100-year frequency flood is only adequate for a low hazard dam of small size.

Failure of the four small upstream water impoundments shown on the 1972 revised USGS map 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 two farmhouses and associated farm buildings, one main county road 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 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 Several items were noted during the visual inspection by the inspection team which should be corrected or controlled. These items which exist on the downstream slope are young trees beginning to grow and erosion. The stability of and seepage conditions on the downstream slope should be investigated by an engineer experienced in the design of dams. The one-half PMF will overtop the dam; however, the reservoir and principal spillway are adequate to contain a flood which has a 1% chance of being exceeded (100-year flood) in any given year.

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 that these data are 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 Spillway size and/or height of dam should be increased to pass one-half the probable maximum flood without overtopping the dam.

b. Perform Stability and Seepage Analyses If the results indicate a need, appropriate corrective measures should be designed and constructed.

c. O&M Maintenance and Procedures The following O&M maintenance and procedures are recommended:

(1) Remove first-year sapling trees and vegetation from the downstream slope. Care should be taken during removal not to destroy the existing condition of the downstream slope.

(2) Fill, grade, fertilize, seed and mulch the erosion channels on the downstream slope. If these are allowed to continue to erode, eventual sloughing and sliding of the downstream face of the dam may occur.

(3) Periodically check the condition of the 8-inch steel pipe through the dam for evidence of corrosion and leakage. Water leaking into or out of a corroded principal spillway pipe could cause piping failure of the earth embankment.

(4) Maintain the trash rack at the inlet of the principal spillway. Remove accumulations of trash which, if left in place, could eventually greatly reduce the capacity of the pipe.

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

(6) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams.

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 outlet works, 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 spillways 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 2A. Definitions of these variables are contained in the "User's Manual" for the computer program.

HYDRAULIC COMPUTATIONS

5. Capacity of the 8-inch pipe spillway was based on one velocity head energy and 0.5 velocity head entrance loss up to 6 cfs. Above this discharge friction in the outlet pipe controls. The discharge in the emergency spillways 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. This is equivalent to calculating the spillway as a broad-crested weir with a discharge coefficient of 2.80.

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 3 AUG 78
*****
1 A ***** ID # 30100 - STRUCKHOFF DAM ** ADD 420 FOR USGS FLEV ***
2 A ***** PEITZ & JFNS, INC. - AUGUST 1978 *****
3 A ***** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****
4 R 2RR 0 5 -0 -0 -0 -0 -4 -0
5 1 5
6 J 1 1 9
7 J1 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.50 1.00
8 R 0 1
9 1 ***** INFLOW HYDROGRAPH - SCS METHOD *****
10 M 1 2 0.245 1
11 P 1 24.8 101 120 130
12 T
13 W2 0.17
14 X -0.10 2.0
15 K 1 ***** RESERVOIR ROUTING - RATING CURVE SUPPLIED - SLOPING DAM *****
16 Y 1
17 Y 1
18 Y1 1
19 Y4 99.4 100.4 105.4 105.5 106.0 106.5 107.0 107.5 108.0
20 Y4 108.5 109.0 109.5
21 Y5 0.0 3 5
22 Y5 1267 1435 2431
23 $4 0.00 4.27 27.09
24 $F 73.0 99.4 120.0
25 $$ 99.4
26 $D 107.0 3.0 2.5 63.4
27 K 99

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

QUN DATE 09/13/78.
 TIME 16.06.48.

***** ID # 30100 - STRUCKHOFF DAM ** ADD 420 FOR USGS ELEV ***
 ***** REITZ @ JFNS, INC. - AUGUST 1978 *****
 ***** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****

JOB SPECIFICATION											
NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN		
200	0	5	-0	-0	-0	-0	-0	-4	-0		
			5	NWT	IROPT	TRACE					
				-0	-0	-0					

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRATIO= 9 LPTIO= 1

OTIOS= .10 .15 .20 .25 .30 .35 .40 .50 1.00

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

***** INFLOW HYDROGRAPH - SCS METHOD *****
 ISTAT ICOMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO

1	0	-0	-0	1	3	1	-0	-0
---	---	----	----	---	---	---	----	----

HYDROGRAPH DATA
 IHYG IHNG TARFA SNAP TRSDA TRSPC RATIO ISNOW ISAMF LOCAL

1	2	.25	-0.00	.25	1.00	-0.000	-0	1	-0
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PRECIP DATA
 SPFF PMS R4 R12 R24 R48 R72 R96

-0.00	24.80	101.00	120.00	130.00	-0.00	-0.00	-0.00	-0.00
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LOSS DATA
 LROPT STOKP DLTKR RTIOL ERAIN STRKS RTIOK STPTL CNSTL ALSMX RTIMP

-0	-0.00	-0.00	1.00	-0.00	-0.00	1.00	-1.00	-0.00	-0.00	.06
----	-------	-------	------	-------	-------	------	-------	-------	-------	-----

CURVE NO = -06.00 WETNESS = -1.00 EFFECT CN = 06.00

UNIT HYDROGRAPH DATA
 TC= -0.00 LAG= .17

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

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES. TC= -0.00 HOURS. LAG= .17 VOL= 1.00
 170. 514. 331. 166. 89. 47. 25. 13. 7.
 4. 2.

0
 MO,DA HR,MN PERIOD RAIN EXCS LOSS FND-OF-PERIOD FLOW MO,DA HR,MN PERIOD RAIN EXCS LOSS COMP Q

1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.01	141.
1.01	.10	2	.01	.00	.01	1.	1.01	12.10	146	.21	.20	.01	211.
1.01	.15	3	.01	.00	.01	1.	1.01	12.15	147	.21	.20	.01	284.
1.01	.20	4	.01	.00	.01	1.	1.01	12.20	148	.21	.20	.01	329.
1.01	.25	5	.01	.00	.01	1.	1.01	12.25	149	.21	.20	.01	353.
1.01	.30	6	.01	.00	.01	1.	1.01	12.30	150	.21	.20	.01	366.
1.01	.35	7	.01	.00	.01	2.	1.01	12.35	151	.21	.20	.01	373.
1.01	.40	8	.01	.00	.01	2.	1.01	12.40	152	.21	.20	.01	377.
1.01	.45	9	.01	.00	.01	2.	1.01	12.45	153	.21	.20	.01	380.
1.01	.50	10	.01	.00	.01	2.	1.01	12.50	154	.21	.20	.01	381.
1.01	.55	11	.01	.00	.01	2.	1.01	12.55	155	.21	.20	.01	383.
1.01	1.00	12	.01	.00	.01	2.	1.01	13.00	156	.21	.20	.01	391.
1.01	1.05	13	.01	.00	.01	2.	1.01	13.05	157	.25	.24	.01	412.
1.01	1.10	14	.01	.00	.01	2.	1.01	13.10	158	.25	.24	.01	434.
1.01	1.15	15	.01	.00	.01	2.	1.01	13.15	159	.25	.24	.01	448.
1.01	1.20	16	.01	.00	.01	2.	1.01	13.20	160	.25	.24	.01	456.
1.01	1.25	17	.01	.00	.01	2.	1.01	13.25	161	.25	.24	.01	460.
1.01	1.30	18	.01	.00	.01	2.	1.01	13.30	162	.25	.25	.01	462.
1.01	1.35	19	.01	.00	.01	2.	1.01	13.35	163	.25	.25	.00	464.
1.01	1.40	20	.01	.00	.01	2.	1.01	13.40	164	.25	.25	.00	465.
1.01	1.45	21	.01	.00	.01	2.	1.01	13.45	165	.25	.25	.00	466.
1.01	1.50	22	.01	.00	.01	2.	1.01	13.50	166	.25	.25	.00	466.
1.01	1.55	23	.01	.00	.01	2.	1.01	13.55	167	.25	.25	.00	477.
1.01	2.00	24	.01	.00	.01	2.	1.01	14.00	168	.25	.25	.00	509.
1.01	2.05	25	.01	.00	.01	2.	1.01	14.05	169	.31	.31	.00	542.
1.01	2.10	26	.01	.00	.01	2.	1.01	14.10	170	.31	.31	.00	563.
1.01	2.15	27	.01	.00	.01	2.	1.01	14.15	171	.31	.31	.00	574.
1.01	2.20	28	.01	.00	.01	3.	1.01	14.20	172	.31	.31	.00	580.
1.01	2.25	29	.01	.00	.01	3.	1.01	14.25	173	.31	.31	.00	583.
1.01	2.30	30	.01	.00	.01	3.	1.01	14.30	174	.31	.31	.00	586.
1.01	2.35	31	.01	.00	.01	3.	1.01	14.35	175	.31	.31	.00	587.
1.01	2.40	32	.01	.00	.01	4.	1.01	14.40	176	.31	.31	.00	587.
1.01	2.45	33	.01	.00	.01	4.	1.01	14.45	177	.31	.31	.00	587.
1.01	2.50	34	.01	.00	.01	4.	1.01	14.50	178	.31	.31	.00	567.
1.01	2.55	35	.01	.00	.01	5.	1.01	14.55	179	.31	.31	.00	570.
1.01	3.00	36	.01	.00	.01	5.	1.01	15.00	180	.31	.31	.00	661.
1.01	3.05	37	.01	.00	.01	5.	1.01	15.05	181	.19	.19	.00	817.
1.01	3.10	38	.01	.00	.01	6.	1.01	15.10	182	.38	.38	.00	1147.
1.01	3.15	39	.01	.00	.01	6.	1.01	15.15	183	.38	.38	.00	1935.
1.01	3.20	40	.01	.00	.01	6.	1.01	15.20	184	.57	.57	.00	2767.
1.01	3.25	41	.01	.00	.01	7.	1.01	15.25	185	.67	.64	.01	2776.
1.01	3.30	42	.01	.00	.01	7.	1.01	15.30	186	1.62	1.61	.01	2237.
1.01	3.35	43	.01	.00	.01	7.	1.01	15.35	187	2.67	2.65	.01	1690.
1.01	3.40	44	.01	.00	.01	8.	1.01	15.40	188	1.05	1.04	.00	1292.
1.01	3.45	45	.01	.00	.01	8.	1.01	15.45	189	.67	.66	.00	1015.
1.01	3.50	46	.01	.00	.01	8.	1.01	15.50	190	.57	.57	.00	698.
1.01	3.55	47	.01	.00	.01	8.	1.01	15.55	191	.38	.38	.00	629.
1.01	4.00	48	.01	.00	.01	9.	1.01	16.00	192	.38	.38	.00	571.
1.01	4.05	49	.01	.00	.01	9.	1.01	16.05	193	.29	.29	.00	566.
1.01	4.10	50	.01	.01	.01	9.	1.01	16.10	194	.29	.29	.00	554.
1.01	4.15	51	.01	.01	.01	9.	1.01	16.15	195	.29	.29	.00	553.
1.01	4.20	52	.01	.01	.01	10.	1.01	16.20	196	.29	.29	.00	552.
1.01	4.25	53	.01	.01	.01	10.	1.01	16.25	197	.29	.29	.00	547.
1.01	4.30	54	.01	.01	.01	10.	1.01	16.30	198	.29	.29	.00	510.
1.01	4.35	55	.01	.01	.01	10.	1.01	16.35	199	.29	.29	.00	477.
1.01	4.40	56	.01	.01	.01	10.	1.01	16.40	200	.29	.29	.00	
1.01	4.45	57	.01	.01	.01	11.	1.01	16.45	201	.29	.29	.00	
1.01	4.50	58	.01	.01	.01	11.	1.01	16.50	202	.29	.29	.00	
1.01	4.55	59	.01	.01	.01	11.	1.01	16.55	203	.29	.29	.00	
1.01	5.00	60	.01	.01	.01	11.	1.01	17.00	204	.29	.29	.00	
1.01	5.05	61	.01	.01	.01	12.	1.01	17.05	205	.23	.23	.00	
1.01	5.10	62	.01	.01	.01	12.	1.01	17.10	206	.23	.23	.00	
1.01	5.15	63	.01	.01	.01	12.	1.01	17.15	207	.23	.23	.00	

1.01	5.20	64	.01	.01	12.	1.01	17.20	204	.23	.23	.00	456.
1.01	5.25	65	.01	.01	12.	1.01	17.25	209	.23	.23	.00	446.
1.01	5.30	66	.01	.01	12.	1.01	17.30	210	.23	.23	.00	440.
1.01	5.35	67	.01	.01	13.	1.01	17.35	211	.23	.23	.00	437.
1.01	5.40	68	.01	.01	13.	1.01	17.40	212	.23	.23	.00	436.
1.01	5.45	69	.01	.01	13.	1.01	17.45	213	.23	.23	.00	435.
1.01	5.50	70	.01	.01	13.	1.01	17.50	214	.23	.23	.00	435.
1.01	5.55	71	.01	.01	13.	1.01	17.55	215	.23	.23	.00	434.
1.01	6.00	72	.01	.01	13.	1.01	18.00	216	.23	.23	.00	434.
1.01	6.05	73	.07	.04	18.	1.01	18.05	217	.02	.02	.00	399.
1.01	6.10	74	.07	.04	33.	1.01	18.10	218	.02	.02	.00	292.
1.01	6.15	75	.07	.04	60.	1.01	18.15	219	.02	.02	.00	261.
1.01	6.20	76	.07	.04	67.	1.01	18.20	220	.02	.02	.00	244.
1.01	6.25	77	.07	.04	72.	1.01	18.25	221	.02	.02	.00	228.
1.01	6.30	78	.07	.04	76.	1.01	18.30	222	.02	.02	.00	212.
1.01	6.35	79	.07	.04	79.	1.01	18.35	223	.02	.02	.00	198.
1.01	6.40	80	.07	.04	81.	1.01	18.40	224	.02	.02	.00	185.
1.01	6.45	81	.07	.05	83.	1.01	18.45	225	.02	.02	.00	172.
1.01	6.50	82	.07	.05	85.	1.01	18.50	226	.02	.02	.00	161.
1.01	6.55	83	.07	.05	87.	1.01	18.55	227	.02	.02	.00	150.
1.01	7.00	84	.07	.05	89.	1.01	19.00	228	.02	.02	.00	140.
1.01	7.05	85	.07	.05	90.	1.01	19.05	229	.02	.02	.00	131.
1.01	7.10	86	.07	.05	92.	1.01	19.10	230	.02	.02	.00	122.
1.01	7.15	87	.07	.05	93.	1.01	19.15	231	.02	.02	.00	114.
1.01	7.20	88	.07	.05	94.	1.01	19.20	232	.02	.02	.00	106.
1.01	7.25	89	.07	.05	94.	1.01	19.25	233	.02	.02	.00	99.
1.01	7.30	90	.07	.05	95.	1.01	19.30	234	.02	.02	.00	92.
1.01	7.35	91	.07	.05	97.	1.01	19.35	235	.02	.02	.00	86.
1.01	7.40	92	.07	.05	98.	1.01	19.40	236	.02	.02	.00	80.
1.01	7.45	93	.07	.05	99.	1.01	19.45	237	.02	.02	.00	75.
1.01	7.50	94	.07	.05	100.	1.01	19.50	238	.02	.02	.00	70.
1.01	7.55	95	.07	.05	100.	1.01	19.55	239	.02	.02	.00	65.
1.01	8.00	96	.07	.05	101.	1.01	20.00	240	.02	.02	.00	61.
1.01	8.05	97	.07	.05	102.	1.01	20.05	241	.02	.02	.00	57.
1.01	8.10	98	.07	.06	102.	1.01	20.10	242	.02	.02	.00	53.
1.01	8.15	99	.07	.06	103.	1.01	20.15	243	.02	.02	.00	50.
1.01	8.20	100	.07	.06	104.	1.01	20.20	244	.02	.02	.00	46.
1.01	8.25	101	.07	.06	105.	1.01	20.25	245	.02	.02	.00	43.
1.01	8.30	102	.07	.06	105.	1.01	20.30	246	.02	.02	.00	40.
1.01	8.35	103	.07	.06	106.	1.01	20.35	247	.02	.02	.00	39.
1.01	8.40	104	.07	.06	107.	1.01	20.40	248	.02	.02	.00	39.
1.01	8.45	105	.07	.06	107.	1.01	20.45	249	.02	.02	.00	39.
1.01	8.50	106	.07	.06	108.	1.01	20.50	250	.02	.02	.00	39.
1.01	8.55	107	.07	.06	109.	1.01	20.55	251	.02	.02	.00	39.
1.01	9.00	108	.07	.06	109.	1.01	21.00	252	.02	.02	.00	39.
1.01	9.05	109	.07	.06	109.	1.01	21.05	253	.02	.02	.00	39.
1.01	9.10	110	.07	.06	109.	1.01	21.10	254	.02	.02	.00	39.
1.01	9.15	111	.07	.06	110.	1.01	21.15	255	.02	.02	.00	39.
1.01	9.20	112	.07	.06	110.	1.01	21.20	256	.02	.02	.00	39.
1.01	9.25	113	.07	.06	111.	1.01	21.25	257	.02	.02	.00	39.
1.01	9.30	114	.07	.06	111.	1.01	21.30	258	.02	.02	.00	39.
1.01	9.35	115	.07	.06	111.	1.01	21.35	259	.02	.02	.00	39.
1.01	9.40	116	.07	.06	112.	1.01	21.40	260	.02	.02	.00	39.
1.01	9.45	117	.07	.06	112.	1.01	21.45	261	.02	.02	.00	39.
1.01	9.50	118	.07	.06	112.	1.01	21.50	262	.02	.02	.00	39.
1.01	9.55	119	.07	.06	113.	1.01	21.55	263	.02	.02	.00	39.
1.01	10.00	120	.07	.06	113.	1.01	22.00	264	.02	.02	.00	39.
1.01	10.05	121	.07	.06	113.	1.01	22.05	265	.02	.02	.00	39.
1.01	10.10	122	.07	.06	113.	1.01	22.10	266	.02	.02	.00	39.
1.01	10.15	123	.07	.06	114.	1.01	22.15	267	.02	.02	.00	39.
1.01	10.20	124	.07	.06	114.	1.01	22.20	268	.02	.02	.00	39.
1.01	10.25	125	.07	.06	114.	1.01	22.25	269	.02	.02	.00	39.
1.01	10.30	126	.07	.06	114.	1.01	22.30	270	.02	.02	.00	39.

	1.01	10.35	127	.07	.06	.00	115.	1.01	22.35	271	.02	.02	.00	39.
	1.01	10.40	128	.07	.06	.00	115.	1.01	22.40	272	.02	.02	.00	39.
	1.01	10.45	129	.07	.06	.00	115.	1.01	22.45	273	.02	.02	.00	39.
	1.01	10.50	130	.07	.06	.00	115.	1.01	22.50	274	.02	.02	.00	39.
	1.01	10.55	131	.07	.06	.00	115.	1.01	22.55	275	.02	.02	.00	39.
	1.01	11.00	132	.07	.06	.00	116.	1.01	23.00	276	.02	.02	.00	39.
	1.01	11.05	133	.07	.06	.00	116.	1.01	23.05	277	.02	.02	.00	39.
	1.01	11.10	134	.07	.06	.00	116.	1.01	23.10	278	.02	.02	.00	39.
	1.01	11.15	135	.07	.06	.00	116.	1.01	23.15	279	.02	.02	.00	39.
	1.01	11.20	136	.07	.06	.00	116.	1.01	23.20	280	.02	.02	.00	39.
	1.01	11.25	137	.07	.06	.00	116.	1.01	23.25	281	.02	.02	.00	39.
	1.01	11.30	138	.07	.06	.00	117.	1.01	23.30	282	.02	.02	.00	39.
	1.01	11.35	139	.07	.06	.00	117.	1.01	23.35	283	.02	.02	.00	39.
	1.01	11.40	140	.07	.06	.00	117.	1.01	23.40	284	.02	.02	.00	39.
	1.01	11.45	141	.07	.06	.00	117.	1.01	23.45	285	.02	.02	.00	39.
	1.01	11.50	142	.07	.06	.00	117.	1.01	23.50	286	.02	.02	.00	39.
	1.01	11.55	143	.07	.06	.00	117.	1.01	23.55	287	.02	.02	.00	39.
	1.01	12.00	144	.07	.06	.00	117.	1.02	0.00	288	.02	.02	.00	39.

SUM 32.24 30.48 1.76 59657.
 (919.1) (776.1) (45.1) (1680.30)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
2776.	547.	207.	207.	50640.
79.	18.	6.	6.	1689.
	24.56	31.45	31.45	31.45
	623.82	798.84	798.84	798.84
	321.	411.	411.	411.
	396.	507.	507.	507.

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE
		100.60	99.60	107.00	HOURS	HOURS	HOURS
		91.	73.	156.			
		3.	0.	318.			
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	103.78	0.00	116.	5.	0.00	20.33	0.00
.15	105.10	0.00	131.	29.	0.00	18.67	0.00
.20	105.75	0.00	139.	82.	0.00	18.08	0.00
.25	106.25	0.00	146.	149.	0.00	16.42	0.00
.30	106.83	0.00	154.	274.	0.00	16.17	0.00
.35	107.26	.26	160.	433.	.67	16.00	0.00
.40	107.57	.57	164.	613.	.92	15.92	0.00
.50	107.94	.94	170.	972.	1.50	15.92	0.00
1.00	108.81	1.81	183.	2469.	5.08	15.83	0.00

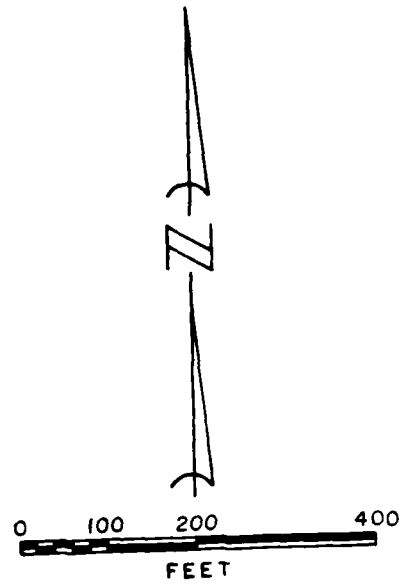
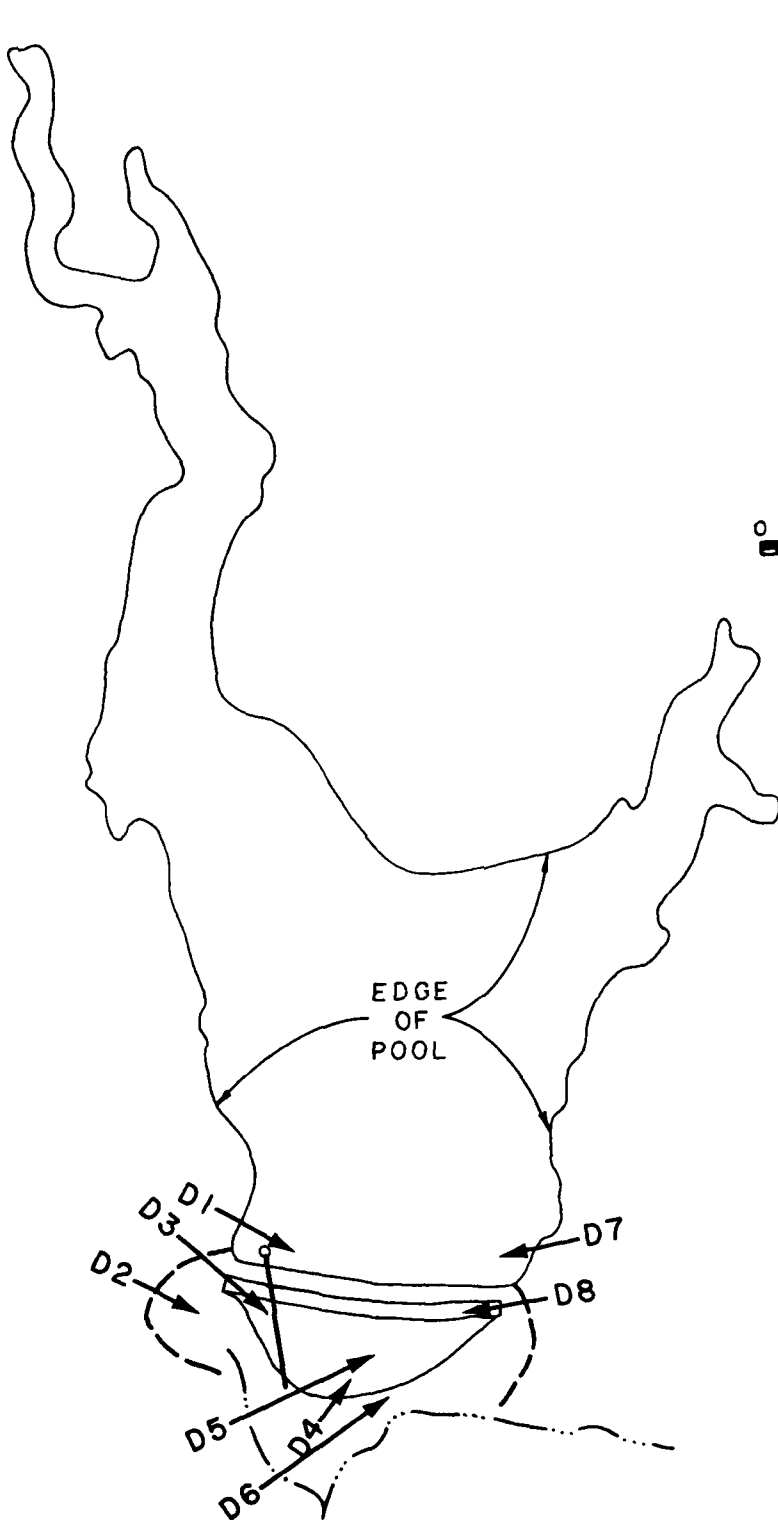


PHOTO INDEX I
FOR
DAM

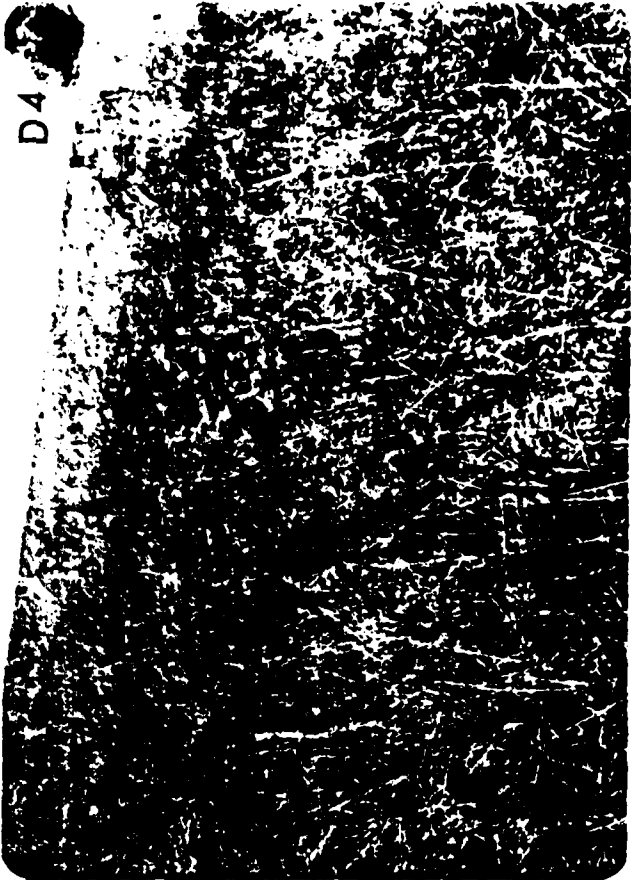
STRUCKHOFFS DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

PREPARED BY
REITZ & JENS, INC

D2



D4



D1



D3





D6



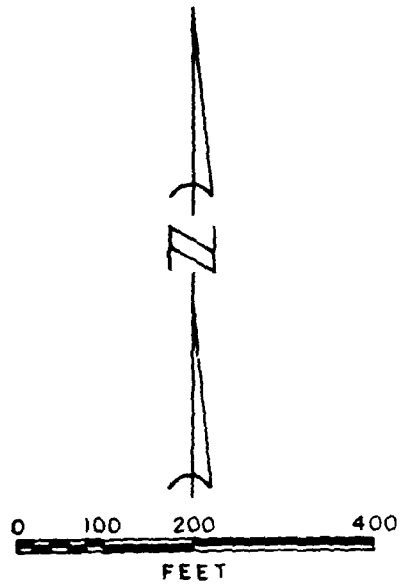
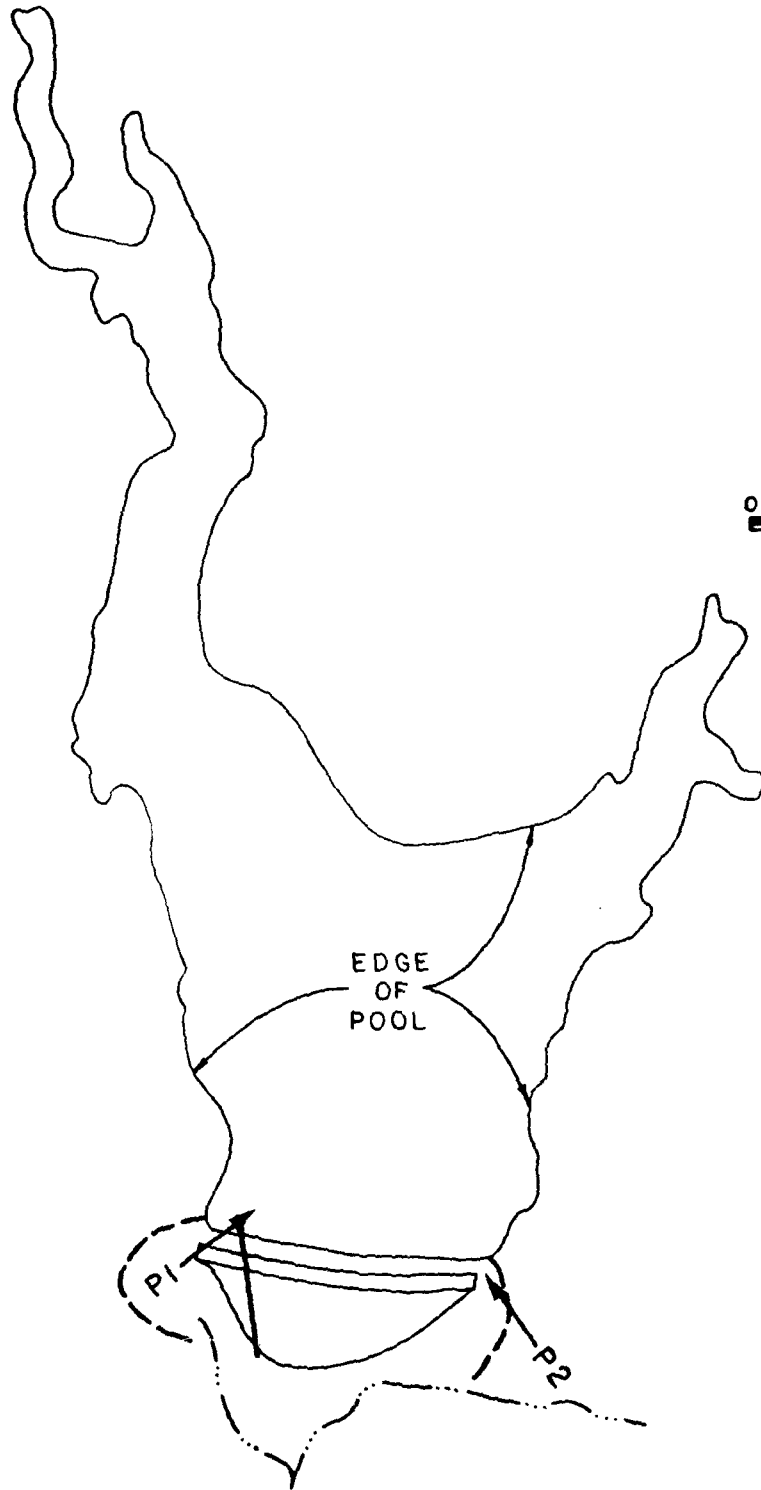
D8



D5



D7



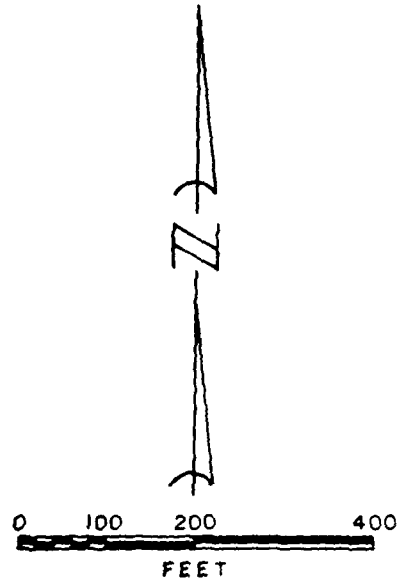
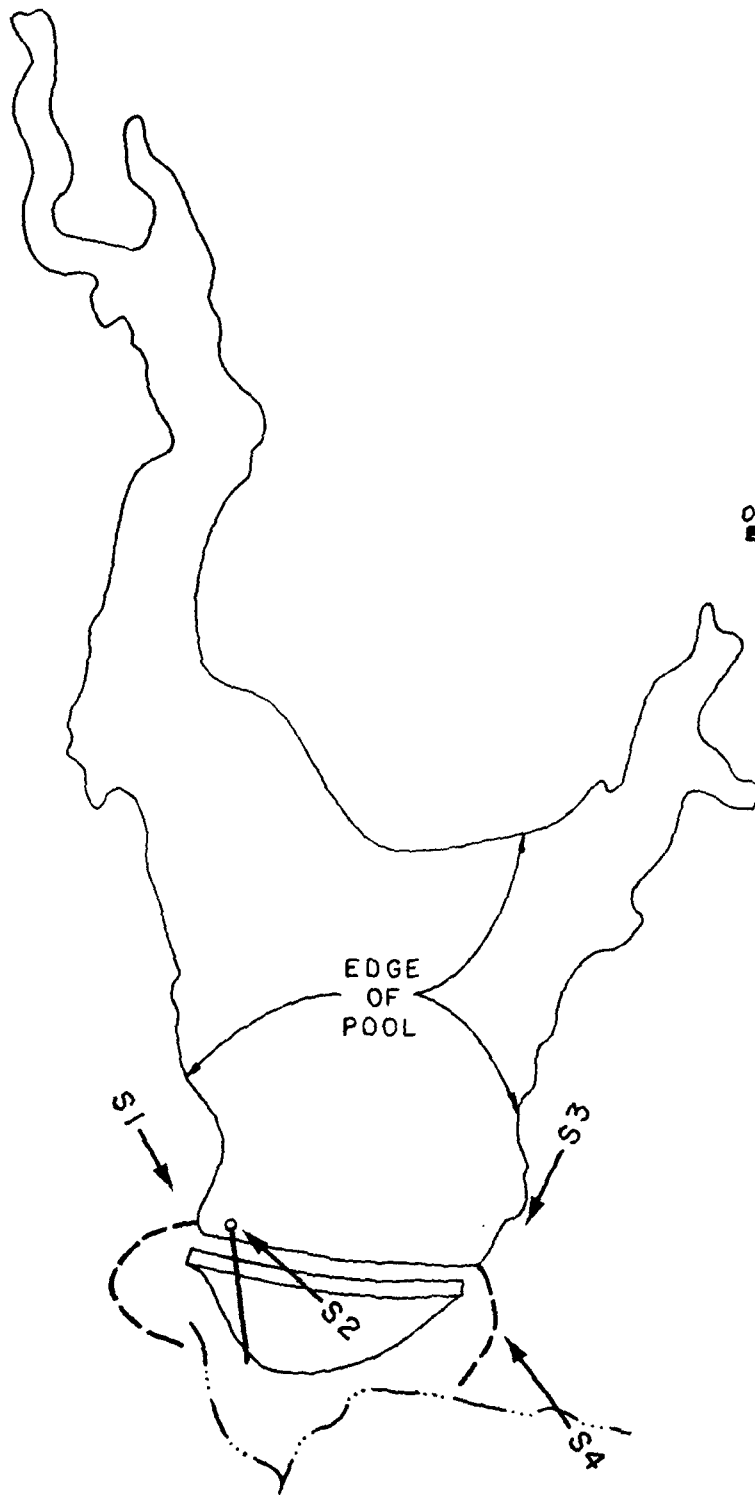
PREPARED BY
REITZ & JENS, INC

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

P2

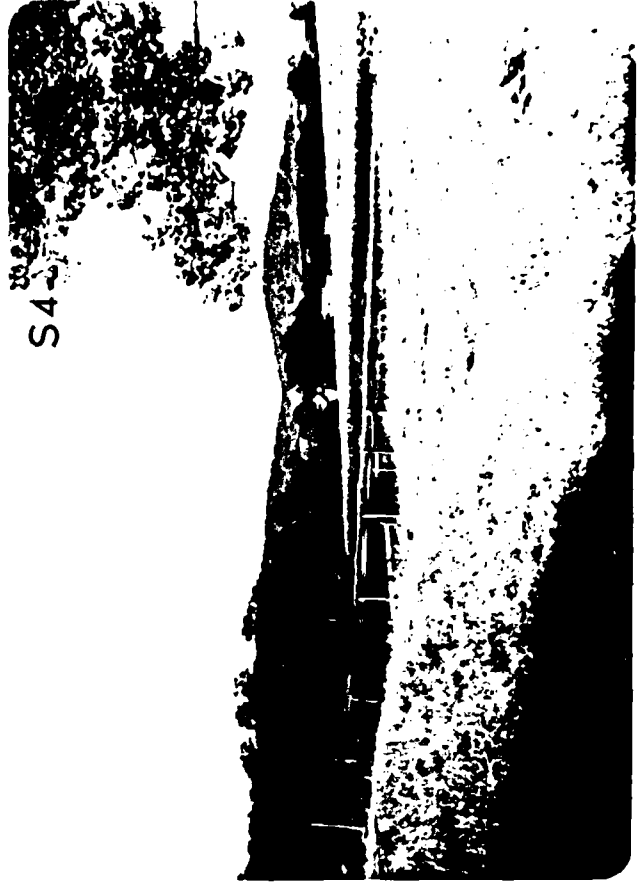


PANORAMA



PREPARED BY
REITZ & JENS, INC

PHOTO INDEX 3
FOR
SPILLWAYS
STRUCKHOFFS DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978



SPILLWAYS

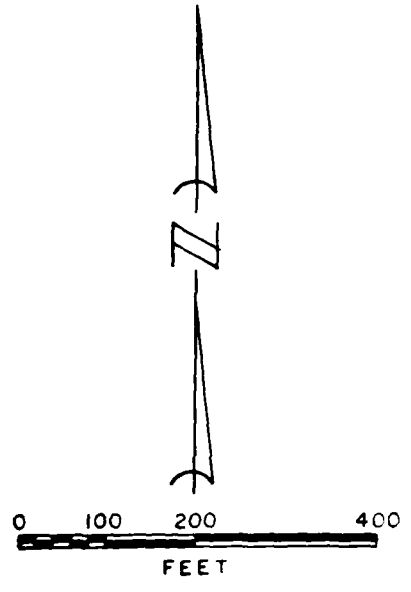
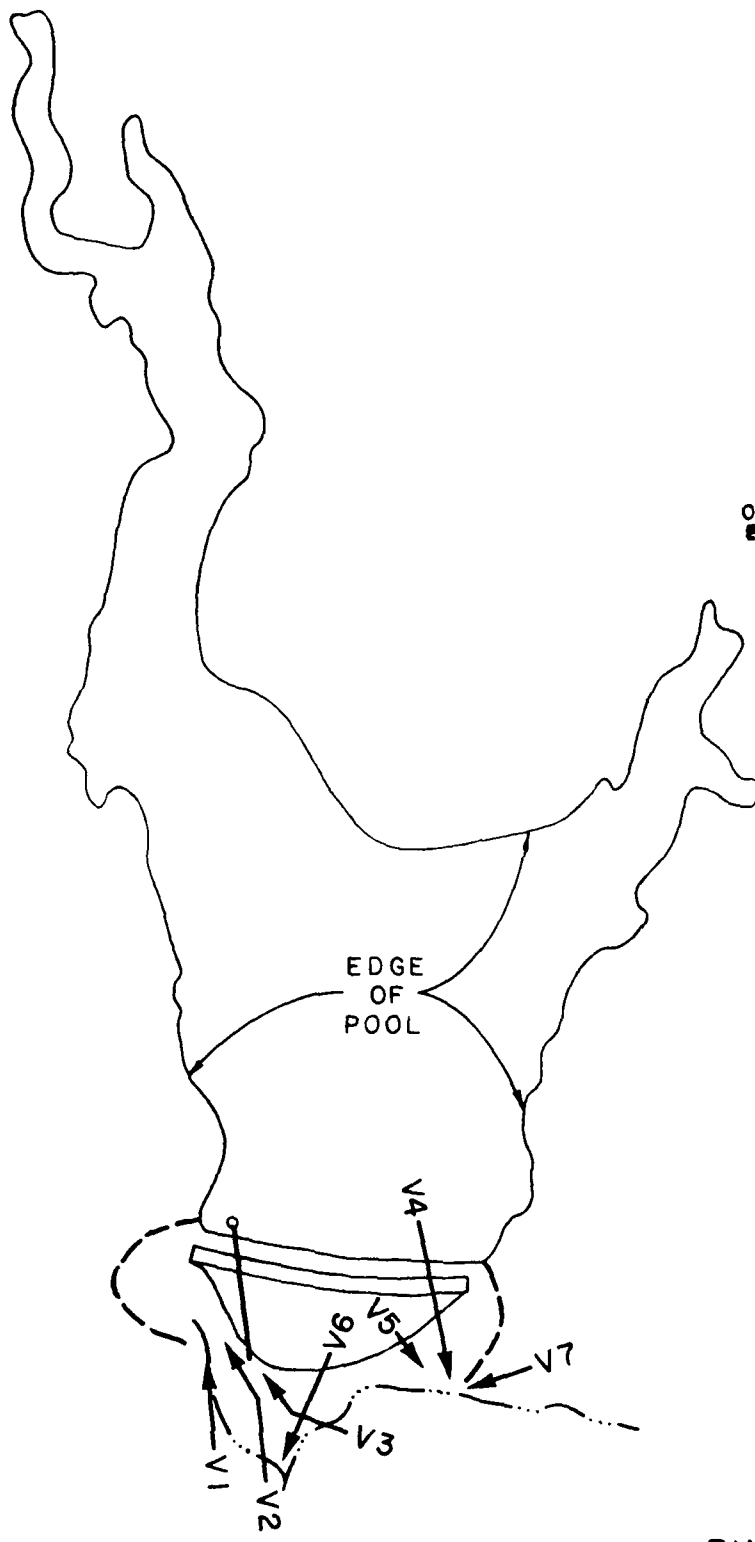


PHOTO INDEX 4
FOR
VALLEY BELOW DAM
STRUCKHOFFS DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

PREPARED BY
REITZ & JENS, INC



VALLEY BELOW DAM

V6



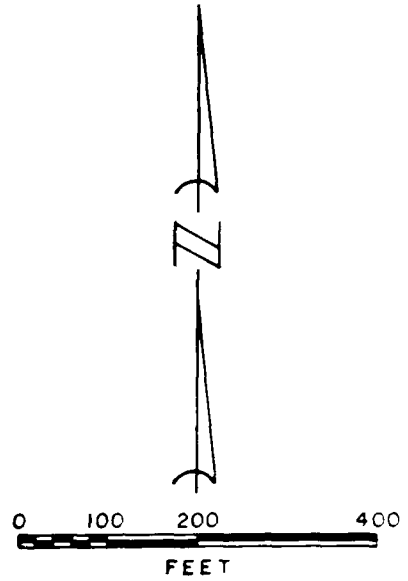
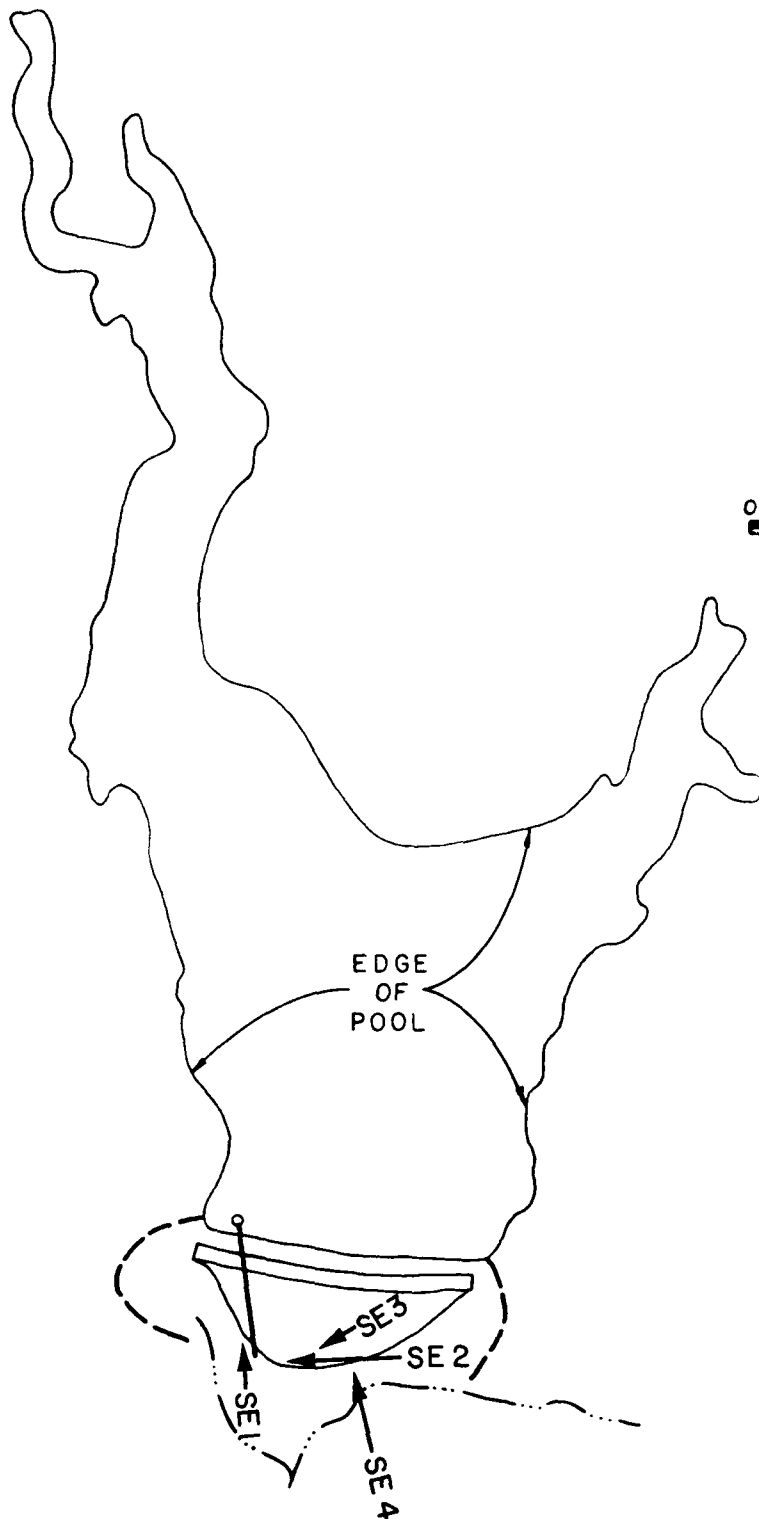
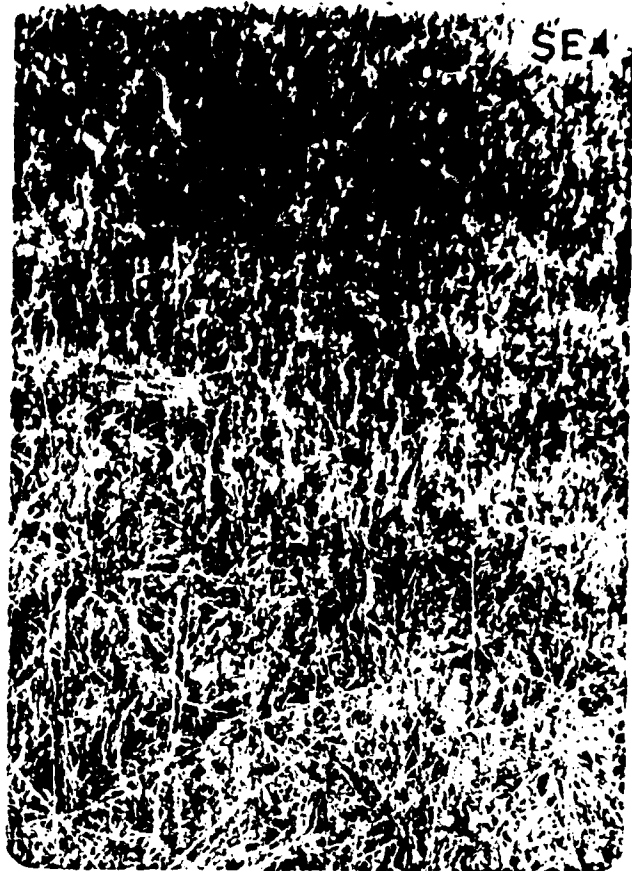


PHOTO INDEX 5
FOR
SEEPAGE

STRUCKHOFFS DAM
ST. CHARLES COUNTY, MO.
SEPTEMBER 1978

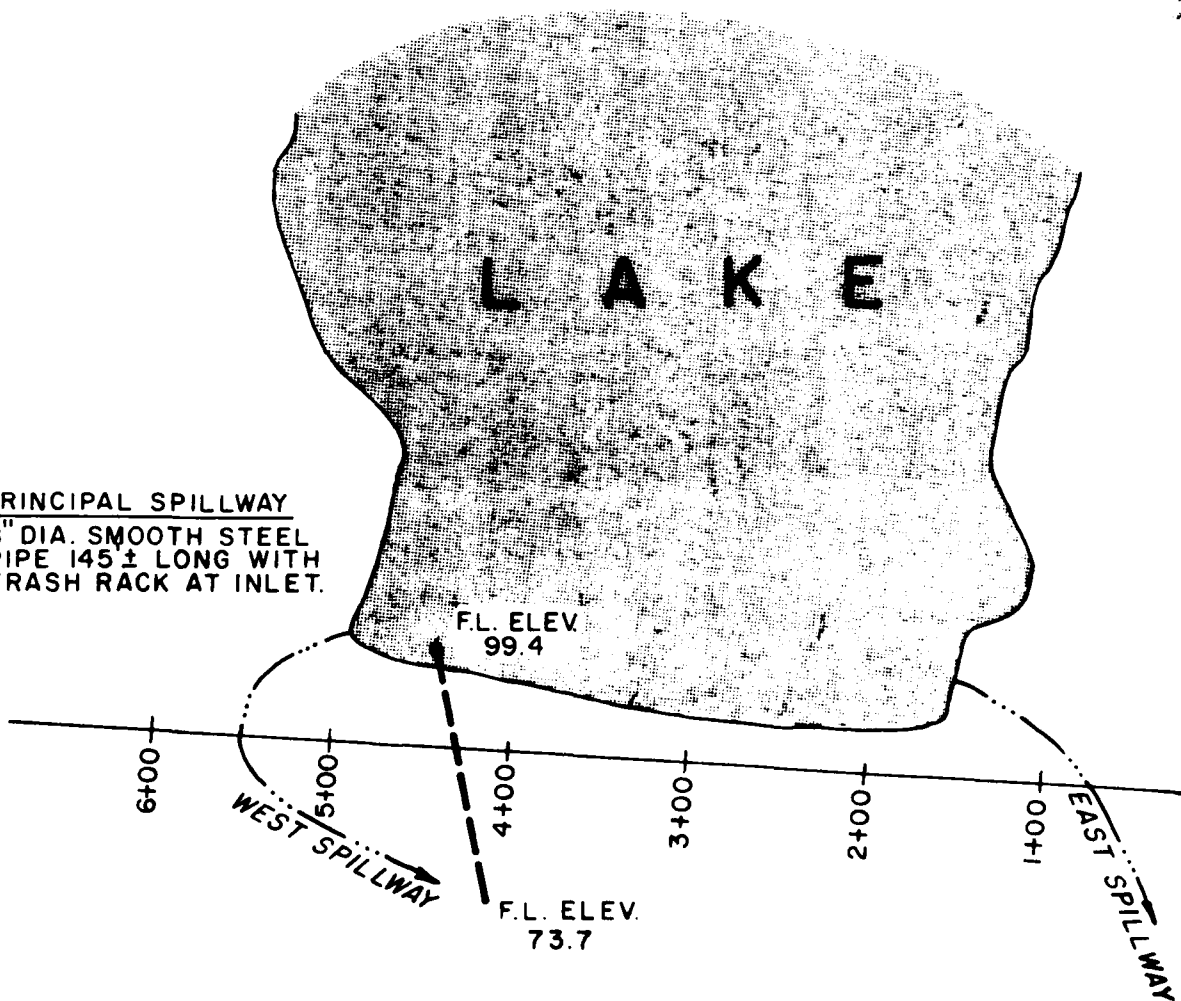
PREPARED BY
REITZ & JENS, INC



SEE PAGE

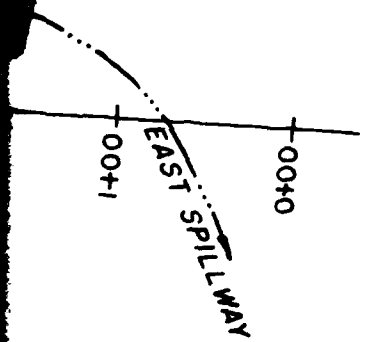
FINAL SURVEY	SURVEYED	BY	DATE
	PLOTTED		
NOTE BOOK NO.	TEMPLATE		
	AREAS CHECKED		

PRINCIPAL SPILLWAY
 8" DIA. SMOOTH STEEL
 PIPE 145' ± LONG WITH
 TRASH RACK AT INLET.

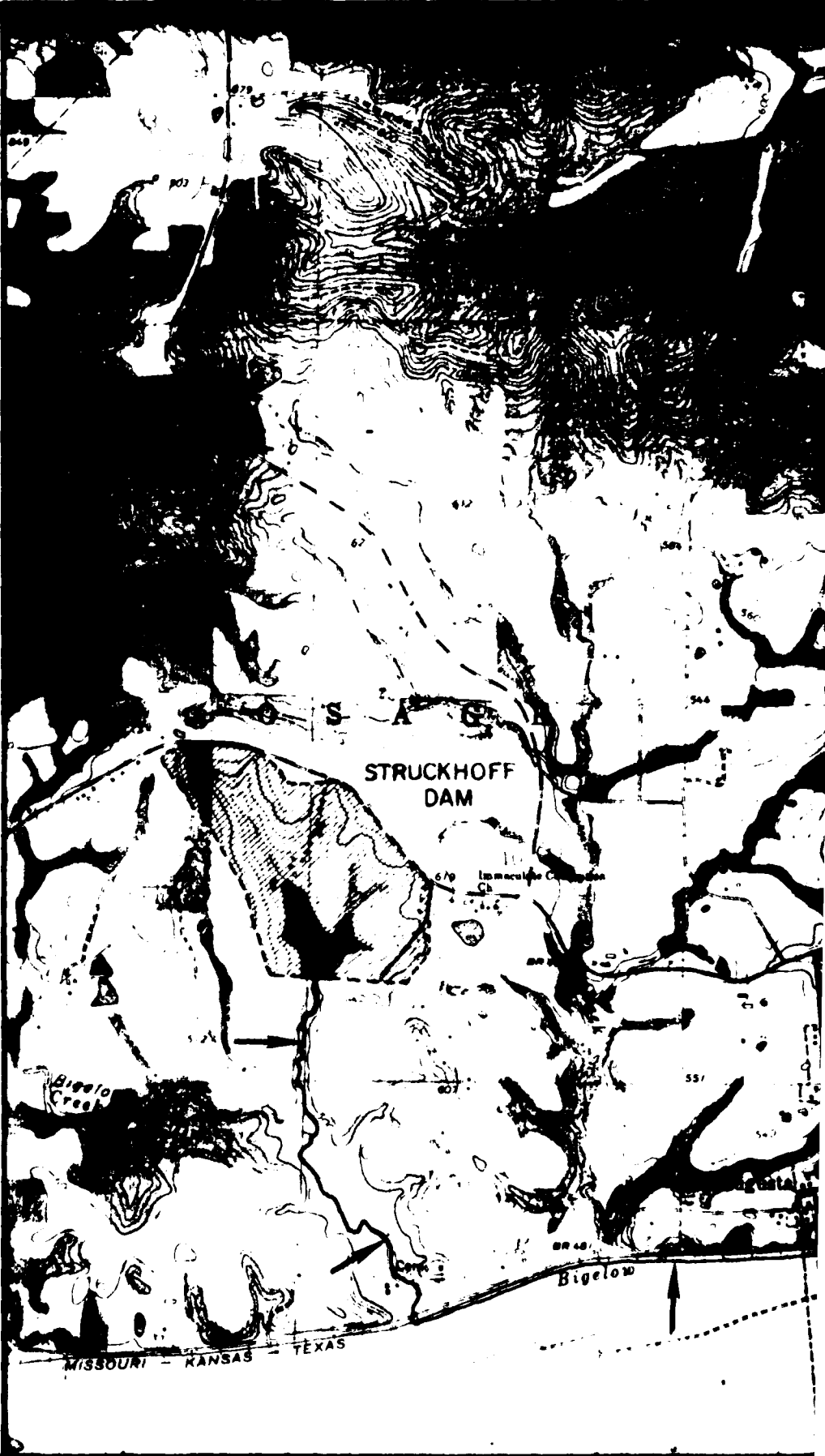


PLAN OF DAM AND SPILLWAYS

2







WATERSHED AND OUTFLOW CHANNEL

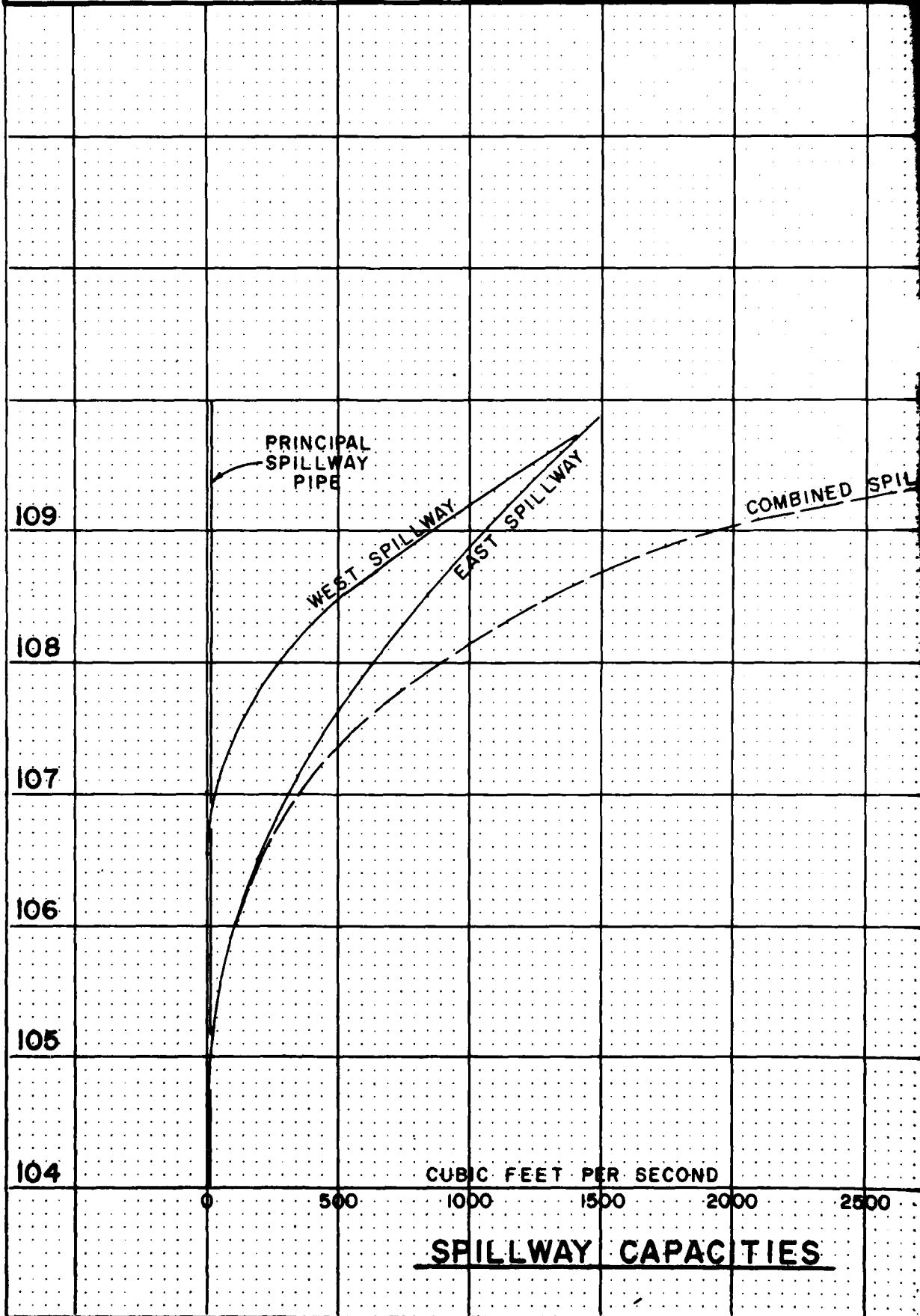
15



NO OUTFLOW CHANNEL

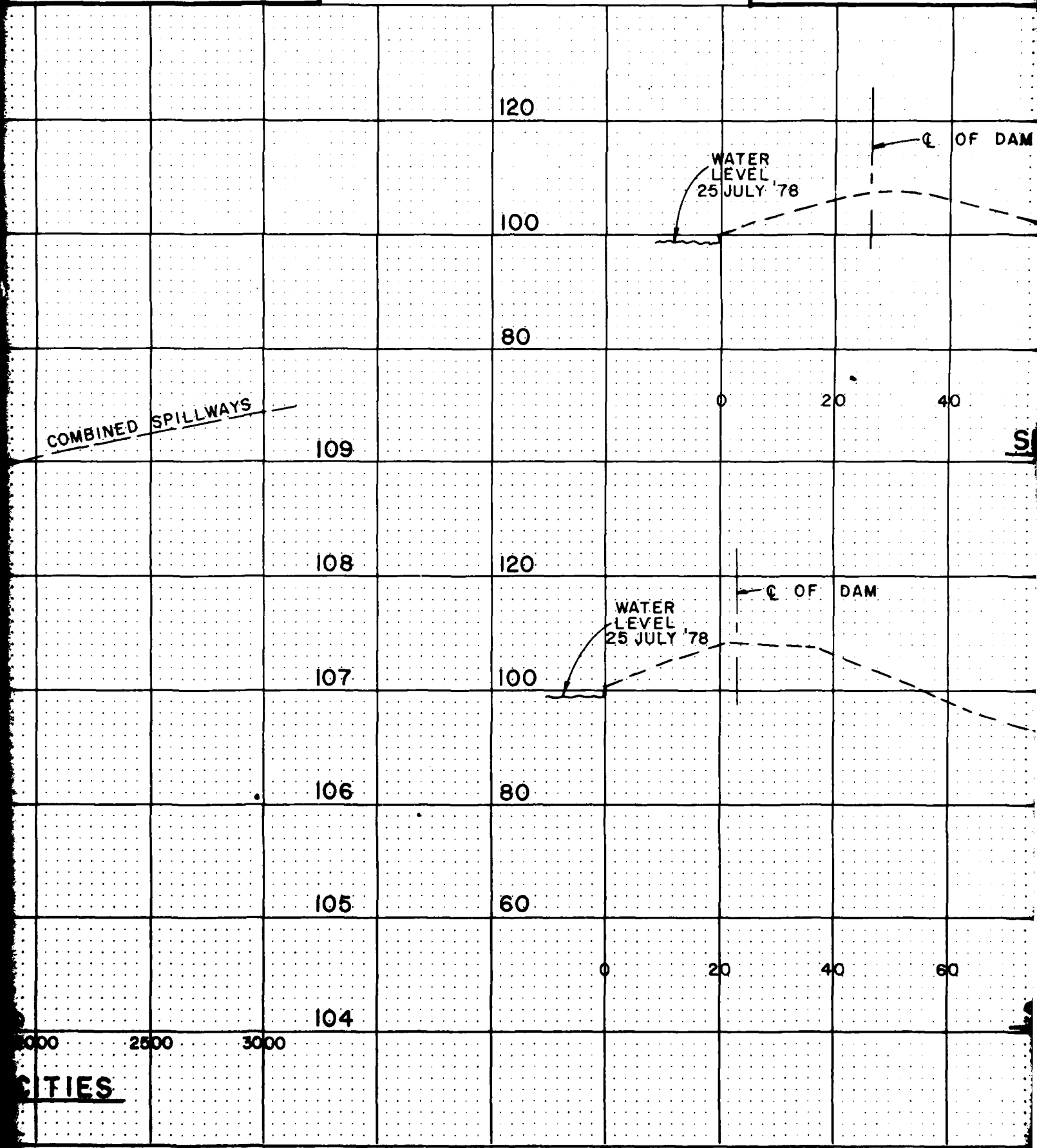
0 50 100 200 300FT.

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



6

300FT.

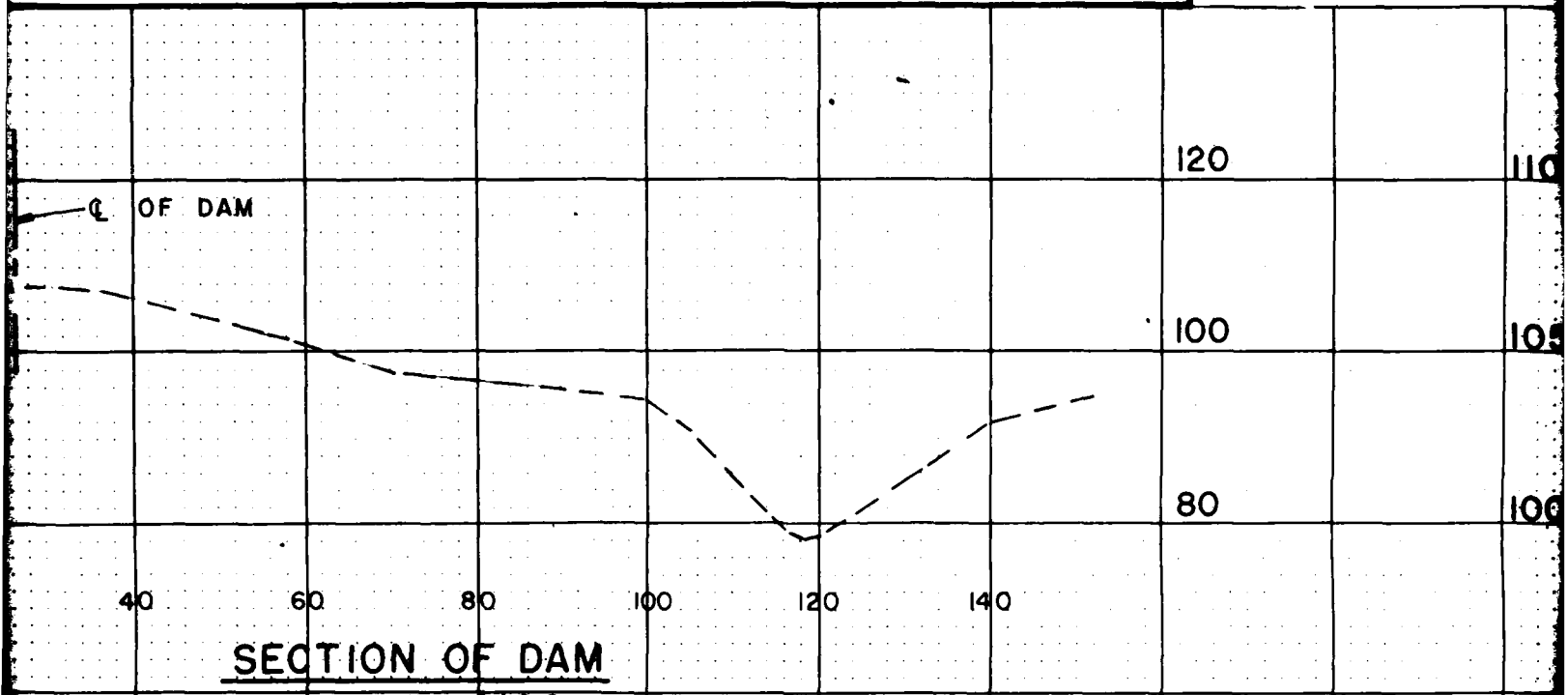


2000 2500 3000

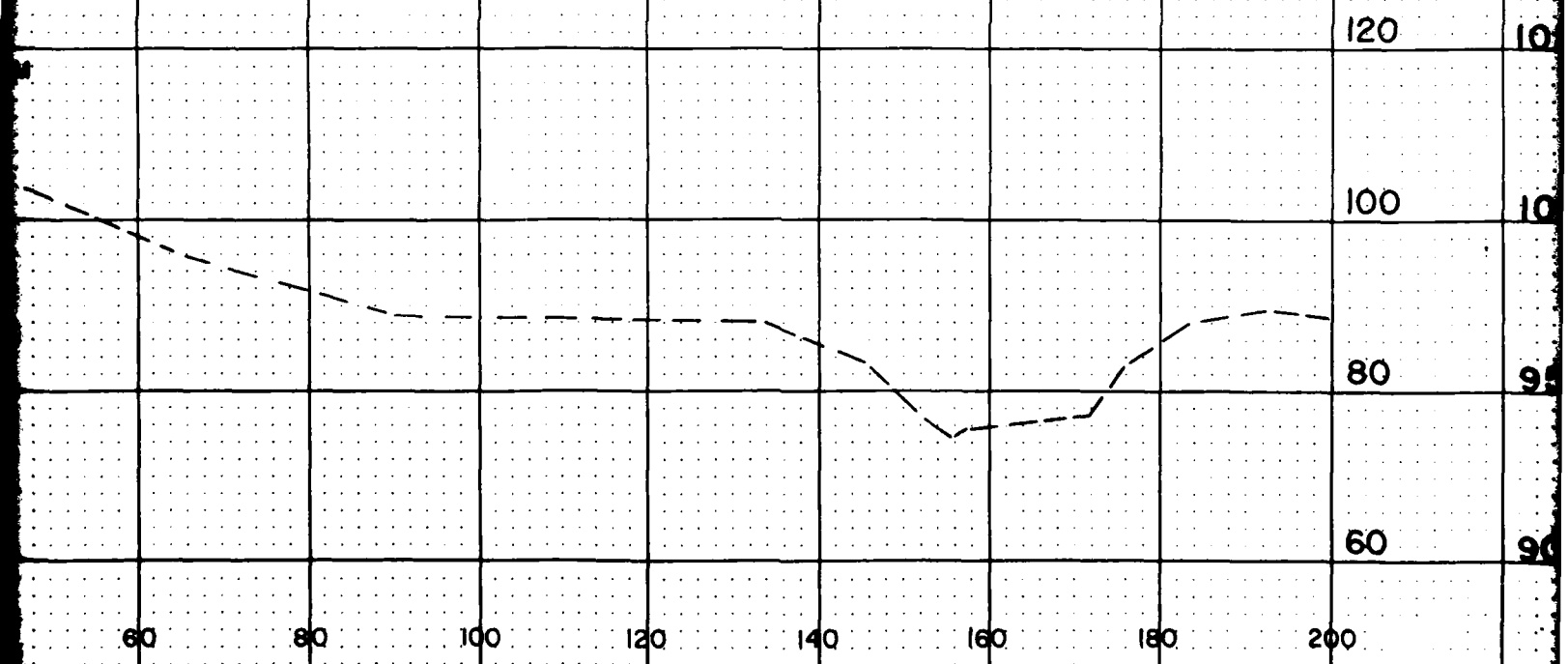
CITIES

17

PLA

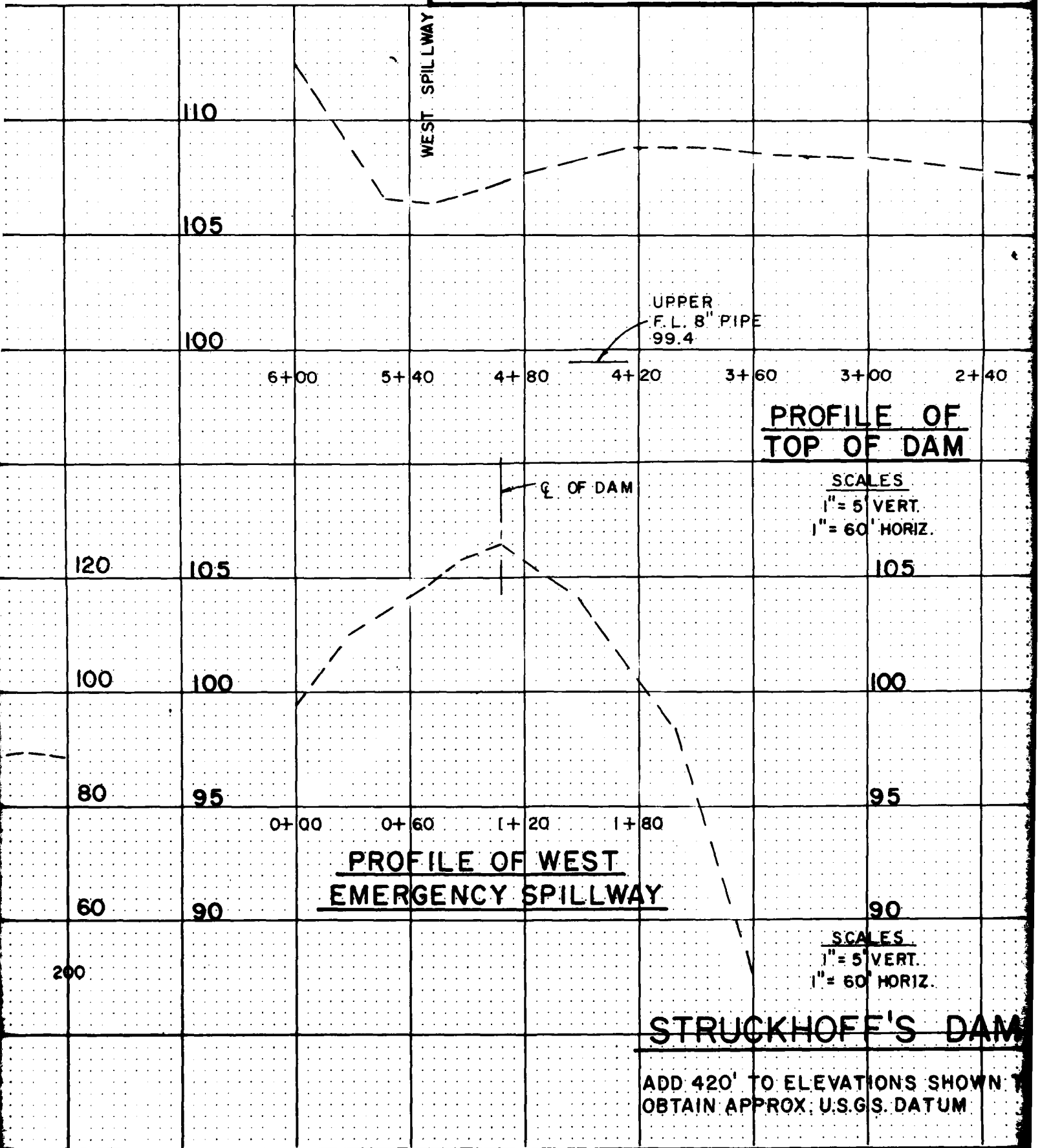


SECTION OF DAM
AT STA. 2+00



SECTION OF DAM
AT STA. 3+00

8



PROFILE OF TOP OF DAM

SCALES
 1" = 5' VERT.
 1" = 60' HORIZ.

PROFILE OF WEST EMERGENCY SPILLWAY

SCALES
 1" = 5' VERT.
 1" = 60' HORIZ.

STRUCKHOFF'S DAM

ADD 420' TO ELEVATIONS SHOWN TO OBTAIN APPROX. U.S.G.S. DATUM

4000 6000 FT.

EAST SPILLWAY

110

105

100

3+00

2+40

1+80

1+20

0+60

0+00

**PROFILE OF
TOP OF DAM**

SCALES

1" = 5' VERT.

1" = 60' HORIZ.

105

— C — OF DAM

105

100

100

95

95

1+80

1+20

0+60

0+00

**PROFILE OF EAST
EMERGENCY SPILLWAY**

90

90

SCALES

1" = 5' VERT.

1" = 60' HORIZ.

PHASE I — INSPECTION

COUNTY I. D. NO. 183

ST. CHARLES COUNTY, MISSOURI

INVENTORY NO. I. D. 30100

KHOFF'S DAM

**ELEVATIONS SHOWN TO
FOX, U.S.G.S. DATUM**

FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS

**REITZ & JENS, INC.
CONSULTING ENGINEERS**

**ST. LOUIS, MISSOURI
SEPTEMBER 1978**