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NATIONAL DAM SAFETY PROGRAM. WILLIAMS DAM (MO 30384), MISSISSIP--ETC(U)
NOV 78 H M REITZ, J J BAILEY DACW43-78-C-0162
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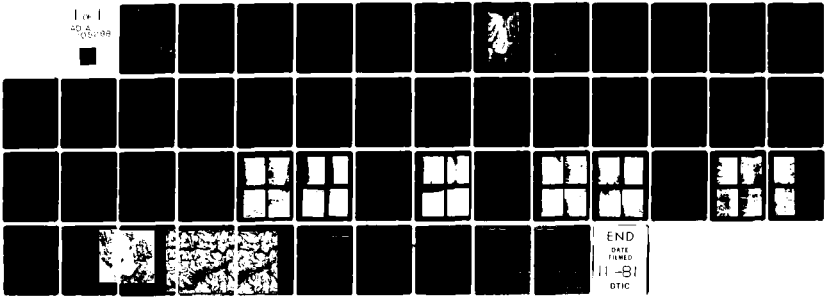

LEVEL

AD A105298

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

WILLIAMS DAM

JEFFERSON COUNTY, MISSOURI

MO 30384

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

FOR: STATE OF MISSOURI

NOVEMBER 1978

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 298	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Williams Dam (MO 30384) Jefferson County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Reitz & Jens, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-78-C-0162
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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Dam Safety, Lake, Dam Inspection, Private Dams

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

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

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

IN REPLY REFER TO

SUBJECT: Williams Dam, MO ID No. 30384

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

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

1) Spillway will not pass 15 percent of the Probable Maximum Flood.

2) Overtopping could result in dam failure.

3) Control of tree and underbrush growth on dam is deficient.

SUBMITTED BY: SIGNED
Chief, Engineering Division

16 FEB 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

16 FEB 1979
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
Williams Dam, MO ID No. 30384

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(Cont.)

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Williams Dam
State Located	Missouri
County Located	Jefferson County
Stream	Unnamed tributary to Joachim Creek
Date of Inspection	10 November 1978 and 23, 24 and 25 October 1978

The Williams 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 five families and cause appreciable damage to one railroad bridge and one highway crossing.

Our inspection and evaluation indicates that the dam is deficient in that the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Considering the small volume of water impounded, the large floodplain downstream and the five buildings downstream, one-half Probable Maximum Flood (PMF) is the appropriate spillway design flood. 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. The dam will begin to be overtopped by a flood having a discharge (peak and volume) equal to 15% of the PMF. The spillways will pass a 1% chance flood (100-year flood) without overtopping, which is a flood that has a 1% chance of being exceeded in any given year.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

The dam is also deficient in that there is a growth of trees and heavy underbrush on the downstream slope.

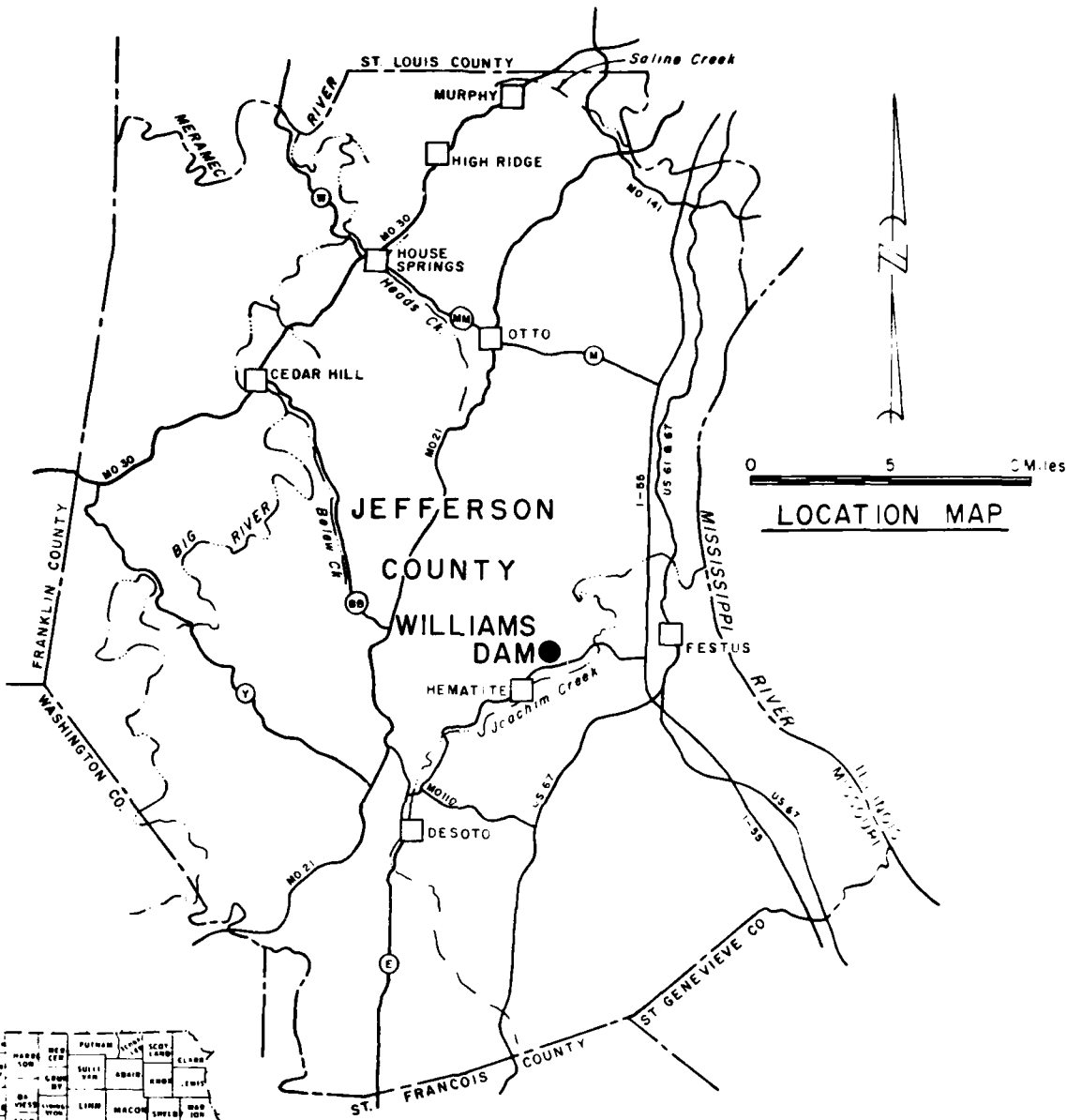
We recommend the owner take prompt action to correct or control the deficiencies described.

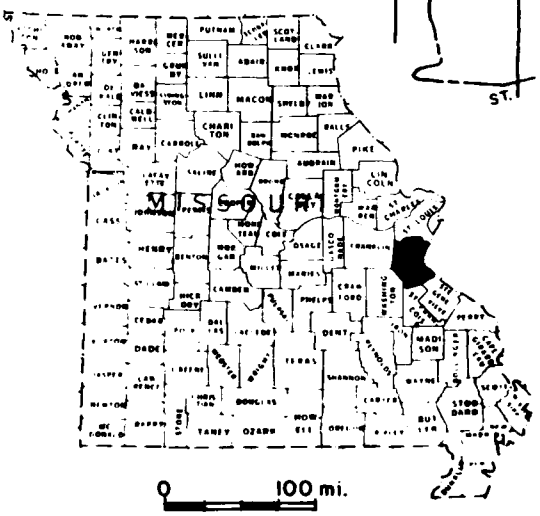
HENRY M. REITZ, President
Reitz & Jens, Inc.

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

OVERVIEW-30384

PLATE I





VICINITY MAP

PLATE 2

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 Williams Dam, MO ID No. 30384.

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 across an unnamed tributary of Joachim Creek in the hills immediately to the north side of the Joachim Creek floodplain. The soil in the drainage area is about 30% steep rocky slopes and about 70% soils in the Union Silt Loam group. There is sparse tree growth on the rocky slopes. Union group soils occur on both flat slopes on the ridges and the sides of the hills. These areas have been cleared and are in pasture. The dam is on a curved alignment concave toward the lake. The east spillway is a long flat channel on the hillside below the dam. The west spillway is a notch where the crest of the dam meets the hillside.

Topography in the vicinity of the dam is shown on Plate 3.

Pertinent physical data are given in paragraph 1.3 below.

b. Location The dam is located in the east south-central portion of Jefferson County about one mile northeast of Hematite as shown on Plate 2. The dam and lake are located in the NW¼ of the NE¼ of Section 9, T40N, R5E, and are shown on the Missouri Festus Quadrangle Sheet, 1964 Edition, covering a portion of Jefferson County.

c. Size Classification Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1.c 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 The dam is owned by Mrs. Jean Jeans, 8730 Cherokee Ct., Leawood, Kansas, 66206

f. Purpose of Dam The dam forms a 4.9-acre recreational lake

g. Design and Construction History The inspection team was unable to find any design data on this dam. It was reported that water impoundment commenced in 1965

h. Normal Operating Procedure Water surface fluctuates to 15 feet below spillway elevation due to leakage from the reservoir area. The maximum water depth experienced at the spillway is unknown.

1.3 PERTINENT DATA

a. Drainage Area - 143 acres

b. Discharge at Damsite -

(1) All discharge at the damsite is through uncontrolled spillways.

(2) Estimated experienced maximum flood at damsite - unknown

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

(a) East spillway - 83 cfs

(b) West spillway - 0 cfs

(c) Total - 83 cfs

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

(1) Top of dam - 463.3 to 464.7 feet M.S.L. (See Plate 3.)

(2) Spillway crest (1) 460.6, east spillway
(2) 463.4, west spillway

(3) Streambed at centerline of dam - 436.4 (est.)

(4) Maximum tailwater - unknown.

d. Reservoir Length of maximum pool - 1000 feet ±.

e. Storage (Acre-Feet) - (1) top of dam - 127 acre feet.
(2) spillway crest - 93 acre feet.

f. Reservoir Surface (Acres)

(1) top of dam - 11.2 acres (est.)

(2) Spillway crest - 9.2 acres (measured on aerial photo)

g. Dam

(1) Type - earth embankment

(2) Length - 500 feet

(3) Height - 26.5 feet maximum (from survey).

(4) Top width - 12 feet

(5) Side Slopes -

(a) Downstream - 1V on 2H(determined from section at Station 4+00)

(b) Upstream - 1V on 3H (determined from section at Station 4+00)

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - None

i. Spillways

(1) East spillway: 480-foot long channel on side hill alignment. Channel depth is about 3½ feet and the top width varies from 22 to 40 feet. Flowline grade is about 0.2%.

(2) West spillway: This is a 20-foot wide depression at the west end of the dam. The flowline is about the same elevation as the low part of the dam crest. A channel about 1½ feet deep and 10 feet wide would carry flow from this spillway about 75 feet south of the centerline of the dam where it would turn and flow down the valley slope.

j. Regulating Outlets - None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were found to be readily available.

2.2 CONSTRUCTION

No data on construction were available. See paragraph 1.2.g.

2.3 OPERATION

The maximum loading on the dam is unknown. The lake level seems to vary appreciably below spillway crest elevation.

It appears from the condition of the east spillway that, at some time since completion, appreciable discharge from the reservoir has flowed in it.

2.4 EVALUATION

a. Availability No engineering data were available.

b. Adequacy No engineering data were available 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.

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

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General A visual inspection of the Williams dam was made on 10 November 1978. This followed three days of field measurements by a survey party on 23, 24 and 25 October 1978. The training and experience of personnel in these inspections included hydraulic/hydrologic engineering, soils and materials engineering, surveying and structural engineering. Specific observations are discussed below.

b. Dam The grade of the top of the dam varies approximately 1½ feet which makes it relatively uniform. When visited, the downstream slope of the dam had trees growing on it and relatively heavy underbrush (D-2, D-3, D-4 D-5). The upstream slope of the dam which shortly before the visit appears to have had the same type cover, was strewn with the cut trees that had been felled toward the reservoir (D-7, D-8). There is a larger capacity emergency spillway at the east end (S-2, S-4, S-7) and the appearance of a small emergency spillway at the west end (S-1, S-3, S-8). However, the grade difference between the bottom of the west emergency spillway and the center elevation of the dam was small to the point that water would overflow the center portion of the dam as soon as it would start flowing in the west emergency spillway.

The outlet channel for the east spillway was on a nearly flat grade and had a length approaching 400 feet. It was entirely in virgin soil. Rock is exposed at various points in the bottom of the channel (S-5, S-6, S-7) and has been washed clean at the lower end (S-4). The hydraulic capacity of this spillway and outlet channel could be substantially improved by re-routing the spillway into the downstream valley in one of two small natural sub-valleys between the present outlet and existing dam.

Downstream from the dam, on high ground (V-3, V-4, V-6), is a cemetery which location in no way is impacted by the dam and reservoir. At the time of the surveys, the lake level was approximately 10 feet below the control elevation of the lower (east) emergency spillway due to loss by seepage beneath. No hydrophilic growth was at or above the downstream toe of the dam nor was there any indication of through-seepage in the dam section or along the contact between the base of dam and natural ground.

c. Appurtenant Structures No low level outlets, regulating works or other appurtenant structures were visible

d. Reservoir Area Since the level of the lake was at least 10 feet below the control elevation, a barren slope (P-1, P-2, P-3) was visible both on the lake side of the dam and along the natural banks. This prevented and indication of surface erosion which could be considered potentially hazardous to the development. The present conditions do not necessarily indicate absence of potential under or through seepage problems for the dam.

e. Downstream Channel The downstream channel leads through a pasture with some farm buildings which were not habitated (V-1, V-3, V-5). Several residences are below the elevation of the top of the dam down valley from the

dam. However, the surface grade at each is at least 10 feet above the corresponding grade of the lowest point of the valley. Also the cemetery (V-4) mentioned above, is on sufficiently high ground (V-6) that it would not be endangered by rupture of the dam. Approximately 800 feet downvalley from the dam dam is Missouri Highway 21A (V-5) and another 1,500 feet is a Missouri Pacific track and another 1,000 feet, the runoff from this watershed enters Joachim Creek.

3.1 EVALUATION

The tree growth on the dam is a deficiency which, if uncorrected or uncontrolled, could result in eventual serious safety deficiencies.

Trees provide shelter and habitat for rodents whose burrowing activity might cause detrimental seepage. Furthermore, as the trees mature and die, sloughing of the embankment may occur as the roots decay. The tree growth on the downstream slope of the dam should be removed then turf established. Continued annual attention to cutting growth on the slopes of the dam is suggested.

None of the conditions observed is significant enough to indicate a need for immediate remedial action or a serious potential failure.

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 amount of brush and size of trees on the downstream slope and the felled trees on the upstream slope, attention to control of growth of vegetation has been inadequate.

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 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 143 acres developed from USGS Festus Missouri Quadrangle. Also available are 1"=2000' aerial stereo pairs taken 8 April 1977, by Surdex Corporation. 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. For grades to USGS-msl, see Plate 3.

c. Visual Observations

(1) The spillways and exit channels are located at the east and west ends of the dam.

(2) The east spillway channel is in good condition. However, the berm along the west side of the exit channel is low. Maximum spillway discharges will overflow and erode this berm at its upper end near the dam and may endanger the dam embankment.

(3) The west spillway crest is at too high an elevation to be effective in discharging water before the dam is overtopped.

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

d. Overtopping Potential Although the lake seems to remain well below spillway elevation, prudent engineering analysis requires that spillway capacities be evaluated on the basis of a reservoir full to the spillway crest. On this basis 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 expected from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible in the region. The dam will start to be overtopped by a flood equal to 15% of the PMF. The one-half PMF will overtop the dam to a maximum depth of about 1.5 feet. The depth will vary to zero across the dam because of the sloping crest. A width of 360 feet of dam crest will be subject to some overtopping flow. Maximum rate of flow over the dam crest will be about 942 cubic feet per second. Overtopping flow will have a duration of 6 hours. The existing lake and spillway will contain a 100-year frequency flood below the crest of the dam. For numerical data see Plates A-1 and A-2.

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.

The effect from rupture of the dam could extend approximately two miles downstream of the dam. There are five inhabited homes downstream of the dam which could be severely damaged with loss of life if the dam fails.

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 3.1.b.

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 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 inadequate to pass the required one-half Probable Maximum Flood (PMF). Considering the small volume of water impounded, the large floodplain downstream and the five buildings downstream, one-half PMF is the appropriate spillway design flood. 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.

The heavy growth of trees on the upstream and downstream slopes of the dam is a safety deficiency.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

b. Adequacy of Information Due to 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 Spillway size and/or height of dam should be increased to prevent overtopping by the probable maximum flood. The owner should obtain the services of an experienced engineer to design and observe construction of remedial measures.

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

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

(1) Remove uncontrolled vegetation growth on the downstream slope of the dam and establish grass on any resulting bare areas.

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

(3) After completion of remedial measures, detailed inspections of the dam should be made periodically by an engineer experienced in the design and construction of dams. Records should be kept of these inspections and major maintenance.

APPENDIX A

HYDROLOGIC CALCULATIONS

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 spillways 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 and the sloping top of dam is defined by a composite elevation discharge curve.

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 1A. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. The capacity of the east spillway was calculated using computer program HEC-2 from the cited source in paragraph 4 above. This program calculated critical velocity at the lower end of the 380-foot long spillway channel and then computed a drawdown curve up the channel to the reservoir water level taking account of velocity head changes, losses and friction. The west spillway was included as part of the dam crest because of its relatively high flowline elevation with respect to the lowest elevation of the dam crest.

6. Discharge over the irregular top of dam (the crest is not level) including the west spillway was calculated using a coefficient of 3.0 in the broad-crested weir equation for the sections of dam crest at different elevations. All spillway and overtopping discharges were included in a composite rating curve. Dummy values of 0.1 for dam length, coefficient of discharge and exponent were entered on the $D card to suppress diagnostic statements in the output. The amount of this dummy flow is never greater than 0.02 cfs.

```
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DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
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    2                 A   ********** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS **********
    3                 A   ********** REITZ & JENS, INC. -    AUGUST 1978 **********************
    4                 B     288       0        5       -0       -0       -0       -0       -0       -4       -0
    5                 J       5
    6                 J       1        9        1
    7                 J1   0.10     0.15     0.20     0.25     0.30     0.35     0.40     0.50     1.00
    8                 K       0    PMF                          1        3        1
    9                 1   ***** INFLOW HYDROGRAPH - SCS METHOD *****
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   12                 T                                                            -1       -85                0.04
   13                 W2             0.17
   14                 X             -0.10      2.0
   15                 K       1       05                          1                 1
   16                 1   ***** RESERVOIR ROUTING - RATING CURVE SUPPLIED - SLOPING DAM *****
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   18                 Y1      1                                                 -109.9       -1
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   20                 Y4  114.9    115.1    115.5
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   25                 $$  109.9
   26                 $D  113.3       0.1      0.1      0.1
   27                 K      99
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PLATE A-1
Sheet 1 of 5

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

RUN  DATE= 12/18/78.
     TIME= 14.10.34.

 * ********* ID # 30384 WILLIAMS DAM * ADD 350 FOR USGS ELEV. *******
  ********** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS **********
  ********** REITZ & JENS, INC. -    AUGUST 1978 **********************

                                JOB SPECIFICATION
      NQ      NHR     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
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          RTIOS=     .10     .15     .20     .25     .30     .35     .40     .50    1.00


**********          **********          **********          **********          **********

                                SUB-AREA RUNOFF COMPUTATION

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                                PRECIP DATA
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                 -0.00   25.70  101.00  120.00  130.00   -0.00   -0.00   -0.00

                                LOSS DATA
        LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
           -0   -0.00   -0.00    1.00   -0.00   -0.00    1.00   -1.00  -85.00   -0.00     .04

          CURVE NO =  -85.00  WETNESS =   -1.00  EFFECT CN =   85.00

                                UNIT HYDROGRAPH DATA
                              TC= -0.00    LAG=   .17

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

        UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC=   -0.00 HOURS, LAG=    .17  VOL= 1.00
     155.      470.      483.      303.      152.       81.       43.       22.       12.        6.
       4.        1.

     0                          END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
```

PLATE A-1
Sheet 2 of 5

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.22	.20	.01	133.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.22	.21	.01	199.
1.01	.15	3	.01	.00	.01	1.	1.01	12.15	147	.22	.21	.01	267.
1.01	.20	4	.01	.00	.01	1.	1.01	12.20	148	.22	.21	.01	311.
1.01	.25	5	.01	.00	.01	1.	1.01	12.25	149	.22	.21	.01	333.
1.01	.30	6	.01	.00	.01	1.	1.01	12.30	150	.22	.21	.01	345.
1.01	.35	7	.01	.00	.01	1.	1.01	12.35	151	.22	.21	.01	352.
1.01	.40	8	.01	.00	.01	1.	1.01	12.40	152	.22	.21	.01	356.
1.01	.45	9	.01	.00	.01	1.	1.01	12.45	153	.22	.21	.01	358.
1.01	.50	10	.01	.00	.01	1.	1.01	12.50	154	.22	.21	.01	360.
1.01	.55	11	.01	.00	.01	1.	1.01	12.55	155	.22	.21	.01	361.
1.01	1.00	12	.01	.00	.01	1.	1.01	13.00	156	.22	.21	.01	362.
1.01	1.05	13	.01	.00	.01	1.	1.01	13.05	157	.26	.25	.01	369.
1.01	1.10	14	.01	.00	.01	1.	1.01	13.10	158	.26	.25	.01	389.
1.01	1.15	15	.01	.00	.01	1.	1.01	13.15	159	.26	.25	.01	410.
1.01	1.20	16	.01	.00	.01	1.	1.01	13.20	160	.26	.25	.01	424.
1.01	1.25	17	.01	.00	.01	1.	1.01	13.25	161	.26	.25	.01	431.
1.01	1.30	18	.01	.00	.01	1.	1.01	13.30	162	.26	.25	.01	435.
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.26	.25	.01	437.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.26	.25	.01	438.
1.01	1.45	21	.01	.00	.01	1.	1.01	13.45	165	.26	.25	.01	439.
1.01	1.50	22	.01	.00	.01	1.	1.01	13.50	166	.26	.25	.01	440.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.26	.25	.00	441.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.26	.25	.00	441.
1.01	2.05	25	.01	.00	.01	1.	1.01	14.05	169	.32	.32	.01	451.
1.01	2.10	26	.01	.00	.01	1.	1.01	14.10	170	.32	.32	.01	482.
1.01	2.15	27	.01	.00	.01	1.	1.01	14.15	171	.32	.32	.01	513.
1.01	2.20	28	.01	.00	.01	1.	1.01	14.20	172	.32	.32	.00	533.
1.01	2.25	29	.01	.00	.01	2.	1.01	14.25	173	.32	.32	.00	543.
1.01	2.30	30	.01	.00	.01	2.	1.01	14.30	174	.32	.32	.00	548.
1.01	2.35	31	.01	.00	.01	2.	1.01	14.35	175	.32	.32	.00	551.
1.01	2.40	32	.01	.00	.01	3.	1.01	14.40	176	.32	.32	.00	553.
1.01	2.45	33	.01	.00	.01	3.	1.01	14.45	177	.32	.32	.00	554.
1.01	2.50	34	.01	.00	.01	3.	1.01	14.50	178	.32	.32	.00	555.
1.01	2.55	35	.01	.00	.01	4.	1.01	14.55	179	.32	.32	.00	556.
1.01	3.00	36	.01	.00	.01	4.	1.01	15.00	180	.32	.32	.00	556.
1.01	3.05	37	.01	.00	.01	4.	1.01	15.05	181	.20	.20	.00	537.
1.01	3.10	38	.01	.00	.01	5.	1.01	15.10	182	.39	.39	.00	508.
1.01	3.15	39	.01	.00	.01	5.	1.01	15.15	183	.39	.39	.00	539.
1.01	3.20	40	.01	.00	.01	5.	1.01	15.20	184	.59	.59	.01	626.
1.01	3.25	41	.01	.00	.01	5.	1.01	15.25	185	.69	.68	.01	774.
1.01	3.30	42	.01	.00	.01	6.	1.01	15.30	186	1.68	1.66	.01	1086.
1.01	3.35	43	.01	.00	.01	6.	1.01	15.35	187	2.76	2.75	.02	1832.
1.01	3.40	44	.01	.00	.01	6.	1.01	15.40	188	1.09	1.08	.01	2620.
1.01	3.45	45	.01	.00	.01	7.	1.01	15.45	189	.69	.69	.00	2629.
1.01	3.50	46	.01	.00	.01	7.	1.01	15.50	190	.59	.59	.00	2118.
1.01	3.55	47	.01	.00	.01	7.	1.01	15.55	191	.39	.39	.00	1600.
1.01	4.00	48	.01	.00	.01	7.	1.01	16.00	192	.39	.39	.00	1224.
1.01	4.05	49	.01	.00	.01	8.	1.01	16.05	193	.30	.30	.00	961.
1.01	4.10	50	.01	.00	.01	8.	1.01	16.10	194	.30	.30	.00	778.
1.01	4.15	51	.01	.00	.01	8.	1.01	16.15	195	.30	.30	.00	661.
1.01	4.20	52	.01	.01	.01	8.	1.01	16.20	196	.30	.30	.00	595.
1.01	4.25	53	.01	.01	.01	8.	1.01	16.25	197	.30	.30	.00	561.
1.01	4.30	54	.01	.01	.01	9.	1.01	16.30	198	.30	.30	.00	541.
1.01	4.35	55	.01	.01	.01	9.	1.01	16.35	199	.30	.30	.00	530.
1.01	4.40	56	.01	.01	.01	9.	1.01	16.40	200	.30	.30	.00	526.
1.01	4.45	57	.01	.01	.01	9.	1.01	16.45	201	.30	.30	.00	524.
1.01	4.50	58	.01	.01	.01	9.	1.01	16.50	202	.30	.30	.00	524.
1.01	4.55	59	.01	.01	.01	10.	1.01	16.55	203	.30	.30	.00	523.
1.01	5.00	60	.01	.01	.01	10.	1.01	17.00	204	.30	.30	.00	523.

PLATE A-1
Sheet 3 of 5

1.01	5.05	61	.01	.01	.01	10.
1.01	5.10	62	.01	.01	.01	10.
1.01	5.15	63	.01	.01	.01	10.
1.01	5.20	64	.01	.01	.01	11.
1.01	5.25	65	.01	.01	.01	11.
1.01	5.30	66	.01	.01	.01	11.
1.01	5.35	67	.01	.01	.01	11.
1.01	5.40	68	.01	.01	.01	11.
1.01	5.45	69	.01	.01	.01	11.
1.01	5.50	70	.01	.01	.01	12.
1.01	5.55	71	.01	.01	.01	12.
1.01	6.00	72	.01	.01	.01	12.
1.01	6.05	73	.07	.03	.03	16.
1.01	6.10	74	.07	.04	.03	30.
1.01	6.15	75	.07	.04	.03	44.
1.01	6.20	76	.07	.04	.03	54.
1.01	6.25	77	.07	.04	.03	61.
1.01	6.30	78	.07	.04	.03	65.
1.01	6.35	79	.07	.04	.02	69.
1.01	6.40	80	.07	.04	.02	72.
1.01	6.45	81	.07	.05	.02	74.
1.01	6.50	82	.07	.05	.02	76.
1.01	6.55	83	.07	.05	.02	78.
1.01	7.00	84	.07	.05	.02	80.
1.01	7.05	85	.07	.05	.02	82.
1.01	7.10	86	.07	.05	.02	83.
1.01	7.15	87	.07	.05	.02	85.
1.01	7.20	88	.07	.05	.02	86.
1.01	7.25	89	.07	.05	.02	87.
1.01	7.30	90	.07	.05	.02	88.
1.01	7.35	91	.07	.05	.01	89.
1.01	7.40	92	.07	.05	.01	90.
1.01	7.45	93	.07	.05	.01	91.
1.01	7.50	94	.07	.05	.01	92.
1.01	7.55	95	.07	.05	.01	93.
1.01	8.00	96	.07	.06	.01	94.
1.01	8.05	97	.07	.06	.01	95.
1.01	8.10	98	.07	.06	.01	96.
1.01	8.15	99	.07	.06	.01	96.
1.01	8.20	100	.07	.06	.01	97.
1.01	8.25	101	.07	.06	.01	98.
1.01	8.30	102	.07	.06	.01	98.
1.01	8.35	103	.07	.06	.01	99.
1.01	8.40	104	.07	.06	.01	100.
1.01	8.45	105	.07	.06	.01	100.
1.01	8.50	106	.07	.06	.01	101.
1.01	8.55	107	.07	.06	.01	101.
1.01	9.00	108	.07	.06	.01	102.
1.01	9.05	109	.07	.06	.01	102.
1.01	9.10	110	.07	.06	.01	102.
1.01	9.15	111	.07	.06	.01	103.
1.01	9.20	112	.07	.06	.01	103.
1.01	9.25	113	.07	.06	.01	104.
1.01	9.30	114	.07	.06	.01	104.
1.01	9.35	115	.07	.06	.01	104.
1.01	9.40	116	.07	.06	.01	105.
1.01	9.45	117	.07	.06	.01	105.
1.01	9.50	118	.07	.06	.01	105.
1.01	9.55	119	.07	.06	.01	106.
1.01	10.00	120	.07	.06	.01	106.

1.01	17.05	205	.24	.24	.00	513.
1.01	17.10	206	.24	.24	.00	483.
1.01	17.15	207	.24	.24	.00	452.
1.01	17.20	208	.24	.24	.00	432.
1.01	17.25	209	.24	.24	.00	422.
1.01	17.30	210	.24	.24	.00	417.
1.01	17.35	211	.24	.24	.00	414.
1.01	17.40	212	.24	.24	.00	413.
1.01	17.45	213	.24	.24	.00	412.
1.01	17.50	214	.24	.24	.00	412.
1.01	17.55	215	.24	.24	.00	411.
1.01	18.00	216	.24	.24	.00	411.
1.01	18.05	217	.02	.02	.00	378.
1.01	18.10	218	.02	.02	.00	276.
1.01	18.15	219	.02	.02	.00	248.
1.01	18.20	220	.02	.02	.00	231.
1.01	18.25	221	.02	.02	.00	215.
1.01	18.30	222	.02	.02	.00	201.
1.01	18.35	223	.02	.02	.00	188.
1.01	18.40	224	.02	.02	.00	175.
1.01	18.45	225	.02	.02	.00	163.
1.01	18.50	226	.02	.02	.00	152.
1.01	18.55	227	.02	.02	.00	142.
1.01	19.00	228	.02	.02	.00	133.
1.01	19.05	229	.02	.02	.00	124.
1.01	19.10	230	.02	.02	.00	115.
1.01	19.15	231	.02	.02	.00	108.
1.01	19.20	232	.02	.02	.00	101.
1.01	19.25	233	.02	.02	.00	94.
1.01	19.30	234	.02	.02	.00	88.
1.01	19.35	235	.02	.02	.00	82.
1.01	19.40	236	.02	.02	.00	76.
1.01	19.45	237	.02	.02	.00	71.
1.01	19.50	238	.02	.02	.00	66.
1.01	19.55	239	.02	.02	.00	62.
1.01	20.00	240	.02	.02	.00	58.
1.01	20.05	241	.02	.02	.00	54.
1.01	20.10	242	.02	.02	.00	50.
1.01	20.15	243	.02	.02	.00	47.
1.01	20.20	244	.02	.02	.00	44.
1.01	20.25	245	.02	.02	.00	41.
1.01	20.30	246	.02	.02	.00	38.
1.01	20.35	247	.02	.02	.00	37.
1.01	20.40	248	.02	.02	.00	37.
1.01	20.45	249	.02	.02	.00	37.
1.01	20.50	250	.02	.02	.00	37.
1.01	20.55	251	.02	.02	.00	37.
1.01	21.00	252	.02	.02	.00	37.
1.01	21.05	253	.02	.02	.00	37.
1.01	21.10	254	.02	.02	.00	37.
1.01	21.15	255	.02	.02	.00	37.
1.01	21.20	256	.02	.02	.00	37.
1.01	21.25	257	.02	.02	.00	37.
1.01	21.30	258	.02	.02	.00	37.
1.01	21.35	259	.02	.02	.00	37.
1.01	21.40	260	.02	.02	.00	37.
1.01	21.45	261	.02	.02	.00	37.
1.01	21.50	262	.02	.02	.00	37.
1.01	21.55	263	.02	.02	.00	37.
1.01	22.00	264	.02	.02	.00	37.

1.01	10.05	121	.07	.06	.01	106.	1.01	22.05	265	.02	.02	.00	37.
1.01	10.10	122	.07	.06	.01	107.	1.01	22.10	266	.02	.02	.00	37.
1.01	10.15	123	.07	.06	.01	107.	1.01	22.15	267	.02	.02	.00	37.
1.01	10.20	124	.07	.06	.01	107.	1.01	22.20	268	.02	.02	.00	37.
1.01	10.25	125	.07	.06	.01	107.	1.01	22.25	269	.02	.02	.00	37.
1.01	10.30	126	.07	.06	.01	108.	1.01	22.30	270	.02	.02	.00	37.
1.01	10.35	127	.07	.06	.01	108.	1.01	22.35	271	.02	.02	.00	37.
1.01	10.40	128	.07	.06	.01	108.	1.01	22.40	272	.02	.02	.00	37.
1.01	10.45	129	.07	.06	.01	108.	1.01	22.45	273	.02	.02	.00	37.
1.01	10.50	130	.07	.06	.01	108.	1.01	22.50	274	.02	.02	.00	37.
1.01	10.55	131	.07	.06	.00	109.	1.01	22.55	275	.02	.02	.00	37.
1.01	11.00	132	.07	.06	.00	109.	1.01	23.00	276	.02	.02	.00	37.
1.01	11.05	133	.07	.06	.00	109.	1.01	23.05	277	.02	.02	.00	37.
1.01	11.10	134	.07	.06	.00	109.	1.01	23.10	278	.02	.02	.00	37.
1.01	11.15	135	.07	.06	.00	109.	1.01	23.15	279	.02	.02	.00	37.
1.01	11.20	136	.07	.06	.00	109.	1.01	23.20	280	.02	.02	.00	37.
1.01	11.25	137	.07	.06	.00	110.	1.01	23.25	281	.02	.02	.00	37.
1.01	11.30	138	.07	.06	.00	110.	1.01	23.30	282	.02	.02	.00	37.
1.01	11.35	139	.07	.06	.00	110.	1.01	23.35	283	.02	.02	.00	37.
1.01	11.40	140	.07	.06	.00	110.	1.01	23.40	284	.02	.02	.00	37.
1.01	11.45	141	.07	.06	.00	110.	1.01	23.45	285	.02	.02	.00	37.
1.01	11.50	142	.07	.06	.00	110.	1.01	23.50	286	.02	.02	.00	37.
1.01	11.55	143	.07	.06	.00	111.	1.01	23.55	287	.02	.02	.00	37.
1.01	12.00	144	.07	.06	.00	111.	1.02	0.00	288	.02	.02	.00	37.
									SUM	33.41	31.46	1.95	56310.
										(849.)	(799.)	(49.)	(1594.52)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2629.	612.	195.	195.	56295.
CMS	74.	17.	6.	6.	1594.
INCHES		25.42	32.47	32.47	32.47
MM		645.70	824.74	824.74	824.74
AC-FT		304.	388.	388.	388.
THOUS CU M		374.	478.	478.	478.

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	109.90	109.90	113.30
STORAGE	93.	93.	127.
OUTFLOW	0.	0.	83.

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	112.57	0.00	119.	43.	0.00	17.33	0.00
.15	113.38	.08	128.	92.	1.25	16.33	0.00
.20	113.90	.60	133.	236.	2.67	16.00	0.00
.25	114.16	.86	136.	456.	3.25	15.92	0.00
.30	114.36	1.06	138.	620.	4.17	15.83	0.00
.35	114.51	1.21	140.	746.	4.[illegible]	15.83	0.00
.40	114.61	1.31	141.	900.	5.42	15.83	0.00
.50	114.79	1.49	143.	1160.	6.25	15.83	0.00
1.00	115.42	2.12	150.	2462.	8.42	15.75	0.00

PLATE A-1
Sheet 5 of 5

THIS RUN EXECUTED 11/24/78. 13.??.??.

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**************************************************
  HPCR RELEASE DATED NOV 78 UPDATED  AUG1977
  ERROR CODE =  01.02
  MODIFICATION =  50.51.52.53
**************************************************

 II  ICHECK     INO        NINV       IDIB       STRT      METRIC.    MVINS      0          WSEL       FO
       -1.        2.         0.         0. -1.000000        0.00       0.0        0.    111.000        0.000
 ID  NPROF     IPLOT      PRFVS      XSECV      XSECH        FN        ALLOC      IRN        CHNIM      ITRACE
       1.000      0.000     -1.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

NC        .000       .000       .000       .100       .300      0.000      0.000      0.000      0.000      0.000
ST       7.000      5.000     10.000     20.000     40.000     40.000    120.000    160.000      0.000      0.000

VI    140.000      9.000      4.000     26.000      0.000      0.000      0.000      0.000      0.000      0.000
AB    113.000      4.000    112.400     19.000    110.800     12.000    110.400     14.000    110.100     17.000
AB    109.500     19.000    109.700     21.000    111.400     25.000    111.600     26.000      0.000      0.000

VI    170.000      0.000      0.000      0.000      2.000      2.000      2.000      0.000      0.000      0.000

VI    174.000      0.000      0.000      0.000      4.000      4.000      4.000      0.000      0.000      0.000

VI    144.100      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

VI    199.000      0.000      0.000     20.000     11.000     11.000     11.000      0.000      0.000      0.000
AB    114.300      0.000    113.500      3.000    110.100      9.000    110.100     13.000    110.700     18.000
AB    110.000     21.000    113.700     27.000    113.700     28.000      0.000      0.000      0.000      0.000

VI    140.000      9.000      4.000     26.000      0.000      0.000      0.000      0.000      0.000      0.000
AB    113.000      4.000    112.400     19.000    110.800     12.000    110.400     14.000    110.100     17.000
AB    109.500     19.000    109.700     21.000    111.400     25.000    111.600     26.000      0.000      0.000

VI    170.000      0.000      0.000      0.000      2.000      2.000      2.000      0.000      0.000      0.000

VI    174.000      0.000      0.000      0.000      4.000      4.000      4.000      0.000      0.000      0.000

VI    144.100      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

VI    199.000      0.000      0.000     20.000     11.000     11.000     11.000      0.000      0.000      0.000
AB    114.300      0.000    113.500      3.000    110.100      9.000    110.100     13.000    110.700     18.000
AB    110.000     21.000    113.700     27.000    113.700     28.000      0.000      0.000      0.000      0.000

VI    199.000      0.000      0.000      0.000     20.000     20.000     20.000      0.000      0.000      0.000

VI    100.000      0.000      0.000      0.000     35.000     35.000     35.000      0.000      0.000      0.000

VI    209.000      9.000      0.000     14.000     95.000     95.000     95.000      0.000      0.000      0.000
AB    113.500      0.000    111.900      6.000    110.100     12.000    109.900     16.000    110.100     19.000
AB    111.000     23.000    112.400     28.000    114.100     32.000    114.400     34.000      0.000      0.000

VI     74.000     11.000      0.000     44.000    129.000    129.000    129.000      0.000      0.000      0.000
AB    110.000      0.000    117.200      5.000    112.900     13.000    111.500     21.000    110.900     25.000
AB    110.000     27.000    110.700     30.000    111.300     34.000    112.600     38.000    110.200     42.000
AB    110.000     40.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

VI     40.000     12.000      0.000     51.000     27.000     27.000     27.000      0.000      0.000      0.000
AB    110.000      0.000    110.200      0.000    110.000     11.000    111.100     22.000    110.400     28.000
AB    110.300     32.000    110.000     35.000    110.100     39.000    109.900     41.000    110.400     43.000
AB    112.000     46.000    112.700     51.000      0.000      0.000      0.000      0.000      0.000      0.000
      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
```

PLATE A-2
Sheet 1 of 3

THIS RUN EXECUTED 11/24/78. 13.22.19.

****
HEC2 RELEASE DATED NOV 76 UPDATED AUG1977
ERROR CORR - 01.02
MODIFICATION - 50,51,52,53
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	FLTRD	FLLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	380.000	0.00	0.00	0.00	109.50	5.00	110.04	110.04	110.21	814.71	3.29	1.52	.18
*	380.000	0.00	0.00	0.00	109.50	10.00	110.27	110.27	110.47	743.24	3.58	2.79	.37
*	380.000	0.00	0.00	0.00	109.50	20.00	110.51	110.51	110.78	706.48	4.13	4.85	.75
*	380.000	0.00	0.00	0.00	109.50	40.00	110.83	110.83	111.20	642.15	4.85	8.25	1.58
*	380.000	0.00	0.00	0.00	109.50	80.00	111.27	111.27	111.80	569.47	5.85	13.66	3.35
*	380.000	0.00	0.00	0.00	109.50	120.00	111.62	111.62	112.27	544.78	6.44	18.63	5.14
*	380.000	0.00	0.00	0.00	109.50	160.00	111.91	111.91	112.66	507.41	6.96	22.98	7.10
	378.000	2.00	0.00	0.00	109.50	5.00	110.24	0.00	110.30	217.67	1.91	2.62	.34
	378.000	2.00	0.00	0.00	109.50	10.00	110.48	0.00	110.55	215.84	2.22	4.51	.58
	378.000	2.00	0.00	0.00	109.50	20.00	110.75	0.00	110.86	221.97	2.72	7.35	1.34
	378.000	2.00	0.00	0.00	109.50	40.00	111.10	0.00	111.29	236.77	3.48	11.50	2.60
	378.000	2.00	0.00	0.00	109.50	80.00	111.59	0.00	111.90	263.14	4.43	18.06	4.93
	378.000	2.00	0.00	0.00	109.50	120.00	111.97	0.00	112.36	253.77	5.02	23.89	7.53
	378.000	2.00	0.00	0.00	109.50	160.00	112.27	0.00	112.76	264.32	5.60	28.55	9.84
	374.000	4.00	0.00	0.00	109.50	5.00	110.33	0.00	110.37	127.72	1.53	3.26	.44
	374.000	4.00	0.00	0.00	109.50	10.00	110.57	0.00	110.62	131.74	1.86	5.38	.87
	374.000	4.00	0.00	0.00	109.50	20.00	110.85	0.00	110.94	146.10	2.35	8.50	1.65
	374.000	4.00	0.00	0.00	109.50	40.00	111.23	0.00	111.37	160.16	3.05	13.13	3.14
	374.000	4.00	0.00	0.00	109.50	80.00	111.76	0.00	111.99	174.83	3.87	20.68	6.05
	374.000	4.00	0.00	0.00	109.50	120.00	112.14	0.00	112.46	188.63	4.55	26.37	8.74
	374.000	4.00	0.00	0.00	109.50	160.00	112.46	0.00	112.86	196.67	5.07	31.54	11.41
	364.000	8.00	0.00	0.00	109.50	5.00	110.42	0.00	110.44	75.59	1.25	4.00	.58
	364.000	8.00	0.00	0.00	109.50	10.00	110.67	0.00	110.70	81.81	1.57	6.39	1.11
	364.000	8.00	0.00	0.00	109.50	20.00	110.97	0.00	111.03	92.64	2.02	9.89	2.08
	364.000	8.00	0.00	0.00	109.50	40.00	111.37	0.00	111.48	105.72	2.64	15.13	3.89
	364.000	8.00	0.00	0.00	109.50	80.00	111.93	0.00	112.11	121.64	3.43	23.30	7.25
	364.000	8.00	0.00	0.00	109.50	120.00	112.33	0.00	112.59	134.51	4.06	29.53	10.35
	364.000	8.00	0.00	0.00	109.50	160.00	112.68	0.00	113.00	147.75	4.56	35.06	13.14
	355.000	11.00	0.00	0.00	110.10	5.00	110.52	0.00	110.54	103.21	1.21	4.12	.49
	355.000	11.00	0.00	0.00	110.10	10.00	110.76	0.00	110.79	74.74	1.39	7.20	1.16
	355.000	11.00	0.00	0.00	110.10	20.00	111.08	0.00	111.12	68.22	1.71	11.67	2.42
	355.000	11.00	0.00	0.00	110.10	40.00	111.50	0.00	111.57	69.79	2.17	18.43	4.79
	355.000	11.00	0.00	0.00	110.10	80.00	112.10	0.00	112.22	75.79	2.77	28.88	9.19
	355.000	11.00	0.00	0.00	110.10	120.00	112.56	0.00	112.71	77.66	3.15	38.07	13.62
	355.000	11.00	0.00	0.00	110.10	160.00	112.95	0.00	113.13	78.14	3.43	46.59	18.10

PLATE A-2
Sheet 2 of 3

SECNO	XLCH	FLTRD	FLLC	FLMIN	Q	CWSEL	CRIWS	EB	10K*S	VCH	AREA	.01K
335.000	20.00	0.00	0.00	110.10	5.00	110.65	0.00	110.66	38.64	.88	5.70	.80
335.000	20.00	0.00	0.00	110.10	10.00	110.88	0.00	110.90	39.98	1.13	8.82	1.58
335.000	20.00	0.00	0.00	110.10	20.00	111.20	0.00	111.23	44.08	1.48	13.49	3.01
335.000	20.00	0.00	0.00	110.10	40.00	111.63	0.00	111.69	50.59	1.94	20.57	5.62
335.000	20.00	0.00	0.00	110.10	80.00	112.26	0.00	112.35	56.64	2.50	31.98	10.63
335.000	20.00	0.00	0.00	110.10	120.00	112.72	0.00	112.85	60.69	2.89	41.54	15.40
335.000	20.00	0.00	0.00	110.10	160.00	113.12	0.00	113.28	62.58	3.17	50.44	20.23
300.000	35.00	0.00	0.00	110.10	5.00	110.75	0.00	110.76	20.46	.72	6.99	1.11
300.000	35.00	0.00	0.00	110.10	10.00	110.99	0.00	111.01	24.02	.96	10.42	2.04
300.000	35.00	0.00	0.00	110.10	20.00	111.33	0.00	111.36	28.82	1.29	15.55	3.73
300.000	35.00	0.00	0.00	110.10	40.00	111.79	0.00	111.84	34.92	1.71	23.37	6.77
300.000	35.00	0.00	0.00	110.10	80.00	112.44	0.00	112.52	41.18	2.24	35.77	12.47
300.000	35.00	0.00	0.00	110.10	120.00	112.93	0.00	113.03	45.20	2.60	46.13	17.85
300.000	35.00	0.00	0.00	110.10	160.00	113.34	0.00	113.47	47.51	2.88	55.64	23.21
205.000	95.00	0.00	0.00	109.90	5.00	110.90	0.00	110.91	12.31	.63	7.97	1.43
205.000	95.00	0.00	0.00	109.90	10.00	111.18	0.00	111.19	16.08	.84	11.87	2.49
205.000	95.00	0.00	0.00	109.90	20.00	111.56	0.00	111.58	19.83	1.10	18.12	4.49
205.000	95.00	0.00	0.00	109.90	40.00	112.08	0.00	112.11	23.39	1.41	28.27	8.27
205.000	95.00	0.00	0.00	109.90	80.00	112.78	0.00	112.83	25.76	1.77	45.11	15.76
205.000	95.00	0.00	0.00	109.90	120.00	113.30	0.00	113.36	26.85	2.02	59.55	23.16
205.000	95.00	0.00	0.00	109.90	160.00	113.73	0.00	113.81	26.93	2.20	72.43	30.93
74.000	129.00	0.00	0.00	110.70	5.00	111.25	0.00	111.28	121.69	1.33	3.77	.45
74.000	129.00	0.00	0.00	110.70	10.00	111.55	0.00	111.57	69.23	1.34	7.45	1.20
74.000	129.00	0.00	0.00	110.70	20.00	111.94	0.00	111.97	50.01	1.47	13.60	2.83
74.000	129.00	0.00	0.00	110.70	40.00	112.46	0.00	112.51	41.60	1.67	23.96	6.20
74.000	129.00	0.00	0.00	110.70	80.00	113.16	0.00	113.22	35.37	1.93	41.36	13.45
74.000	129.00	0.00	0.00	110.70	120.00	113.68	0.00	113.75	32.91	2.15	55.80	20.92
74.000	129.00	0.00	0.00	110.70	160.00	114.10	0.00	114.19	32.12	2.33	68.58	28.23
40.000	27.00	0.00	0.00	109.90	5.00	111.29	0.00	111.29	1.43	.26	19.41	4.18
40.000	27.00	0.00	0.00	109.90	10.00	111.59	0.00	111.59	2.19	.37	26.82	6.75
40.000	27.00	0.00	0.00	109.90	20.00	111.99	0.00	112.00	3.25	.53	37.74	11.09
40.000	27.00	0.00	0.00	109.90	40.00	112.53	0.00	112.54	4.73	.74	54.36	18.39
40.000	27.00	0.00	0.00	109.90	80.00	113.24	0.00	113.26	6.18	1.00	80.09	32.18
40.000	27.00	0.00	0.00	109.90	120.00	113.77	0.00	113.79	7.22	1.20	99.78	44.67
40.000	27.00	0.00	0.00	109.90	160.00	114.20	0.00	114.23	8.00	1.37	117.12	56.58

SUMMARY OF ERRORS

CAUTION SECNO= 380.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 380.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 380.000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 380.000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 380.000 PROFILE= 5 CRITICAL DEPTH ASSUMED
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CAUTION SECNO= 380.000 PROFILE= 7 CRITICAL DEPTH ASSUMED

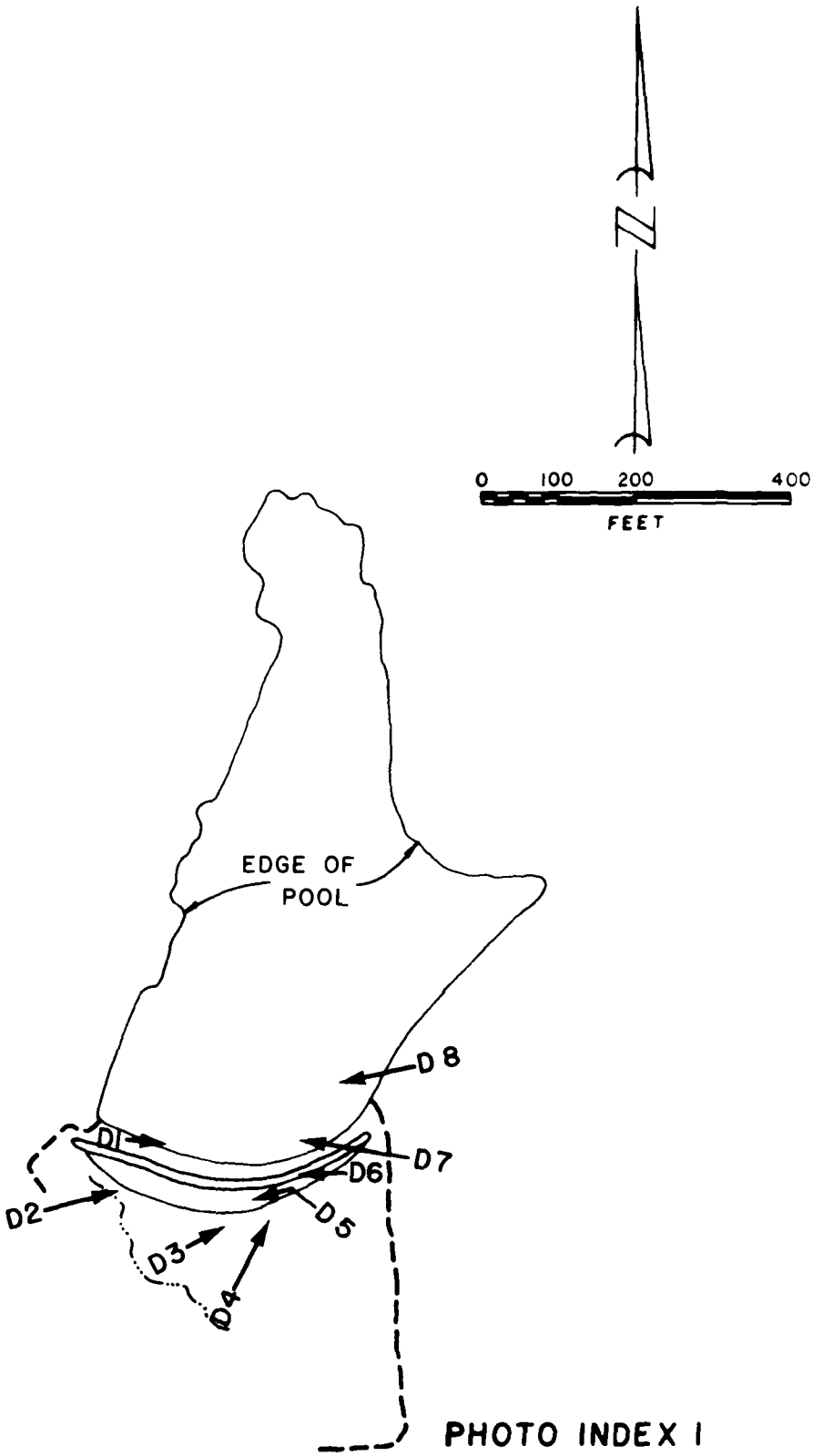
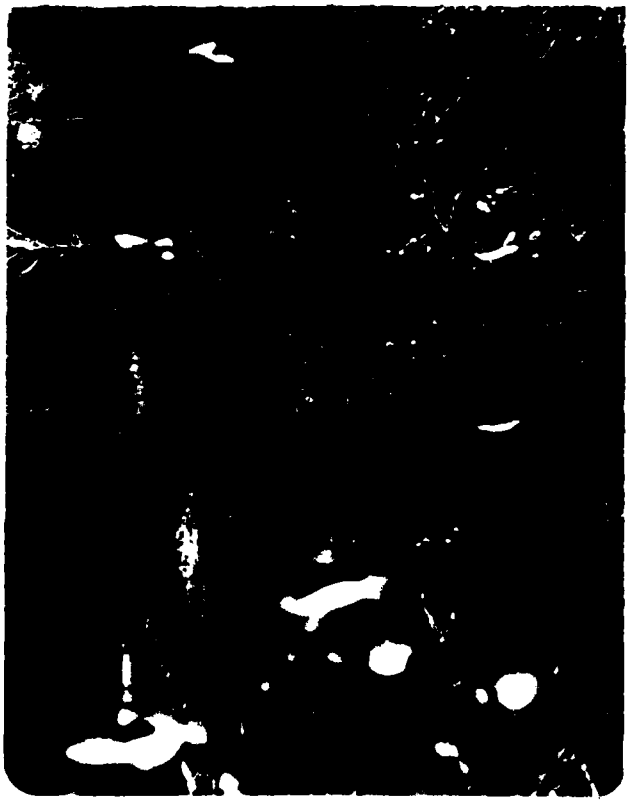


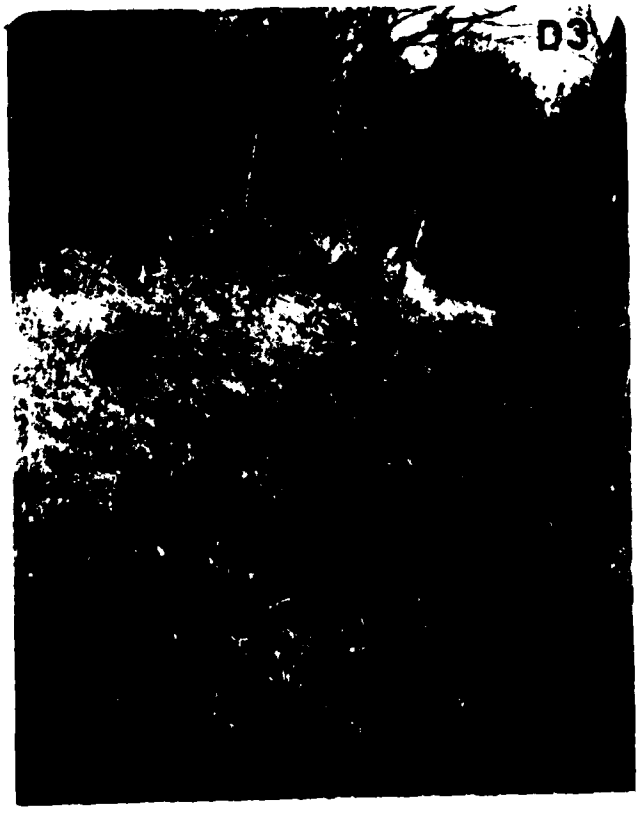
PHOTO INDEX I
FOR
DAM

WILLIAMS DAM
JEFFERSON COUNTY, MO.
NOVEMBER 1978

PREPARED BY
REITZ & JENS, INC.


D2

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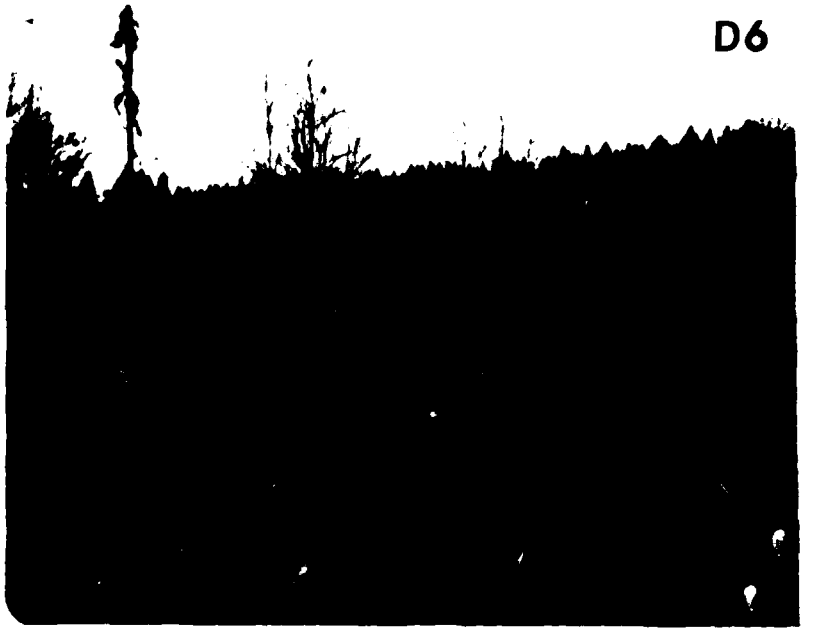
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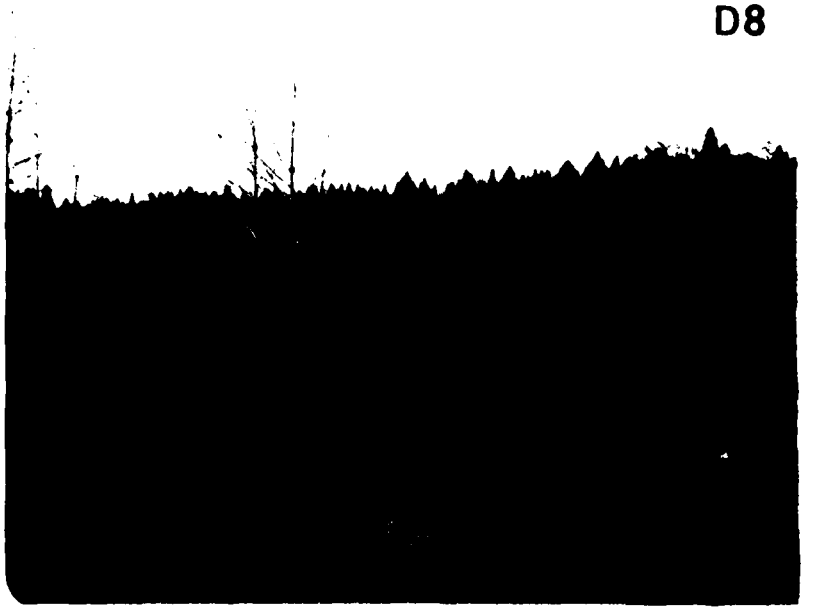
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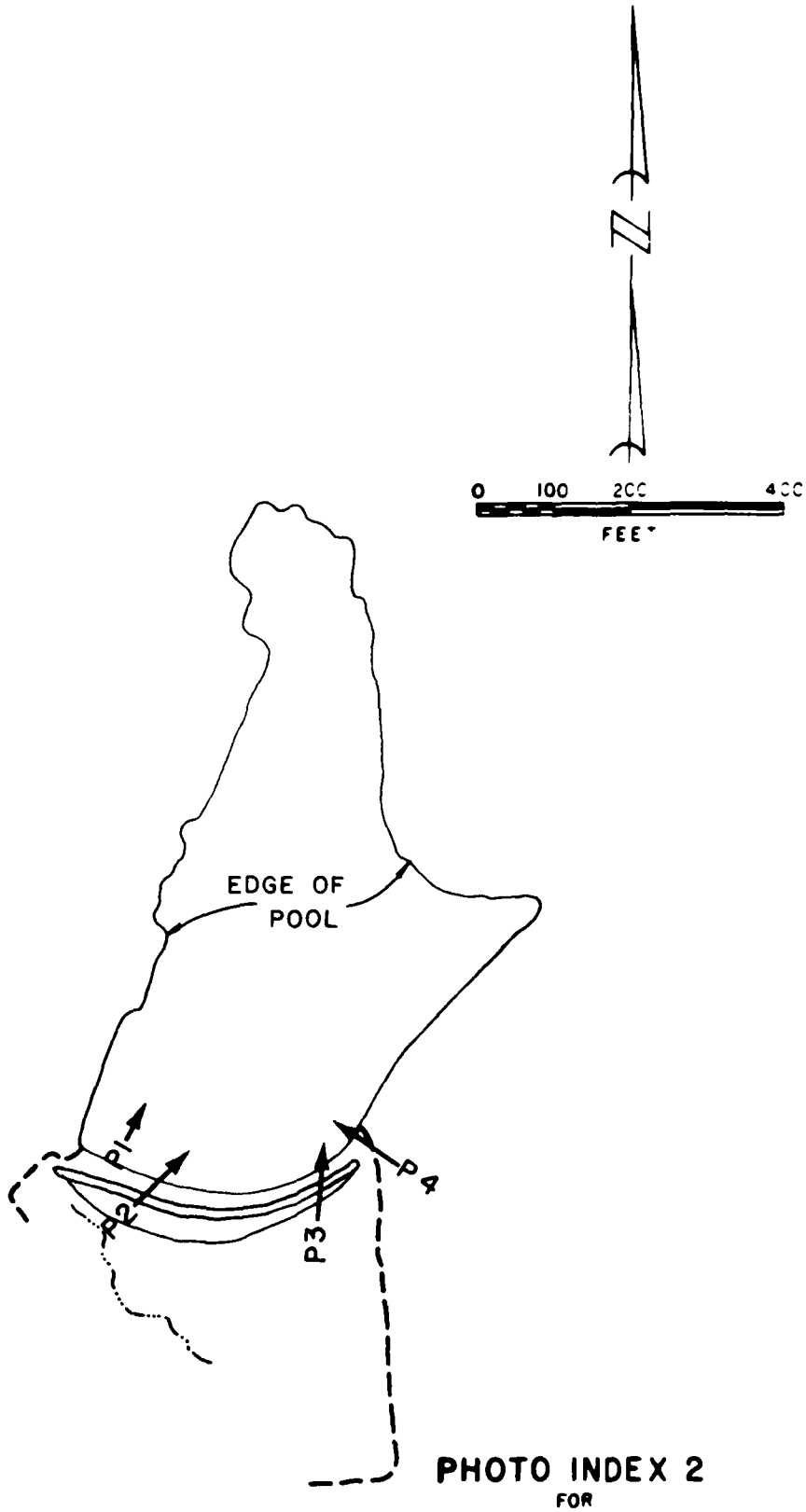
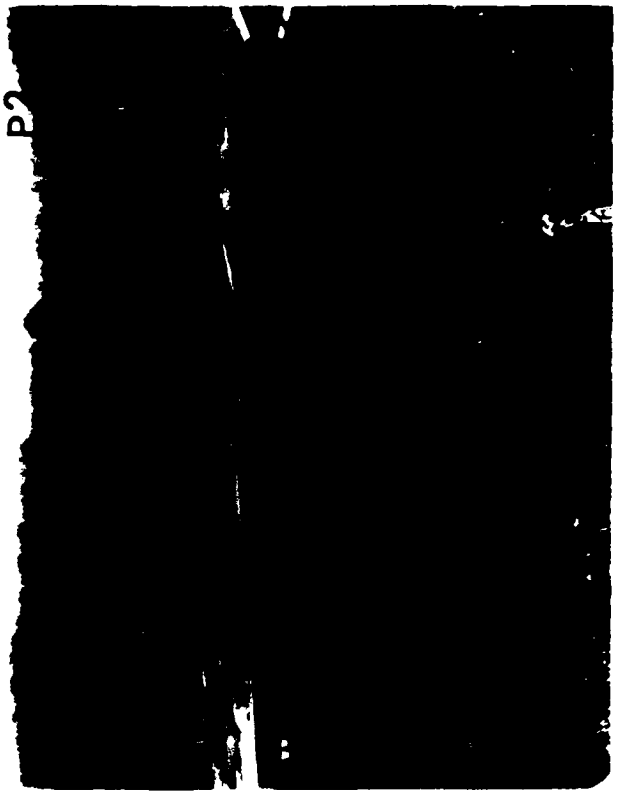
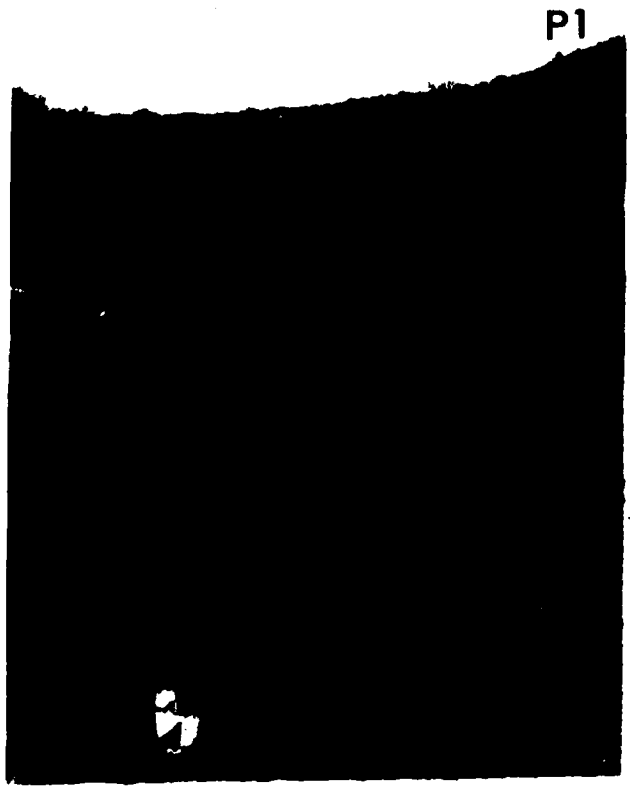


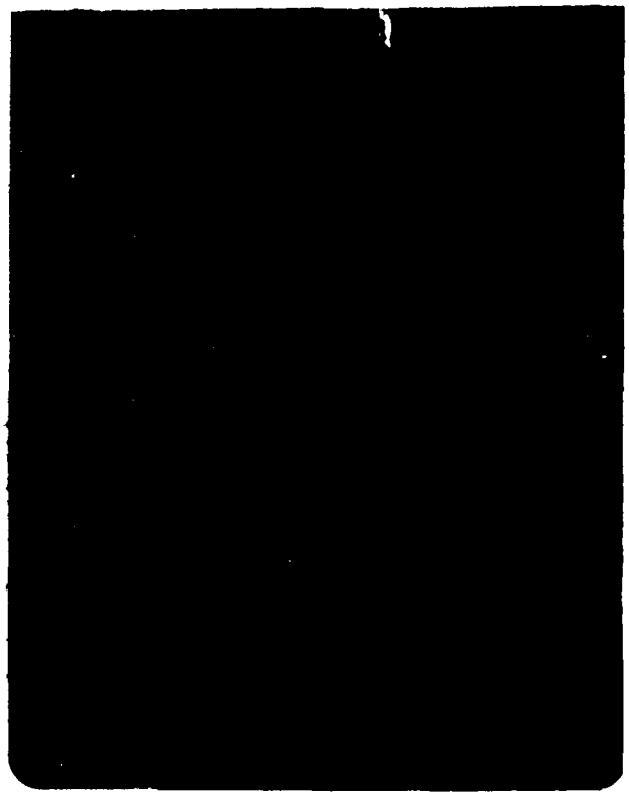
PHOTO INDEX 2
FOR
PANORAMA

WILLIAMS DAM
JEFFERSON COUNTY, MO.
NOVEMBER 1978

PREPARED BY
REITZ & JENS, INC







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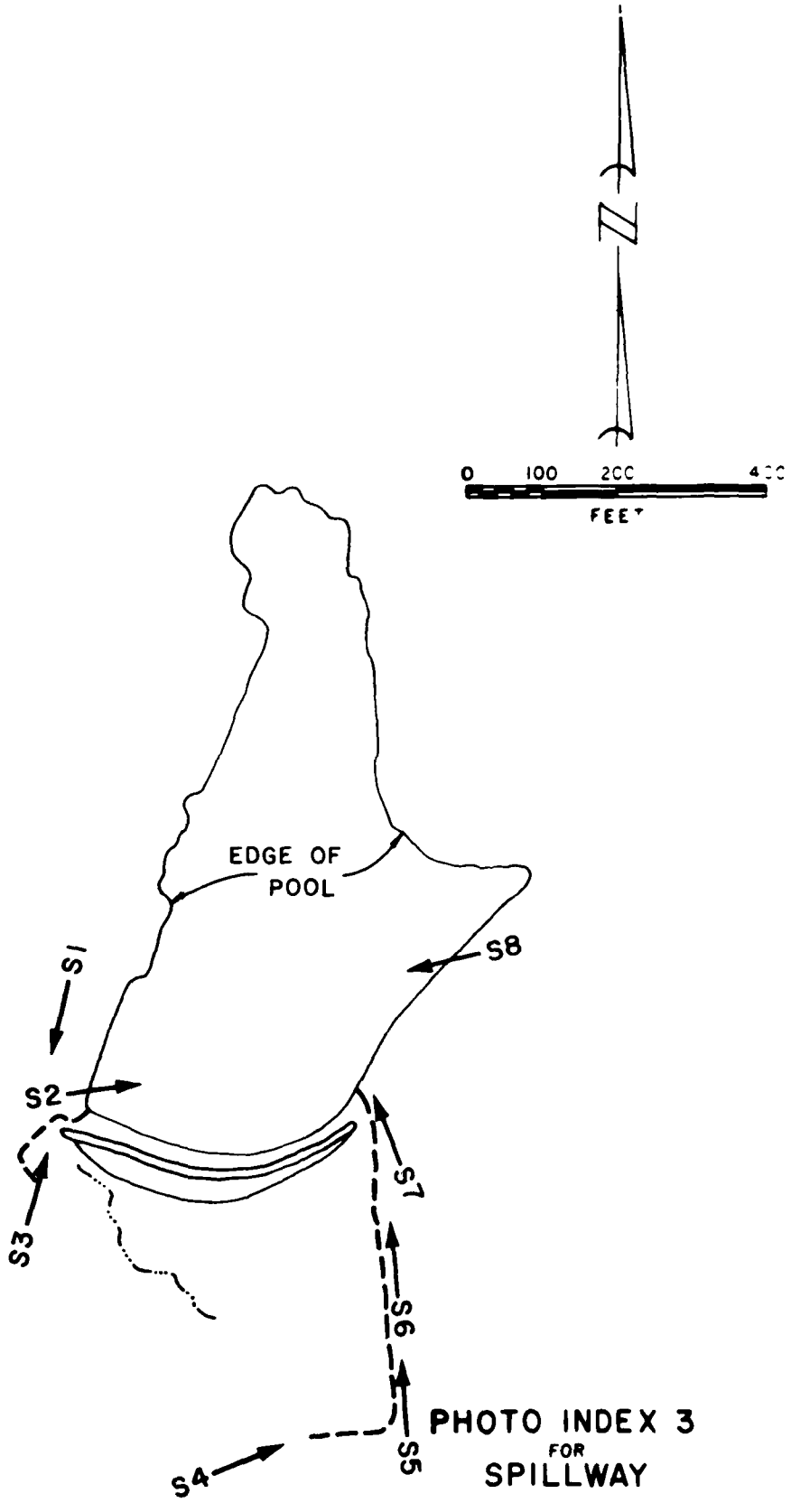


PHOTO INDEX 3 FOR SPILLWAY

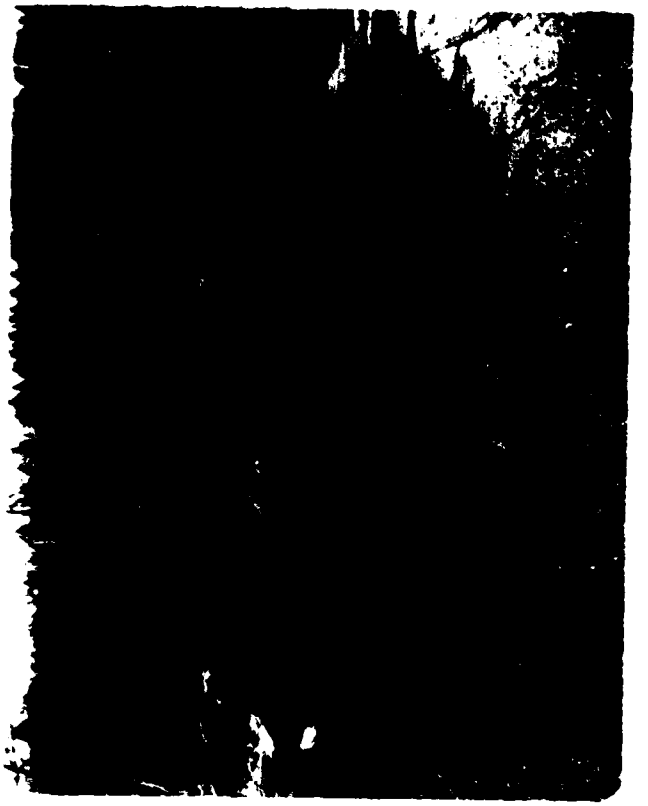
WILLIAMS DAM

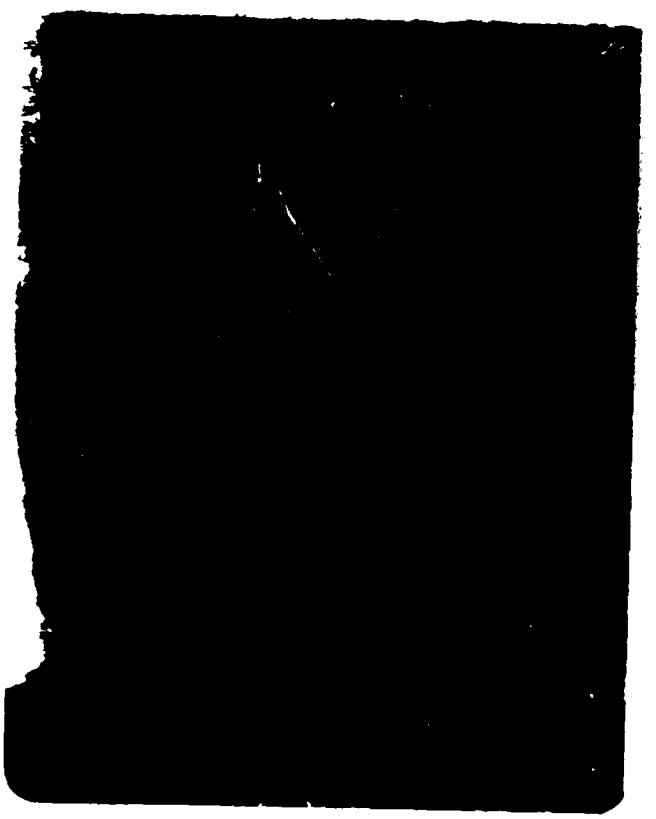
JEFFERSON COUNTY, MO.

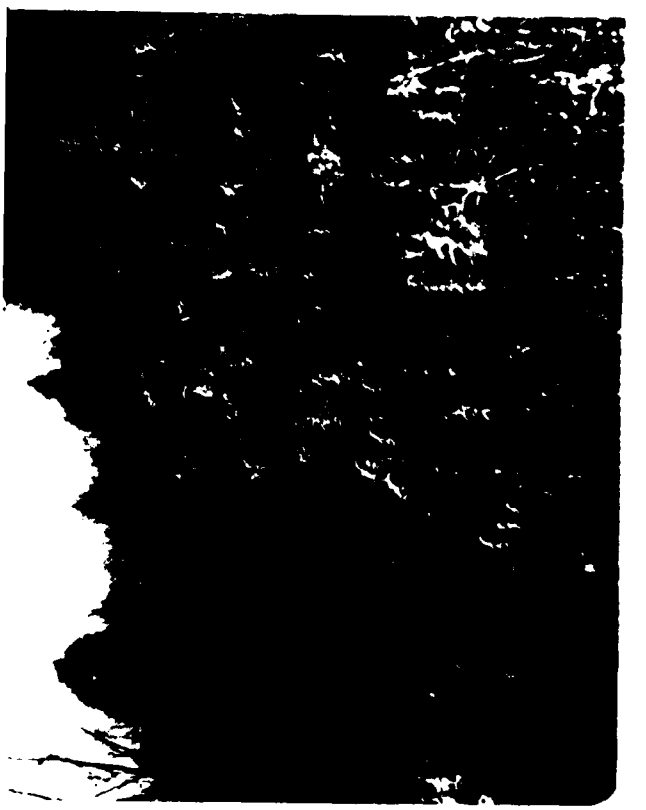
NOVEMBER 1978

PREPARED BY

REITZ & JENS, INC

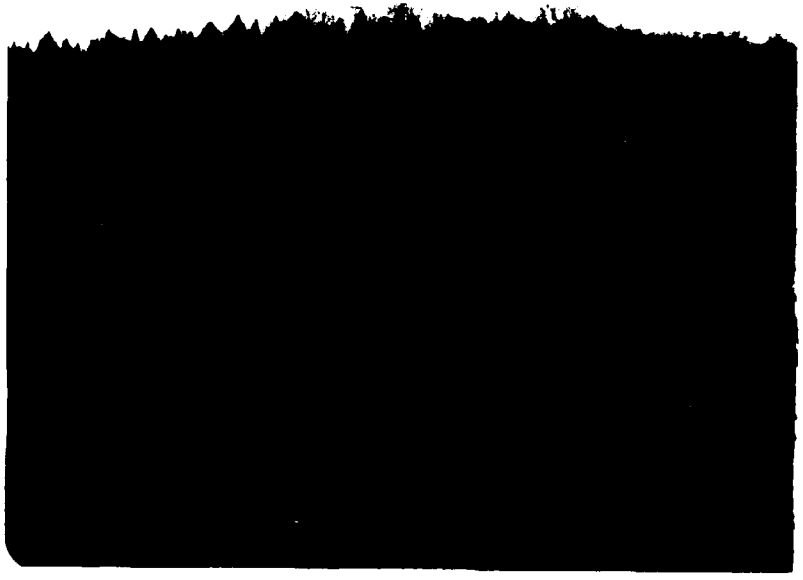






SPILLWAYS

S8



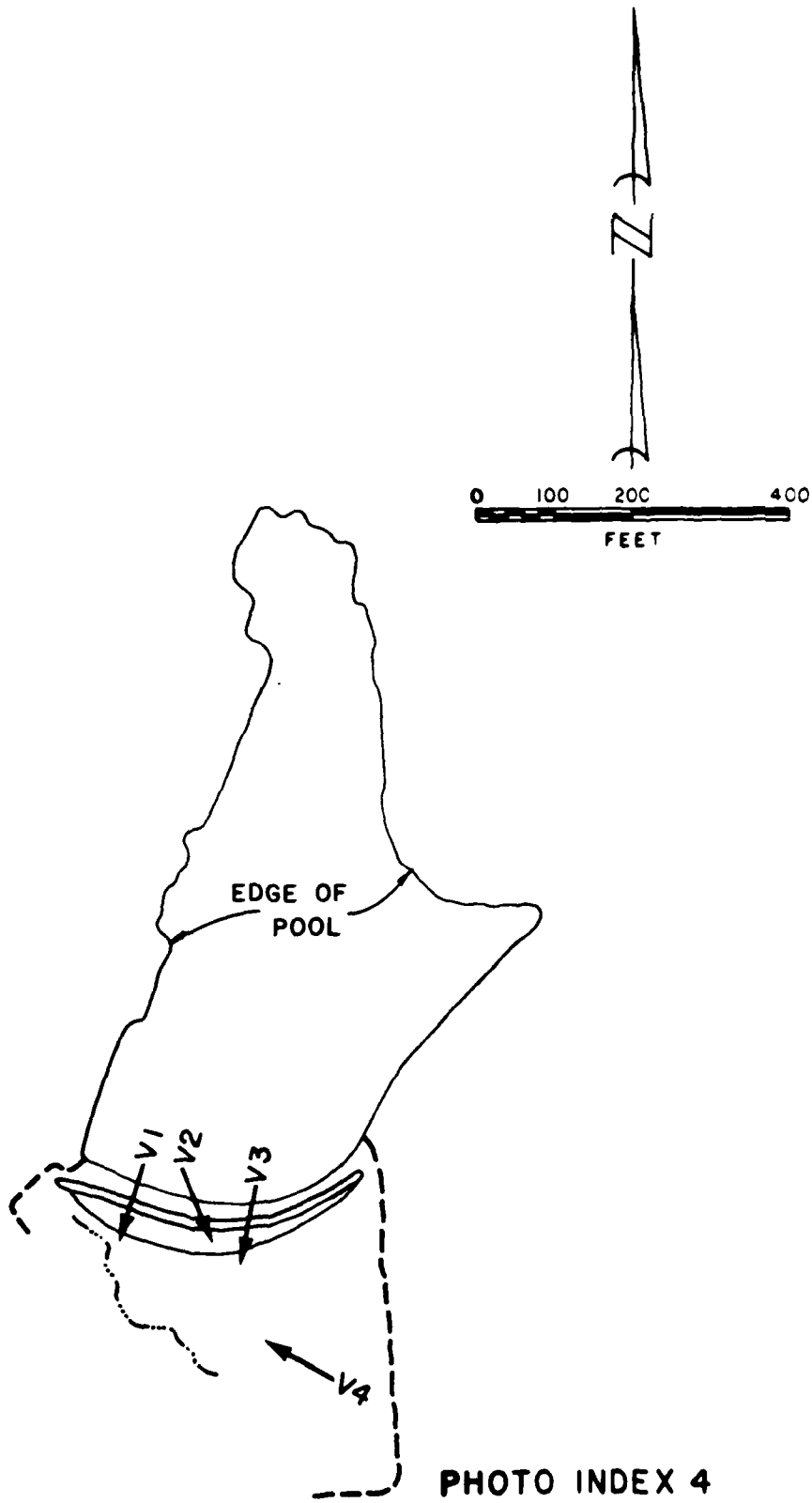
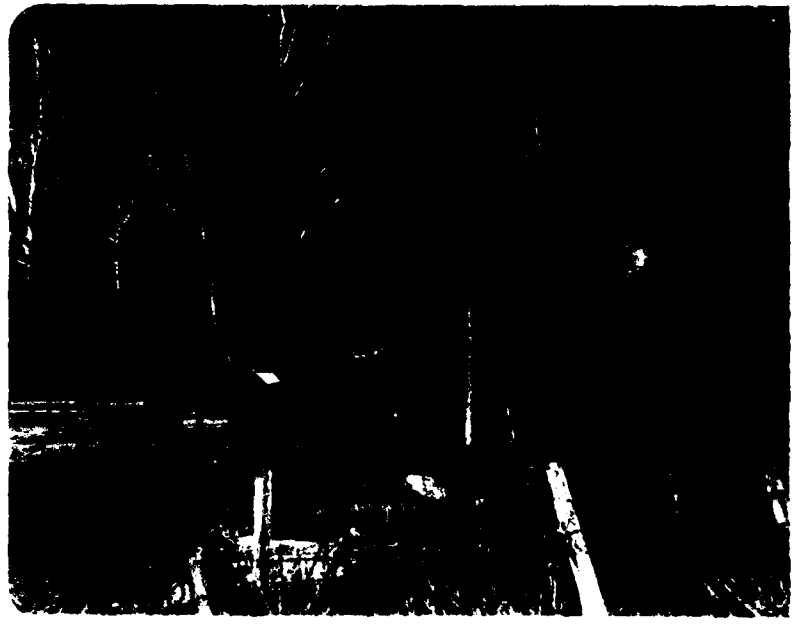


PHOTO INDEX 4
FOR
VALLEY BELOW DAM

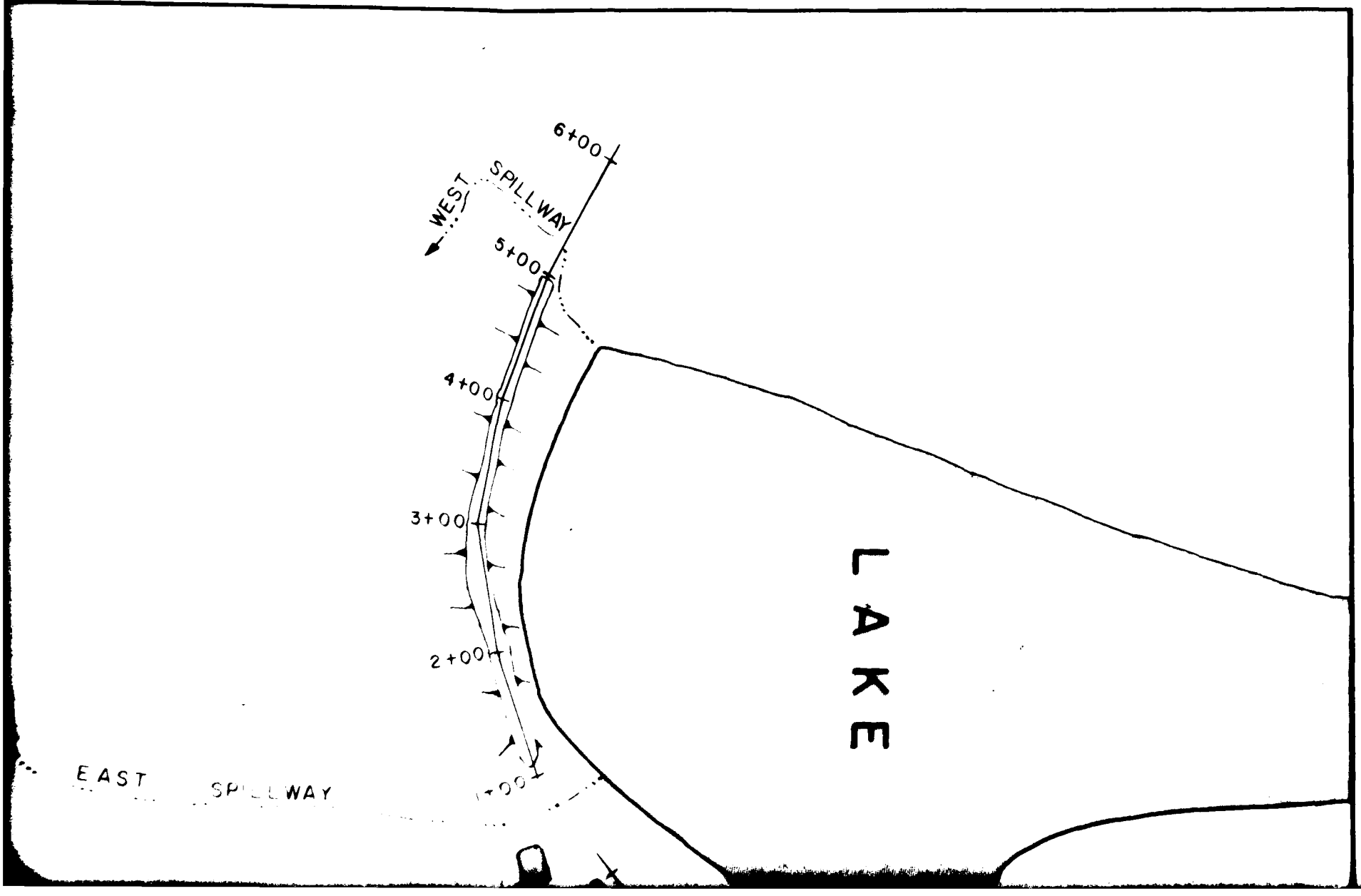
WILLIAMS DAM
JEFFERSON COUNTY, MO.
NOVEMBER 1978

PREPARED BY
REITZ & JENS, INC

VALLEY BELOW DAM



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



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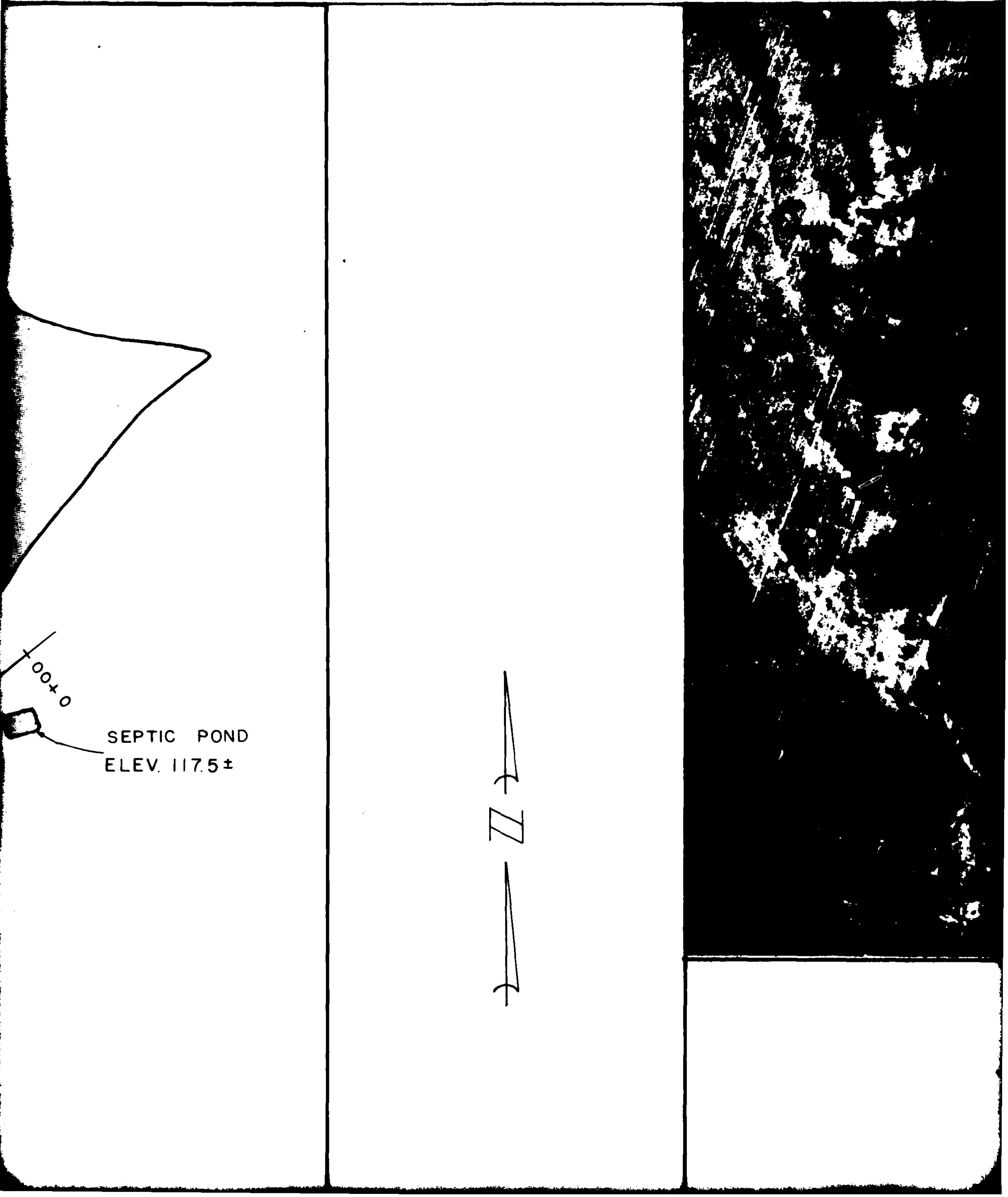


N

PLAN OF LAKE

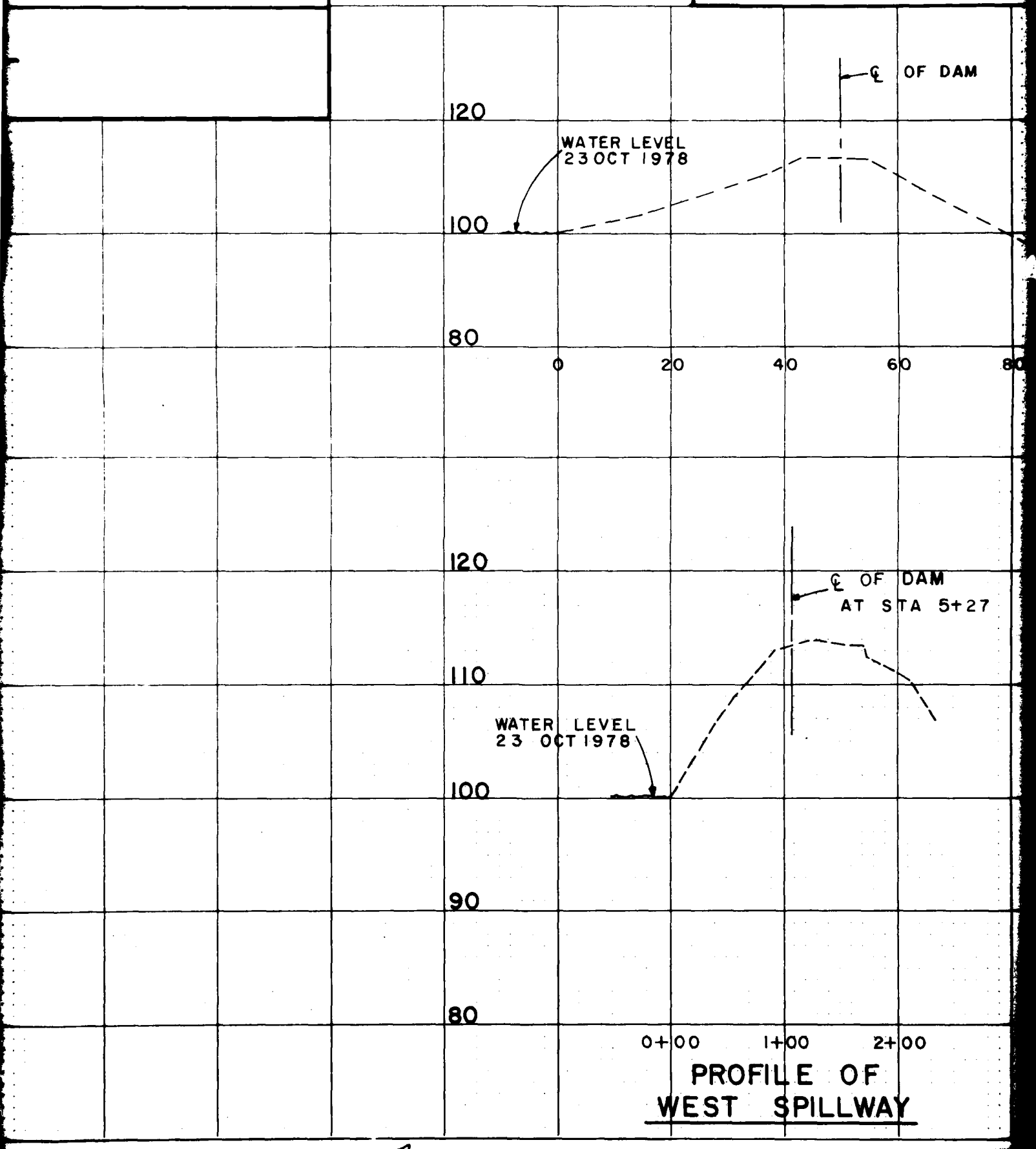
0 100 200 400FT

WATERSHED AND OUTFLOW CHANNEL


Creek
WILLIAMS
DAM
Substation
PACIFIC
428
MISSOURI

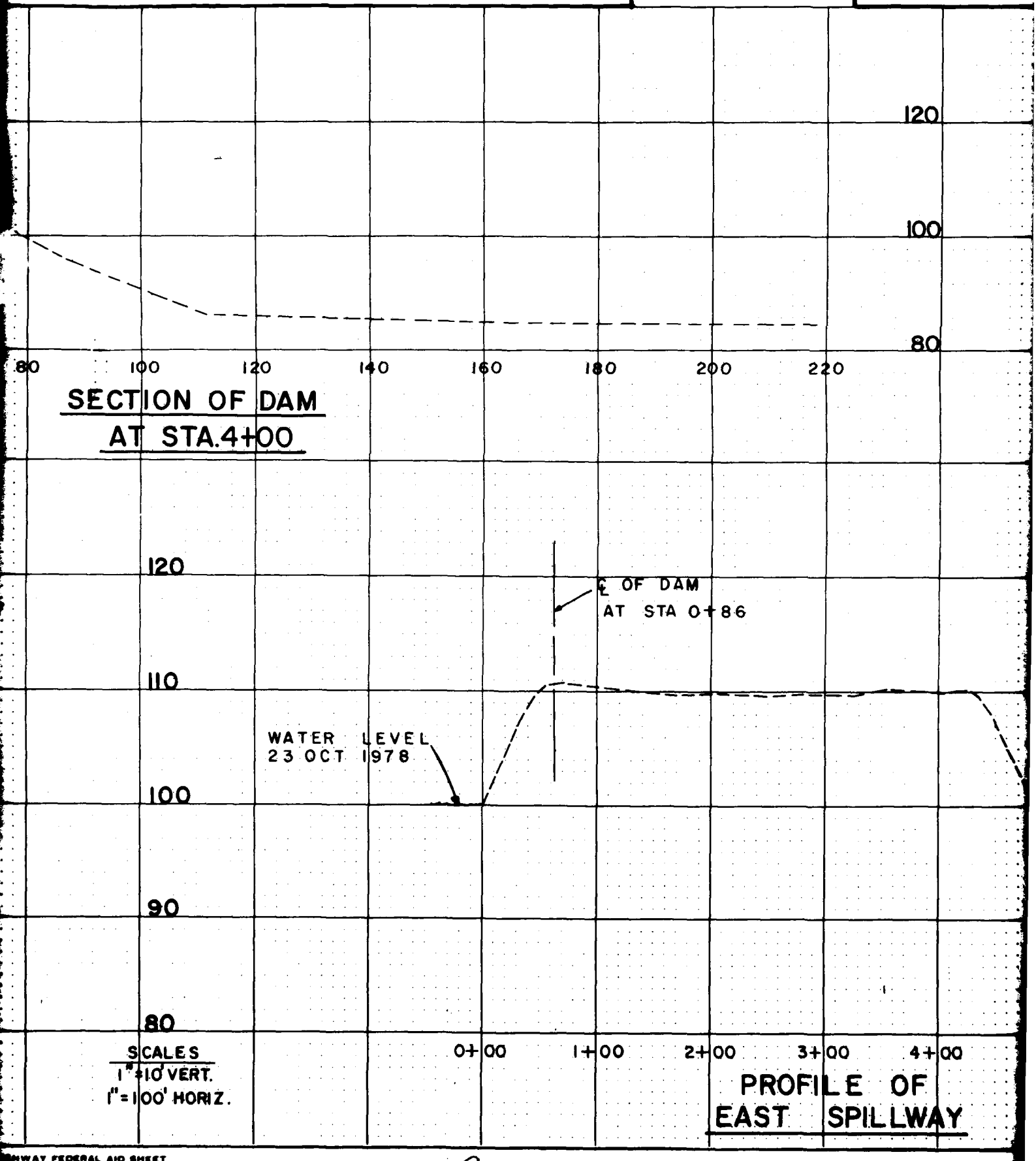
ORIGINAL SURVEY		BY	DATE
	SURVEYED		
	PLOTTED		
NOTE BOOK NO.	TEMPLATE		
	AREAS		
	AREAS CHECKED		

PLAN OF DAM AND SPILLWAY



PROFILE OF
WEST SPILLWAY

PLATE 4-SINGLE

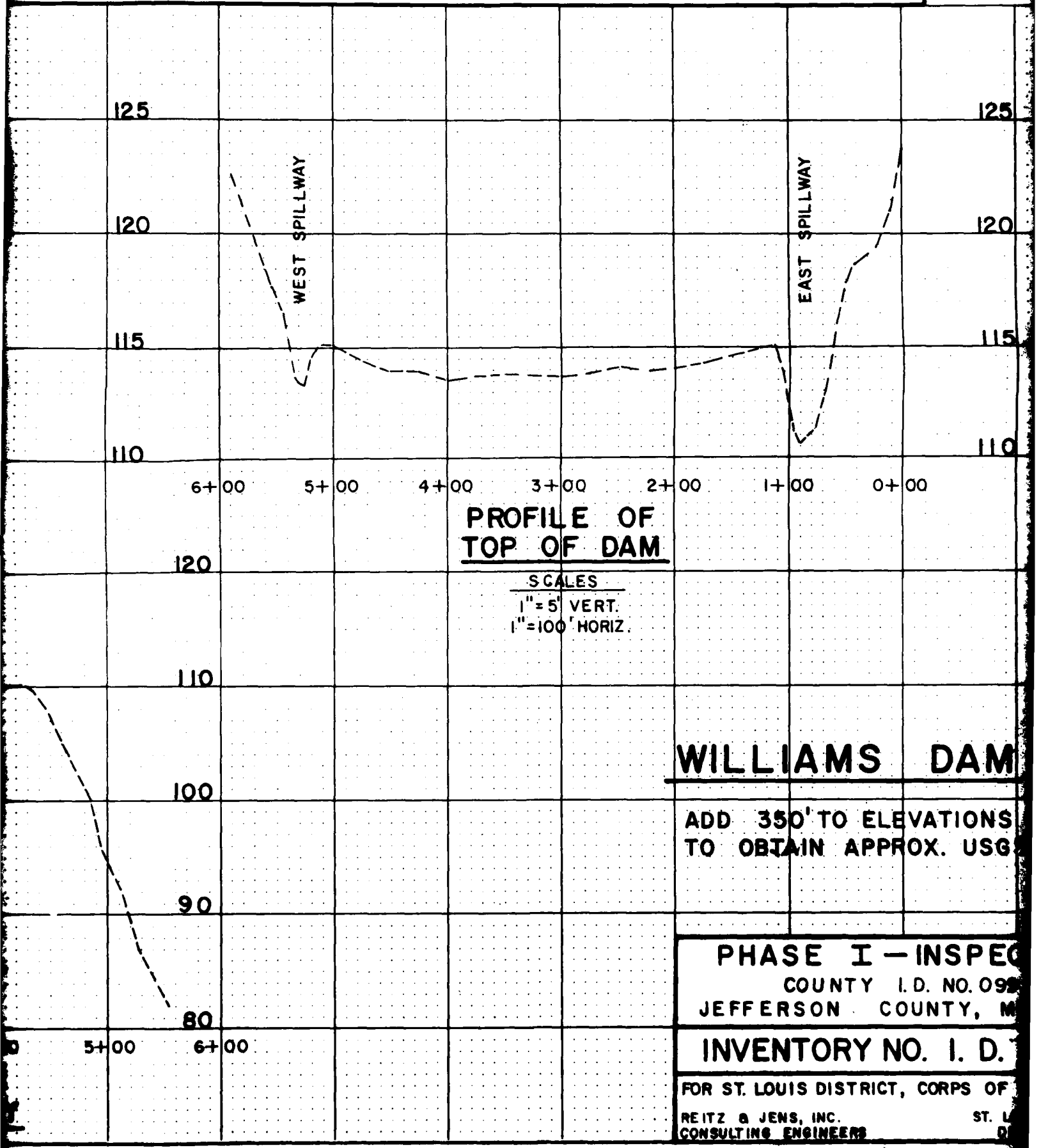


NWAY FEDERAL AID SHEET
AN AND CROSS SECTION-LINE & POT

2

WATERSHED AND OUTFLOW CHANNEL

0 1000 2000 4000 6000 FT.



PROFILE OF TOP OF DAM

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

WILLIAMS DAM

ADD 350' TO ELEVATIONS TO OBTAIN APPROX. USG

PHASE I — INSPEC
COUNTY I. D. NO. 09
JEFFERSON COUNTY, M

INVENTORY NO. I. D.

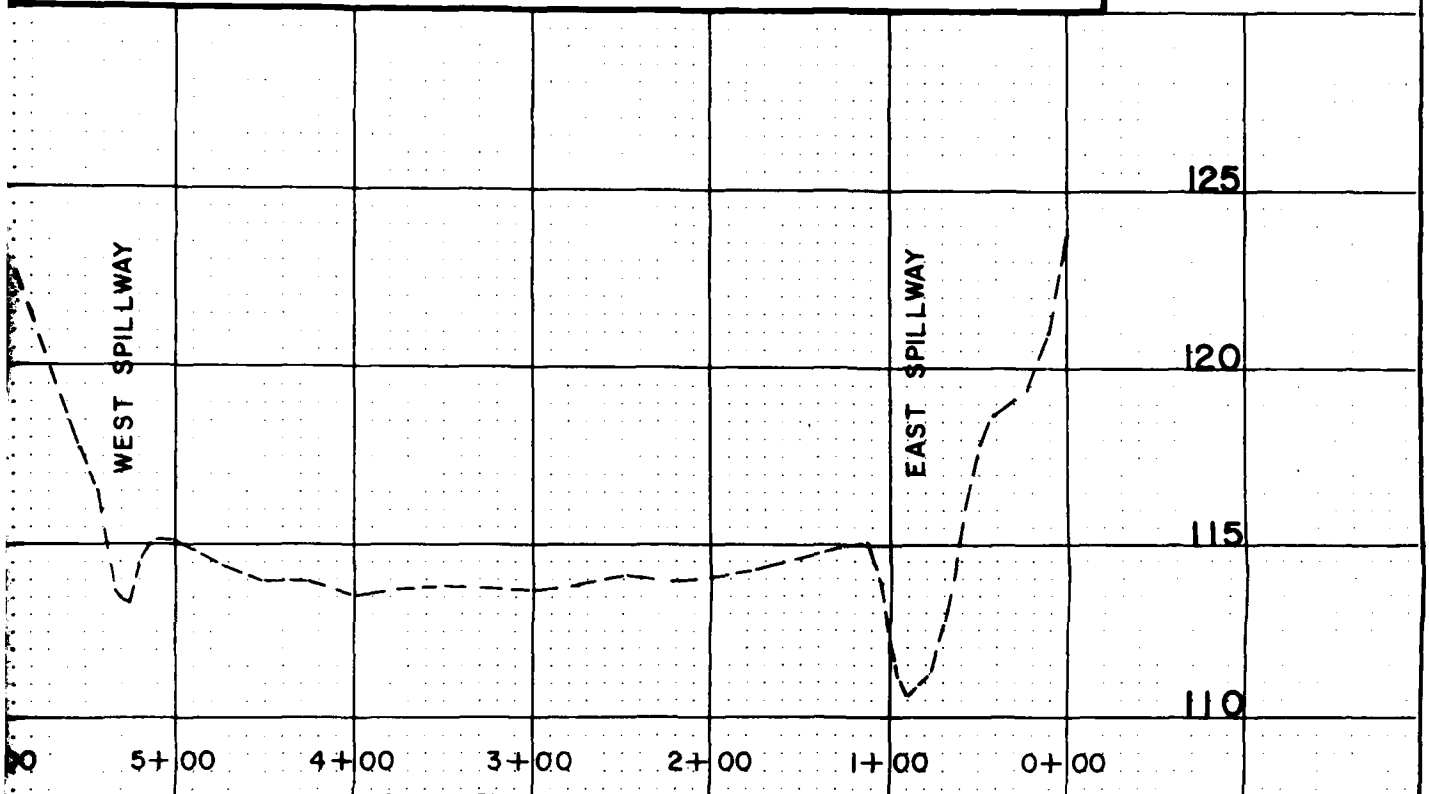
FOR ST. LOUIS DISTRICT, CORPS OF

REITZ & JENS, INC. ST. L
CONSULTING ENGINEERS

PLATE

SHED AND OUTFLOW CHANNEL

0 1000 2000 4000 6000 FT.



PROFILE OF TOP OF DAM

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

WILLIAMS DAM

ADD 350' TO ELEVATIONS SHOWN TO OBTAIN APPROX. USGS DATUM

PHASE I — INSPECTION
COUNTY I. D. NO. 099
JEFFERSON COUNTY, MISSOURI

INVENTORY NO. I. D. 30384

FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS

REITZ & JENS, INC.
CONSULTING ENGINEERS

ST. LOUIS, MISSOURI
DECEMBER 1978