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NATIONAL DAM SAFETY PROGRAM. BEAR CREEK WATERSHED STRUCTURE B-2--ETC(U)
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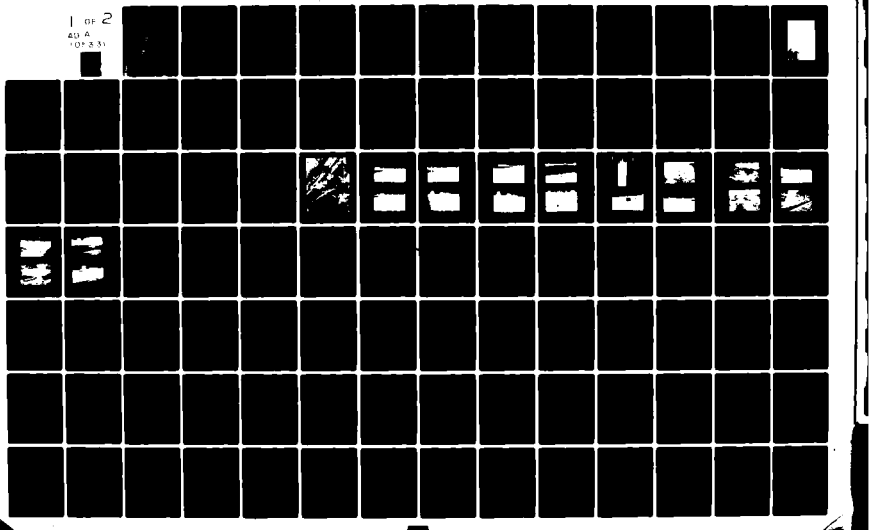

LEVEL II

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

BEAR CREEK WATERSHED STRUCTURE B-26

SCOTLAND COUNTY, MISSOURI

MO 10981

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

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

FOR: STATE OF MISSOURI

MAY, 1980

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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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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

National Dam Safety Program. Bear Creek Watershed Structure B-26 (MO 10981), Mississippi - Kaskaskia - St. Louis Basin Scotland County, Missouri. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

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

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

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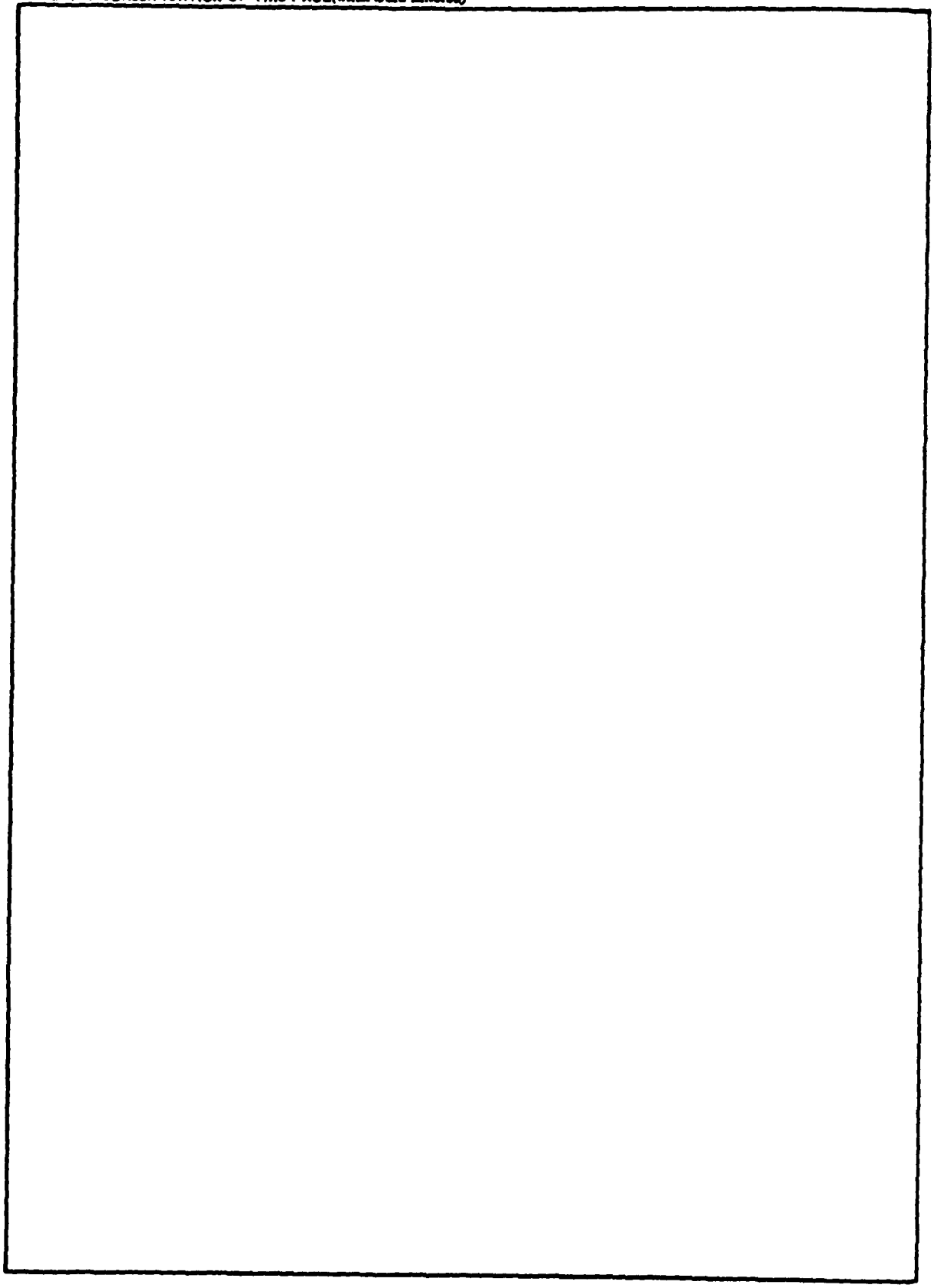

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BEAR CREEK WATERSHED STRUCTURE B-26
SCOTLAND COUNTY, MISSOURI
MISSOURI INVENTORY NO. 10981

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY, 1980

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

REPLY TO ATTENTION OF

SUBJECT: Bear Creek Watershed Structure B-26 Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Bear Creek Watershed Structure B-26 Phase I Inspection Report (MO 10981).

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

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

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

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

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

SUBMITTED BY: _____ _____
Chief, Engineering Division Date

APPROVED BY: _____ _____
Colonel, CE, District Engineer Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

APPENDIX A - MAPS

APPENDIX B - PHOTOGRAPHS

APPENDIX C - PROJECT PLATES

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Bear Creek Watershed Structure B-26
State Located	Missouri
County Located	Scotland County
Stream	Tributary to Bear Creek
Date of Inspection	May 5, 1980

Bear Creek Watershed Structure B-26 was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions 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.

Bear Creek Watershed Structure B-26 has a height of twenty-three and one-half (23.5) feet and a storage capacity at the minimum top elevation of the dam of two hundred and seventeen (217) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Bear Creek Watershed Structure B-26 is classified as small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends approximately one mile downstream of the dam. Within the damage zone are two house trailers, four or five commercial buildings located in the town of Gorin, a bridge crossing for a main line track of the Santa Fe Railroad, Highway A and Highway U.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the volume of water impounded and the downstream hazards, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways

will pass the 100-year flood (1% probability flood, a flood having a one percent change of being exceeded in any year) without overtopping the dam. The spillways will pass 40% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Design data were available from the Soil Conservation Service for this dam. Seepage and stability analyses presented in the Soil Conservation reports are considered adequate for this structure.

The following remedial measure is recommended and should be performed under the guidance of a professional engineer experienced in the design and construction of dams:

The emergency spillway size and/or the height of dam should be increased to pass 50% of the probable maximum flood without overtopping.

No other deficiencies were observed. The dam is maintained in excellent condition.

Rey S. Decker
E-3703

Gordon Jamison

Harold Ulmer
Garold Ulmer
E-19246

H. P. Hoskins
Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

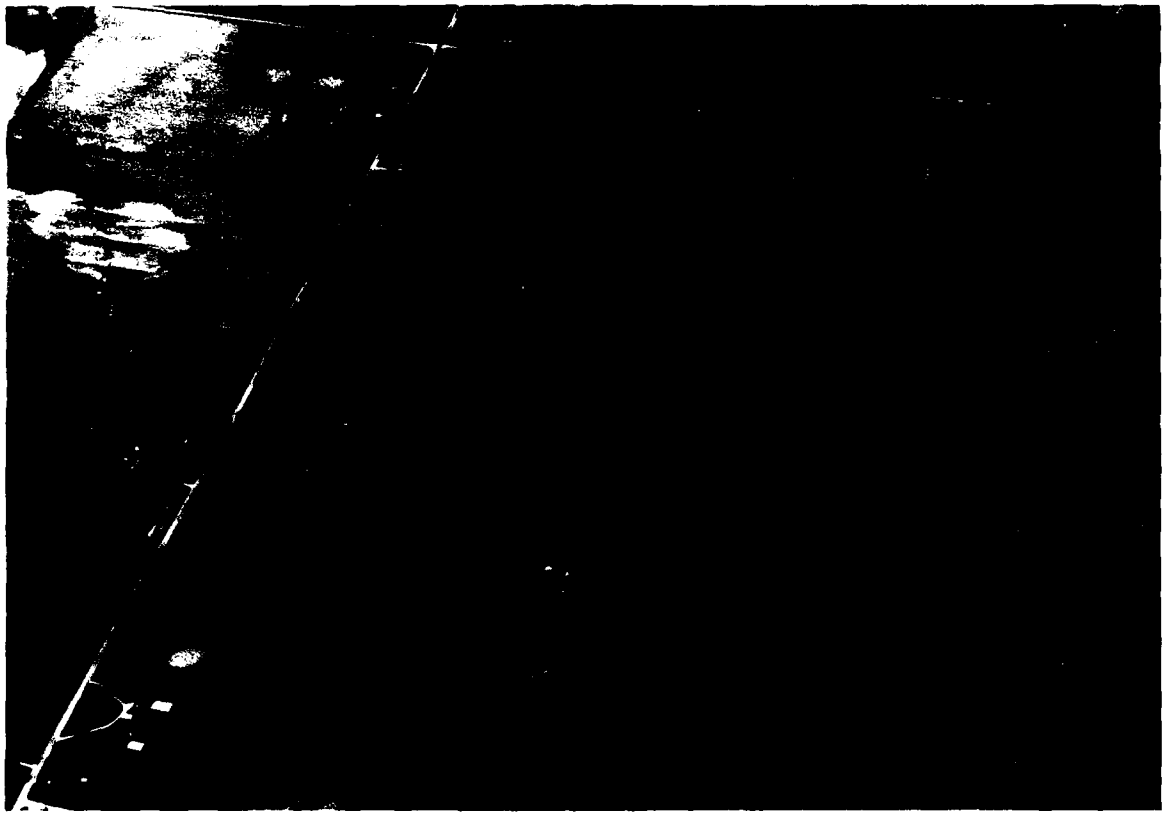


PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
BEAR CREEK WATERSHED STRUCTURE B-26-MO 10981
SCOTLAND COUNTY, MISSOURI

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 directed that a safety inspection of Bear Creek Watershed Structure B-26 be made.

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," Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth fill approximately 585 feet in length and 23.5 feet in height. The maximum water storage at the minimum top elevation of the dam is 217 acre-feet. It is located in rolling hills which are mantled with a thin cover of loessial soils and are underlain by fine grained glacial till.

(2) The principal spillway is uncontrolled and consists of a reinforced concrete drop inlet (riser) with a reinforced concrete pipe conduit which is 24 inches in diameter.

(3) An uncontrolled vegetated earth emergency spillway is cut through the glacial till abutment on the left end of the dam.

(4) A 16-inch diameter reinforced concrete drawdown pipe enters the base of the riser. The drawdown facility is controlled by a rising stem slide gate.

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

b. Location. The dam is located in the southeast portion of Scotland County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the S 1/2 of Section 17, T64N, R10W. The lake formed behind the dam is shown in the S 1/2 of Section 17, T64N, R10W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Bear Creek Watershed Structure B-26 has a height of 23.5 feet and a storage capacity at the minimum top elevation of the dam of 217 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines and visual observation, this dam is in the High Hazard Classification. The estimated damage zone extends about one mile downstream from the dam. Within the damage zone are two house trailers, 4 or 5 commercial buildings located in the town of Gorin, a bridge crossing for a main line track of the Santa Fe Railroad, Highway A and Highway U.

e. Ownership. The dam is owned by the Soil and Water Conservation Districts of Clark and Scotland Counties, Memphis, Missouri 63555 and by Amus Z. Martin, R.R. No. 1, Gorin, Missouri 63543.

f. Purpose of Dam. The dam was constructed for flood prevention and grade stabilization.

g. Design and Construction History. The damsite was investigated and designed by the Soil Conservation Service, Columbia, Missouri in 1975-76 and was constructed in 1977. The SCS provided technical assistance for supervision and inspection during construction of the dam and appurtenances. Portions of the SCS geologic and soil mechanics reports and the construction plans are included with this report as Appendix C.

h. Normal Operating Procedure. There are no established operating procedures for this dam. However, Mr. Martin reported that he opens the drawdown facility whenever the reservoir level exceeds about elevation 109 (present lake level).

1.3 PERTINENT DATA

a. Drainage Area. 240 acres (0.375 square miles.)

b. Discharge At Damsite.

(1) All discharges at the damsite are through an uncontrolled reinforced concrete drop inlet (riser) and an uncontrolled vegetated earth spillway cut through the left abutment.

(2) Estimated maximum flood - unknown

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 114.0 feet to 63 c.f.s. at the crest of the emergency spillway (elevation 116.7 feet) to 68 c.f.s. at elevation 120.0 feet (minimum top of dam).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 116.7 feet to 485 c.f.s. at elevation 120.0 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 553 c.f.s. ±.

c. Elevations. (Assumed)

(1) Top of dam - 120.5 (minimum on right end = 120.0)
(2) Principal spillway crest - 114.0
(3) Emergency spillway crest - 116.7
(4) Observed and normal pool - 109.0
(5) Maximum experienced pool - 111.0±
(6) Streambed at centerline - 97.0±
(7) Maximum tailwater - 99.0

d. Reservoir. Length (feet) of pool.

(1) Principal spillway - 2,250±
(2) Emergency spillway - 2,360±
(3) Top of dam (minimum) - 2,700±

e. Storage (Acre-feet).

(1) Top of dam - 217±
(2) Emergency spillway crest - 146±
(3) Principal spillway crest - 99±
(4) Observed 2nd normal pool - 43±
(5) Maximum experienced pool - 62±

f. Reservoir Surface (Acres).

(1) Top of dam - 25±
(2) Emergency spillway crest - 18.4
(3) Principal spillway crest - 14.1

g. Dam.

(1) Type - Rolled earth fill
(2) Length - 585 feet±
(3) Height - 23.5 feet±
(4) Top width - 12 feet
(5) Side slopes.
  (a) Downstream 1v on 2.5H (Plans) 1v on 2.75H (measured)
  (b) Upstream - 1v on 2.5H with berm 10 feet in width at elevation 114.0
(6) Zoning - Homogeneous earth fill.
(7) Impervious core - None, homogeneous section.
(8) Cutoff - 4 to 12 feet deep, 12 foot bottom width, side slopes 1v on 1H.
(9) Grout curtain - none
(10) Wave protection - Vegetated upstream slope with a sacrificial earth berm at elevation 114. The berm is 10 feet wide and is well vegetated.

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal (uncontrolled)

  (a) Type. Reinforced concrete drop inlet (riser) 2 feet wide x 6 feet long with weir length of 12 feet. The outlet conduit is 24-inch diameter reinforced concrete pipe.

  (b) Crest (invert) elevation - 114.0
  Invert conduit entrance elevation - 101.0
  Invert conduit outlet elevation - 99.0

  (c) Length (conduit) = 96 feet

(2) Emergency

  (a) Type - Vegetated earth, uncontrolled, cut through left abutment, bottom width - 30 feet, side slopes = 1v on 3H.

  (b) Control section - Vegetated earth, level section 30 feet in length, 30 foot bottom width, side slopes 1v on 3H.

  (c) Crest elevation - 116.7 feet

(d) Upstream Channel - 100 feet long, 30 foot bottom width, slopes 2%.

(e) Downstream Channel (exit channel) 150 feet ± long, 30 foot bottom width, slope = 6% ±.

j. Regulating Outlets. Reinforced concrete pipe. 16-inch diameter, 40 feet in length with 14-inch diameter slide gate.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data for this dam were supplied by the Soil Conservation Service (SCS) and are included with this report as Appendix C.

2.2 CONSTRUCTION

The SCS provided technical supervision, inspection and quality control for construction of this dam.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. Martin that neither the principal nor the emergency spillway has operated since the dam was constructed. Mr. Martin maintains the reservoir level at about elevation 109, some 5 feet below the principal spillway crest. When reservoir levels exceed elevation 109 ±, Mr. Martin operates the drawdown facility.

2.4 EVALUATION

a. Availability. The data included as Appendix C were readily available from the SCS.

b. Adequacy. The data available are considered adequate to support the conclusions of this report. Seepage and stability analyses presented in the SCS reports shown in Appendix C are considered adequate for this structure.

c. Validity. The data and analyses are considered valid and adequate.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Bear Creek Watershed Structure B-26 was made on May 5, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey S. Decker, Geotechnical; Gordon Jamison and Garold Ulmer, Hydrology and Hydraulics. Mr. Martin accompanied the inspection party.

b. Dam.

(1) Geology & Soils (abutment & embankment). Upland soils in the watershed consist of a thin mantle of loess (CL-ML) underlain by glacial till (CL or CH). Abutments at the site consist of 3 to 4 feet of loessial material underlain by fine grained glacial till. The valley bottom consists of 8 to 10 feet of CL-ML alluvium, derived from loess and underlain by glacial till (CL-CH). Photo No. 12 shows an outcrop of glacial till in the upstream left abutment. Bedrock in the area occurs at depths of 20 to 30 feet and probably consists of interlayered sequences of shale, sandstone, limestone, underclays, and thin coal seams. Materials in the embankment consist of lean to fat clay (CL-CH) taken from the abutments and toe slope areas along the valley bottom.

(2) The upstream slope and berm are very well vegetated with adapted grasses. There was no indication of erosion along the water line. There are no trees or shrubs on the slope. There were no indications of cracks, abnormal deformations or rodent activity. Measurements indicate that the upstream slopes were constructed according to the plans shown in Appendix C. Photo Nos. 4 & 11 show the upstream slope and berm.

(3) Crest. The crest is exceptionally uniform in profile and width. Measurements indicate that the crest elevation is essentially as constructed, which, according to the plans includes about 1 foot of overfill to compensate for settlement. Very little settlement has occurred. The crest is well vegetated with adapted grasses. There were no indications of cracks, slumps or other deformations. Photo No. 2 shows the crest.

(4) Downstream slope. The downstream slope is well vegetated with adapted grasses. There were no indications of slides, sinks, abnormal deformations nor rodent activity. There

were no signs of seepage on the slope or at the toe of the dam. There are no trees or shrubs on the slope. Measurements indicate that the downstream slope conforms to the plans. Photo No. 3 shows the downstream slope.

(5) Miscellaneous. The vegetative cover on the dam is in excellent condition. Mr. Martin controls the vegetation by periodic grazing and occasional mowing. The excellent vegetative cover and the erosion resistant nature of the soils in the embankment indicate that this dam could withstand significant overtopping without serious damage.

c. Appurtenant Structures.

(1) The Principal Spillway. Measurements indicate that the principal spillway was constructed according to the plans. There were no signs of spalling, scaling or deterioration of the concrete in the riser or the exposed conduit at the outlet end. There was no deterioration of the trash rack. There were no signs of logs or trash around the inlet at the structure. According to Mr. Martin, there has never been water over the principal spillway crest. The highest reservoir level was about 111 feet, some three feet below the crest of the riser. Photos 8, 10 and 11 show the inlet of the principal spillway. Photos 9 and 14 show the outlet of the conduit.

(2) The Emergency Spillway. The emergency spillway has an excellent cover of adapted grasses. There are no trees or trash in the spillway. Measurements indicate that the emergency spillway was constructed according to the plans. This spillway has not operated. There are no signs of erosion, sinks or slides in the channel or banks. Photos 5, 6 and 7 show the emergency spillway.

(3) Drawdown Facility. The drawdown facility consists of a 16-inch reinforced concrete pipe with a 14-inch slide gate located on the upstream side of the principal spillway riser. This facility is in good condition and is operated whenever the reservoir level rises above elevation 109 +. Photo No. 10 shows the valve and rising stem for the drawdown works.

d. Reservoir Area. There is no significant erosion around the shoreline. The shoreline appears to be clear of trees, brush and trash. There was no indication of trash or rubbish anywhere around the dam. The reservoir elevation was 109 feet, 5 feet below the crest of the principal spillway, at the time of inspection. Photo No. 8 shows the reservoir area.

e. Downstream Channel. There is no significant erosion in the scour hole at the outlet of the principal spillway as shown in Photo No. 15. The channel is overgrown with trees and brush for about one-half mile downstream from the dam. This is shown in photos 9 and 16. As the channel approaches the town of Gorin, it is fairly open and clean as shown in Photos 17, 18, 19, 20 and 21.

3.2 EVALUATION

This structure appears to be in excellent condition with no likely potential of failure. It would also appear that the dam could withstand the overtopping that might result from one-half of the Probable Maximum Flood (0.4 feet for 1.0+ hours) without failure or serious damage.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways for this dam are uncontrolled. The pool level is designed to be controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways. However, Mr. Martin presently controls the pool level at about elevation 109 by operating the drawdown facilities.

4.2 MAINTENANCE OF DAM

Maintenance of the structure appears to be excellent. Mr. Martin controls the vegetative growth on the dam and in the emergency spillway by periodic grazing and occasional mowing. He has enclosed his portion of the pool area with electric fences to prevent grazing along the shoreline.

4.3 MAINTENANCE OF OPERATING FACILITIES

The drawdown facilities for this dam are operated by Mr. Martin whenever the reservoir level gets above elevation 109 feet.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The excellent condition of this dam is in great part due to the maintenance performed by Mr. Martin. The control of the water level in the reservoir by operation of the drawdown facilities is good procedure and should be continued.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Detailed plans for the structure were furnished by the SCS. Pertinent hydraulic and hydrologic data which were taken from as-built plans furnished by the SCS are tabulated in Sections 1, 1.3 and in Appendix D as hydrologic computations. The supporting computations are attached.

b. Experience Data. The drainage area, reservoir water surface areas, and elevation-storage data were taken from the SCS as-built plans. The hydraulic computations for the spillway discharge ratings were based on data taken from the as-built plans. The hydraulic computations for the dam overtopping rating were based on data collected during the field inspection in order to reflect settled conditions.

c. Visual Observations.

(1) Principal and emergency spillways are in excellent condition.

(2) The emergency spillway and exit channel are in the left abutment away from the dam. Spillway releases will not endanger the integrity of the dam.

(3) Mr. Martin reported that neither the principal nor the emergency spillways have operated since the dam was constructed.

(4) The observed pool elevation at the time of inspection was at elevation 109 feet and it was reported by Mr. Martin that he maintains the pool at about the observed pool by operating the drawdown facility.

d. Overtopping Potential. The spillways are too small to pass one-half of the Probable Maximum Flood (PMF) without overtopping the dam. The existing spillways will pass 40% of the PMF and the 1 percent probability flood without overtopping the dam. It should be noted that due to the operating procedure by Mr. Martin, routing of the PMF at the normal operating pool elevation would result in passing a higher percentage of the PMF. Due to the nature of the materials in this dam and the excellent vegetative cover, significant overtopping should cause little damage to this dam. The results of the routings through the dam are tabulated in regards to the following conditions.

Frequency	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation	Maximum Depth Over * Dam	Duration Over Top Hrs.
1/2 PMF	1,400	780	120.4	0.4	1+
PMF	2,800	2,670	121.3	1.3	4-
0.40 PMF	1,100	500	119.7	-0.3	0

*Minimum top of dam elevation - 120.0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the 1/2 PMF to PMF is the test for the adequacy of the dam and its spillways.

The estimated damage zone is described in Paragraph 1.2d in this report. Photos 17 through 21 show the conditions in the damage zone.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. This dam appears to be structurally stable. There is no evidence of slips, slides, deformations nor seepage.

b. Design and Construction Data. Design data and "As Built" plans were available from the Soil Conservation Service and are included as *Appendix C of this report.* Seepage and stability analyses presented in the SCS reports are considered adequate for this structure.

c. Operating Records. The 16-inch reinforced concrete pipe drawdown facility is manually controlled by opening and closing a 14-inch slide gate. Mr. Martin controls the level of the lake by operation of the slide gate.

d. Post Construction Changes. There have been no post construction changes for this structure.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The dam appears to be in excellent condition with no likely potential of failure. The flood from one-half the Probable Maximum Flood will overtop the dam by 0.4 feet for a period of 1+ hours. The effects of such overtopping are not known, but it would appear, based on the materials in the dam and the excellent vegetative cover, that such overtopping would not cause failure or serious damage.

b. Adequacy of Information. The design data and the "As Built" plans furnished by the SCS and included as Appendix C of this report and the visual observations made during the inspection are considered adequate to support the conclusions and recommendations presented in this report. Seepage and stability analyses presented in the SCS reports are considered adequate for this structure.

c. Urgency. There does not appear to be an immediate urgency to accomplish the remedial measure recommended in paragraph 7.2a.

d. Necessity for Further Investigations. Prior to any action being taken on the remedial measure recommended in paragraph 7.2a, the owner should conduct a breach routing of the dam to determine the downstream effects of the failure of the dam.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) The emergency spillway size and/or the height of dam should be increased to pass 50% of the Probable Maximum Flood without overtopping.

(2) An engineer experienced in the design and construction of earth dams should be retained to design the above corrective measure.

b. Operation and Maintenance Procedures.

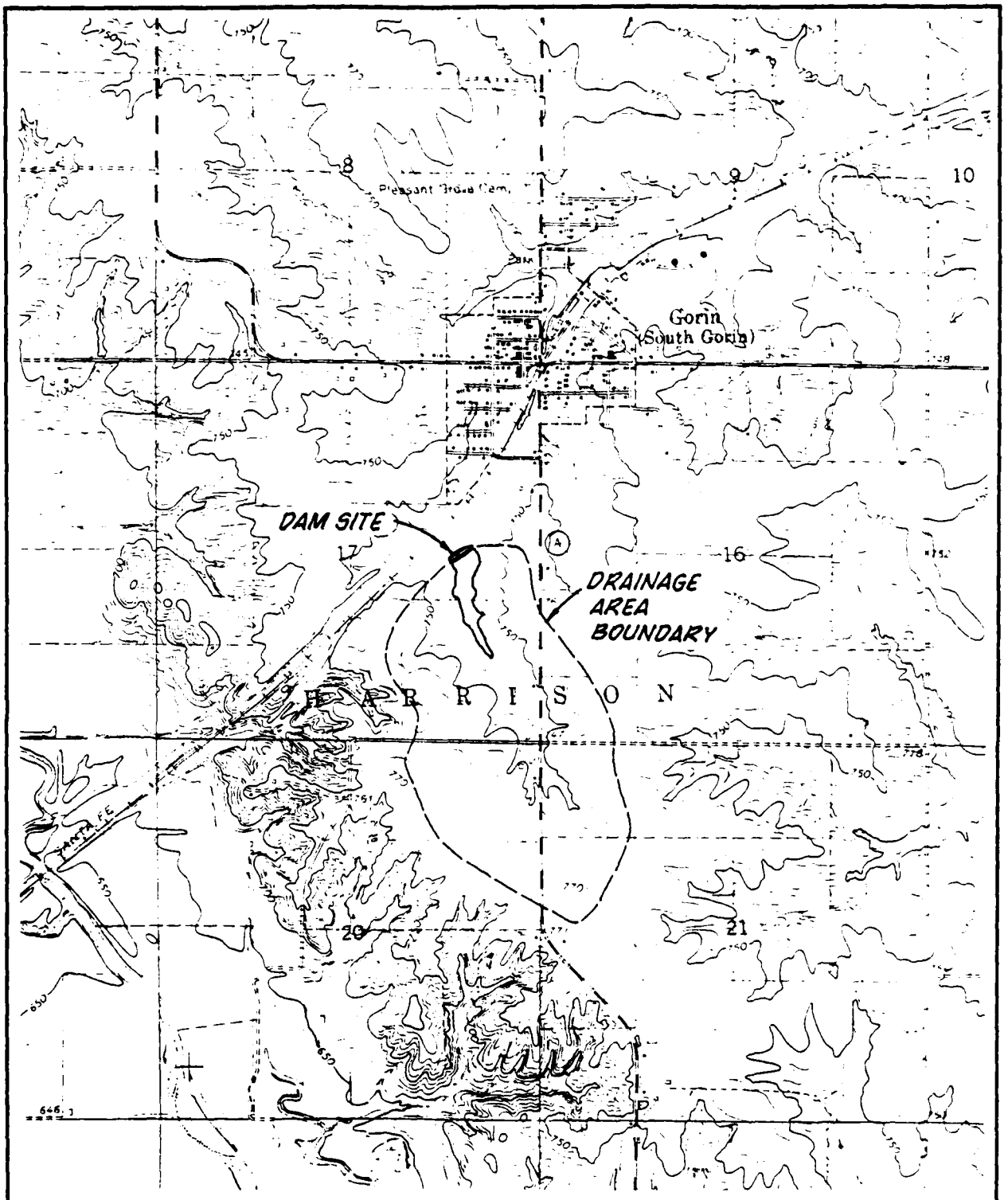
(1) The operation and maintenance procedures being performed by Mr. Martin at the present time; namely, controlled grazing, mowing, and regulation of the water level behind

the dam, should be continued. Mr. Martin's pride in this structure is evidenced by the overall good appearance of the dam and reservoir.

(2) In addition to the operation and maintenance procedures already being performed, tree and brush growth should be discouraged from occurring on the embankments and the crest of the dam as well as in the emergency spillway and the exit channel from the principal spillway. Rodents, which are not a problem at the present time, should also be discouraged.

(3) Periodic inspections of the dam should be made. Since neither spillway has operated since the dam was constructed, an inspection should be made shortly, after spillway operation has occurred.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

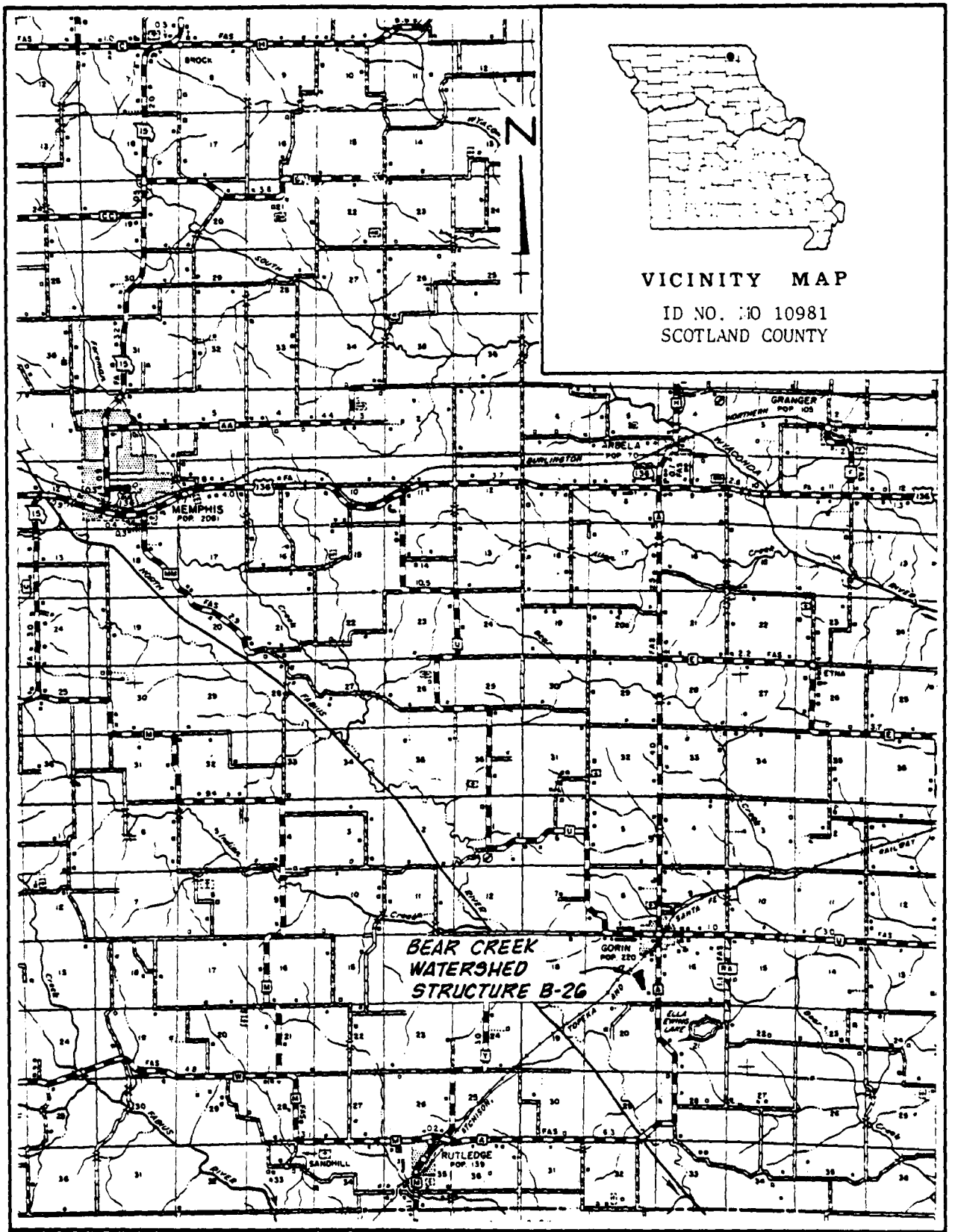
Contour Interval – 10 Feet

N

VICINITY TOPOGRAPHY

BEAR CREEK WATERSHED STRUCTURE B-26
SCOTLAND COUNTY, MISSOURI
MO 10981

PLATE A-1


N
VICINITY MAP
ID NO. MO 10981
SCOTLAND COUNTY
BROCK
MEMPHIS
POP 2081
GRANGER
POP 105
ARBELA
POP 70
GORIN
POP 220
RUTLEDGE
POP 139
SANDHILL
ETNA
SANTA FE
BEAR CREEK
WATERSHED
STRUCTURE B-26
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

BEAR CREEK WATERSHED STRUCTURE B-26
SCOTLAND COUNTY, MISSOURI
MO 10981

PHOTO INDEX

PLATE B-1

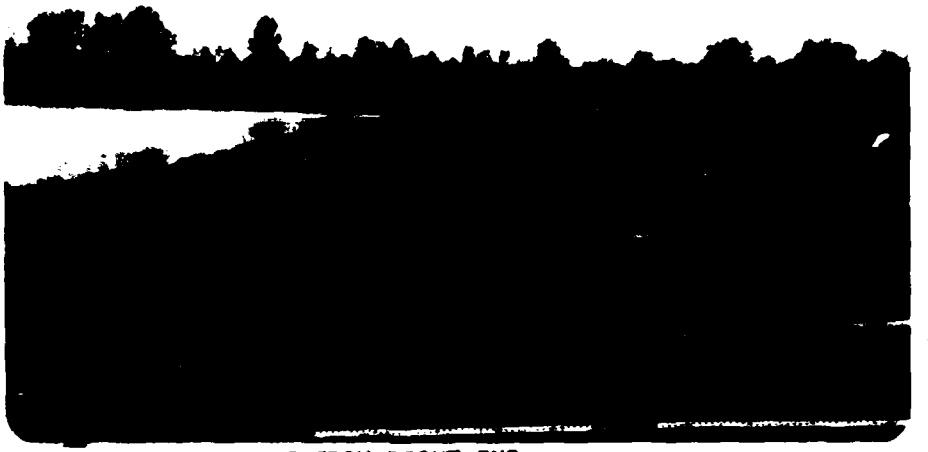


PHOTO NO. 2 - CREST FROM RIGHT END.

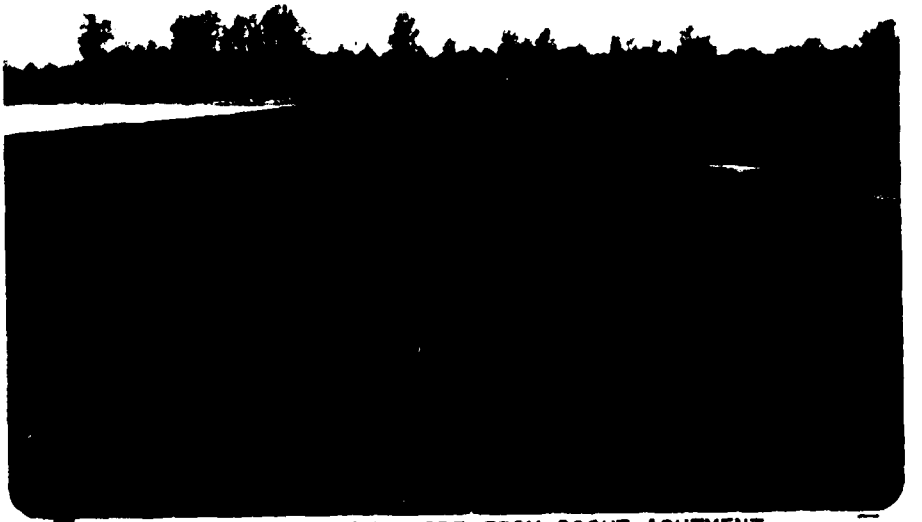


PHOTO NO. 3 - DOWNSTREAM SLOPE FROM RIGHT ABUTMENT.

PHOTO NO. 4 - UPSTREAM SLOPE FROM RIGHT ABUTMENT

PHOTO NO. 5 - LOOKING DOWN THE OUTLET EXIT CHANNEL OF THE EMERGENCY SPILLWAY. SPILLWAY CUT THROUGH LEFT ABUTMENT.

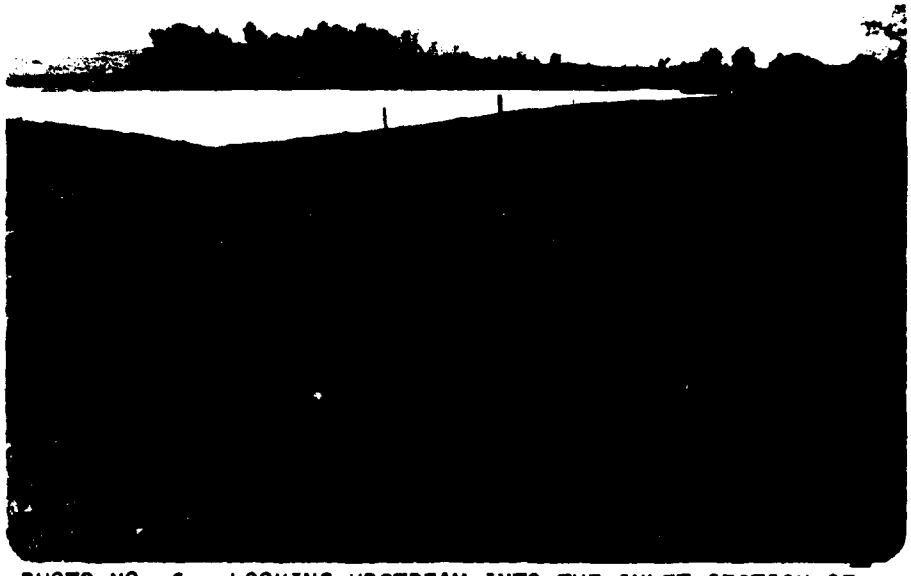


PHOTO NO. 6 - LOOKING UPSTREAM INTO THE INLET SECTION OF THE EMERGENCY SPILLWAY..

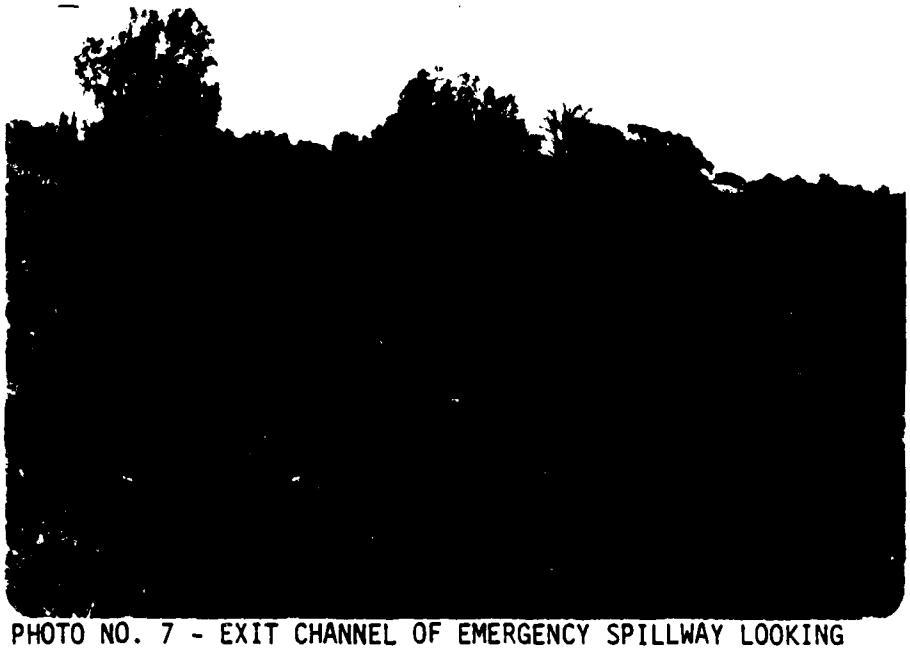


PHOTO NO. 7 - EXIT CHANNEL OF EMERGENCY SPILLWAY LOOKING DOWNSTREAM.

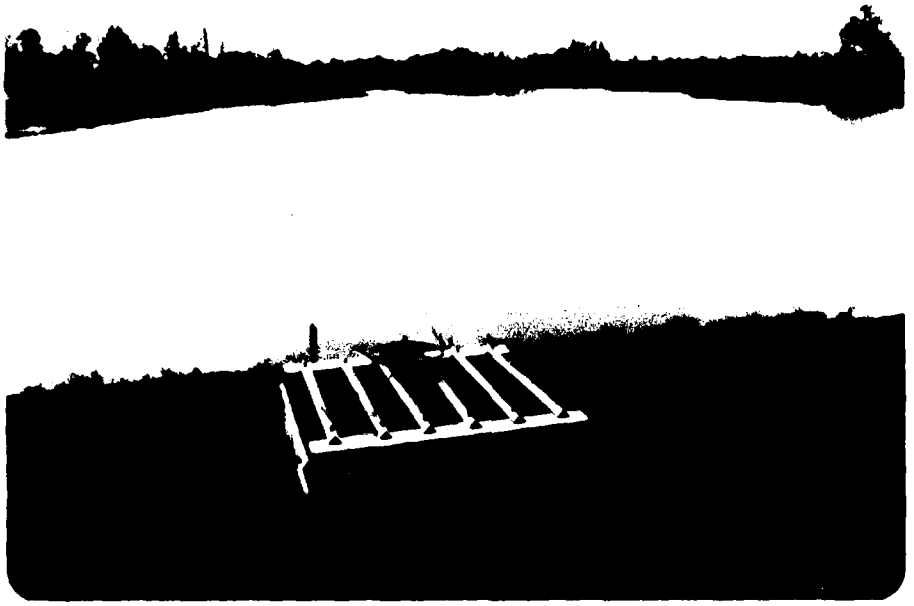


PHOTO NO. 8 - PRINCIPAL SPILLWAY INLET.

PHOTO NO. 9 - OUTLET END OF PRINCIPAL SPILLWAY AND OUTLET CHANNEL TAKEN FROM CREST.

PHOTO NO. 10 - WEIR AND RISING STEM OF SLIDE GATE. PRINCIPAL SPILLWAY INLET.

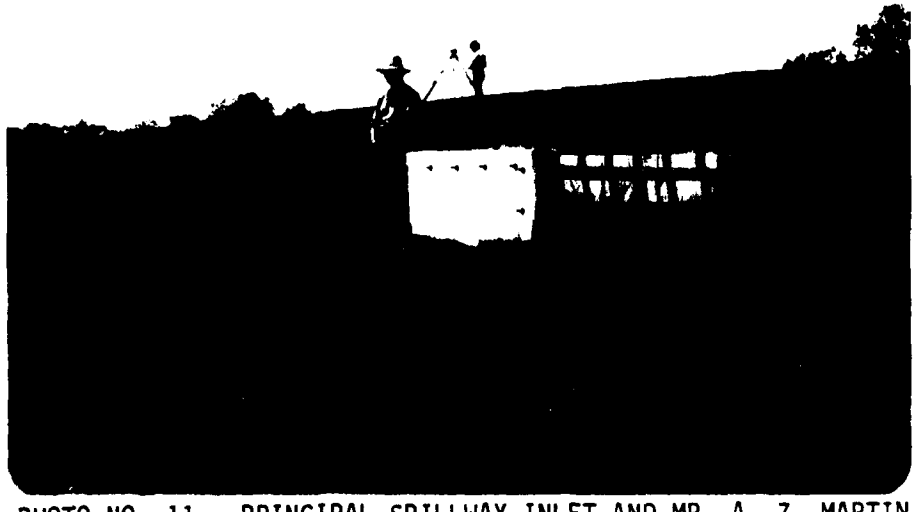


PHOTO NO. 11 - PRINCIPAL SPILLWAY INLET AND MR. A. Z. MARTIN, OWNER OF PROPERTY.

PHOTO NO. 12 - CL - CH GLACIAL TILL EXPOSED IN LEFT ABUTMENT UPSTREAM FROM DAM.

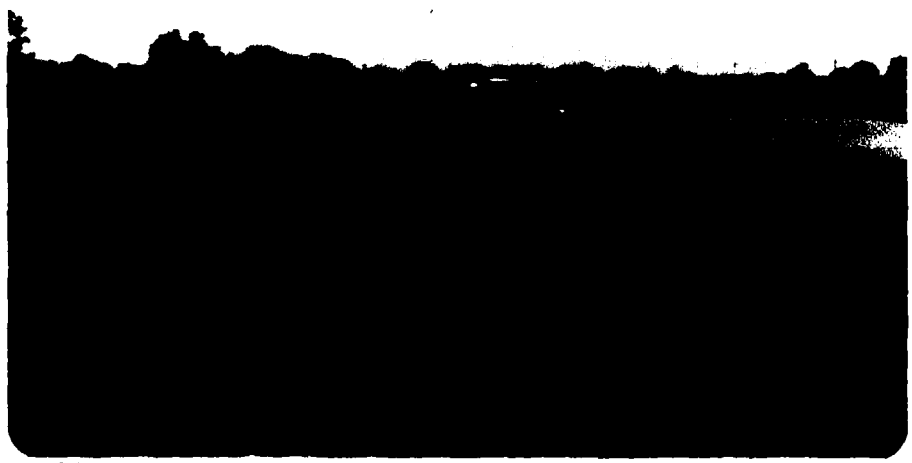


PHOTO NO. 13 - OVERVIEW FROM LEFT ABUTMENT.

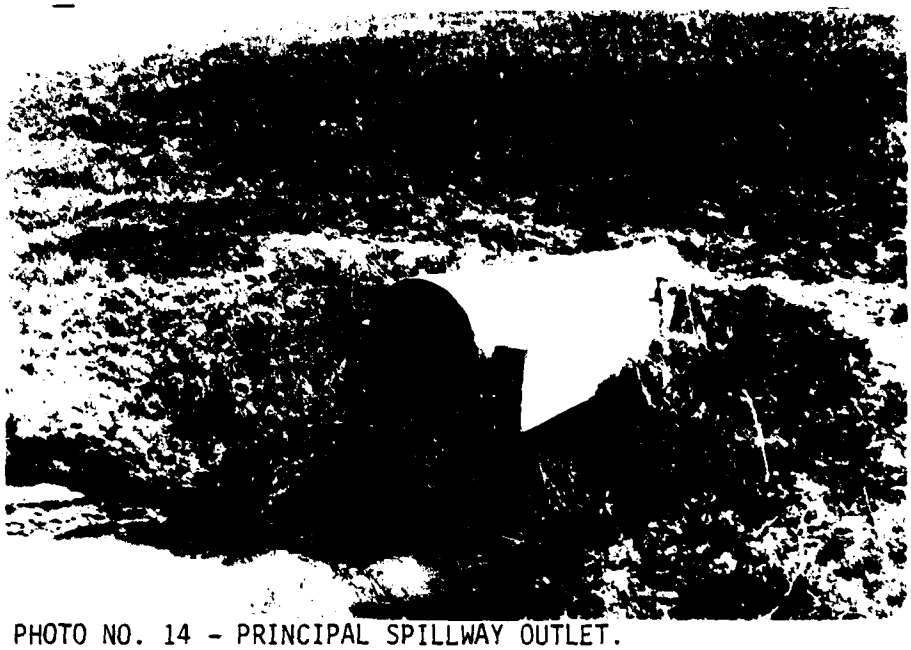


PHOTO NO. 14 - PRINCIPAL SPILLWAY OUTLET.

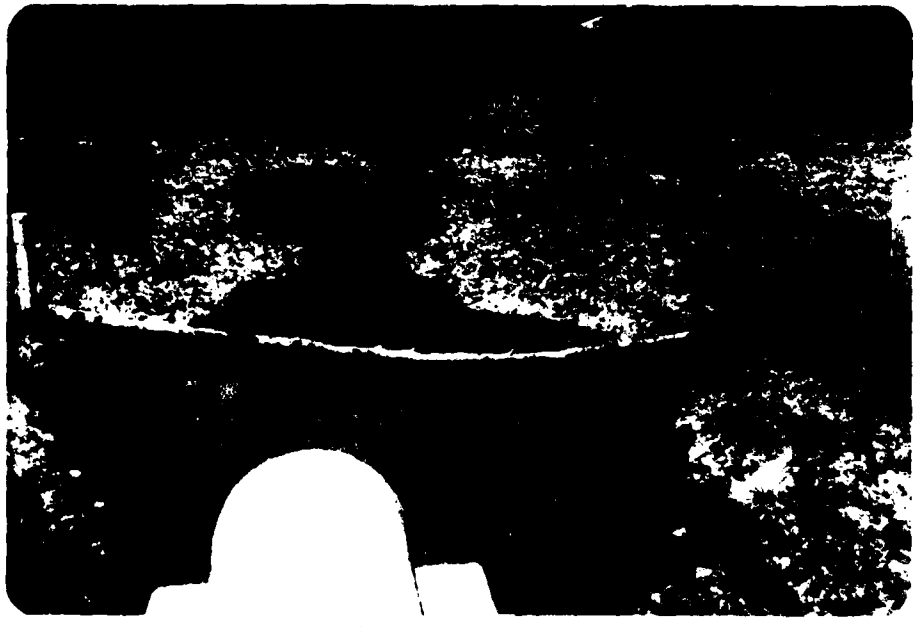


PHOTO NO. 15 - PRINCIPAL SPILLWAY OUTLET CHANNEL.
STORAGE SHED ON RIGHT.

PHOTO NO. 16 - LOOKING DOWNSTREAM AT CREEK. TOWN OF GORIN IN BACKGROUND.

PHOTO NO. 17 - COMMERCIAL BUILDINGS IN GORIN DOWNSTREAM FROM RAILROAD BRIDGE.

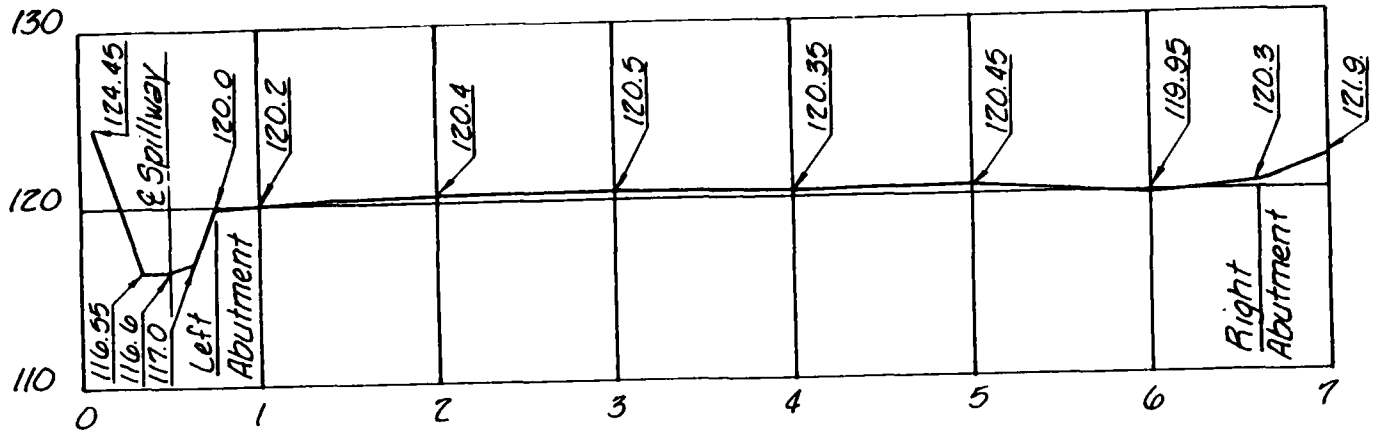
PHOTO NO. 18 - TWO MOBILE HOMES ON RIGHT SIDE OF CREEK UPSTREAM FROM RAILROAD BRIDGE.

PHOTO NO. 19 - RAILROAD BRIDGE WITH COMMERCIAL BUILDINGS IN BACKGROUND.

PHOTO NO. 20 - VIEW LOOKING NORTHEAST FROM INTERSECTION OF HIGHWAY U AND HIGHWAY A. BRIDGE IN CENTER CROSSES DRAINAGEWAY FROM DAM.

PHOTO NO. 21 - VIEW UPSTREAM FROM BRIDGE SHOWN IN PHOTO NO. 20. BOX CULVERT AT LEFT IN PICTURE CARRIES WATER UNDER INTERSECTION OF HIGHWAYS U AND A.

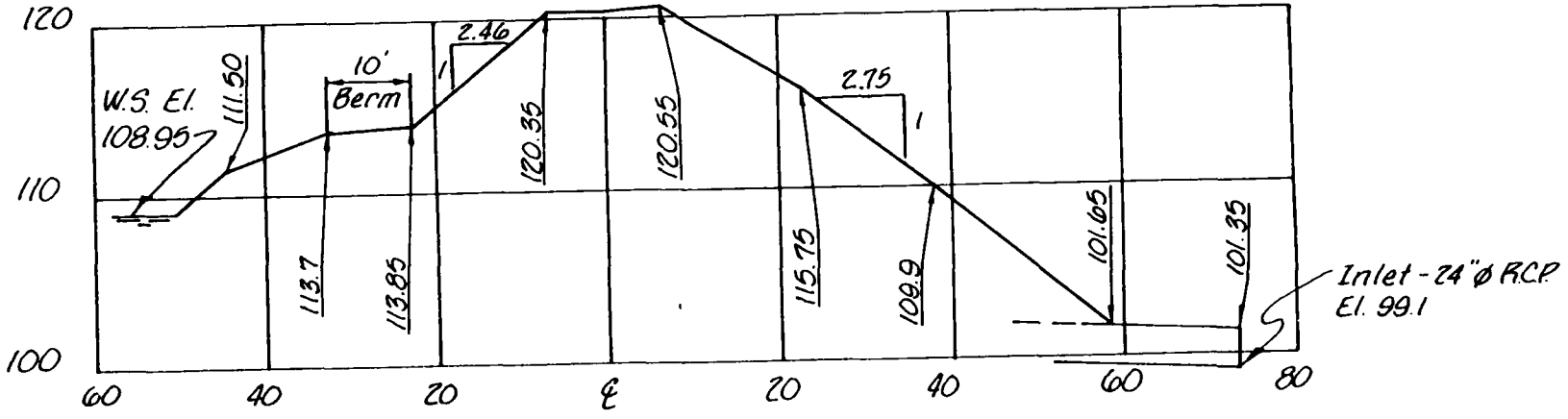
APPENDIX C
PROJECT PLATES



CENTERLINE PROFILE ALONG TOP OF DAM

(As Measured by Inspection Team)

Scale: 1"=100'H; 1"=10'V.

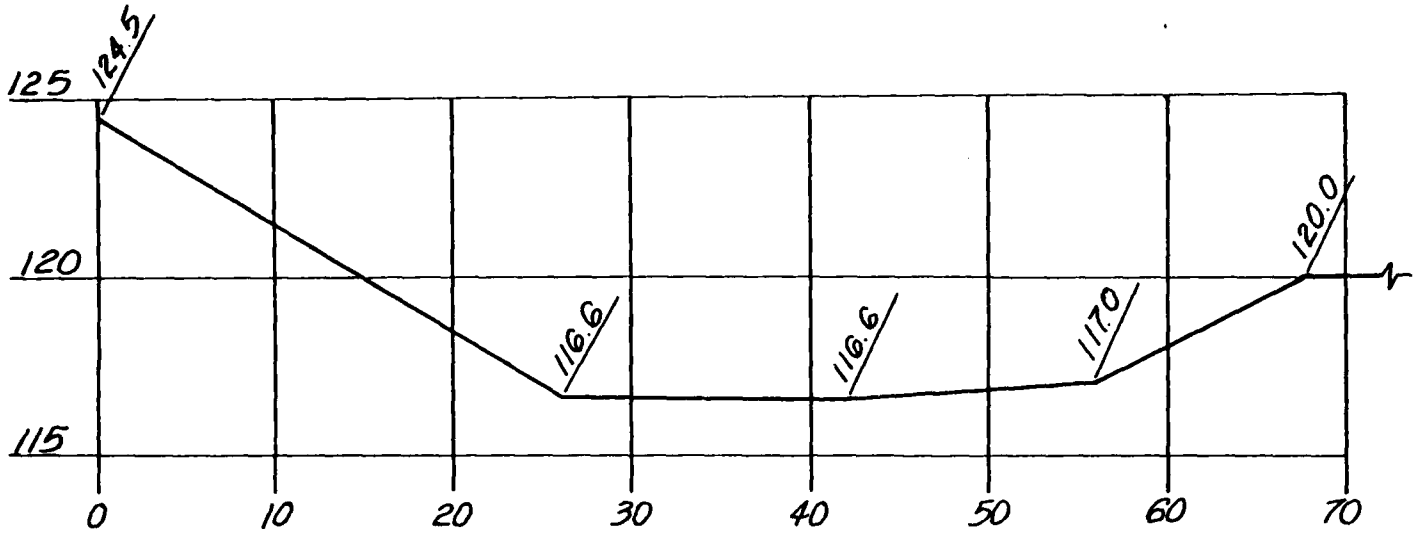


MAXIMUM CROSS-SECTION AT STA. 4+00

(As Measured by Inspection Team)

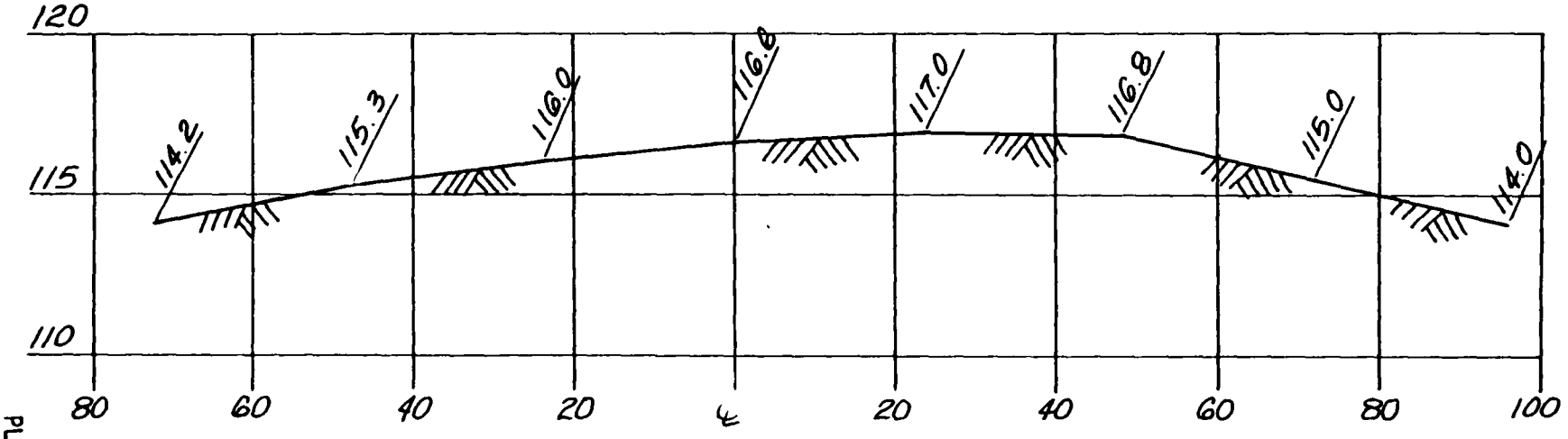
Scale: 1"=20'H; 1"=10'V.

PLATE C-1



SECTION OF SPILLWAY AT
CENTERLINE OF DAM

Scale: 1" = 10' H.
1" = 5' V.



PROFILE ALONG EMERGENCY SPILLWAY CENTERLINE

Scale: 1" = 20' H.
1" = 5' V.

PLATE C-2

INDEX OF DRAWINGS	
TITLE	SHEET NO
Cover Sheet	1
General Plan of Basement	2
Plan of Embankment & Spillways	3
General Layout Sheet	4
Cantilever Outlet Details	5
Intake & Gate Details	6
RC Notes Details	7, 8, 9, 10, 12
Trash Rack Details	11
Fence Details	14
Plan Geologic Investigation	15
Profile Geologic Investigation	16
Cross Sections, Geologic Investigation	13

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAIL PLANS FOR
BEAR CREEK WATERSHED PROTECTION AND FLOOD PREVENTION PROJECT

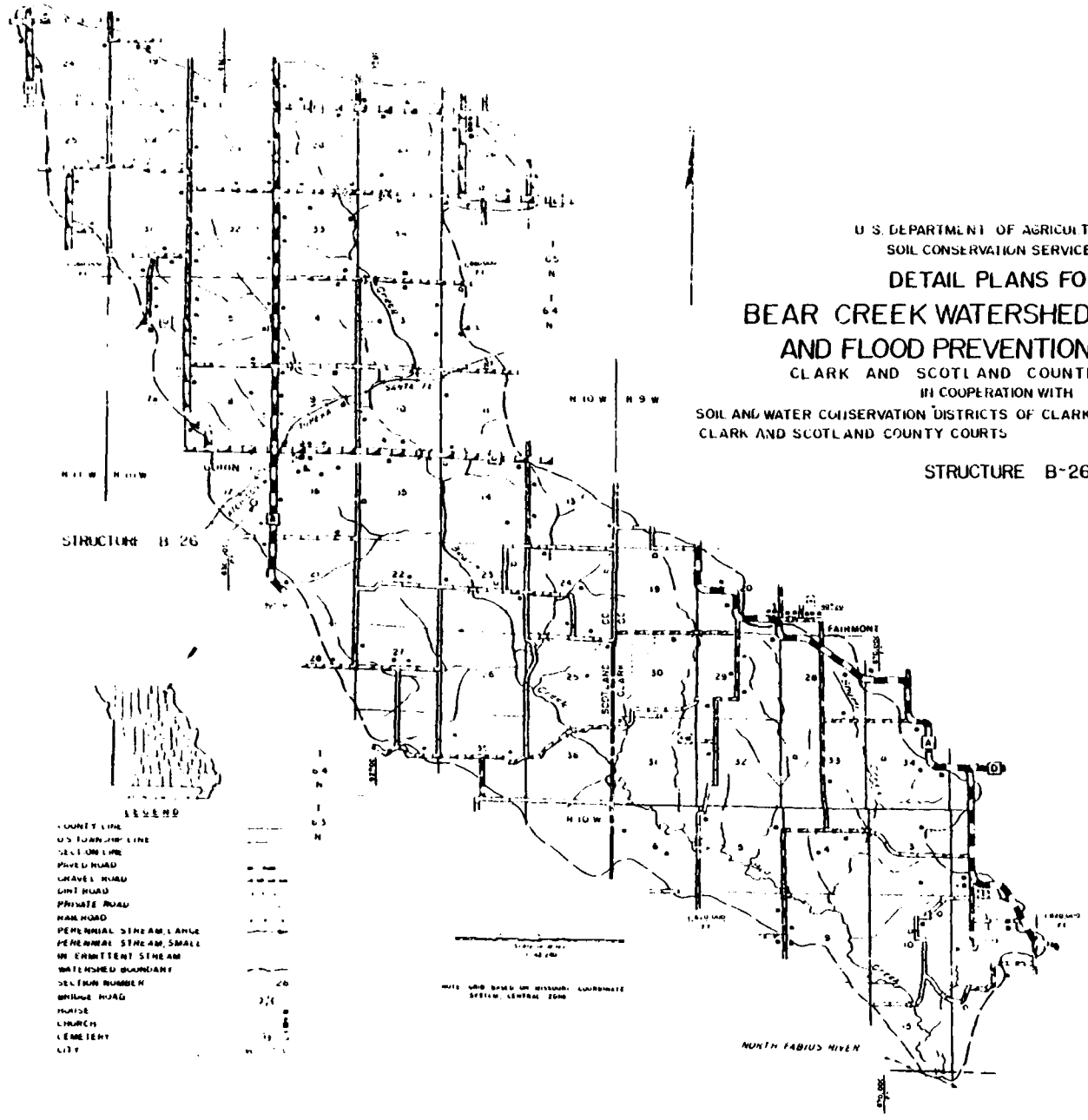
CLARK AND SCOTLAND COUNTIES, MISSOURI

IN COOPERATION WITH

SOIL AND WATER CONSERVATION DISTRICTS OF CLARK AND SCOTLAND COUNTIES
CLARK AND SCOTLAND COUNTY COURTS

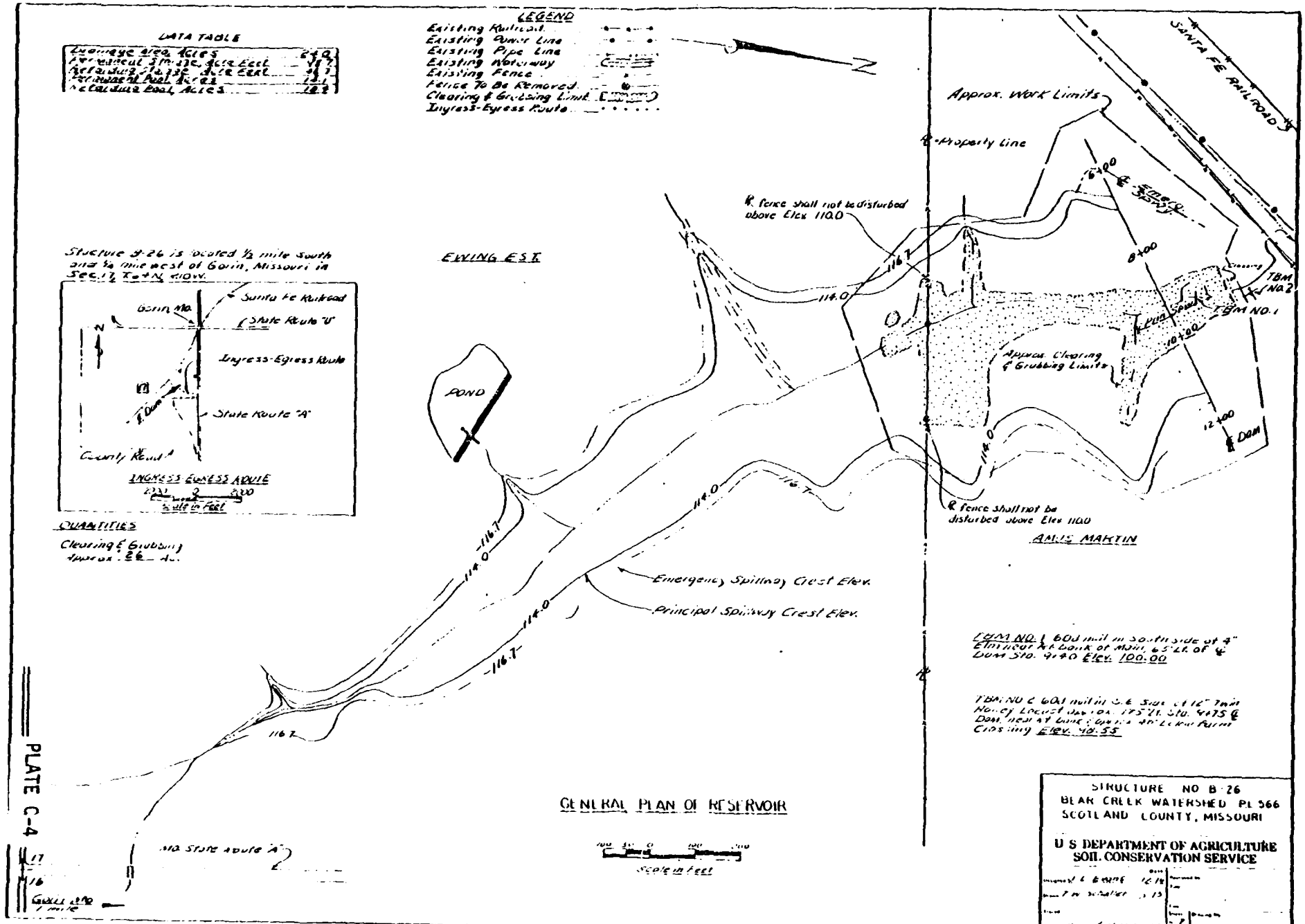
STRUCTURE B-26

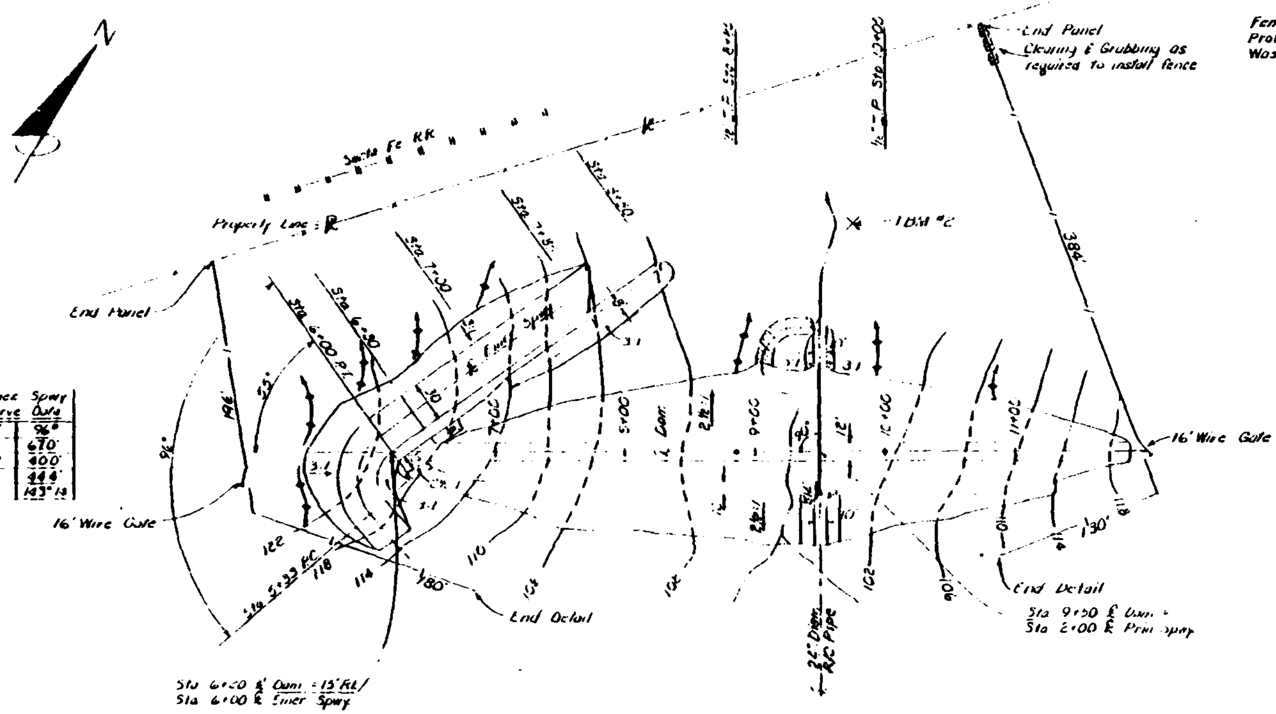
As Built 11-23-77



Hal H. Randall
DATE 7-28-76

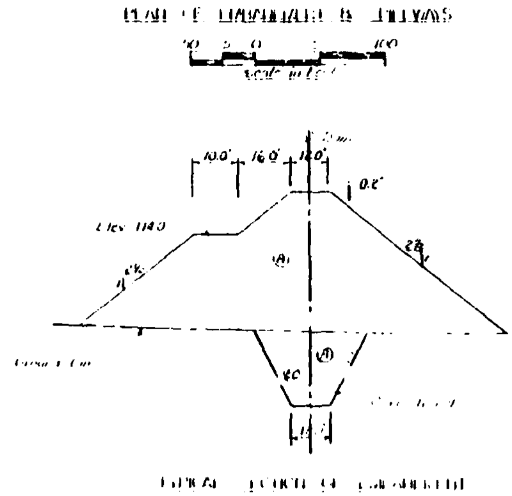
PLATE C-3


DATA TABLE
Drainage area, Acres 640
Permanent Storage, Acre Feet 19.7
Retarding Storage, Acre Feet 43.7
Permanent Pool, Acres 13.1
Reservoir Pool, Acres 18.2
LEGEND
Existing Railroad
Existing Power Line
Existing Pipe Line
Existing Waterway
Existing Fence
Fence To Be Removed
Clearing & Grubbing Limit
Ingress-Egress Route
Approx. Work Limits
Property Line
SANTA FE RAILROAD
R fence shall not be disturbed above Elev. 110.0
EWING EST.
POND
Emergency Spillway Crest Elev.
Principal Spillway Crest Elev.
Approx. Clearing & Grubbing Limits
TBM NO. 1
TBM NO. 2
DAM
AMIS MARTIN
Structure #-26 is located ½ mile South and ¼ mile west of Gorin, Missouri in Sec. 17, T 64 N, R 10 W.
Gorin, Mo.
Santa Fe Railroad
State Route "U"
Ingress-Egress Route
State Route "A"
County Road
INGRESS EGRESS ROUTE
Scale in Feet
QUANTITIES
Clearing & Grubbing
Approx. 26 Ac.
PLATE C-4
GENERAL PLAN OF RESERVOIR
Scale in Feet
STRUCTURE NO B-26
BEAR CREEK WATERSHED PL 566
SCOTLAND COUNTY, MISSOURI
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



Emer Spwy Curve	Data
I	96°
L	670'
R	400'
T	444'
D	143°19'

PLAN OF EMBANKMENT & SPILLWAYS



TYPICAL SECTION OF EMBANKMENT

LEGEND

Fence to be Constructed
Protective Dike
Waste Area

NOTES

Protective Dikes
Protective dike dimensions 1.5' effective height, 3:1 side slopes, minimum base width 9'

Topsoil
A minimum of six (6) inches of topsoil to be placed on all compacted earth fill and in the emergency spillway

Waste Area
Waste area will be as shown or as directed by the Engineer

QUANTITIES		
Excavation, Common (EC)		
Core Trench	1670	1,585 Cu Yds
Structure	696	485 Cu Yds
Stream Channel	553	290 Cu Yds
Outlet Channel	17	30 Cu Yds
Total	2736	2,390 Cu Yds
Earth Fill		
Class (A)	19,175	17,860 Cu Yds
*Topsoil	1,217	1730 Sq Yds
Seeding	2.3	4.0 Acres
Mulching	7.6	8.0 Tons
Temporary Seeding		2.0 Acres
Fence, Barbed Wire	1,107	890 Lin Ft

*1,730 Sq Yds topsoil at a depth of six inches is equal to 288 Cu Yds

STRUCTURE B-26
BEAR CREEK WATERSHED PL-566
SCOTLAND COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

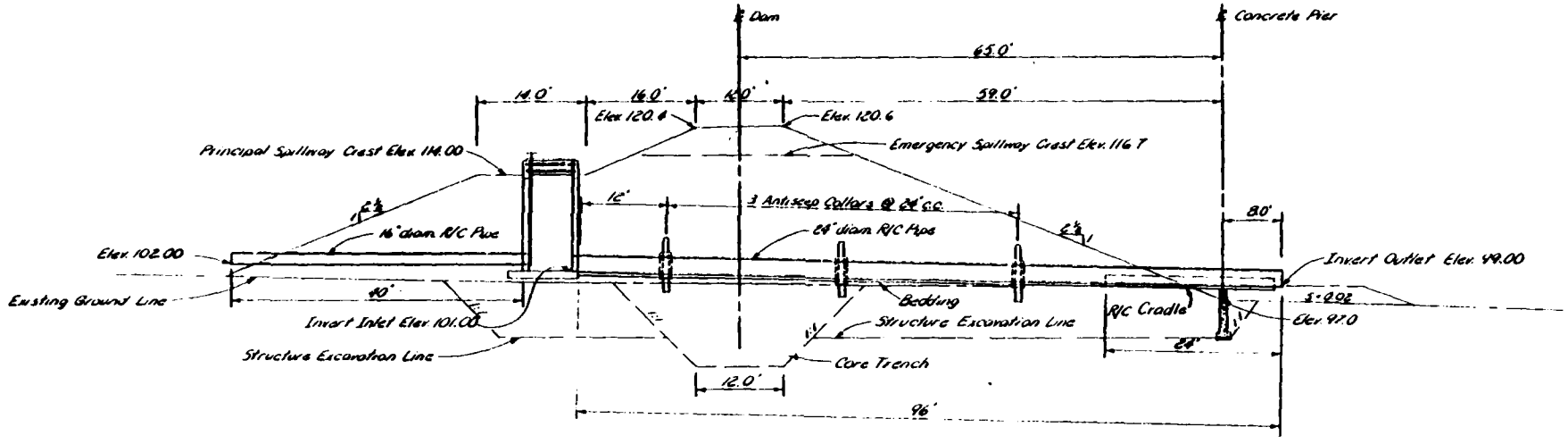
Head, Design Section
SE-35,718

PLATE C-5

PIPE CAMBER TABLE	
Distance from Outlet	Elevation
0	99.00
16	99.33
24	99.50
32	99.82
48	100.25
64	100.63
80	100.87
96	101.00

NOTES

1. Camber pipe in accordance with the elevations shown in the table.
2. Pipe elevations other than those shown will be furnished by the Engineer, when required.
3. Anti-seep collars shall not be placed closer than two (2) feet to a pipe joint.



SECTION ON CENTERLINE

0 4 8 16

Scale in Feet

MATERIALS

Concrete, Class 4000	21.8 Cu. Yds.
Steel Bar Reinforcement	1,844 Pounds
Prestressed Concrete Pressure Pipe, 24" Diam, Steel Cylinder Type	96 Lin. Ft.
Prestressed Concrete Pressure Pipe, 16" Diam, Steel Cylinder Type	40 Lin. Ft.
Aluminum Trash Rack	Lump Sum
Slide Gate, 14" Diam	1 Each

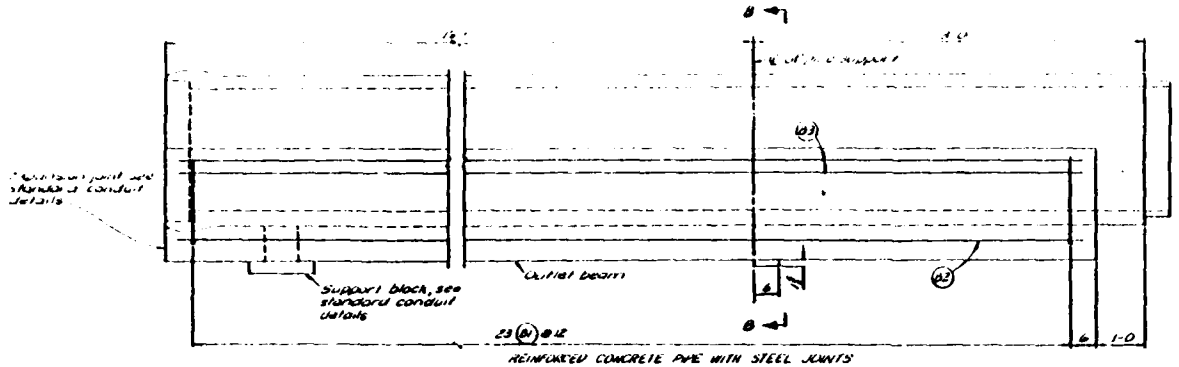
STRUCTURE B-26

R/C DROP INLET FOR 24" DIAM PIPE
GENERAL LAYOUT
BEAR CREEK WATERSHED PL 566
SCOTLAND COUNTY, MISSOURI

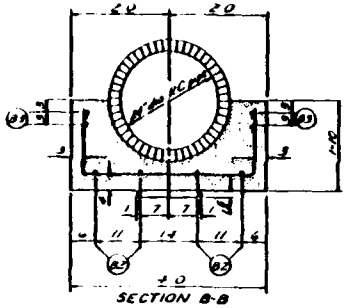
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	BES & HJH	Date	12-75
Drawn	BAE		1-76
Traced			
Checked	MMB & RWK		2-76
Sheet	4 of 12	Drawing	S.E-35,718

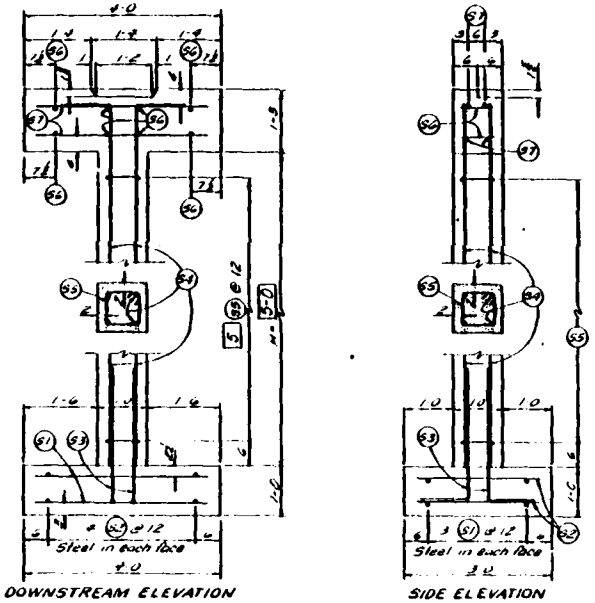
PLATE C-6



SIDE ELEVATION OF CANTILEVER OUTLET

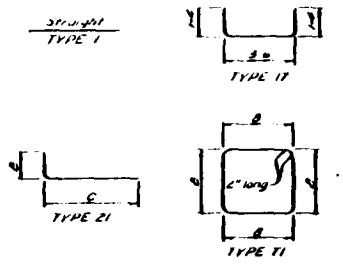


DETAILS OF BEAM AT PIPE SUPPORT



DETAILS OF PIPE SUPPORT

BAR TYPES



STEEL SCHEDULE

OUTLET BEAM

MARK	SIZE	QUANTITY	LENGTH	TYPE	TOTAL LENGTH
81	5	23	6-2	17	141-10
82	5	1	22-4	1	22-4
83	5	1	22-4	1	22-4

PIPE SUPPORT

MARK	SIZE	QUANTITY	LENGTH	TYPE	TOTAL LENGTH	B	C
51	5	6	5-4	1	32-0		
52	5	3	7-6	1	20-6		
53	6	6	3-9	21	15-0	1-6	2-6
54	6	6	7-9	21	23-0	1-6	2-6
55	3	3	2-8	21	8-0		
56	5	3	0-8	1	2-4		
57	5	6	2-6	1	15-0		

QUANTITIES

CONCRETE	CU YD
OUTLET BEAM	4.24
PIPE SUPPORT	0.82
REINFORCING STEEL	LB.
OUTLET BEAM	424
PIPE SUPPORT	110

CONCRETE QUANTITY OF OUTLET BEAM
$= 2.66 - 0.0023(D_1 + 33)(D_1 - 32)$ CU YD.

CONCRETE QUANTITY FOR PIPE SUPPORT
$= 0.83 + 0.031n$ CU YD

D_1 = OUTSIDE DIAMETER OF FURNISHED PIPE, INCHES.

n = TOTAL HEIGHT OF COLUMN OF PIPE SUPPORT (10" MAX.).

STEEL QUANTITIES OF OUTLET BEAM DO NOT VARY WITH OUTSIDE DIAMETER OF PIPE

STEEL QUANTITIES OF PIPE SUPPORT VARY WITH n

NOTES.

1. ALL DIMENSIONS SHOWING DISTANCE FROM FACE OF CONCRETE TO REINFORCING STEEL DESIGNATE THE CLEAR DISTANCE
2. ALL BAR DIMENSIONS ARE OUT TO OUT OF BAR
3. THE DOWNSTREAM END SECTION OF PIPE SHALL BE AT LEAST 12' LONG
4. AT EACH PIPE JOINT, FILL OUTSIDE SPACE BETWEEN PIPE SECTIONS WITH JOINT SEALING COMPOUND
5. PROVIDE A LAYER OF ROOFING FELT BETWEEN PIPE SUPPORT AND OUTLET BEAM TO PREVENT BOND

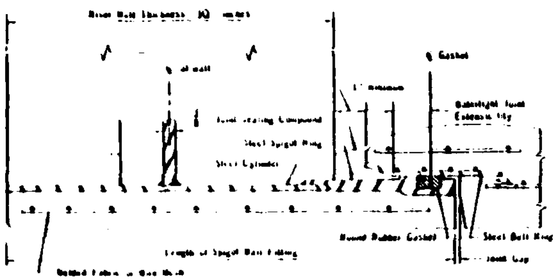
PLATE C-7

CANTILEVER OUTLET
FOR 24" DIA R C PIPE
E B W P UNIT - DESIGN SECTION
LINCOLN, NEBRASKA
BASE DRG. NO. SE 13,650,221
DATE APPROVED DEC 9, 1969
SHEET 1 OF 1
Rev. 6-72

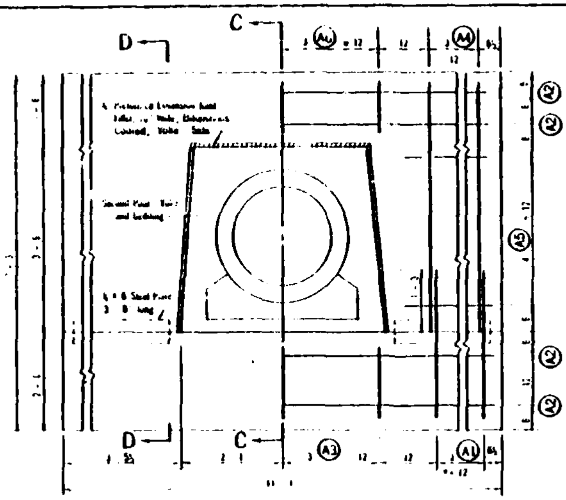
STRUCTURE B-26
BEAR CREEK WATERSHED PL-566
SCOTLAND COUNTY, MISSOURI
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	B J W	3-70
Drawn	J A B	3-70
Traced		
Checked	B L S	3-70

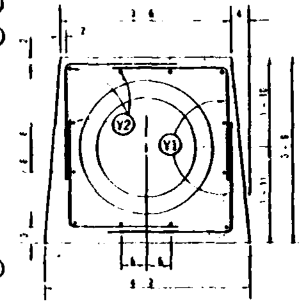
Approved by
Title
Date
Sheet No. 5 of 12
Drawing No. SE 35,718



DETAIL A



DETAIL OF ANTI-SEEP COLLAR



DETAIL OF ANTI-SEEP COLLAR YOKE

STEEL SCHEDULE

Anti-seep Collar and Yoke, 3 Required

Mark	Size	Quantity per Collar	Length	Type	Total Quantity	Total Length*
A1	4	6	2-8	1	18	84-0
A2	4	4	10-7	1	12	127-0
A3	4	5	1-6	1	15	22-6
A4	4	6	5-0	1	18	90-0
A5	4	8	3-0	1	24	72-0
A6	4	5	1-0	1	15	15-0
Y1	4	12	5-0	21	36	180-0
Y2	4	12	1-2	1	36	42-0

QUANTITIES

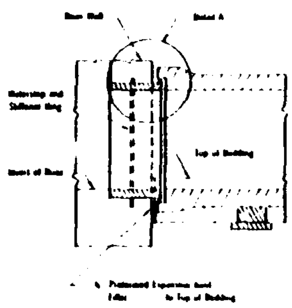
Concrete	Cu Yds
Anti-seep Collar including Yoke	
* Each	2.210
Total	6.63
Bedding	
** Per Lineal Foot of Bedding	0.0678
Total	4.88
Steel	**Pounds**
Anti-seep Collar including Yoke	394.5

Concrete quantities are based on an outside diameter of pipe of 28 ¾ inches. Steel quantities do not change with outside diameter of pipe.

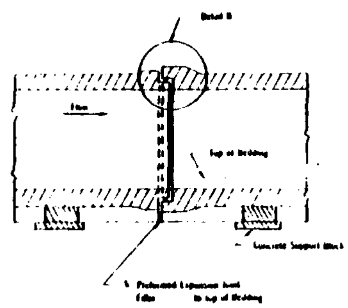
* This quantity is given by
2.155 + 0.000 [illegible] (D_f - 32) (D_f 32) cu. yds.

** This quantity is given by
0.0666 + 0.0000 (D_f 32) cu. yds.

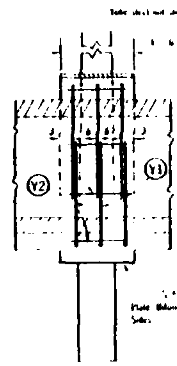
D_f – outside diameter of pipe furnished, inches



DETAIL OF SPIGOT WALL FITTING

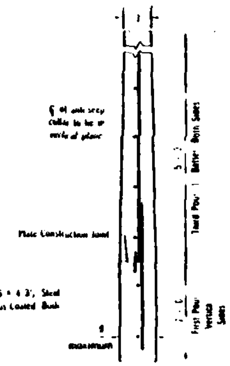


DETAIL OF PIPE JOINT

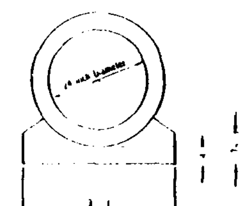


SECTION C-C

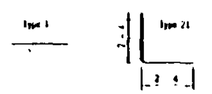
Anti-seep collar steel not shown



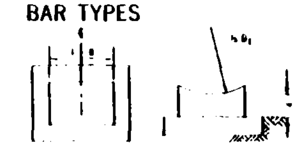
SECTION D-D



DETAIL OF BEDDING

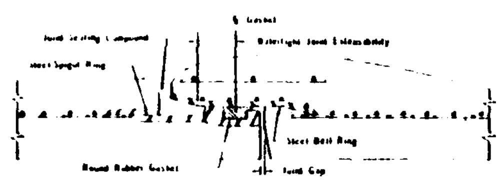


BAR TYPES



SUGGESTED SUPPORT BLOCKS

A minimum of two blocks shall be provided per section of pipe to support the pipe to the required line and grade. The contractor shall determine the size of the blocks required. Wedges may be used as an alternate. Concrete for the blocks or wedges shall be Class 4000.



DETAIL B

JOINT REQUIREMENTS

Length of Pipe Section	Minimum Joint Length	Minimum Joint Limiting Angle	
feet	inches	radians	degrees
16	2.75	0.0174	1°00'

For pipe length other than shown, joint requirements will be determined by the Engineer.

Where pipes of different length are connected, adjoining pipes shall meet the requirements of the longer pipe.

Prior to delivery of pipe, the pipe joint detail proposed for use shall be submitted to the Engineer for approval.

STRENGTH REQUIREMENTS

Outside Diameter of Pipe	Inside Diameter of Pipe	Internal Load: Hydrostatic Pressure	External Load: Minimum 3 Edge Bearing Strength in Pounds per Linear Foot of Pipe — AWWA C 301	AWWA C 306
		Head of Water	Load to produce 0.001 inch crack one foot long	Load to produce 0.01 inch crack one foot long
inches	inches	feet		
28 ¾	24	16.7	6000	—
19 ¾	16	14.0	4000	—

The outside diameter of pipe assumed in design is as shown. Where the pipe furnished has an outside diameter greater than assumed in design, the three edge bearing strength of the pipe furnished must not be less than the specified three edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter assumed in design.

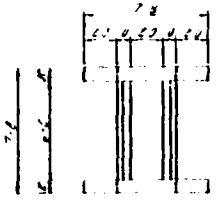
PLATE C-8

STANDARD CONDUIT DETAILS FOR REINFORCED CONCRETE PRESSURE PIPE PRINCIPAL SPILLWAY
STANDARD DWG. NO. ES 5024-BE
DATE 2-70 — SHEET 1 OF 1

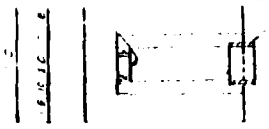
STRUCTURE B-26
BEAR CREEK WATERSHED PL-566
SCOTLAND COUNTY, MISSOURI

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

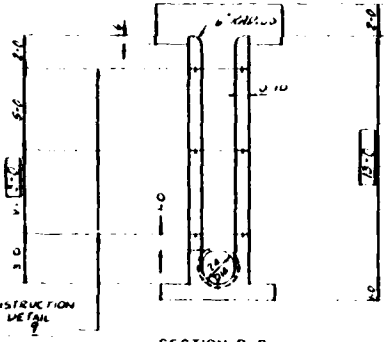
Designed	Date	Approved by
R. J. W.	1-76	
Drawn J. A. G.	3-76	
Traced		
Checked B. L. S. & M. M. B.	3-76	Sheet No. 6 of 15 — Drawing No. 5-E-35,718



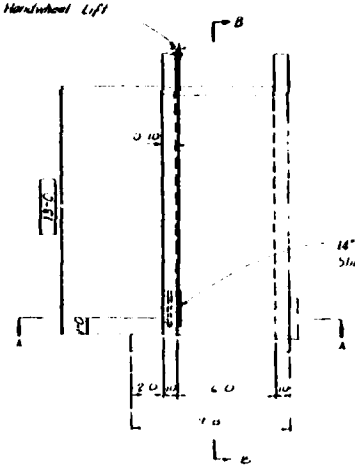
TOP PLAN



SECTION A-A



SECTION B-B



SIDEWALL ELEVATION

STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	5	13	6 6	1			84 6
B2	5	7	9 2	1			64 2
B3	5	19	7 9	21	2 1	5 2	139 8
B4	5	7	9 2	1			64 2
B5	5	10	6 6	1			65 5
B6	5	2	2 6	1			5 0
B7	5	2	8 1	21	1 0	5 1	12 2
B8	5	2	6 1	21	1 0	5 1	12 2
B9	5	12	6 1	21	1 0	5 1	73 0
B10	5	2	6 1	21	1 0	5 1	12 2
B11	5	6	8 8	1			53 4
B12	5	4	2 8	1			10 8
B13	5	8	7 0	21	2 6	4 6	36 0
B14	5	4	4 11	21	0 5	4 6	19 8
B15	5	4	4 9	21	0 3	4 6	19 0
B16	5	2	5 7	21	1 1	4 6	11 2
B17	5	2	2 3	1			4 6
B18	5	2	2 3	1			4 6
B19	5	1	2-0	1			2 0
B20	5	1	2 6	21	1 0	1 6	2 6
B21	5	6	3 3	21	0 9	4 6	9 6

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
R1	5	10	9 6	1			95 0
R2	5	4	9 6	1			38 0
R3	5	12	9 9	1			117 0
R4	5	6	9 6	1			57 0
R5	5	4	6 8	1			40 0
R6	5	6	2 8	1			14 0
R7	6	14	7 9	21	2 8	4 8	117 4
R8	5	8	6 8	1			53 4
R9	5	8	2 8	1			21 4
R10	5	24	7 0	21	2 6	4 6	168 0
T1	5	4	3 10	1			15 4
T2	5	4	2 8	1			10 8
T3	5	4	6 8	1			26 8
T4	5	6	3 10	1			23 0
T5	5	12	7 0	21	2 6	4 6	84 0
T6	5	12	2 2	1			26 0
T7	5	6	7 4	1			46 0
T8	5	8	2 2	1			17 4
T9	5	6	7 4	1			46 0

Detail and Flange Adapter to Conform to Details See Sheet 9

Wing Wall Fitting for Details See Sheet 6

Removable Handwheel Lift

14" Diam Rising Stem Slide Gate

PLATE CONSTRUCTION JOINT FOR DETAIL SEE SHEET 7

NOTES
1 FOR TRASH RACK DETAILS SEE SHEET 11
2 FOR BAR TYPE DETAILS SEE SHEET 10
3 CHAMFER ALL EXPOSED CONCRETE EDGES ¾"

PLATE C-9

STANDARD OPEN RISER
STANDARD DWG NO ES 3124 1515E
DATE 3 67 SHEET 3 OF 4
ADAPTED FROM
STANDARD COVERED RISER
DESIGN CONSTANTS f'c - 4000 psi fc - 1600 psi n - 8 fs - 20,000 psi
STANDARD DWG NO ES 3024 2015 E
DATE 4 66 SHEET 1 OF 4

SCALE IN FEET 0 2 4 6

QUANTITIES

STEEL
#5 BARS [2503 #] [368 #] LBS
#6 BARS [256 #] [385 #] LBS
[1954 #] LBS

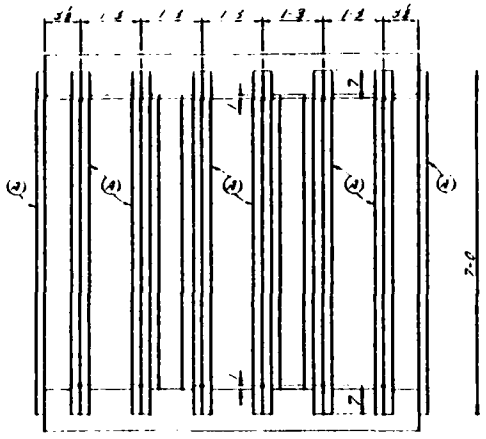
CONCRETE, CLASS 4000 - [1145] CU. YDS.

STRUCTURE B-26

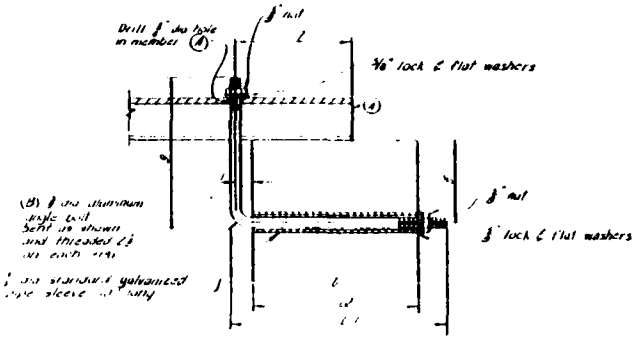
2-0 x 6-0 x 13-0 R/C RISER
FOR 24" DIAM PIPE
BEAR CREEK WATERSHED PL-566
SCOTLAND COUNTY, MISSOURI

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

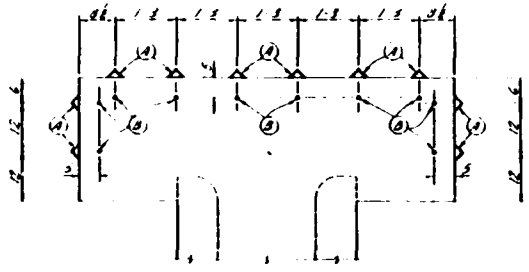
DESIGNED N J W 2 76
DRAWN J A G 3 76
TRACED
CHECKED B E S & M M N 3 76
SHEET 7 OF 15
DRAWING NO. 56-35,718



PLAN - TOP



DETAIL OF ANCHORAGE FOR ANGLES



ENDWALL ELEVATION

TABLE OF QUANTITIES

MARK	SIZE	QUANTITY
A	ANGLE 1" x 1" x 1/8" D 108" ALUMINUM	10
B	3/8" ALUMINUM ANGLE BOLT (SEE DETAIL OF ANCHORAGE FOR ANGLES)	4

NOTES

1. Trash Rack shall be fabricated of new structural aluminum alloy 6061-T6
2. All aluminum surfaces in contact with concrete or other dissimilar material shall be cleaned and given a heavy coat of alkali resistant bituminous paint and allowed to dry before assembly
3. The lock and flat washers may be either aluminum or galvanized steel
4. All cuts shall be saw cuts
5. All holes for bolts shall be 1/16" larger than bolt diameters
6. Galvanized steel angle bolts may be substituted for the aluminum angle bolts

TRASH RACK FOR 2'-0" x 6'-0" STANDARD OPEN RISER

STRUCTURE B-26
BEAR CREEK WATERSHED PL-566
SCOTLAND COUNTY, MISSOURI

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DES.	R J W	2-76
TRACED	J A G	3-76
CHKD.	D E S B M M B	3-76

Sheet No. 11 of 15 Sheets
S.C. 35,719

PLATE C-10

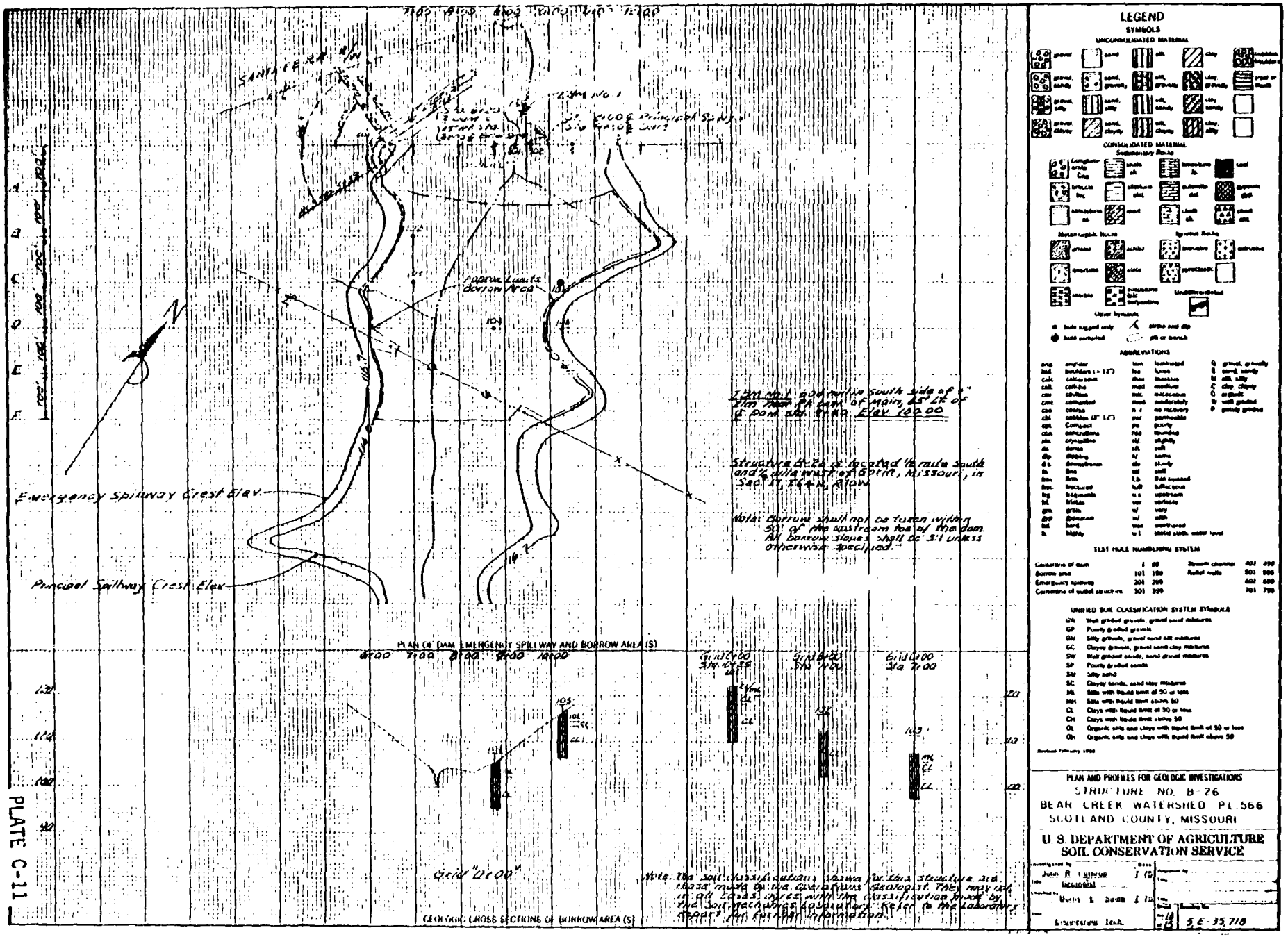

Emergency Spillway Crest Elev.
Principal Spillway Crest Elev
Approx. Limits Borrow Area
Structure B-26 is located 1½ miles South and ¼ mile East of Bethel, Missouri, in Sec. 17, T54N, R10W.
Note: Borrow shall not be taken within 50' of the upstream toe of the dam. All borrow slopes shall be 3:1 unless otherwise specified.
PLAN OF DAM, EMERGENCY SPILLWAY AND BORROW AREA (S)
GEOLOGIC CROSS SECTIONS OF BORROW AREA (S)
Grid "D" 00
Note: The soil classifications shown for this structure are based on the Geologist. They may not in all cases agree with the classification made by the Soil Mechanics Laboratory. Refer to the Laboratory Report for further information.
LEGEND
SYMBOLS
UNCONSOLIDATED MATERIAL
CONSOLIDATED MATERIAL
ABBREVIATIONS
TEST HOLE NUMBERING SYSTEM
UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS
GW Well graded gravels, gravel sand mixtures
GP Poorly graded gravels
GM Silty gravels, gravel sand silt mixtures
GC Clayey gravels, gravel sand clay mixtures
SW Well graded sands, sand gravel mixtures
SP Poorly graded sands
SM Silty sand
SC Clayey sands, sand clay mixtures
ML Silts with liquid limit of 50 or less
MH Silts with liquid limit above 50
CL Clays with liquid limit of 50 or less
CH Clays with liquid limit above 50
OL Organic silts and clays with liquid limit of 50 or less
OH Organic silts and clays with liquid limit above 50
PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
STRUCTURE NO. B-26
BEAR CREEK WATERSHED P.L.566
SCOTLAND COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SE-35,710

PLATE C-11

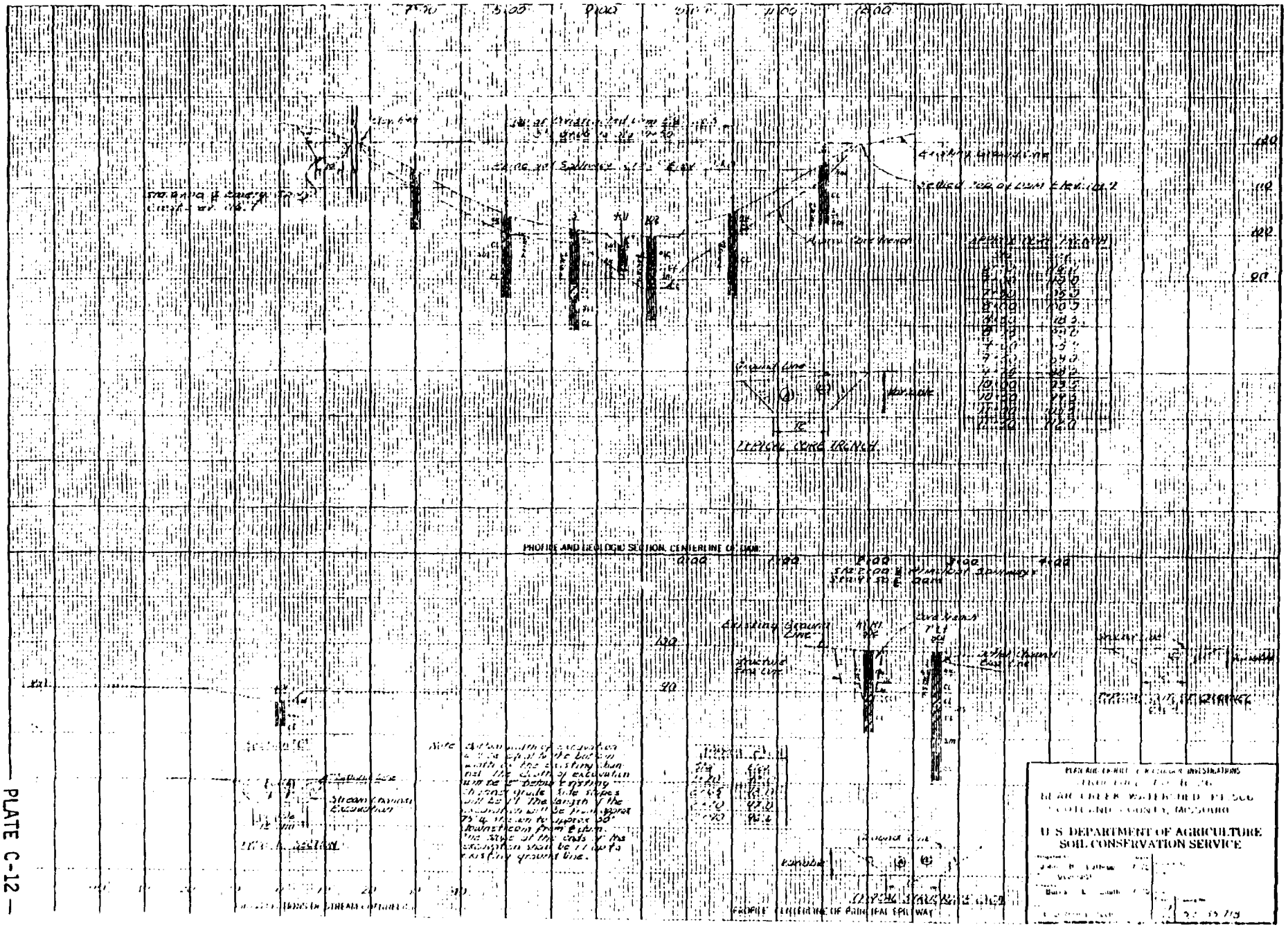

PROFILE AND GEOLOGIC SECTION CENTERLINE OF DAM
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE C-12

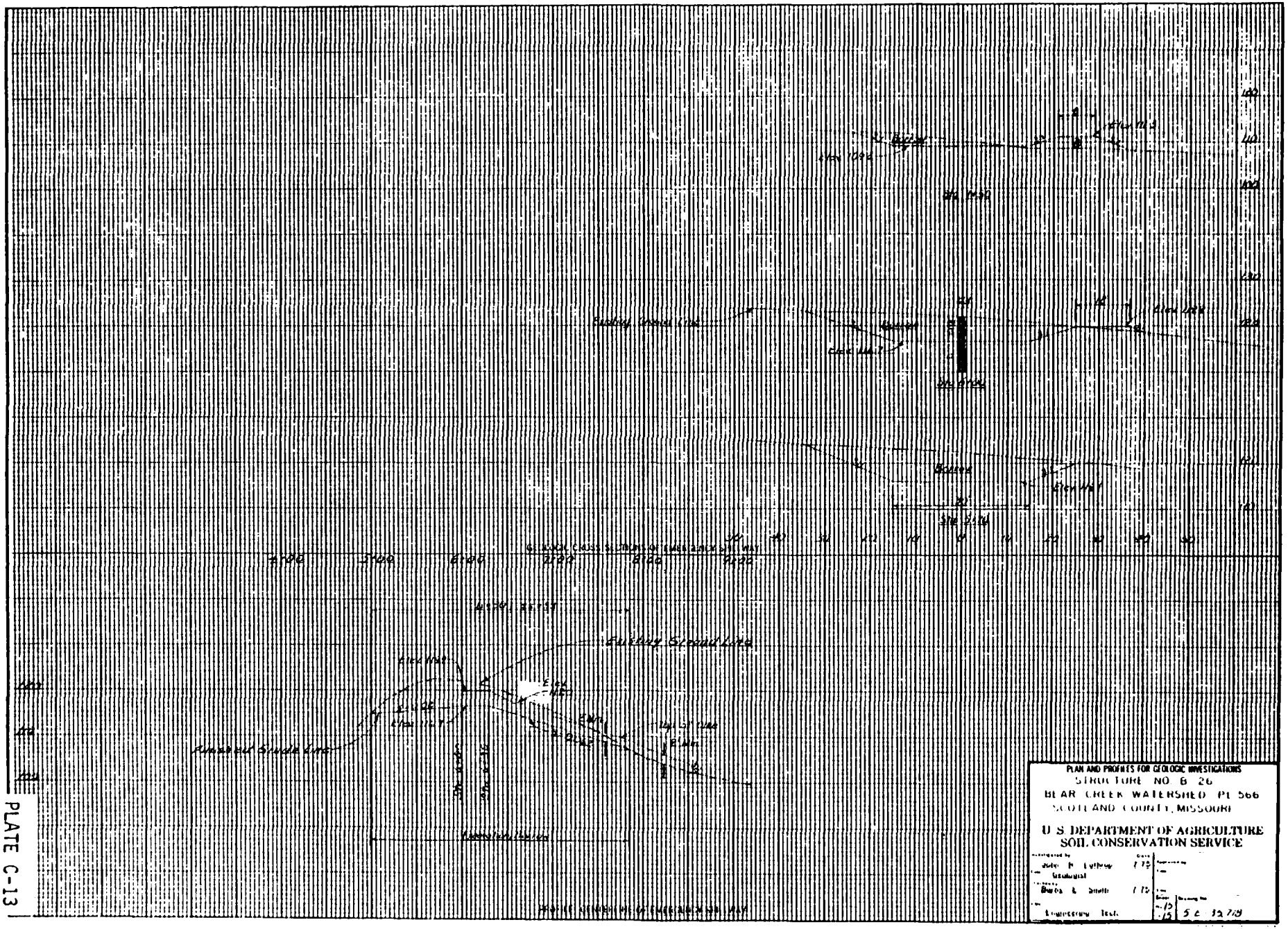

PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
STRUCTURE NO. B-26
BEAR CREEK WATERSHED PL 566
SCOTT AND COUNTY, MISSOURI
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE C-13

Site No. of Structure "B" Group Site Number

Drainage Area (total) 240 Ac. .375 Sq.Mi.

(uncontrolled) 240 Ac. .375 Sq.Mi.

Time of Concentration .070 Hours

Soil Cover Complex Number 79 For A,M.C. II

Sediment Capacity Available 98.7 Ac.Ft. below Elev. 1140

Total Sediment Capacity Available 98.7 Ac.Ft.

Capacity Equivalents (Vol.) 4.94 In.

Retarding Capacity Provided 96.7 Ac.Ft.

Capacity Equivalents (Vol.) 2.33 In.

Water Supply Provided None Ac.Ft.-Identify Uses

Principal Spillway:

Maximum Capacity ~~(low stage)~~ 61 c.f.s.

Maximum Capacity (high stage) — c.f.s.

10 Day Drawdown Elev. 1140

Emergency Spillway:

Percent Chance Use 2 Storm Duration 6 Hour

Type Vegetated Earth "n" Value Used .041

Emergency Spillway Hydrograph for Class 6 Structures

Rainfall 7.70 in.

Runoff 5.22 in.

Peak Inflow 723 c.f.s.

Maximum Discharge - Emergency Spillway 91 c.f.s.

Maximum Water Surface Elev. 1179

Velocity of Flow (Ve) 5.9 f.p.s.

Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. =1140

Emergency Spillway Crest Elev. =1167

Emergency Spillway Bottom Width = 30'

Top of Settled Dam Elev. =1197

Max. Int. Storage = 19.5 x 1454 =2,835

Freeboard Hydrograph for Class 6 Structures

Rainfall 12.50 in.

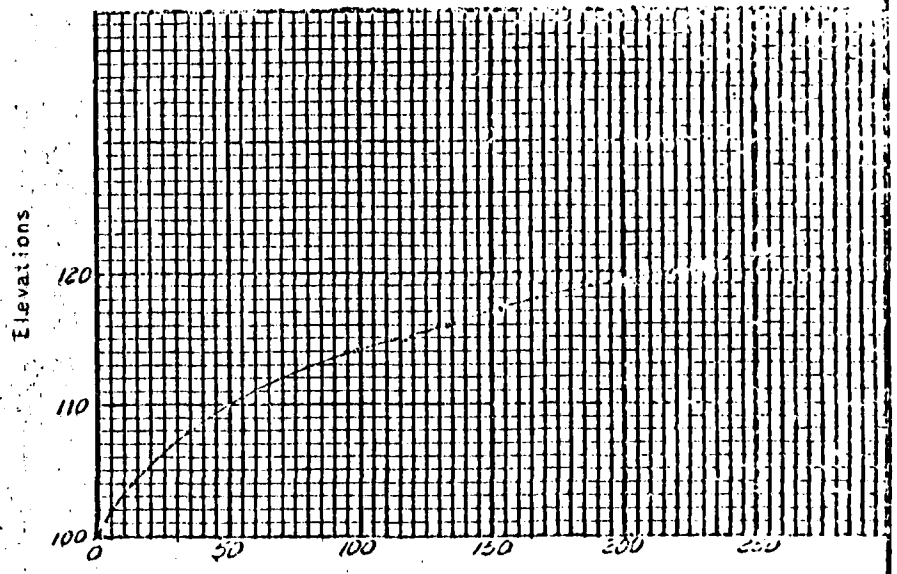
Runoff 10.76 in.

Peak Inflow 1560 c.f.s.

Maximum Discharge - Emergency Spillway 1581 c.f.s.

Maximum Water Surface Elev. 1197

Reservoir Capacity



Total Storage - Ac.Ft.

Supplementary Data and Special Design Features:

AS BUILT

11-23-77

STRUCTURE C-26

BEAR CREEK WATERSHED PL-566

SCOTLAND COUNTY, MISSOURI

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE C-14

Sheet 1 of 5

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

USDA - SCS
SOIL MECHANICS UNIT
LINCOLN, NEBRASKA 68510

SCS-ENG-375

ENG-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County Scotland ; ___ ¼, ___ ¼, Sec. 17, T 64N R 10W ; Watershed Bear Creek

Subwatershed ___ Fund class WF-99 2002 (FP-2, WP-1, e.c.) Site number B-26 Site group III Structure class b

Investigated by [signature] (signature and title) Equipment used Failing 1500 3D, Hand Auger (type, size, make, model, etc.) Date 7/16/75

SITE DATA

Drop Inlet

Drainage area size .375 sq. mi., 240 acres. Type of structure Compacted Earth Purpose Grade Stabilization

Direction of valley trend (downstream) North Maximum height of fill 225 feet. Length of fill 550 feet.

Estimated volume of compacted fill required 18,990 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment			16.5
Floodwater			19.5

SURFACE GEOLOGY AND PHYSIOGRAPHY

Heavy Till

Physiographic description Iowa & Missouri Plain Topography Rolling Attitude of beds: Dip - Strike -

Steepness of abutments: Left 10 percent; Right 10½ percent. Width of floodplain at centerline of dam 150 feet

General geology of site: This site is underlain by very stiff glacial till clay (CL) material. Bedrock underlying the till was not penetrated by any of the investigative borings but is believed to be limestone of the Mermecian series and Mississippian in age.

The till on the site consists of a very stiff, slightly gravelly calcareous tan-yellow clay (CL) which occurs at a maximum depth of 19 feet (boring #3) through the flood plain and at or near the surface on both abutments.

Soils developed above the till, in the floodplain, consist of silt (ML), sandy clays (CL) and silty sands (SM). The standard penetration test of the silty sand horizon in boring #3 at depths of 15 to 16 feet was 3 blows, or soft consistency. All other materials were of at least medium consistency.

Average water table elevation on the centerline dam alignment was at an elevation of 962 feet. The channel was dry at the time of the site investigation.

PLATE C-15

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-3768
REV. 2-64
SHEET 2 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Centerline Dam
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	5	1	-	-	2 split spoo
TOTAL	5	1	-	-	2

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

This site is underlain by a glacial till clay (CL). Bedrock, underlying the till was not penetrated by any of the investigative borings.

The till on the site consists of a very stiff tonaceous slightly gravelly calcareous tan-yellow clay which occurs at a maximum depth of 9 feet through the floodplain and at or near the surface on both abutments.

Soils developed above till in the higher elevations is loess or modified loess of probable Wisconsinan age. Soils developed above till in the flood plain areas are: from the surface down. The surface horizon is a black medium soft silt (ML) that averages four feet of depth. The second horizon is a sandy clay (CL) that becomes increasingly more sandy with depth. The clay (second horizon) overlies a very silty sand horizon (SM). The SM horizon is very silty in the upper portion and gravelly in the basal part. The SM was wet when encountered.

Average water table elevation on the centerline dam alignment was at an elevation of 960 feet.

PLATE C-16

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-3768
REV. 2-64
SHEET 3 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Principal Spillway
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	2	-	-	-	-
TOTAL	2	-	-	-	-

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Two borings were drilled along this alignment. Large trees were present at the upstream location and this boring was not drilled.

Along the principal spillway alignment the surface horizon is a slightly clayey organic silt (ML) that averages 5 to 6 feet in depth. Underlying the surface horizon a very lenticular silty sand (SM) and or sandy clay (CL) horizon extends in depth to the clay till horizon. The till is encountered at average depth of 12 feet.

Average water level elevation along the principal spillway alignment was at an elevation of 959 feet.

PLATE C-17

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-3768
REV. 2-64
SHEET 4 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Emergency Spillway
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	1	-	-	-	-
TOTAL	1	-	-	-	-

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

A thin surface mantle of silt (ML) overlies tan-yellow very stiff silty clay (CL-till) in this area. The very stiff till clay will be encountered at proposed grade over most of this area.

PLATE C-18

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 5 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Stream Channel

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Hand Auger	1	-	-	-	-
TOTAL	1	-	-	-	-

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

From observation, correlation and one hand auger boring the brown-black surface sandy silt (ML) horizon crops out in the channel banks and extends to below the channel floor.

Sand and silt is present to a depth of 1 foot on the channel floor. From 1 to 5 feet depth a black medium soft sandy slightly clay silt (ML) horizon is present. Underlying the ML horizon a black sandy clay (CL) horizon is encountered at average depth of five feet.

No water was present in the channel at the time of the site investigation.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 6 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Borrow Area
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	5	1	-	3 large	-
TOTAL	5	1	-	3	-

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

In the higher elevations (borings #101, #102, #103, and #105) the surface horizon is a thin mantle of brown slightly clayey silt (ML) that averages 2 feet in depth. The underlying horizon is a yellow-tan very stiff clay (CL-till). The second horizon is medium to stiff in the top portion of approximately 2 feet.

In the lower elevations (boring #104) the surface horizon is a black medium soft silt (ML) that averages three feet in depth. The underlying horizon is a black very silty medium consistency clay (CL).

A water table was present in boring #104 at 7 feet depth. All other borrow borings were dry.

PLATE C-20

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-376C
REV. 2-64
SHEET 7 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Bear Creek		Scotland	Missouri

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)	DATE
B-26			[signature]	7-16-75

INTERPRETATIONS AND CONCLUSIONS

Centerline Dam - The suggested minimum cutoff trench depths should provide a near positive cutoff, and the trench should bottom in stiff clay (CL) at all stations.

Care should be taken to cut off the the surface (ML) horizon which extends to a maximum depth of 6 feet in boring #302. The SM horizon overlying the till in the floodplain area should not be cut off.

Principal Spillway - Foundation alignment and the location of station 9+50 centerline dam is satisfactory. Minimum trench depths should be adequate for a dam of this height.

However, since this is a "b" structure, consideration should be given to eliminating the low consistency surface silt (ML) horizon down to an average depth of 4 or 5 feet. The logs of borings along the principal spillway alignment may not reflect it but the basal part of the surface ML horizon was more plastic than the upper portion.

Emergency Spillway - An estimated 1600 cubic yards of required excavation will be needed in this area. All excavation will be common.

Stream Channel - Suggest two feet removal at all stations to eliminate, silt, gravel and trash from the channel.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-376C
REV. 2-64
SHEET 8 OF 8

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Bear Creek			

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)	DATE
B-26				

INTERPRETATIONS AND CONCLUSIONS

Borrow - Ample materials are available to grid E and within detention pool limits to construct the embankment. Borrowing should be done on the abutment flanks to take maximum advantage of the stiff till clay present there. The areas immediately adjacent to the channel should contain silt (ML) and very silty clays to below a water level which was encountered in boring #104 at approximate elevation of 98 feet. Samples were submitted from boring #101.

Engineer's Report

Core Trench

A core cut 4 to 8 feet deep from station 7+00 to 11+80 and into the dark CL material overlying till should provide near positive cutoff. CL material found in the borrow area on either abutment or in the emergency spillway cut should be used to backfill the core trench.

Principal Spillway

Structure excavation should be 5 to 8 feet deep to CL material, to insure positive water cutoff along the principal spillway. No consolidation problems are anticipated.

Stream Channel

Two to three feet of material should be taken from the stream channel, sections A to C to remove debris, roots, etc.

SML File Copy

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory

800 "J" Street, Lincoln, Nebraska 68508

SUBJECT: ENG 13-18, Missouri WF-08, Bear Creek, Site B-26 (Scotland County) DATE: December 2, 1975

TO: James M. Dale
State Conservation Engineer
Soil Conservation Service
Lincoln, Nebraska

ATTACHMENTS

1. Form SCS-ENG-354, Soil Mechanics Laboratory Data, 1 sheet
2. Form SCS-ENG-355A & B, Triaxial Shear Test Data, 2 tests, 4 sheets
3. Form SCS-352, Compaction and Penetration Resistance, 1 sheet
4. Form SCS-357, Summary - Slope Stability Analysis, 2 sheets
5. Pin Hole Test Data, 1 sheet

DISCUSSION

GENERAL

The proposed structure is a Class B grade stabilization structure. It has a 240-acre drainage area. The planned maximum fill height is 22.5 feet.

FOUNDATION

About 4 feet of loess overlies glacial till on the abutments. The alluvium has a maximum thickness of about 19 feet in the central portion of the valley, and thins to about the thickness of the loess on the abutments.

The alluvium is described as a surface zone of silty soil described as black medium-soft silt and slightly clayey silt overlying CL described as clay that is silty in the upper part and sandy in the lower part. The bottom layer of alluvium is logged as SM.

The surface silty zone ranges from 3 to 8 feet thick. No information was provided the Soil Mechanics Laboratory to evaluate the engineering properties of this zone. The CL alluvium has a blow count of 7 blows per foot in test hole 3, and the zone logged as SM has a blow count of 3 blows per foot. The blow count data suggest that the CL and SM are probably O.K. for the structure planned, and the till is undoubtedly strong enough for the planned structure.

The index test data for the two foundation samples submitted are recorded on the attached Form SCS-ENG-354.

The crumb test indicated dispersive clay in the samples of alluvium, but the laboratory dispersion test and the pinhole test indicated non-dispersive clay, and these are considered more positive tests.

EMBANKMENT

A. Soil Classification. Three borrow samples were submitted. The materials represented are sandy clays that contain from about 30% to 40% sand with 24% to 33% finer than 0.002 mm. The LL's range from 35 to 42 with PI's from 14 to 19. The clay is non-dispersive.

B. Compacted Density. The standard Proctor density is 104 pcf and the optimum moisture content is 19%.

C. Shear Strength. Triaxial shear tests were made on Sample 101.2 (76W465). Initially a test was made at 90% of Proctor density, which was the planned embankment density. At this density the shear strength is very low (total stress CU values of $\phi = 12.5°$, c = 150 psf), and the factor of safety for the planned $2\frac{1}{2}$:1 slopes is less than 1.0.

A subsequent $\overline{CU}$ triaxial shear test was made with specimen density of 95% of Proctor, and the shear strength parameters obtained for the total stress CU condition are $\phi = 11°$, c = 425 psf. Effective stress shear strength parameters are $\phi = 21.5°$, c = 275 psf. The test data are considered to be reliable.

SLOPE STABILITY

The stability of the proposed $2\frac{1}{2}$:1 slopes was checked for placement at both 90% of Proctor density and 95% of Proctor density. A summary of the analysis is attached. For placement at 90% of Proctor density the factors of safety are less than 1. For placement at 95% of Proctor the factors of safety are in the range of 1.6, which are acceptable.

It must be recognized that this analysis is for the embankment material only, and for analysis purposes it was assumed that the foundation was as strong or stronger than the embankment. Since no foundation samples or blow count information was submitted from the upper zone of alluvium, this is the inferred condition. Based on the description of the surface zone, we would question this assumption.

CONCLUSIONS AND RECOMMENDATIONS

We concur with the proposals outlined in the engineer's report for the cutoff and the principal spillway.

We suggest that you reassess the surface zone of alluvium to determine whether or not it has adequate strength. The data also suggest that an embankment placement density of 95% of standard Proctor should be considered.

If you need additional information on the slope requirements for placement at 90% of Proctor density, please advise us.

Lorn P. Dunnigan

Lorn P. Dunnigan
Head

Attachments

cc:
James L. Evans, Monticello (2)
Buell M. Ferguson, Lincoln, Nebr.
David C. Ralston, Washington, D.C. w/SCS-ENG-354 and shear test data sheets

USDA-SCS:LPDunnigan:io 12/2/75

SCS-ENG-354
Rev. 3-70
Field Code ENG-13-18

Ht. = 22.5'
18,990 cu yd

Class B
Grade Stabilization

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MECHANICS LABORATORY DATA
Sheet 1 of 1

7/30/75

MISSOURI

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Classification	Mechanical Analysis: Grain Size Distribution Expressed as Percent Finer by Dry Weight — Fines					Sand					Gravel						Atterberg Limits		Unified Classification	Soluble Salts %	Dispersion % (Method)	Moisture-Density Relationships: Standard / Modified — Max. lb/cu ft			Undisturbed Sample Data		Gs	Special Tests				
					#200 0.075 mm	#100 0.150 mm	#60 0.250 mm	#40 0.425 mm	#20 0.850 mm	#10 2.00 mm	#4 4.76 mm	3/8" 9.52 mm	1/2" 12.7 mm	3/4" 19.05 mm	1" 25.4 mm	1 1/2" 38.1 mm	2" 50.8 mm	3" 76.2 mm	LL	PI											Shear		Pin Hole		Crumb
76W		Bear Creek Site: B-26																																
462	3.1	℄ Dam 8+75 S. Bag	7-8'	CL	29	35	68	87	88					100							42	23	CL		14									4
463	3.2	" " S. Bag	15-16'	SM	16	20	36	50	56					100							26	11	CL		25									4
464	101.1	Borrow, C @ 10+25 M. Bag	1-2'	CL-ML	24	30	46	65	66	70	85	93	98	100							35	14	CL		TR									1
465	101.2	" " M. Bag	2-4'	CL	33	38	52	66	69	73	86	94	98	100							42	17	CL		TR	(1)	104.1	19.0		2.66	✓ 20			1
466	101.3	" " M. Bag	4-8'	CL	28	33	45	55	62	66	83	92	98	100							38	19	CL		9									1

PLATE C-27

SCS-ENG-355A (Rev. 3-70)
FILE CODE ENG-72

LABORATORY NO 76M465

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: BEAR CREEK SITE B-26, MISSOURI
SAMPLE LOCATION: B-26 W/ C @ 10+25
FIELD SAMPLE NO.: 10.2
DEPTH: 2-4'
GEOLOGIC ORIGIN:
TYPE OF SAMPLE: COMPACTED
TESTED AT: SMH-LINCOLN
APPROVED BY:
DATE:

INDEX TEST DATA

USCS CL ; LL 42 ; PI 17
% FINER (mm): 0.002 33 ; 0.005 38 ;
0.074 (#200) 69
G_s (-#4) 2.66 ; G_s (+#4) _____
STANDARD: γ_d MAX. 104.0 pcf; w_o 19.0 %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

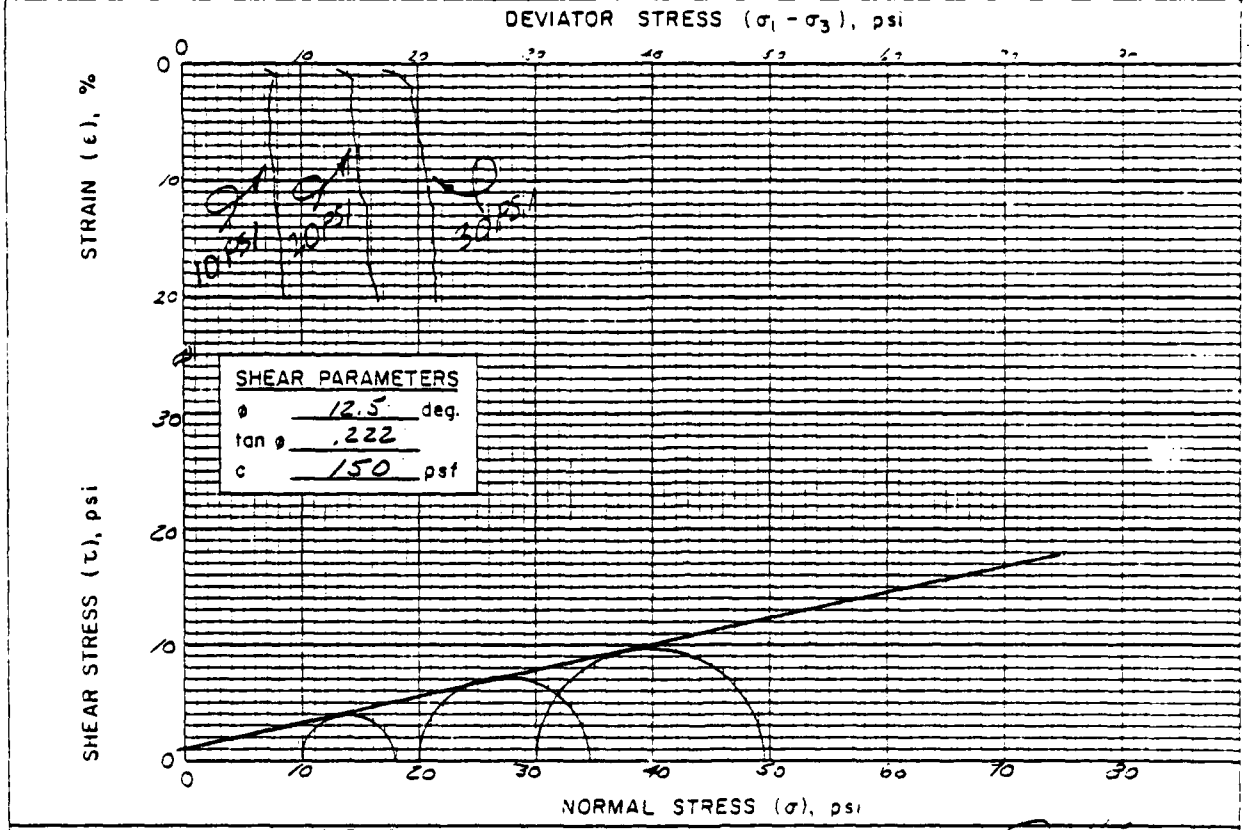
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION STATIC COMPACTED IN 2 LIFTS
MOLDING MOISTURE 24.2 %
MOLDED AT 89.9 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☐
$\overline{CU}$ ☑
CD ☐

DRY DENSITY INITIAL	DRY DENSITY CONSOLIDATED	B, Parameter	MOISTURE CONTENT, % START OF TEST	MOISTURE CONTENT, % DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, % END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
93.5 pcf		0.98			27.5	16.47	10	7.3	1.0
93.6 pcf		0.98			25.2	16.33	20	14.4	1.5
93.4 pcf		0.98			23.9	16.67	30	19.5	2.0



REMARKS BACK-PRESSURED

PLATE C-28

SCS-ENG-3558 (6-71)
FILE CODE ENG-22

LABORATORY NO. 76W465

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST with pore pressure measured

PROJECT and STATE: BEAR CREEK SITE: B-26, MISSOURI

SAMPLE LOCATION: BORROW, C @ 10+25

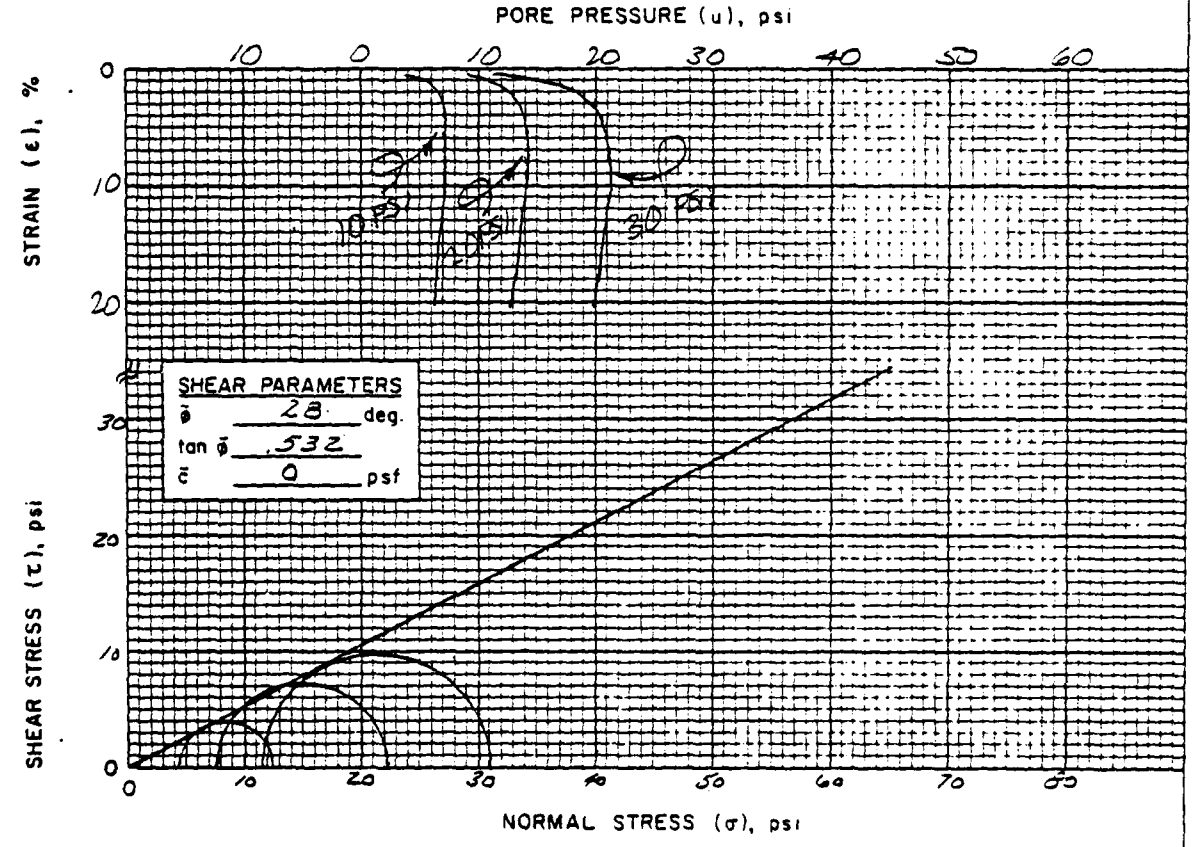
TYPE OF SAMPLE: COMPACTED

TESTED AT: SML - LINCOLN

APPROVED BY:

DATE:

MINOR PRINCIPAL STRESS, σ_3 (psi)	PORE PRESSURE, u (psi)	EFFECTIVE MINOR PRINCIPAL STRESS, $\bar{\sigma}_3$ (psi)	DEVIATOR STRESS, $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA	AXIAL STRAIN AT FAILURE, ε (%)
10	5.5	4.5	7.8		1.0
20	12.1	7.9	14.4		1.5
30	18.4	11.6	19.5		2.0



REMARKS: BACK-PRESSURED

PLATE C-29

SCS-ENG-355A (Rev. 3-70)
FILE CODE ENG-22

LABORATORY NO 76W 425

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: BEAR CREEK SITE: B-26 MISSOURI
SAMPLE LOCATION: BORROW C @ 10+25
FIELD SAMPLE NO.: 101.2
DEPTH: 2.0 - 4.0 '
GEOLOGIC ORIGIN:
TYPE OF SAMPLE: COMPACTED
TESTED AT: SML LINCOLN
APPROVED BY:
DATE:

INDEX TEST DATA

USCS CL ; LL 42 ; PI 17
% FINER (mm): 0.002 33 ; 0.005 38 ;
0.074 (#200) 69
G_s (-#4) 2.66 ; G_s (+#4) _____
STANDARD: γ_d MAX. 104.4 pcf; w_o 19.0 %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

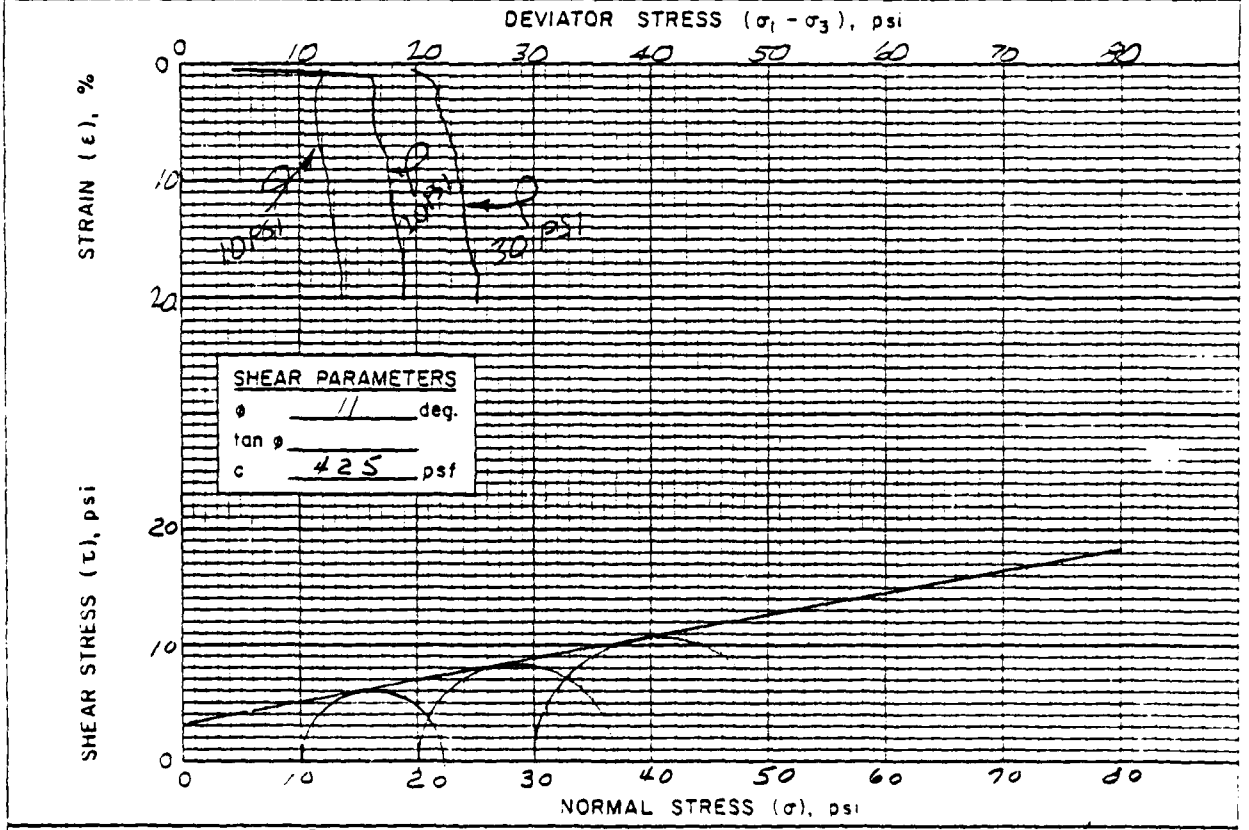
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION STATIC 2 LAYER COMPACTION
MOLDING MOISTURE 21.6 %
MOLDED AT 95.2 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☐
$\overline{CU}$ ☒
CD ☐

DRY DENSITY INITIAL	DRY DENSITY CONSOLIDATED	B Parameter	MOISTURE CONTENT, % START OF TEST	MOISTURE CONTENT, % DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, % END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
99.1		0.99			25.3	16.50	10	12.0	1.0
98.8		0.98			24.2	16.67	20	16.4	1.5
99.2		0.98			23.0	16.37	30	21.3	1.5



REMARKS BACK-PRESSURED

PLATE C-30

SCS-ENG-355B (6-71)
FILE CODE ENG-22

LABORATORY NO. 76W 465

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST with pore pressure measured

PROJECT and STATE: BEAR CREEK SITE: B-26 MISSOURI

SAMPLE LOCATION: BORROW C @ 10+25

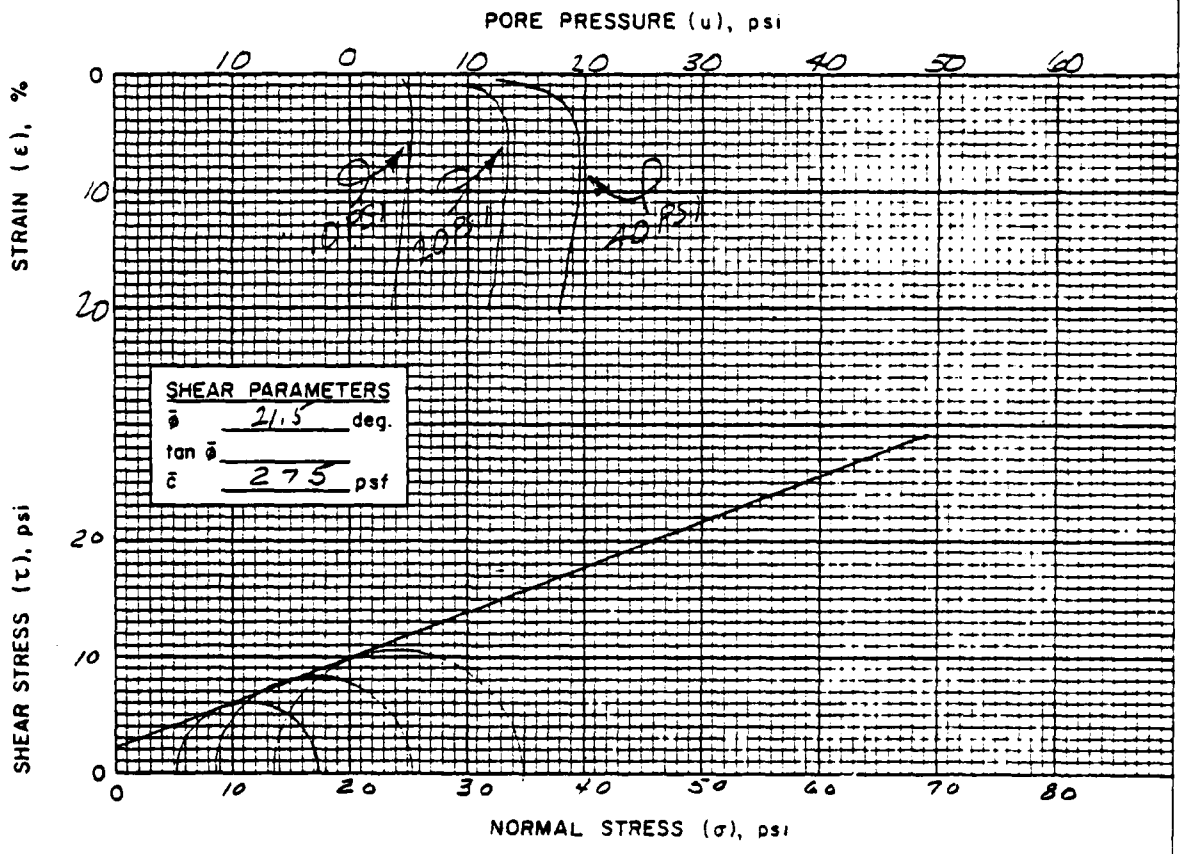
TYPE OF SAMPLE: COMPACTED

TESTED AT: SML LINCOLN

APPROVED BY:

DATE:

MINOR PRINCIPAL STRESS, σ_3 (psi)	PORE PRESSURE, u (psi)	EFFECTIVE MINOR PRINCIPAL STRESS, $\bar{\sigma}_3$ (psi)	DEVIATOR STRESS, $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA	AXIAL STRAIN AT FAILURE, ε (%)
10	4.8	5.2	12.0		1.0
20	11.2	8.8	16.4		1.5
30	16.4	13.6	21.3		1.5



REMARKS BACK-PRESSURED

PLATE C-31

Form SCS 352
Rev 5-65

LABORATORY NO 76W465

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Bear Creek #B-26, Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
101.2	Borrow, C @ 10+25	2'-4'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN		

CLASSIFICATION CL LL 42 PI 17

MAX. PARTICLE SIZE INCLUDED IN TEST ¼ #4 "

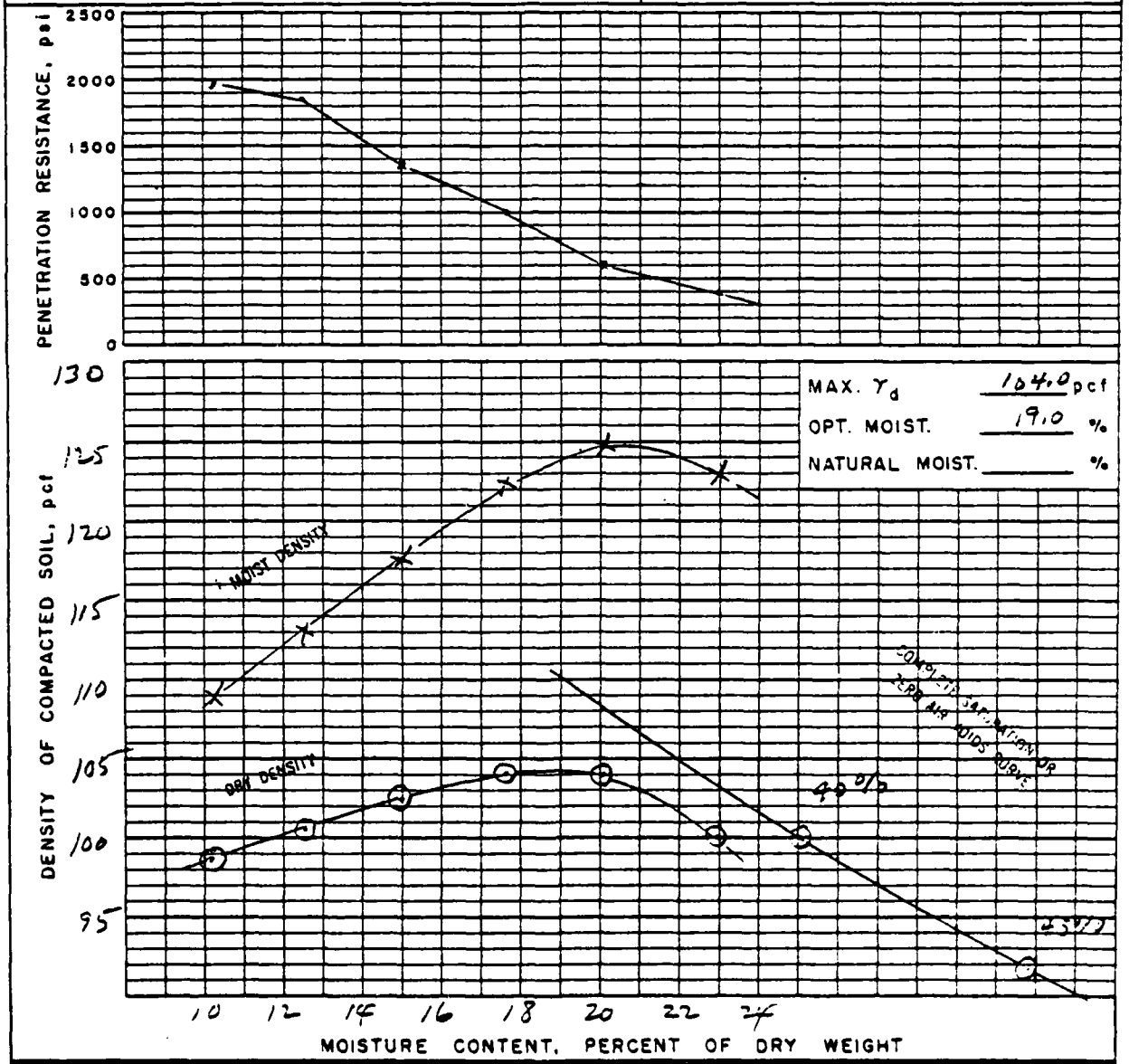
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.66 ; PLUS NO. 4 ____

CURVE NO. 1 OF 1

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.0 pcf

OPT. MOIST. 19.0 %

NATURAL MOIST. ____ %

REMARKS

PLATE C-32

Form SCS 387
Rev. 6-65

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: REAR CREEK #R-26 MISSOURI
METHOD OF ANALYSIS: ICES
ANALYZED AT: S.M.L.R.S.S.L. VICKSBURG, MISS.
APPROVED BY:
DATE: 9-22-75

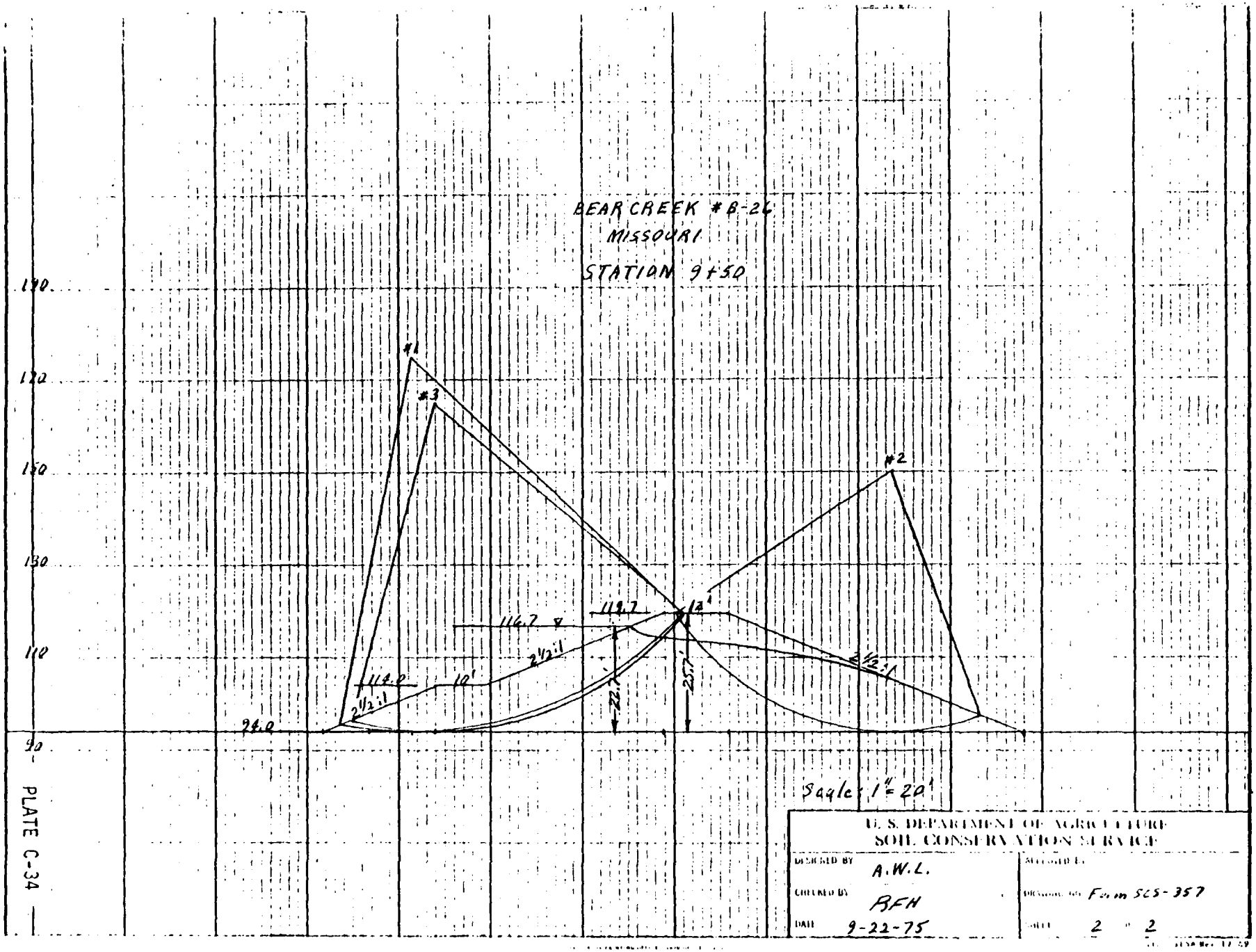
	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA γd (pcf)	γm (pcf)	γsat (pcf)	γsub (pcf)	φ (deg.)	tan φ	c (psf)	REMARKS
①	Embankment	CL	93.5	111.5	121.0	58.5	12.5	.222	150	
②							28	.532	0	
③	Embankment	CL	99.0	119.0	123.5	61.0	11	.194	425	
④							21.5	.394	275	
⑤										
⑥										
⑦										
⑧										

TRIAL NO.	SLOPE	CONDITIONS	F_s	F_s
		Upstream - Full drawdown Dnstr - Steady Seepage Station @ 9+50	Bishop	Swedish
1Up	2½:1	Embank. (12.5°-15°) only, 10' berm @ elev. 114.0	0.91	0.92
2Dn	2½:1	Embank. (12.5°-15°) only.	0.90	0.88
3Up	2½:1	Embank. (21.5°-27.5) only, 10' berm @ elev. 114.0.	1.64	1.64
4Dn	2½:1	Embank. (21.5°-27.5) only.	1.61	1.56

PLATE C-33

Sheet 1 of 2

BEAR CREEK #B-24
MISSOURI
STATION 9+50



Scale: 1" = 20'

PLATE C-34

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY A.W.L.	ACCEPTED BY
CHECKED BY RFH	DESIGNATION Form SCS-357
DATE 9-22-75	SHEET 2 OF 2

PIN HOLE TEST DATA

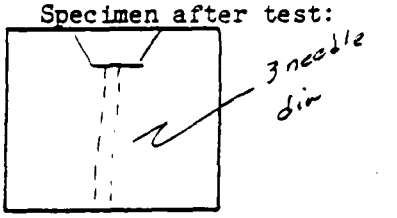
Date: 9-9-75

Pin Hole Test No. _____

Page: _____

Sample No. 76W462

Specimen after test:



Compaction Characteristics GOOD

Water Content near Optimum 20.29%

Distilled water added: ✓ yes or ___ no

Curing time: overnight

Flow started on 1 trial

Clock Time	Head	Flow Rate		Color from Side				Completely Clear from Top	Particles Falling			Remarks
		ml	sec	Dark	Slight to Medium	Barely Visible	Completely Clear		None	Few	Heavy	
8:26	2"	10	24				✓		✓			
8:28	7"	10	16				✓		✓			
		10	12				✓		✓			
		25	27				✓			✓		Falling Particles
		25	25				✓			✓	"	"
		25	20				✓			✓	"	"
		25	18				✓			✓	"	"
		25	17				✓	Slight Haze		✓	"	"
		25	17				✓	"		✓	"	"
		25	15				✓	"		✓	"	"
		25	14				✓	"		✓	"	"
		25	14				✓	"		✓	"	"
		25	14				✓	"		✓	"	"
		25	14				✓	"		✓	"	"
		25	14				✓	"		✓	"	"
8:33	15"	50	20				✓	Haze		✓	"	"
		50	18				✓	Slight Haze		✓	"	"
		50	18				✓	"		✓	"	"
		50	19				✓	Slight		✓	"	"
		50	18				✓	"		✓	"	"
		50	18				✓	"		✓	"	"
		50	17				✓	"		✓	"	"
		50	18				✓	"		✓	"	"
		50	17				✓	"		✓	"	"
8:38	40	50	10				✓	"		✓	"	"
		50	10				✓	"		✓	"	"
		50	10				✓	"		✓	"	"
		50	10				✓	"		✓	"	"

ND 2

PLATE C-35

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see this Section).

   a. Twenty-four hour, 1 percent probability rainfall for the dam location was taken from the data for the rainfall station at Kirksville, MO., as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.375 square miles (240 acres).

   c. Time of concentration of runoff = 42 minutes (from SCS as-built plans). The time of concentration was verified using both the SCS "Upland" method and the "Kirpich" formula.

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occured on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 1 percent probability precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the weir crest of the riser.

   e. The total twenty-four hour storm duration losses for the 1 percent probability storm were 2.42 inches. The total losses for the PMF storm were 1.16 inches. These data are based on SCS runoff curve No. 79 and No. 91 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil groups C & D (Edina and Lamoni silt loam-D soils; Kilwinning silt loam and Armster loam-C soils). Beans and corn are the major crops of the watershed with about half of the watershed being contoured and terraced.

   f. Average soil loss rates = 0.05 inch per hour approximately (for PMF storm, AMC III).

2. The discharge ratings for the principal spillway were developed using equations for orifice, weir, and full conduit flow. They are as follows:

a. Orifice flow equation ($Q = CA\sqrt{2gH}$)
where C = orifice coefficient = 0.6
A = area of opening, ft^2 = 12.0
H = total head, ft.

b. Weir flow equation ($Qw = CLH^{1.5}$)
where C = weir coefficient = 3.1 (from SCS Engr. Memo 50)
L = length of weir, ft. = 12
H = total head, ft.

c. Full conduit flow equation

$$Q = a\sqrt{\frac{2gH}{1 + Kr + K_pL}}$$

where a = cross-sectional area of pipe, ft^2 = 3.14
H = total head, ft.
K_r = coefficient for riser = 0.7 (SCS Design Note 8)
K_p = coefficient for pipe friction loss = 0.01058 (ES-42,SCS NEH, Section 5)
L = length of pipe, ft. = 96

The emergency spillway discharge rating was developed using the Corps of Engineers *Surface Water Profile* HEC-2 computer program assuming critical depth just downstream of the control section.

The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program using the irregular top of dam option.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The output and plotted hydrographs are shown in this Section.

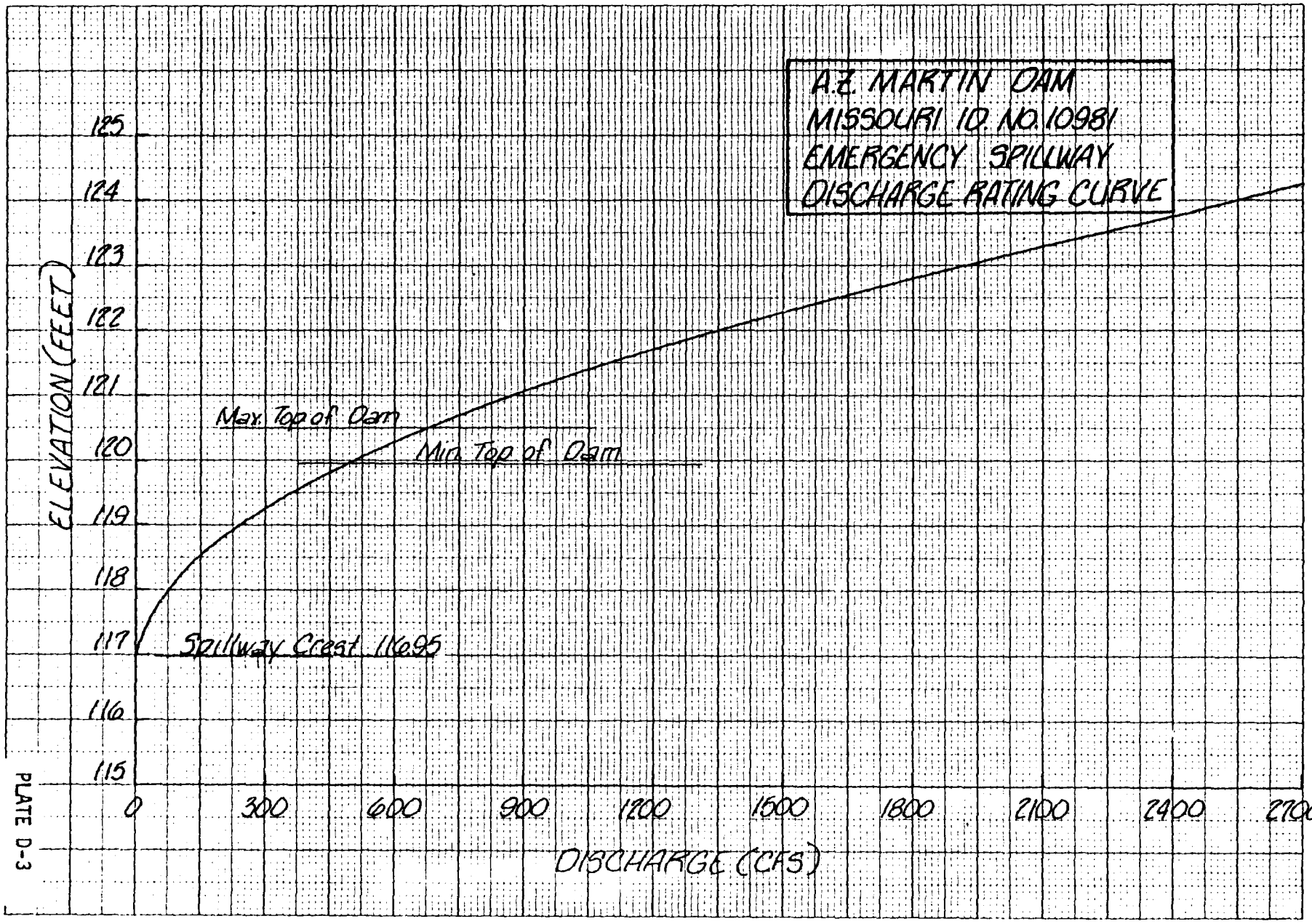


PLATE D-3

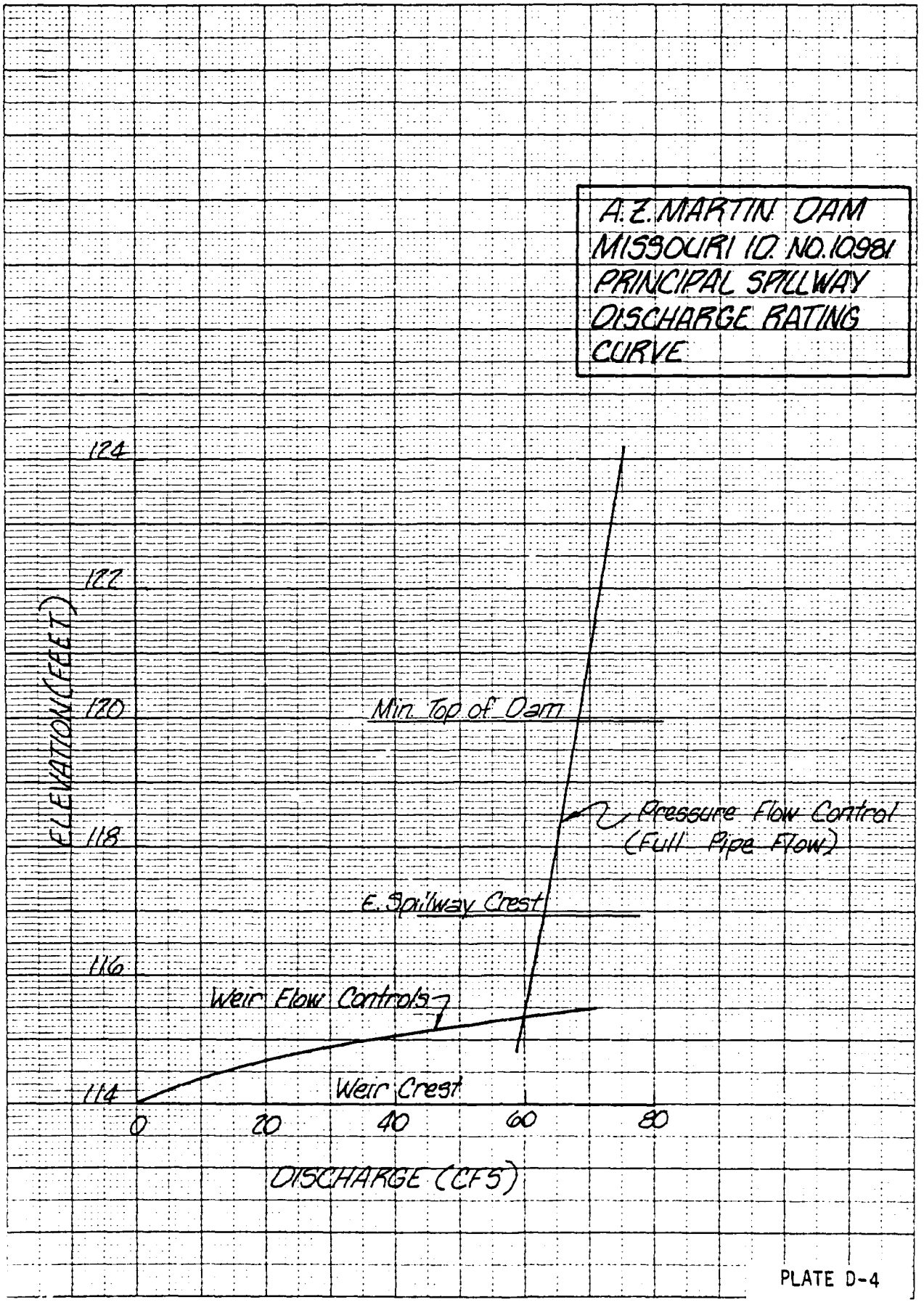


PLATE D-4

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A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF A Z MARTIN DAM 10981
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 0002880000000000000005                                  000000000000000000000003
B1000005
J 000001000000090000001
J10000.2000000.300000.3500000.4000000.4500000.5000000.55000000.8000001.0
K 00000000000001                          000000000000000000000001
K1       CALCULATION OF INFLOW HYDRO TO RES 10981
M 000001000000020000.375          0000.375000001.0                          00000001
P 000000000023.70000010200000121000001 30
T                                                              -1.0    -91.0
W2       00000.42
X 000000     1.0100000001
K 00000100000002                          000000020000000000000001
K1       ROUTED FLOWS THRU RES 10981
Y                              0000000100000001
Y1000001                                                     -114.0       -1
Y40114.0000114.5000115.0000116.0000117.0000118.0000119.0000120.0000120.5000121.0
Y40122.0000123.0000124.0
Y50000000000013.0000037.0000061.0000068.0000135.0000302.0000568.0000739.0000930.
Y501402.0001973.0002625.
$S0000000000013.0000035.0000050.000098.7000145.40000167.0000218.0000267.0000316.
$E00100.0000104.0000108.0000110.0000114.000116.70000118.0000120.0000122.0000124.
$$0114.0
$D119.95000002.5000001.50000584.
$L0000000000022.0000115.0000355.0000590.0000601.0000613.0000623.0000651.0000676.
$V119.95000120.0000120.2000120.4000120.6000121.0000121.5000121.9000123.0000124.0
K 000099
A
A
A
A
A
```

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE  80/05/19.
     TIME  12.18.04.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF A Z MARTIN DAM 10981
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .20 .30 .35 .40 .45 .50 .55 .80 1.00

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDRO TO RES 10981

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.38	0.00	.38	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.70	102.00	121.00	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	-91.00	0.00	0.00

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

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .42

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 27 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .42 VOL= 1.00

34.	103.	215.	331.	388.	389.	347.	288.	210.	152.
113.	86.	64.	48.	36.	26.	20.	15.	11.	8.
6.	5.	4.	3.	2.	1.	0.			

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.20	.20	.01	181.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.20	.20	.00	195.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.20	.20	.00	224.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.20	.20	.00	269.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.20	.20	.00	322.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.20	.20	.00	375.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.20	.20	.00	423.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.20	.20	.00	462.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.20	.20	.00	491.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.20	.20	.00	512.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.20	.20	.00	528.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.20	.20	.00	540.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.24	.24	.00	551.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.24	.24	.00	562.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.24	.24	.00	576.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.24	.24	.00	593.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.24	.24	.00	611.
1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.24	.24	.00	629.
1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.24	.24	.00	645.
1.01	1.40	20	.01	.00	.01	0.	1.01	13.40	164	.24	.24	.00	658.
1.01	1.45	21	.01	.00	.01	0.	1.01	13.45	165	.24	.24	.00	668.
1.01	1.50	22	.01	.00	.01	1.	1.01	13.50	166	.24	.24	.00	675.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.24	.24	.00	680.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.24	.24	.00	684.
1.01	2.05	25	.01	.00	.01	2.	1.01	14.05	169	.30	.30	.00	689.
1.01	2.10	26	.01	.00	.01	2.	1.01	14.10	170	.30	.30	.00	698.
1.01	2.15	27	.01	.00	.01	3.	1.01	14.15	171	.30	.30	.00	713.
1.01	2.20	28	.01	.00	.01	4.	1.01	14.20	172	.30	.30	.00	734.
1.01	2.25	29	.01	.00	.01	4.	1.01	14.25	173	.30	.30	.00	758.
1.01	2.30	30	.01	.00	.01	5.	1.01	14.30	174	.30	.30	.00	782.
1.01	2.35	31	.01	.00	.01	5.	1.01	14.35	175	.30	.30	.00	804.
1.01	2.40	32	.01	.00	.01	6.	1.01	14.40	176	.30	.30	.00	822.
1.01	2.45	33	.01	.00	.01	7.	1.01	14.45	177	.30	.30	.00	835.
1.01	2.50	34	.01	.00	.01	7.	1.01	14.50	178	.30	.30	.00	844.
1.01	2.55	35	.01	.00	.01	8.	1.01	14.55	179	.30	.30	.00	851.
1.01	3.00	36	.01	.00	.01	8.	1.01	15.00	180	.30	.30	.00	857.
1.01	3.05	37	.01	.00	.01	9.	1.01	15.05	181	.18	.18	.00	857.
1.01	3.10	38	.01	.00	.01	9.	1.01	15.10	182	.37	.37	.00	854.
1.01	3.15	39	.01	.00	.01	10.	1.01	15.15	183	.37	.37	.00	850.
1.01	3.20	40	.01	.00	.01	10.	1.01	15.20	184	.55	.55	.00	858.
1.01	3.25	41	.01	.00	.01	11.	1.01	15.25	185	.64	.64	.00	897.
1.01	3.30	42	.01	.00	.01	11.	1.01	15.30	186	1.56	1.56	.00	1003.
1.01	3.35	43	.01	.00	.01	12.	1.01	15.35	187	2.57	2.57	.01	1242.
1.01	3.40	44	.01	.01	.01	12.	1.01	15.40	188	1.01	1.01	.00	1622.
1.01	3.45	45	.01	.01	.01	13.	1.01	15.45	189	.64	.64	.00	2105.
1.01	3.50	46	.01	.01	.01	13.	1.01	15.50	190	.55	.55	.00	2538.
1.01	3.55	47	.01	.01	.01	13.	1.01	15.55	191	.37	.37	.00	2775.
1.01	4.00	48	.01	.01	.01	14.	1.01	16.00	192	.37	.37	.00	2797.
1.01	4.05	49	.01	.01	.01	14.	1.01	16.05	193	.28	.28	.00	2646.
1.01	4.10	50	.01	.01	.01	15.	1.01	16.10	194	.28	.28	.00	2382.
1.01	4.15	51	.01	.01	.01	15.	1.01	16.15	195	.28	.28	.00	2062.
1.01	4.20	52	.01	.01	.01	15.	1.01	16.20	196	.28	.28	.00	1777.
1.01	4.25	53	.01	.01	.01	16.	1.01	16.25	197	.28	.28	.00	1550.
1.01	4.30	54	.01	.01	.01	16.	1.01	16.30	198	.28	.28	.00	1372.
1.01	4.35	55	.01	.01	.01	16.	1.01	16.35	199	.28	.28	.00	1232.
1.01	4.40	56	.01	.01	.01	17.	1.01	16.40	200	.28	.28	.00	1126.
1.01	4.45	57	.01	.01	.01	17.	1.01	16.45	201	.28	.28	.00	1048.
1.01	4.50	58	.01	.01	.01	17.	1.01	16.50	202	.28	.28	.00	989.
1.01	4.55	59	.01	.01	.01	17.	1.01	16.55	203	.28	.28	.00	945.

1.01	5.00	60	.01	.01	.01	18.	1.01	17.00	204	.28	.28	.00	912.
1.01	5.05	61	.01	.01	.01	18.	1.01	17.05	205	.22	.22	.00	886.
1.01	5.10	62	.01	.01	.01	18.	1.01	17.10	206	.22	.22	.00	862.
1.01	5.15	63	.01	.01	.00	19.	1.01	17.15	207	.22	.22	.00	836.
1.01	5.20	64	.01	.01	.00	19.	1.01	17.20	208	.22	.22	.00	806.
1.01	5.25	65	.01	.01	.00	19.	1.01	17.25	209	.22	.22	.00	775.
1.01	5.30	66	.01	.01	.00	19.	1.01	17.30	210	.22	.22	.00	746.
1.01	5.35	67	.01	.01	.00	20.	1.01	17.35	211	.22	.22	.00	720.
1.01	5.40	68	.01	.01	.00	20.	1.01	17.40	212	.22	.22	.00	699.
1.01	5.45	69	.01	.01	.00	20.	1.01	17.45	213	.22	.22	.00	683.
1.01	5.50	70	.01	.01	.00	20.	1.01	17.50	214	.22	.22	.00	671.
1.01	5.55	71	.01	.01	.00	20.	1.01	17.55	215	.22	.22	.00	663.
1.01	6.00	72	.01	.01	.00	21.	1.01	18.00	216	.22	.22	.00	658.
1.01	6.05	73	.06	.04	.02	22.	1.01	18.05	217	.02	.02	.00	647.
1.01	6.10	74	.06	.04	.02	26.	1.01	18.10	218	.02	.02	.00	623.
1.01	6.15	75	.06	.04	.02	33.	1.01	18.15	219	.02	.02	.00	577.
1.01	6.20	76	.06	.04	.02	45.	1.01	18.20	220	.02	.02	.00	508.
1.01	6.25	77	.06	.05	.02	59.	1.01	18.25	221	.02	.02	.00	428.
1.01	6.30	78	.06	.05	.02	73.	1.01	18.30	222	.02	.02	.00	348.
1.01	6.35	79	.06	.05	.01	87.	1.01	18.35	223	.02	.02	.00	276.
1.01	6.40	80	.06	.05	.01	99.	1.01	18.40	224	.02	.02	.00	217.
1.01	6.45	81	.06	.05	.01	108.	1.01	18.45	225	.02	.02	.00	174.
1.01	6.50	82	.06	.05	.01	116.	1.01	18.50	226	.02	.02	.00	143.
1.01	6.55	83	.06	.05	.01	122.	1.01	18.55	227	.02	.02	.00	120.
1.01	7.00	84	.06	.05	.01	128.	1.01	19.00	228	.02	.02	.00	102.
1.01	7.05	85	.06	.05	.01	132.	1.01	19.05	229	.02	.02	.00	89.
1.01	7.10	86	.06	.05	.01	136.	1.01	19.10	230	.02	.02	.00	79.
1.01	7.15	87	.06	.05	.01	139.	1.01	19.15	231	.02	.02	.00	72.
1.01	7.20	88	.06	.05	.01	142.	1.01	19.20	232	.02	.02	.00	67.
1.01	7.25	89	.06	.05	.01	145.	1.01	19.25	233	.02	.02	.00	63.
1.01	7.30	90	.06	.05	.01	147.	1.01	19.30	234	.02	.02	.00	60.
1.01	7.35	91	.06	.05	.01	149.	1.01	19.35	235	.02	.02	.00	57.
1.01	7.40	92	.06	.06	.01	151.	1.01	19.40	236	.02	.02	.00	56.
1.01	7.45	93	.06	.06	.01	153.	1.01	19.45	237	.02	.02	.00	54.
1.01	7.50	94	.06	.06	.01	154.	1.01	19.50	238	.02	.02	.00	54.
1.01	7.55	95	.06	.06	.01	156.	1.01	19.55	239	.02	.02	.00	53.
1.01	8.00	96	.06	.06	.01	157.	1.01	20.00	240	.02	.02	.00	52.
1.01	8.05	97	.06	.06	.01	158.	1.01	20.05	241	.02	.02	.00	52.
1.01	8.10	98	.06	.06	.01	159.	1.01	20.10	242	.02	.02	.00	52.
1.01	8.15	99	.06	.06	.01	160.	1.01	20.15	243	.02	.02	.00	52.
1.01	8.20	100	.06	.06	.01	161.	1.01	20.20	244	.02	.02	.00	52.
1.01	8.25	101	.06	.06	.01	162.	1.01	20.25	245	.02	.02	.00	52.
1.01	8.30	102	.06	.06	.01	163.	1.01	20.30	246	.02	.02	.00	52.
1.01	8.35	103	.06	.06	.00	163.	1.01	20.35	247	.02	.02	.00	52.
1.01	8.40	104	.06	.06	.00	164.	1.01	20.40	248	.02	.02	.00	52.
1.01	8.45	105	.06	.06	.00	165.	1.01	20.45	249	.02	.02	.00	52.
1.01	8.50	106	.06	.06	.00	165.	1.01	20.50	250	.02	.02	.00	52.
1.01	8.55	107	.06	.06	.00	166.	1.01	20.55	251	.02	.02	.00	52.
1.01	9.00	108	.06	.06	.00	167.	1.01	21.00	252	.02	.02	.00	52.
1.01	9.05	109	.06	.06	.00	167.	1.01	21.05	253	.02	.02	.00	52.
1.01	9.10	110	.06	.06	.00	168.	1.01	21.10	254	.02	.02	.00	52.
1.01	9.15	111	.06	.06	.00	168.	1.01	21.15	255	.02	.02	.00	52.
1.01	9.20	112	.06	.06	.00	169.	1.01	21.20	256	.02	.02	.00	52.
1.01	9.25	113	.06	.06	.00	169.	1.01	21.25	257	.02	.02	.00	52.
1.01	9.30	114	.06	.06	.00	169.	1.01	21.30	258	.02	.02	.00	52.
1.01	9.35	115	.06	.06	.00	170.	1.01	21.35	259	.02	.02	.00	52.
1.01	9.40	116	.06	.06	.00	170.	1.01	21.40	260	.02	.02	.00	52.
1.01	9.45	117	.06	.06	.00	171.	1.01	21.45	261	.02	.02	.00	52.
1.01	9.50	118	.06	.06	.00	171.	1.01	21.50	262	.02	.02	.00	52.
1.01	9.55	119	.06	.06	.00	171.	1.01	21.55	263	.02	.02	.00	52.
1.01	10.00	120	.06	.06	.00	172.	1.01	22.00	264	.02	.02	.00	52.
1.01	10.05	121	.06	.06	.00	172.	1.01	22.05	265	.02	.02	.00	52.

1.01	10.10	122	.06	.06	.00	172.	1.01	22.10	266	.02	.02	.00	52.
1.01	10.15	123	.06	.06	.00	172.	1.01	22.15	267	.02	.02	.00	52.
1.01	10.20	124	.06	.06	.00	173.	1.01	22.20	268	.02	.02	.00	52.
1.01	10.25	125	.06	.06	.00	173.	1.01	22.25	269	.02	.02	.00	52.
1.01	10.30	126	.06	.06	.00	173.	1.01	22.30	270	.02	.02	.00	52.
1.01	10.35	127	.06	.06	.00	173.	1.01	22.35	271	.02	.02	.00	52.
1.01	10.40	128	.06	.06	.00	174.	1.01	22.40	272	.02	.02	.00	52.
1.01	10.45	129	.06	.06	.00	174.	1.01	22.45	273	.02	.02	.00	52.
1.01	10.50	130	.06	.06	.00	174.	1.01	22.50	274	.02	.02	.00	52.
1.01	10.55	131	.06	.06	.00	174.	1.01	22.55	275	.02	.02	.00	52.
1.01	11.00	132	.06	.06	.00	174.	1.01	23.00	276	.02	.02	.00	52.
1.01	11.05	133	.06	.06	.00	174.	1.01	23.05	277	.02	.02	.00	52.
1.01	11.10	134	.06	.06	.00	175.	1.01	23.10	278	.02	.02	.00	52.
1.01	11.15	135	.06	.06	.00	175.	1.01	23.15	279	.02	.02	.00	52.
1.01	11.20	136	.06	.06	.00	175.	1.01	23.20	280	.02	.02	.00	52.
1.01	11.25	137	.06	.06	.00	175.	1.01	23.25	281	.02	.02	.00	52.
1.01	11.30	138	.06	.06	.00	175.	1.01	23.30	282	.02	.02	.00	52.
1.01	11.35	139	.06	.06	.00	175.	1.01	23.35	283	.02	.02	.00	52.
1.01	11.40	140	.06	.06	.00	176.	1.01	23.40	284	.02	.02	.00	52.
1.01	11.45	141	.06	.06	.00	176.	1.01	23.45	285	.02	.02	.00	52.
1.01	11.50	142	.06	.06	.00	176.	1.01	23.50	286	.02	.02	.00	52.
1.01	11.55	143	.06	.06	.00	176.	1.01	23.55	287	.02	.02	.00	52.
1.01	12.00	144	.06	.06	.00	176.	1.02	0.00	288	.02	.02	.00	52.
									SUM	30.81	29.65	1.16	85776.
										(783.)(	753.)(	29.)(	2428.91)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2797.	951.	298.	298.	85728.
CMS	79.	27.	8.	8.	2428.
INCHES		23.59	29.54	29.54	29.54
MM		599.12	750.21	750.21	750.21
AC-FT		472.	590.	590.	590.
THOUS CU M		582.	728.	728.	728.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	559.	190.	60.	60.	17146.
CMS	16.	5.	2.	2.	486.
INCHES		4.72	5.91	5.91	5.91
MM		119.82	150.04	150.04	150.04
AC-FT		94.	118.	118.	118.
THOUS CU M		116.	146.	146.	146.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	839.	285.	89.	89.	25718.
CMS	24.	8.	3.	3.	728.
INCHES		7.08	8.86	8.86	8.86
MM		179.74	225.06	225.06	225.06
AC-FT		141.	177.	177.	177.
THOUS CU M		174.	218.	218.	218.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

CFS	2237.	761.	238.	238.	68582.
CMS	63.	22.	7.	7.	1942.
INCHES		18.87	23.63	23.63	23.63
MM		479.30	600.17	600.17	600.17
AC-FT		377.	472.	472.	472.
THOUS CU M		465.	583.	583.	583.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2797.	951.	298.	298.	85728.
CMS	79.	27.	8.	8.	2428.
INCHES		23.59	29.54	29.54	29.54
MM		599.12	750.21	750.21	750.21
AC-FT		472.	590.	590.	590.
THOUS CU M		582.	728.	728.	728.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RES 10981

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-114.	-1

STAGE	114.00	114.50	115.00	116.00	117.00	118.00	119.00	120.00	120.50	121.00
	122.00	123.00	124.00							
FLOW	0.00	13.00	37.00	61.00	68.00	135.00	302.00	568.00	739.00	930.00
	1402.00	1973.00	2625.00							
CAPACITY=	0.	13.	35.	50.	99.	145.	167.	218.	267.	316.
ELEVATION=	100.	104.	108.	110.	114.	117.	118.	120.	122.	124.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
114.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
120.0	2.5	1.5	584.

CREST LENGTH	0.	22.	115.	355.	590.	601.	613.	623.	651.	676.
AT OR BELOW ELEVATION	120.0	120.0	120.2	120.4	120.6	121.0	121.5	121.9	123.0	124.0

STATION 000002, PLAN 1, RATIO 1

OVN

STATION 000002, PLAN 1, RATIO 4 [0.40 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	3.	3.	4.
4.	4.	5.	5.	6.	6.	7.	7.	8.	8.
9.	9.	10.	10.	11.	12.	12.	13.	13.	14.
15.	16.	17.	18.	19.	20.	21.	21.	22.	23.
24.	25.	26.	26.	27.	28.	29.	29.	30.	31.
32.	32.	33.	34.	34.	35.	36.	36.	37.	37.
38.	38.	38.	39.	39.	39.	39.	40.	40.	40.
41.	41.	41.	41.	42.	42.	42.	43.	44.	45.
46.	47.	48.	50.	51.	53.	54.	56.	58.	59.
61.	62.	62.	63.	63.	64.	64.	65.	65.	66.
67.	67.	68.	75.	81.	88.	95.	101.	108.	114.
120.	127.	132.	140.	149.	160.	172.	190.	214.	246.
282.	328.	381.	424.	457.	478.	491.	498.	499.	497.
493.	487.	480.	473.	465.	457.	449.	440.	432.	423.
414.	405.	396.	387.	379.	371.	363.	356.	348.	339.
328.	316.	303.	294.	284.	274.	265.	255.	245.	236.
227.	218.	210.	201.	194.	186.	179.	172.	165.	159.
153.	147.	141.	136.	132.	129.	126.	124.	121.	118.
115.	113.	110.	108.	105.	103.	101.	99.	96.	94.
92.	91.	89.	87.	85.	83.	82.	80.	78.	77.
75.	74.	72.	71.	70.	68.	68.	68.	68.	67.
67.	67.	67.	67.	67.	67.	67.	66.		

STORAGE

99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	100.	100.	100.	100.
100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	100.	100.	100.	101.	101.	101.
101.	102.	102.	102.	103.	103.	103.	104.	104.	104.
105.	105.	105.	106.	106.	106.	107.	107.	107.	108.
108.	108.	109.	109.	109.	110.	110.	110.	111.	111.
111.	112.	112.	112.	112.	113.	113.	113.	114.	114.
114.	114.	115.	115.	115.	115.	116.	116.	116.	116.
116.	117.	117.	117.	117.	118.	118.	118.	118.	118.
119.	119.	119.	119.	119.	120.	120.	120.	121.	121.
122.	123.	124.	125.	126.	127.	128.	130.	131.	132.
133.	135.	136.	137.	139.	140.	141.	143.	144.	146.
147.	149.	150.	152.	154.	155.	157.	159.	160.	162.
163.	165.	166.	168.	169.	171.	173.	175.	179.	184.
189.	195.	200.	204.	207.	209.	211.	211.	211.	211.
211.	210.	210.	209.	208.	207.	207.	206.	205.	204.
203.	202.	202.	201.	200.	199.	198.	198.	197.	196.
195.	194.	193.	191.	190.	188.	187.	185.	184.	182.
181.	180.	178.	177.	176.	175.	174.	173.	172.	171.

170.	169.	168.	167.	166.	166.	165.	164.	163.	163.
162.	161.	161.	160.	160.	159.	159.	158.	157.	157.
156.	156.	156.	155.	155.	154.	154.	153.	153.	153.
152.	152.	151.	151.	151.	150.	150.	150.	149.	149.
149.	148.	148.	148.	148.	147.	147.	147.		

STAGE

114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.1	114.1
114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.2	114.2	114.2	114.2	114.2	114.2	114.3	114.3	114.3	114.3
114.3	114.4	114.4	114.4	114.4	114.4	114.5	114.5	114.5	114.5
114.5	114.6	114.6	114.6	114.6	114.6	114.7	114.7	114.7	114.7
114.7	114.7	114.8	114.8	114.8	114.8	114.8	114.8	114.9	114.9
114.9	114.9	114.9	114.9	114.9	115.0	115.0	115.0	115.0	115.0
115.0	115.0	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1
115.1	115.2	115.2	115.2	115.2	115.2	115.2	115.2	115.3	115.3
115.4	115.4	115.5	115.5	115.6	115.7	115.7	115.8	115.9	115.9
116.0	116.1	116.2	116.2	116.3	116.4	116.5	116.6	116.6	116.7
116.8	116.9	117.0	117.1	117.2	117.3	117.4	117.5	117.6	117.7
117.8	117.9	118.0	118.0	118.1	118.1	118.2	118.3	118.5	118.7
118.9	119.1	119.3	119.5	119.6	119.7	119.7	119.7	119.7	119.7
119.7	119.7	119.7	119.6	119.6	119.6	119.6	119.5	119.5	119.5
119.4	119.4	119.4	119.3	119.3	119.3	119.2	119.2	119.2	119.1
119.1	119.1	119.0	118.9	118.9	118.8	118.8	118.7	118.7	118.6
118.6	118.5	118.4	118.4	118.4	118.3	118.3	118.2	118.2	118.1
118.1	118.1	118.0	118.0	118.0	117.9	117.9	117.8	117.8	117.7
117.7	117.7	117.6	117.6	117.6	117.5	117.5	117.5	117.4	117.4
117.4	117.3	117.3	117.3	117.3	117.2	117.2	117.2	117.2	117.1
117.1	117.1	117.1	117.0	117.0	117.0	117.0	117.0	116.9	116.9
116.9	116.9	116.9	116.8	116.8	116.8	116.8	116.8		

PEAK OUTFLOW IS 499. AT TIME 16.58 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	499.	286.	95.	95.	27352.
CMS	14.	8.	3.	3.	775.
INCHES		7.10	9.42	9.42	9.42
MM		180.33	239.36	239.36	239.36
AC-FT		142.	188.	188.	188.
THOUS CU M		175.	232.	232.	232.

OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

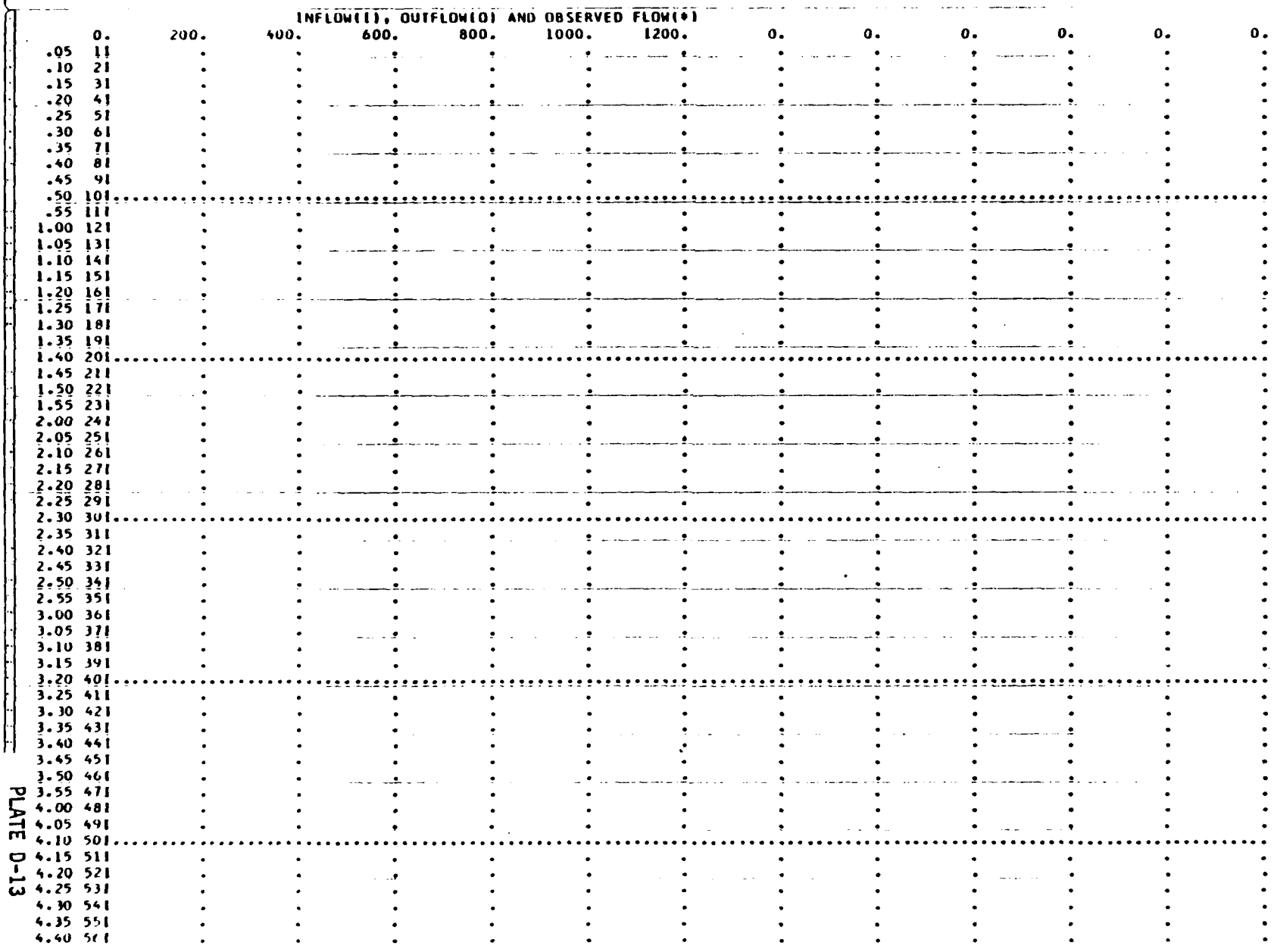
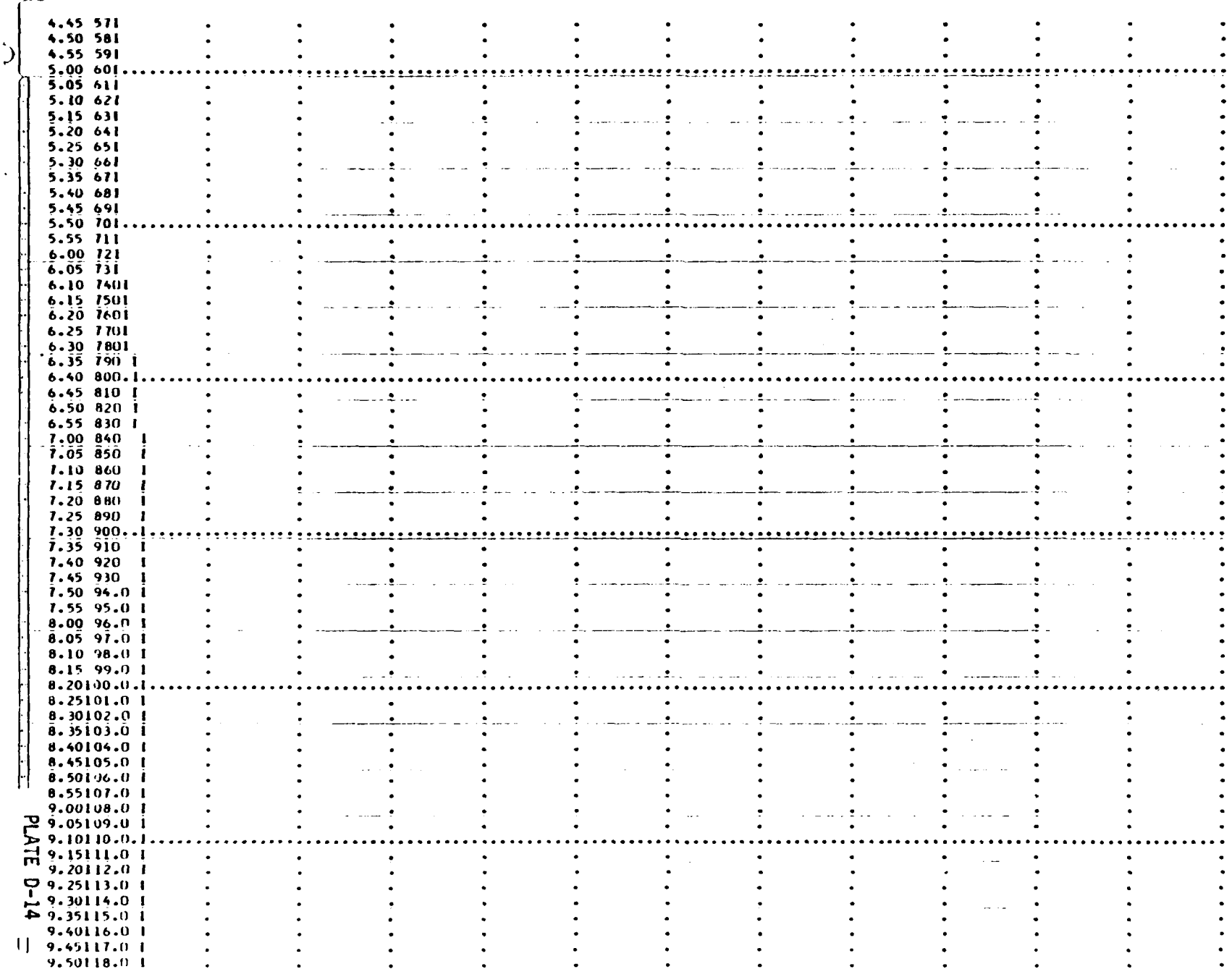


PLATE D-13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4.55 591
5.00 601
5.05 611
5.10 621
5.15 631
5.20 641
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5.30 661
5.35 671
5.40 681
5.45 691
5.50 701
5.55 711
6.00 721
6.05 731
6.10 7401
6.15 7501
6.20 7601
6.25 7701
6.30 7801
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6.40 800.I
6.45 810 I
6.50 820 I
6.55 830 I
7.00 840 I
7.05 850 I
7.10 860 I
7.15 870 I
7.20 880 I
7.25 890 I
7.30 900.I
7.35 910 I
7.40 920 I
7.45 930 I
7.50 94.0 I
7.55 95.0 I
8.00 96.0 I
8.05 97.0 I
8.10 98.0 I
8.15 99.0 I
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PLATE D-14

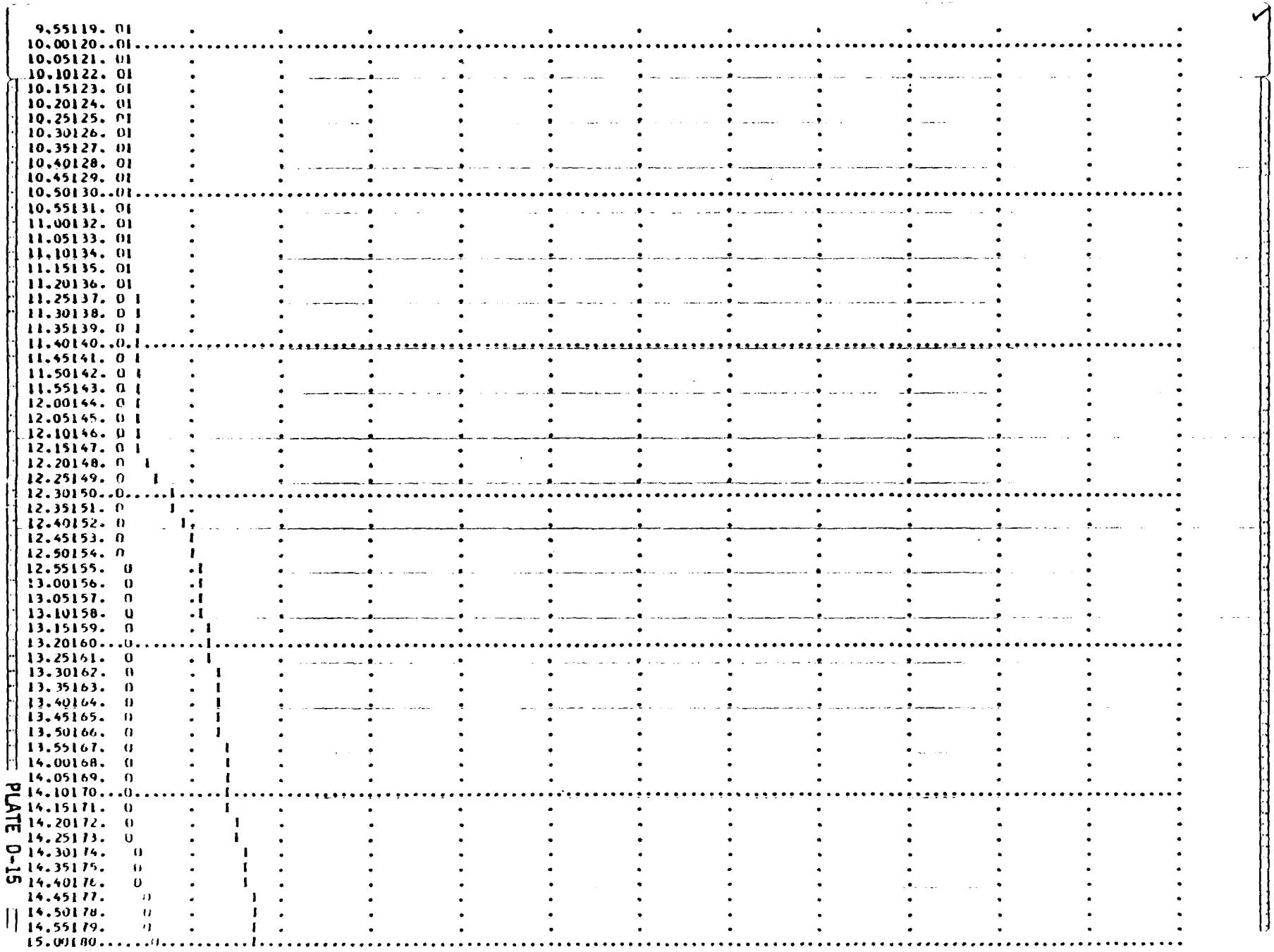

PLATE D-15

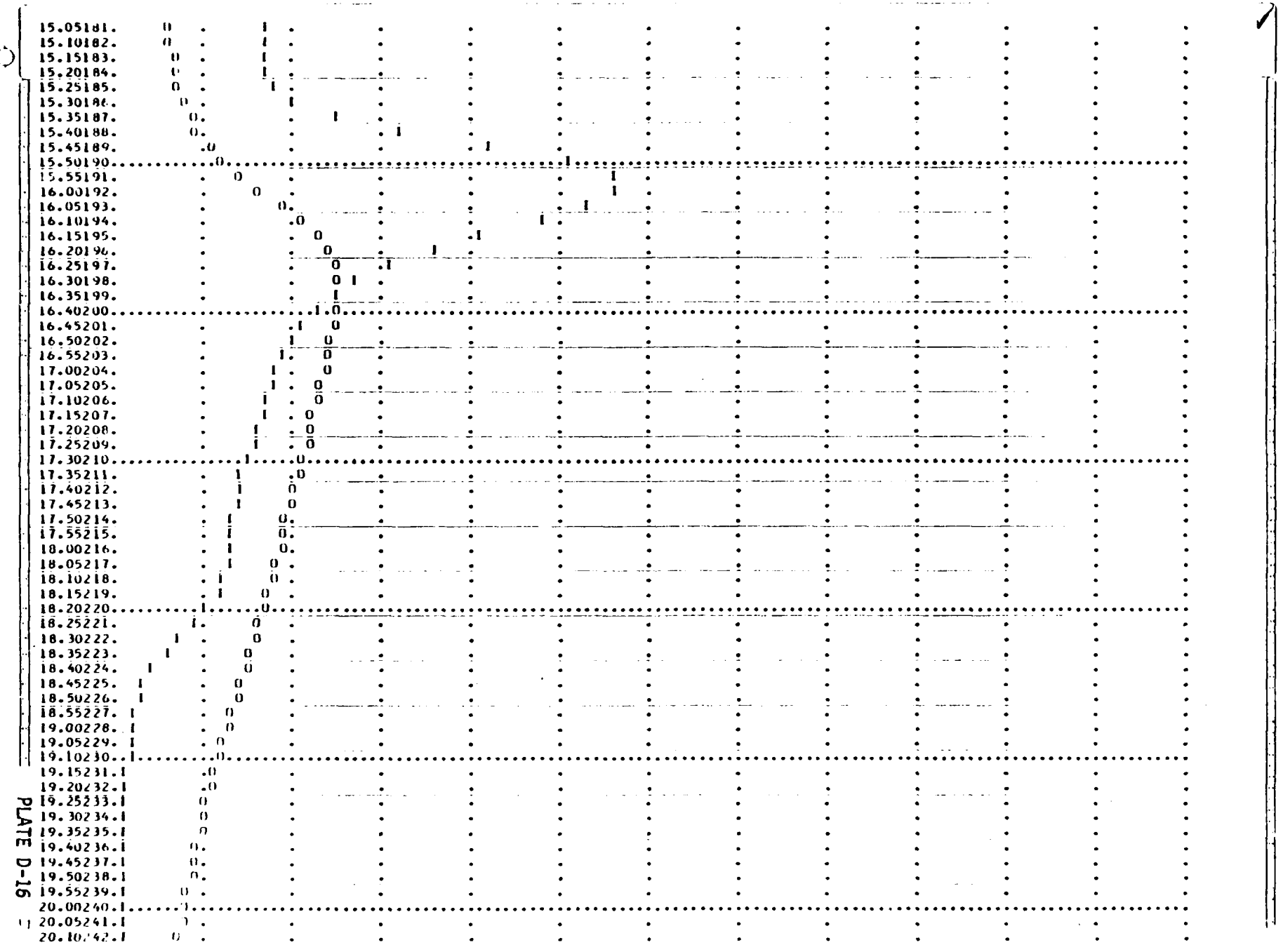
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PLATE D-16

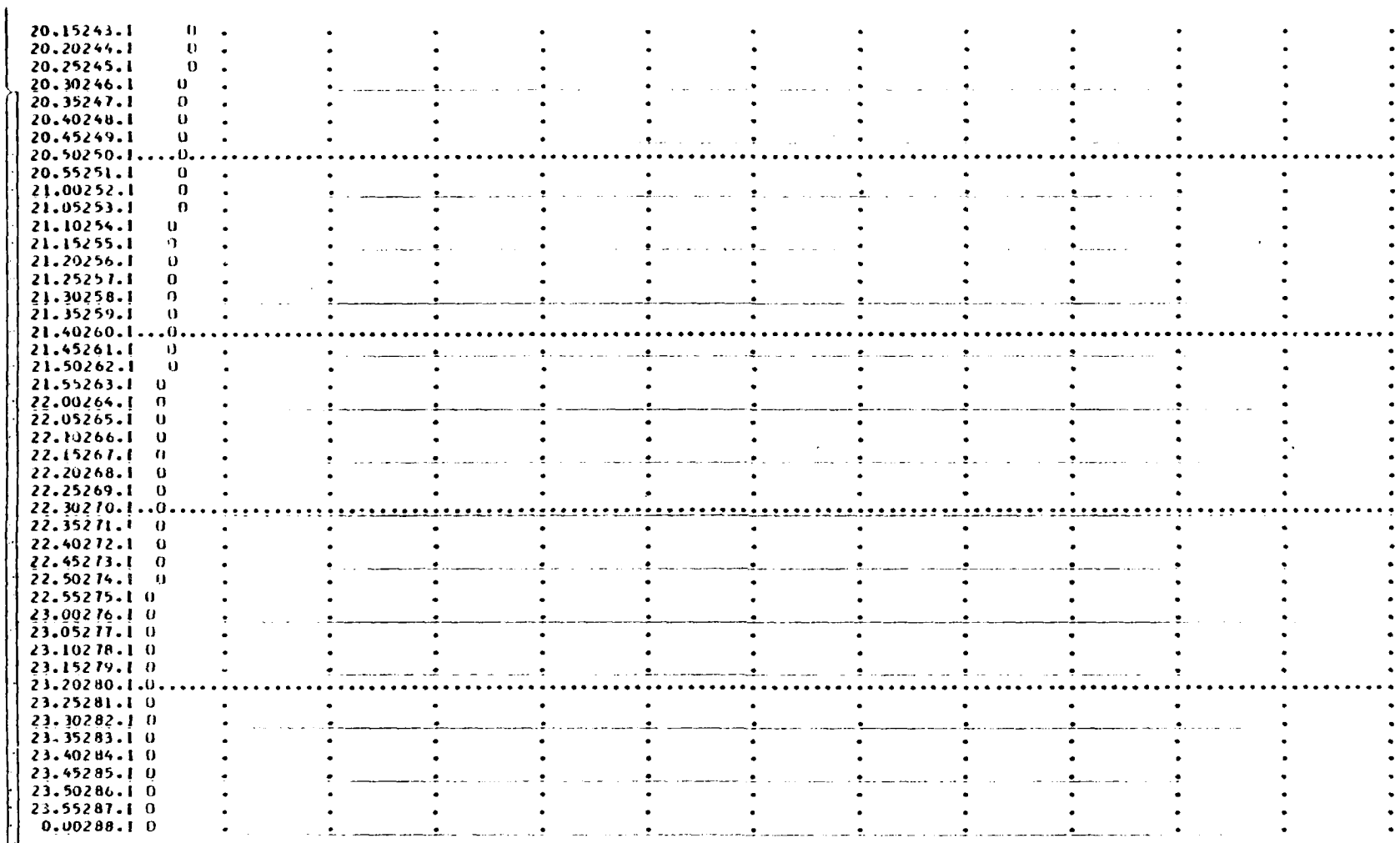
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PLATE D-17

AD-A105 331 HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BEAR CREEK WATERSHED STRUCTURE B-2--ETC(U)
MAY 80 R S DECKER, G JAMISON, G ULMER DACW43-80-C-0071
UNCLASSIFIED NL

OVN

STATION 000002, PLAN 1, RATIO 6 0.50 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	3.
3.	3.	3.	3.	3.	3.	3.	4.	4.	4.
5.	6.	6.	7.	7.	8.	8.	9.	10.	10.
11.	12.	12.	13.	14.	16.	17.	18.	19.	20.
21.	23.	24.	25.	26.	27.	28.	29.	30.	31.
32.	33.	34.	35.	36.	37.	37.	38.	38.	39.
39.	40.	40.	41.	41.	41.	42.	42.	43.	43.
44.	44.	44.	45.	45.	46.	46.	46.	47.	47.
48.	48.	48.	49.	49.	49.	50.	51.	52.	53.
54.	56.	58.	59.	61.	62.	62.	63.	63.	64.
65.	65.	66.	67.	68.	72.	79.	87.	94.	101.
107.	114.	122.	129.	137.	149.	160.	172.	183.	194.
204.	214.	223.	232.	241.	252.	265.	285.	320.	379.
445.	510.	570.	647.	719.	767.	781.	770.	745.	716.
686.	660.	637.	616.	597.	581.	567.	556.	545.	533.
522.	510.	499.	488.	477.	467.	457.	447.	437.	426.
412.	397.	380.	363.	344.	326.	308.	295.	284.	273.
263.	253.	243.	234.	225.	216.	208.	200.	192.	185.
178.	171.	165.	158.	153.	147.	142.	137.	133.	130.
127.	124.	122.	119.	116.	114.	112.	109.	107.	105.
103.	100.	98.	96.	95.	93.	91.	89.	88.	86.
84.	83.	81.	80.	78.	77.	75.	74.	73.	71.
70.	69.	68.	68.	68.	68.	67.	67.		

STORAGE

99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	101.	101.	101.	101.	101.	101.	101.	102.
102.	102.	103.	103.	104.	104.	104.	105.	105.	106.
106.	107.	107.	107.	108.	108.	109.	109.	110.	110.
110.	111.	111.	112.	112.	112.	113.	113.	113.	114.
114.	115.	115.	115.	116.	116.	116.	117.	117.	117.
118.	118.	118.	119.	119.	119.	119.	120.	120.	120.
121.	121.	121.	122.	122.	122.	122.	123.	123.	123.
124.	124.	124.	124.	125.	125.	125.	126.	127.	127.
128.	130.	131.	132.	133.	135.	136.	138.	139.	141.
143.	144.	146.	148.	150.	151.	153.	155.	157.	158.
160.	162.	164.	165.	167.	169.	171.	173.	174.	176.
178.	179.	180.	182.	183.	185.	187.	190.	194.	200.
206.	212.	218.	223.	226.	227.	227.	227.	226.	225.
224.	223.	222.	221.	220.	219.	218.	217.	216.	215.
214.	212.	211.	210.	209.	208.	207.	206.	205.	204.
203.	202.	200.	198.	197.	195.	193.	191.	190.	188.
186.	185.	183.	182.	181.	179.	178.	177.	176.	175.

PLATE D-18

174.	172.	172.	171.	170.	169.	168.	167.	166.	166.
165.	164.	164.	163.	162.	162.	161.	161.	160.	159.
159.	158.	158.	157.	157.	157.	156.	156.	155.	155.
154.	154.	154.	153.	153.	153.	152.	152.	152.	151.
151.	151.	150.	150.	150.	149.	149.	149.		

STAGE

114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.2	114.2
114.2	114.2	114.2	114.3	114.3	114.3	114.3	114.4	114.4	114.4
114.4	114.5	114.5	114.5	114.5	114.6	114.6	114.6	114.6	114.7
114.7	114.7	114.7	114.7	114.8	114.8	114.8	114.8	114.9	114.9
114.9	114.9	114.9	115.0	115.0	115.0	115.0	115.0	115.1	115.1
115.1	115.1	115.1	115.1	115.2	115.2	115.2	115.2	115.2	115.3
115.3	115.3	115.3	115.3	115.3	115.4	115.4	115.4	115.4	115.4
115.4	115.5	115.5	115.5	115.5	115.5	115.5	115.6	115.6	115.7
115.7	115.8	115.9	115.9	116.0	116.1	116.2	116.3	116.4	116.4
116.5	116.6	116.7	116.8	117.0	117.1	117.2	117.3	117.4	117.5
117.6	117.7	117.8	117.9	118.0	118.1	118.2	118.2	118.3	118.4
118.4	118.5	118.5	118.6	118.6	118.7	118.8	118.9	119.1	119.3
119.5	119.8	120.0	120.2	120.3	120.4	120.4	120.4	120.3	120.3
120.3	120.2	120.2	120.1	120.1	120.0	120.0	120.0	119.9	119.9
119.8	119.8	119.7	119.7	119.7	119.6	119.6	119.5	119.5	119.5
119.4	119.4	119.3	119.2	119.2	119.1	119.0	119.0	118.9	118.8
118.8	118.7	118.6	118.6	118.5	118.5	118.4	118.4	118.3	118.3
118.3	118.2	118.2	118.1	118.1	118.1	118.0	118.0	118.0	117.9
117.9	117.8	117.8	117.8	117.7	117.7	117.7	117.6	117.6	117.5
117.5	117.5	117.5	117.4	117.4	117.4	117.3	117.3	117.3	117.3
117.2	117.2	117.2	117.2	117.2	117.1	117.1	117.1	117.1	117.1
117.0	117.0	117.0	117.0	117.0	116.9	116.9	116.9		

PEAK OUTFLOW IS 781. AT TIME 16.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	781.	383.	124.	124.	35607.
CMS	22.	11.	4.	4.	1008.
INCHES		9.49	12.27	12.27	12.27
MM		241.16	311.60	311.60	311.60
AC-FT		190.	245.	245.	245.
THOUS CU M		234.	302.	302.	302.

PLATE D-19

DVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

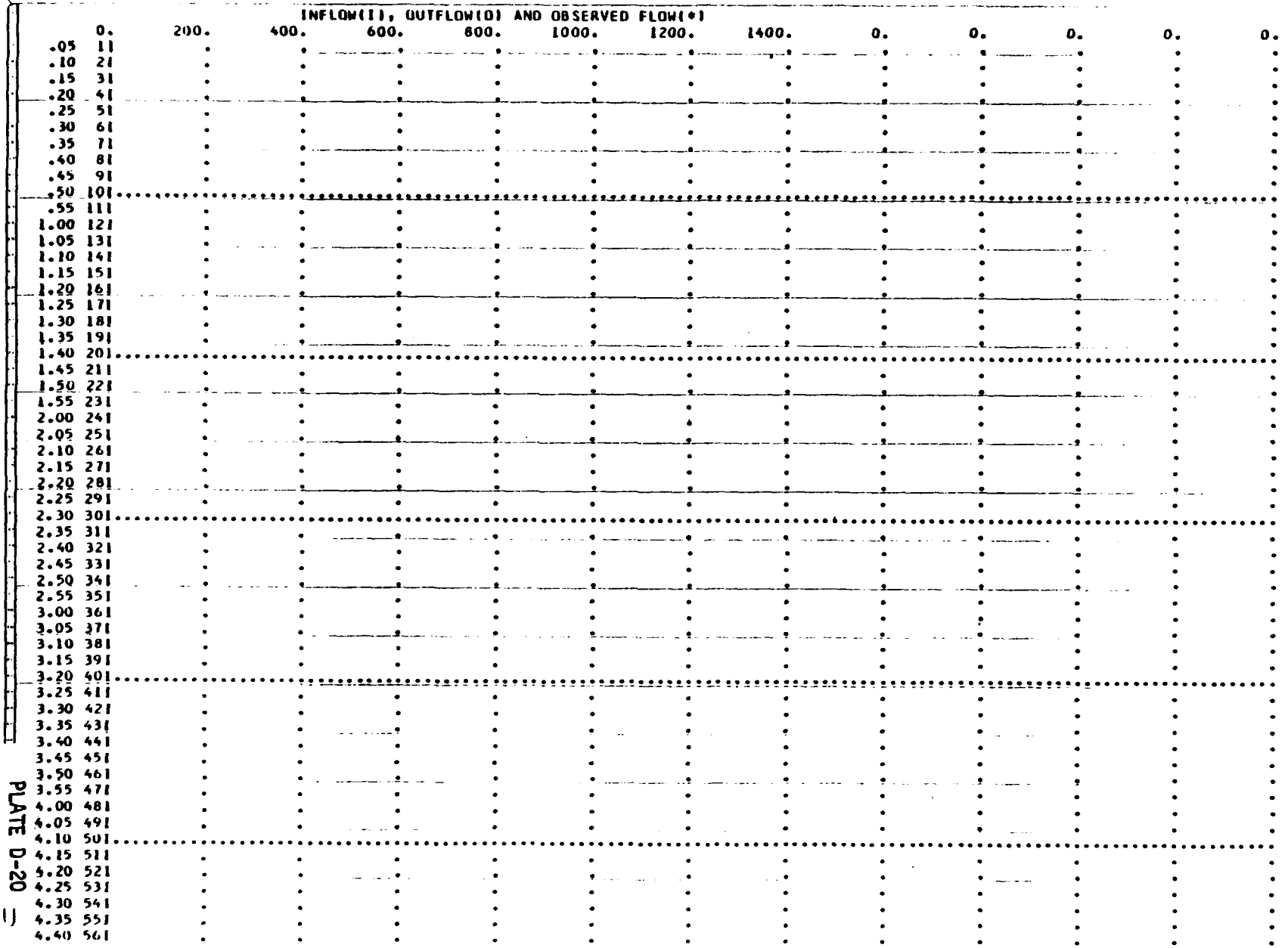
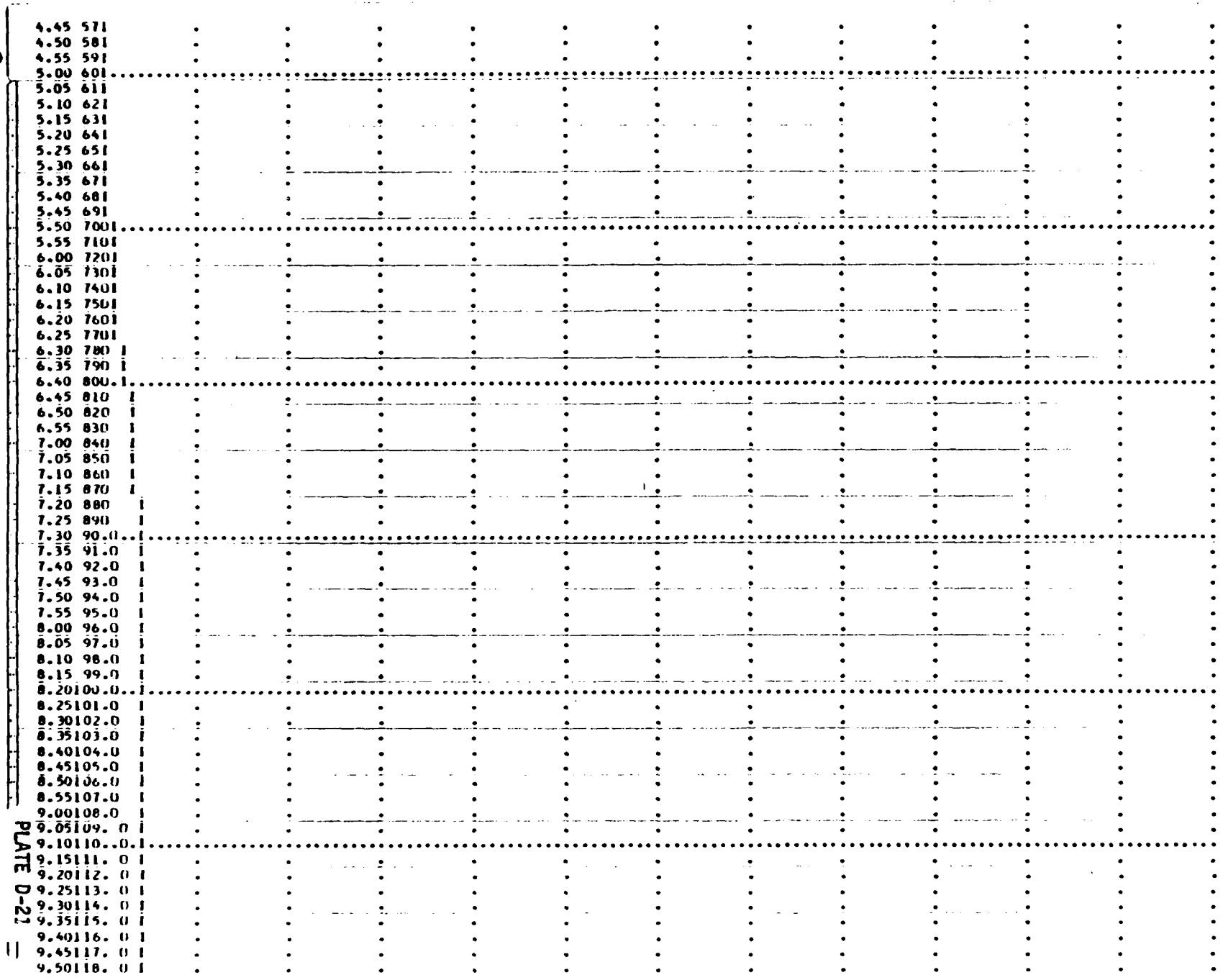


PLATE D-20


4.45 57
4.50 58
4.55 59
5.00 60
5.05 61
5.10 62
5.15 63
5.20 64
5.25 65
5.30 66
5.35 67
5.40 68
5.45 69
5.50 700
5.55 710
6.00 720
6.05 730
6.10 740
6.15 750
6.20 760
6.25 770
6.30 780
6.35 790
6.40 800
6.45 810
6.50 820
6.55 830
7.00 840
7.05 850
7.10 860
7.15 870
7.20 880
7.25 890
7.30 90.0
7.35 91.0
7.40 92.0
7.45 93.0
7.50 94.0
7.55 95.0
8.00 96.0
8.05 97.0
8.10 98.0
8.15 99.0
8.20 100.0
8.25 101.0
8.30 102.0
8.35 103.0
8.40 104.0
8.45 105.0
8.50 106.0
8.55 107.0
9.00 108.0
9.05 109. 0
9.10 110..0.
9.15 111. 0
9.20 112. 0
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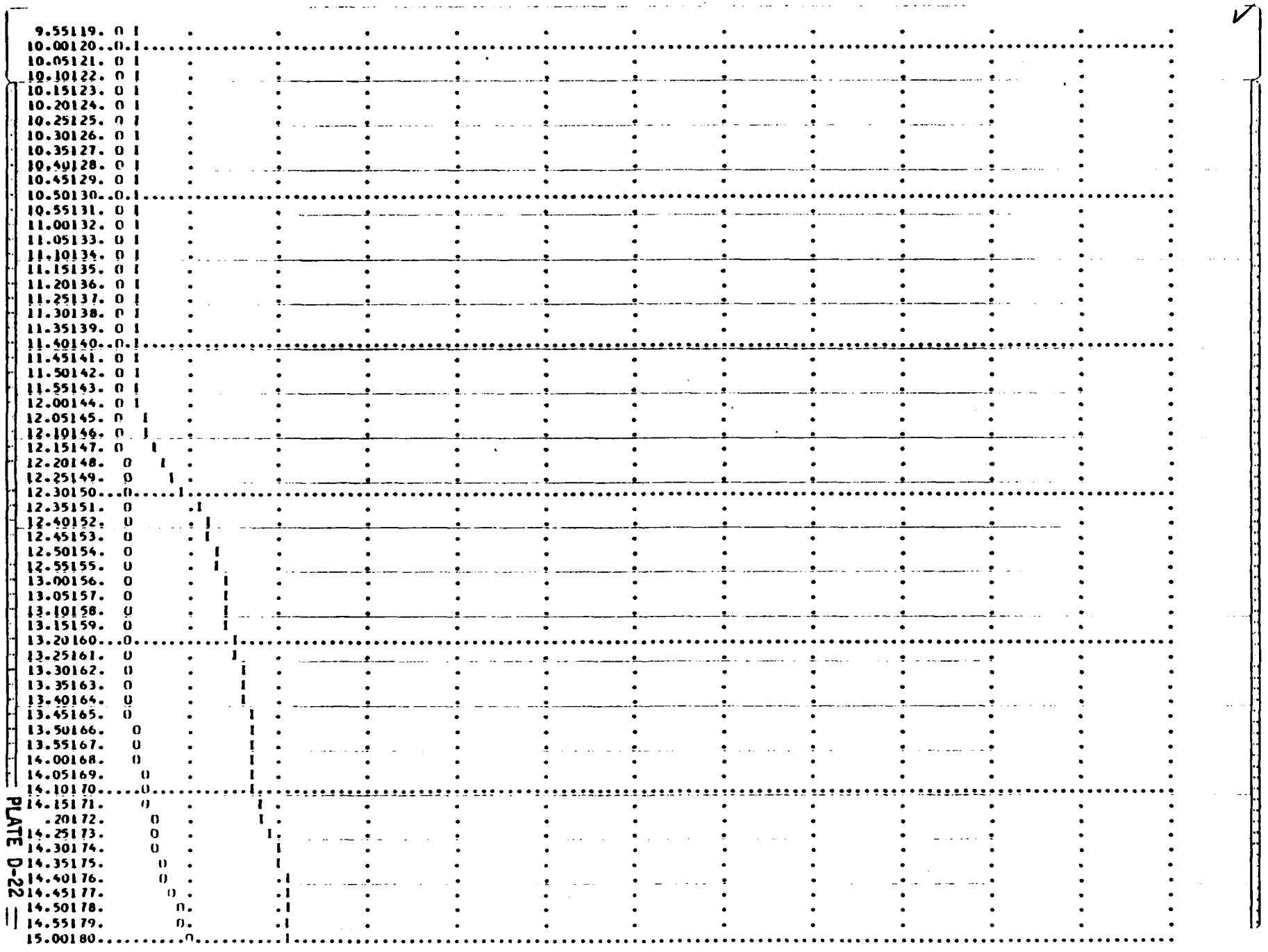
9.30 114. 0
9.35 115. 0
9.40 116. 0
9.45 117. 0
9.50 118. 0

PLATE D-21


9.55119. 0
10.00120. 0
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10.10122. 0
10.15123. 0
10.20124. 0
10.25125. 0
10.30126. 0
10.35127. 0
10.40128. 0
10.45129. 0
10.50130. 0
10.55131. 0
11.00132. 0
11.05133. 0
11.10134. 0
11.15135. 0
11.20136. 0
11.25137. 0
11.30138. 0
11.35139. 0
11.40140. 0
11.45141. 0
11.50142. 0
11.55143. 0
12.00144. 0
12.05145. 0
12.10146. 0
12.15147. 0
12.20148. 0
12.25149. 0
12.30150. 0
12.35151. 0
12.40152. 0
12.45153. 0
12.50154. 0
12.55155. 0
13.00156. 0
13.05157. 0
13.10158. 0
13.15159. 0
13.20160. 0
13.25161. 0
13.30162. 0
13.35163. 0
13.40164. 0
13.45165. 0
13.50166. 0
13.55167. 0
14.00168. 0
14.05169. 0
14.10170. 0
14.15171. 0
.20172. 0
14.25173. 0
14.30174. 0
14.35175. 0
14.40176. 0
14.45177. 0
14.50178. 0
14.55179. 0
15.00180. 0

PLATE D-22

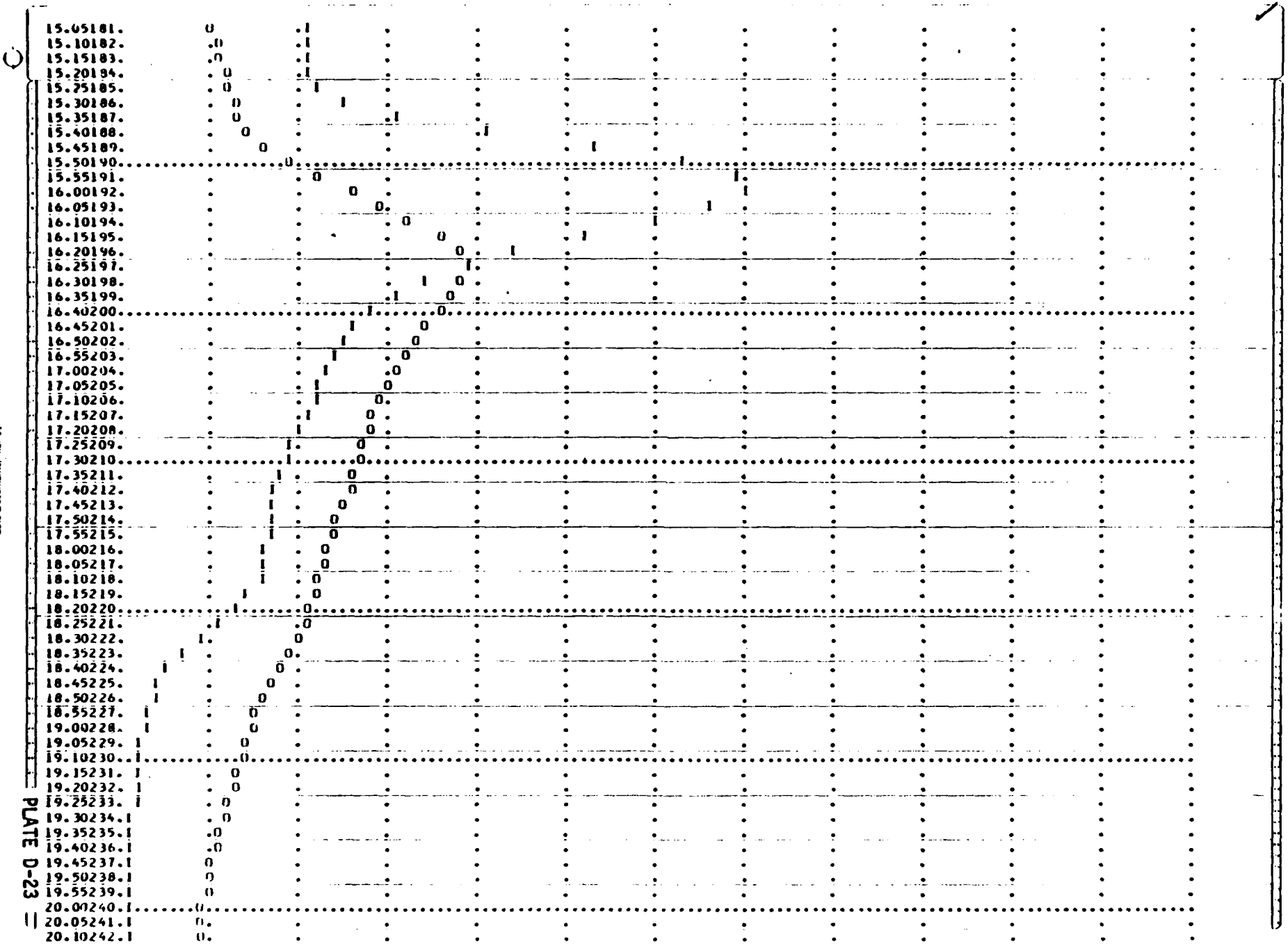
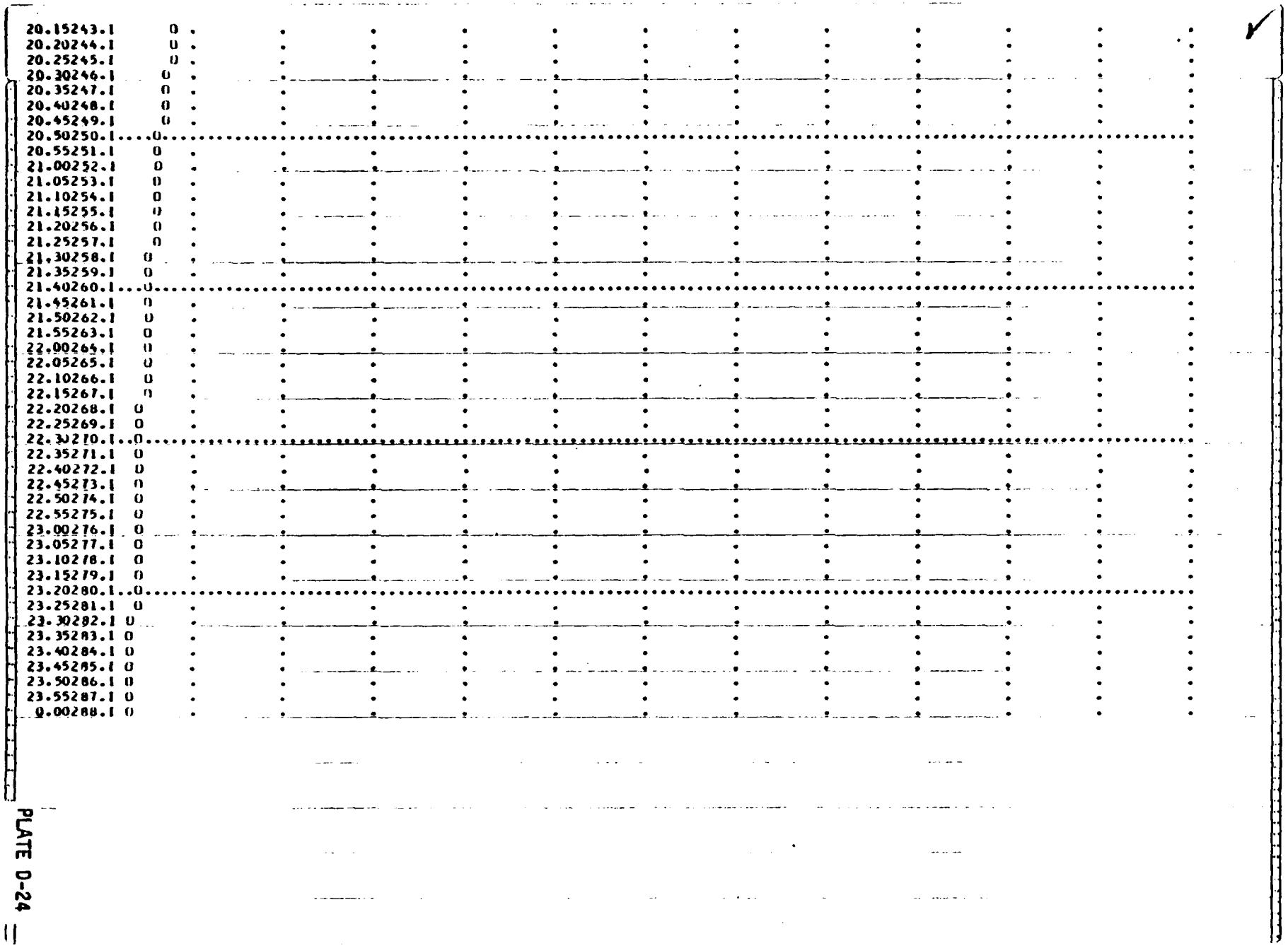


PLATE D-23

Data Documents, no. 82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22.10266.1 0
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22.20268.1 0
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22.30270.1 0
22.35271.1 0
22.40272.1 0
22.45273.1 0
22.50274.1 0
22.55275.1 0
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23.20280.1 0
23.25281.1 0
23.30282.1 0
23.35283.1 0
23.40284.1 0
23.45285.1 0
23.50286.1 0
23.55287.1 0
0.00288.1 0

PLATE D-24

DVN

STATION 000002, PLAN 1, RATIO 9 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	3.	3.	3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	4.	5.	5.	5.	5.
5.	5.	6.	6.	6.	6.	7.	7.	8.	9.
10.	11.	12.	14.	16.	18.	20.	23.	25.	27.
29.	32.	34.	36.	38.	39.	40.	41.	42.	43.
44.	46.	47.	48.	49.	50.	51.	52.	53.	54.
56.	57.	58.	59.	60.	61.	61.	62.	62.	62.
62.	63.	63.	63.	64.	64.	64.	65.	65.	65.
66.	66.	66.	66.	67.	67.	67.	68.	68.	71.
74.	77.	79.	82.	85.	87.	91.	95.	100.	107.
115.	124.	134.	149.	166.	182.	198.	214.	229.	245.
261.	277.	293.	312.	336.	360.	382.	403.	422.	441.
459.	478.	496.	515.	534.	554.	575.	602.	631.	660.
689.	718.	743.	766.	790.	829.	913.	1099.	1435.	1882.
2318.	2596.	2672.	2577.	2366.	2108.	1863.	1655.	1481.	1340.
1228.	1140.	1072.	1019.	977.	942.	913.	885.	858.	832.
808.	785.	764.	747.	731.	718.	707.	695.	680.	660.
635.	606.	575.	550.	526.	500.	475.	449.	425.	401.
379.	357.	337.	318.	301.	290.	279.	270.	260.	251.
242.	234.	226.	218.	211.	204.	197.	190.	184.	179.
173.	168.	162.	158.	153.	148.	144.	140.	136.	133.
131.	129.	127.	125.	123.	121.	119.	117.	115.	114.
112.	110.	109.	107.	106.	104.	103.	102.	100.	99.
98.	97.	96.	94.	93.	92.	91.	90.		

STORAGE

99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	99.	99.	99.	99.	99.
99.	99.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	101.	101.	101.	101.	101.	101.
101.	101.	101.	101.	102.	102.	102.	102.	102.	102.
102.	102.	102.	102.	103.	103.	103.	104.	104.	105.
105.	106.	107.	108.	108.	109.	110.	111.	112.	112.
113.	114.	115.	116.	117.	117.	118.	119.	120.	121.
121.	122.	123.	124.	125.	125.	126.	127.	128.	129.
129.	130.	131.	132.	132.	133.	134.	135.	135.	136.
137.	138.	138.	139.	140.	141.	141.	142.	143.	144.
144.	145.	146.	147.	147.	148.	149.	150.	150.	151.
152.	153.	153.	154.	154.	155.	156.	157.	158.	160.
162.	164.	167.	169.	172.	174.	177.	179.	181.	184.
186.	189.	191.	193.	196.	198.	200.	202.	204.	206.
208.	209.	211.	213.	215.	217.	218.	220.	222.	223.
224.	224.	226.	227.	228.	229.	230.	233.	237.	242.
246.	248.	249.	248.	246.	244.	242.	240.	238.	236.
235.	234.	233.	232.	231.	231.	230.	230.	229.	229.
228.	228.	227.	226.	226.	226.	225.	225.	224.	223.
222.	220.	218.	216.	214.	211.	209.	207.	204.	202.
200.	198.	196.	194.	192.	191.	189.	188.	186.	185.

PLATE D-25

183.	182.	181.	180.	179.	177.	176.	175.	175.	174.
173.	172.	171.	170.	170.	169.	168.	168.	167.	167.
166.	166.	165.	164.	164.	163.	163.	163.	162.	162.
161.	161.	161.	160.	160.	159.	159.	159.	158.	158.
158.	158.	157.	157.	157.	156.	156.	156.		

STAGE

114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0
114.0	114.0	114.0	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1	114.1
114.1	114.1	114.2	114.2	114.2	114.2	114.2	114.2	114.2	114.2
114.2	114.2	114.2	114.2	114.2	114.2	114.3	114.3	114.3	114.3
114.4	114.4	114.5	114.5	114.6	114.6	114.7	114.7	114.7	114.8
114.8	114.9	114.9	115.0	115.0	115.1	115.1	115.2	115.2	115.3
115.3	115.4	115.4	115.5	115.5	115.5	115.6	115.6	115.7	115.7
115.8	115.8	115.9	115.9	115.9	116.0	116.0	116.1	116.1	116.2
116.2	116.3	116.3	116.3	116.4	116.4	116.5	116.5	116.6	116.6
116.6	116.7	116.7	116.8	116.8	116.9	116.9	117.0	117.0	117.0
117.1	117.1	117.2	117.2	117.2	117.3	117.3	117.4	117.5	117.6
117.7	117.8	118.0	118.1	118.2	118.3	118.4	118.5	118.6	118.7
118.8	118.8	118.9	119.0	119.1	119.2	119.3	119.4	119.5	119.5
119.6	119.7	119.7	119.8	119.9	119.9	120.0	120.1	120.2	120.2
120.3	120.3	120.3	120.4	120.4	120.4	120.5	120.6	120.8	121.0
121.1	121.2	121.3	121.2	121.2	121.1	121.0	120.9	120.8	120.7
120.7	120.6	120.6	120.6	120.5	120.5	120.5	120.5	120.5	120.4
120.4	120.4	120.4	120.3	120.3	120.3	120.3	120.3	120.2	120.2
120.2	120.1	120.0	119.9	119.8	119.7	119.6	119.6	119.5	119.4
119.3	119.2	119.1	119.1	119.0	118.9	118.9	118.8	118.7	118.7
118.6	118.6	118.5	118.5	118.5	118.4	118.4	118.3	118.3	118.3
118.2	118.2	118.2	118.1	118.1	118.1	118.1	118.0	118.0	118.0
117.9	117.9	117.9	117.8	117.8	117.8	117.8	117.7	117.7	117.7
117.7	117.6	117.6	117.6	117.6	117.5	117.5	117.5	117.5	117.5
117.4	117.4	117.4	117.4	117.4	117.4	117.3	117.3		

PEAK OUTFLOW IS 2672. AT TIME 16.08 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2672.	875.	269.	269.	77496.
CMS	76.	25.	8.	8.	2194.
INCHES		21.70	26.70	26.70	26.70
MM		551.23	678.17	678.17	678.17
AC-FT		434.	534.	534.	534.
THOUS CU M		535.	658.	658.	658.

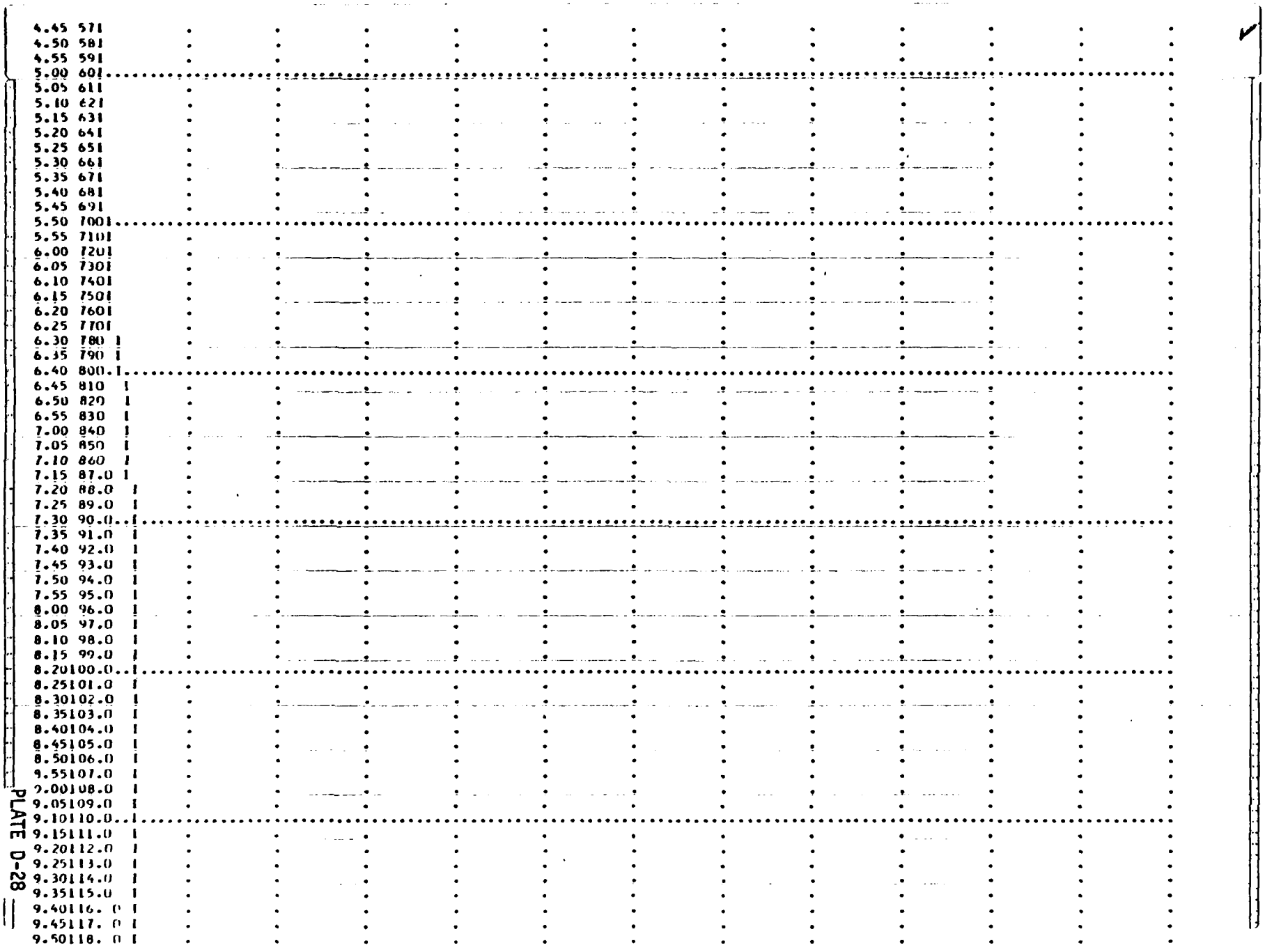
OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
.05	I												
.10	2I												
.15	3I												
.20	4I												
.25	5I												
.30	6I												
.35	7I												
.40	8I												
.45	9I												
.50	10I												
.55	11I												
1.00	12I												
1.05	13I												
1.10	14I												
1.15	15I												
1.20	16I												
1.25	17I												
1.30	18I												
1.35	19I												
1.40	20I												
1.45	21I												
1.50	22I												
1.55	23I												
2.00	24I												
2.05	25I												
2.10	26I												
2.15	27I												
2.20	28I												
2.25	29I												
2.30	30I												
2.35	31I												
2.40	32I												
2.45	33I												
2.50	34I												
2.55	35I												
3.00	36I												
3.05	37I												
3.10	38I												
3.15	39I												
3.20	40I												
3.25	41I												
3.30	42I												
3.35	43I												
3.40	44I												
3.45	45I												
3.50	46I												
3.55	47I												
4.00	48I												
4.05	49I												
4.10	50I												
4.15	51I												
4.20	52I												
4.25	53I												
4.30	54I												
4.35	55I												
4.40	56I												

PLATE D-27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4.55 591
5.00 601
5.05 611
5.10 621
5.15 631
5.20 641
5.25 651
5.30 661
5.35 671
5.40 681
5.45 691
5.50 7001
5.55 7101
6.00 7201
6.05 7301
6.10 7401
6.15 7501
6.20 7601
6.25 7701
6.30 780
6.35 790
6.40 800.
6.45 810
6.50 820
6.55 830
7.00 840
7.05 850
7.10 860
7.15 87.0
7.20 88.0
7.25 89.0
7.30 90.0.
7.35 91.0
7.40 92.0
7.45 93.0
7.50 94.0
7.55 95.0
8.00 96.0
8.05 97.0
8.10 98.0
8.15 99.0
8.20100.0.
8.25101.0
8.30102.0
8.35103.0
8.40104.0
8.45105.0
8.50106.0
9.55107.0
9.00108.0
9.05109.0
9.10110.0.
9.15111.0
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PLATE D-28

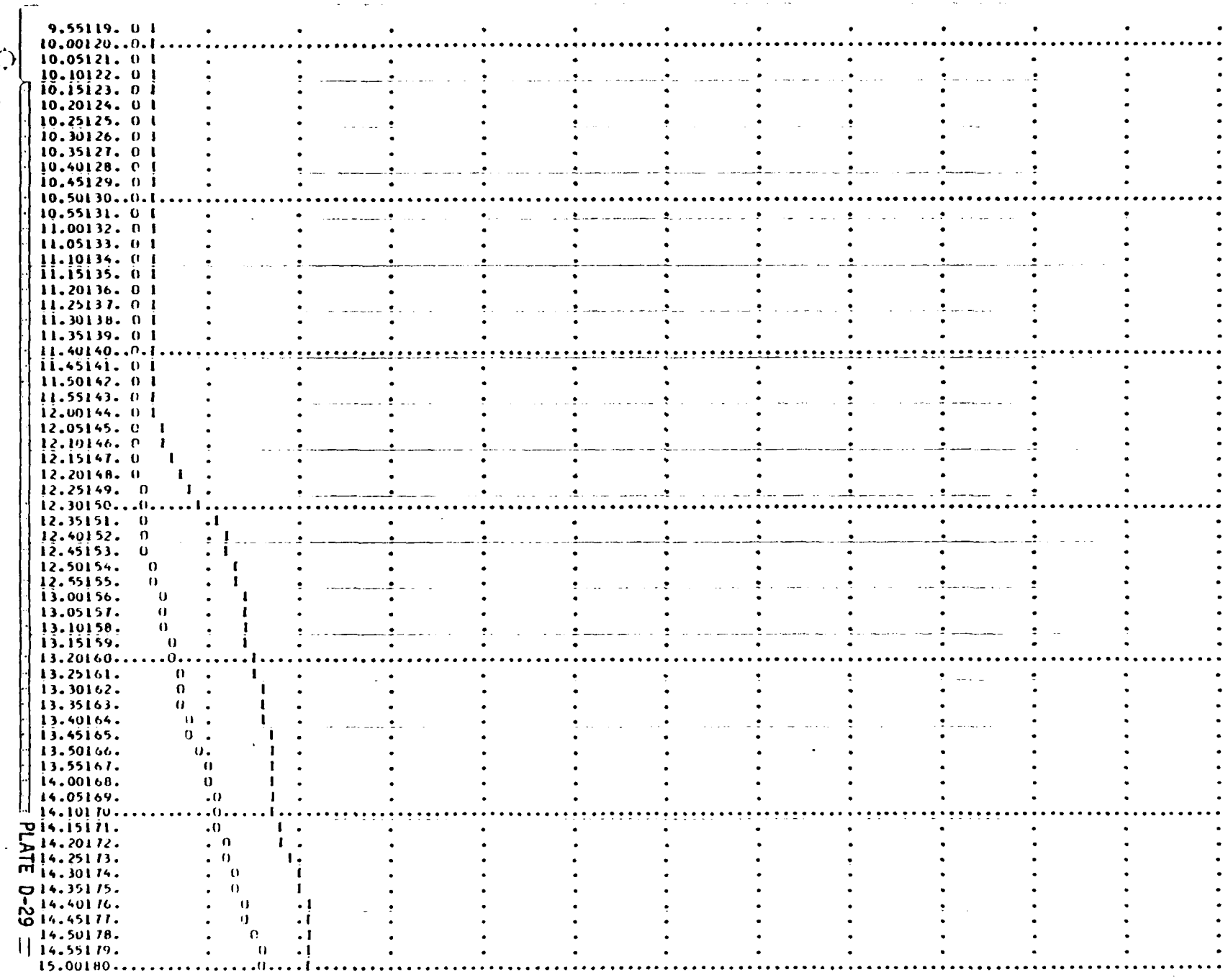
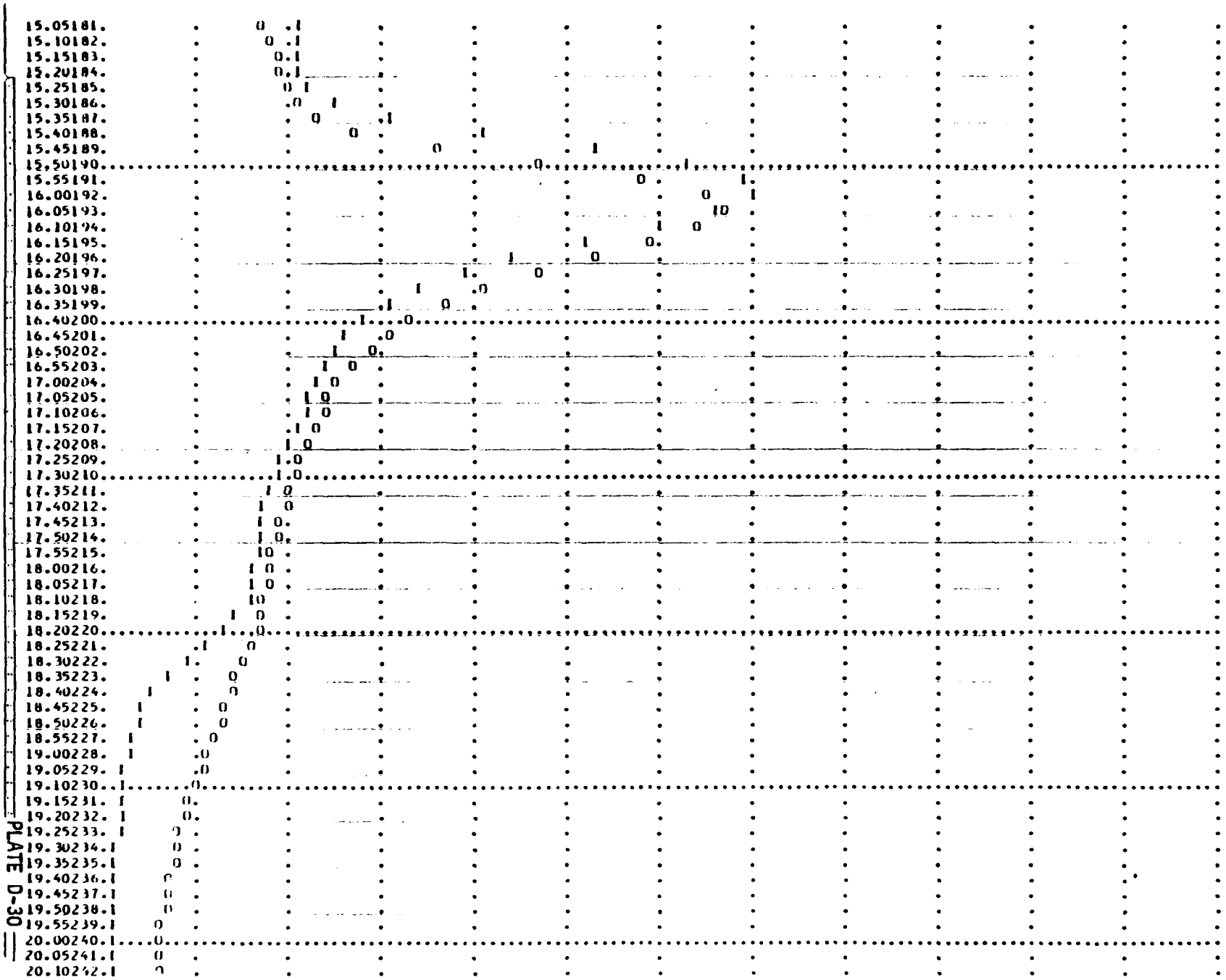


PLATE D-29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16.10194.
16.15195.
16.20196.
16.25197.
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18.05217.
18.10218.
18.15219.
18.20220.
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18.35223.
18.40224.
18.45225.
18.50226.
18.55227.
19.00228.
19.05229.
19.10230.
19.15231.
19.20232.
19.25233.
19.30234.
19.35235.
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19.45237.
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19.55239.
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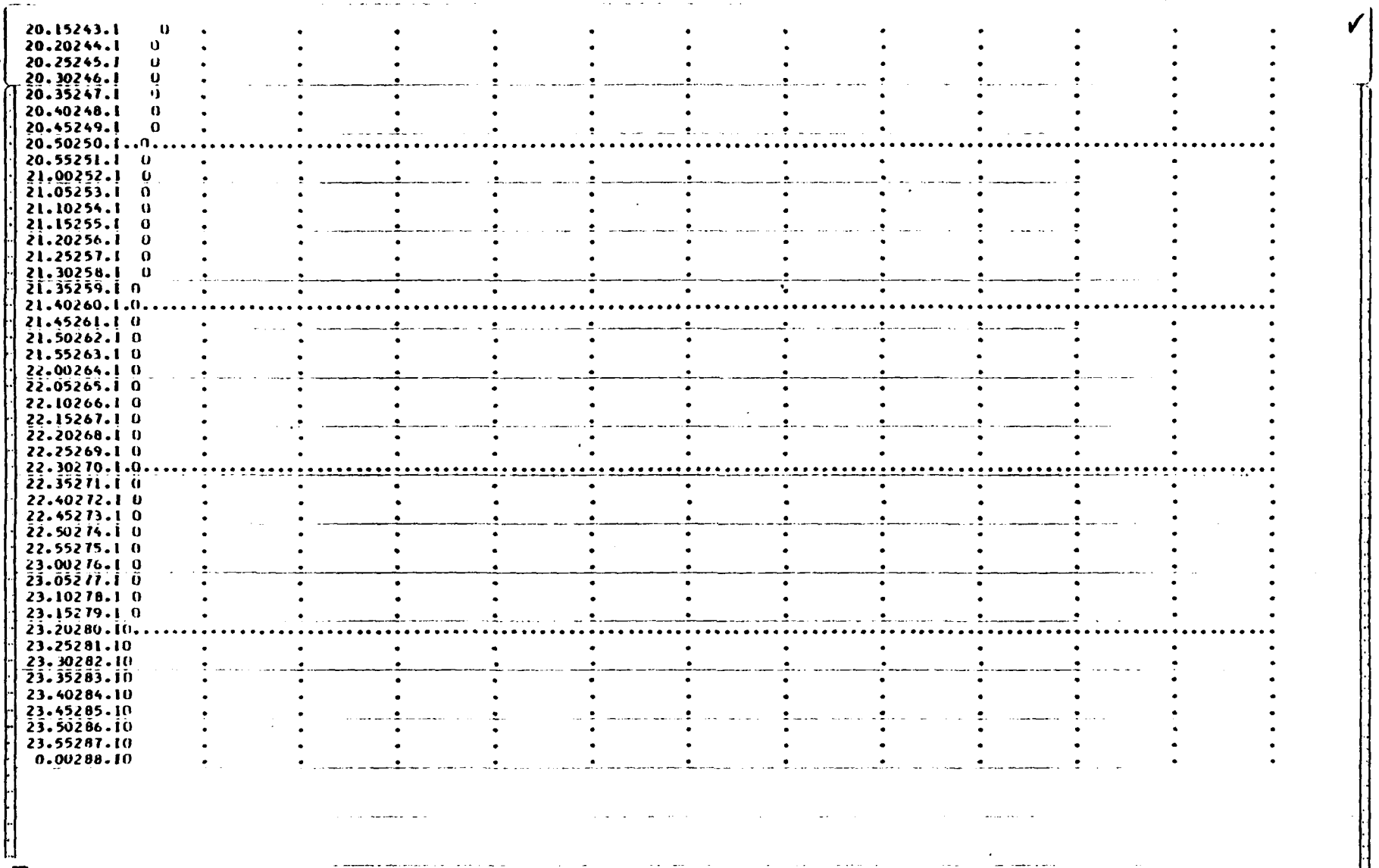
20.10242.

PLATE D-30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23.15279.1 0
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23.25281.10
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23.35283.10
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23.50286.10
23.55287.10
0.00288.10

PLATE D-31

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .30	RATIO 3 .35	RATIO 4 .40	RATIO 5 .45	RATIO 6 .50	RATIO 7 .55	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT	000001	.38	1	559.	839.	979.	1119.	1258.	1398.	1538.	2237.	2797.
	(	.97)	(	15.84)(	23.76)(	27.72)(	31.68)(	35.63)(	39.59)(	43.55)(	63.35)(	79.19)
ROUTED TO	000002	.38	1	136.	293.	398.	499.	606.	781.	1020.	2059.	2672.
	(	.97)	(	3.84)(	8.29)(	11.27)(	14.13)(	17.16)(	22.11)(	28.89)(	58.29)(	75.66)

PLATE D-32

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	114.00	114.00	119.95
STORAGE	99.	99.	217.
OUTFLOW	0.	0.	555.

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
.20	118.00	0.00	167.	136.	0.00	17.75	0.00
.30	118.95	0.00	191.	293.	0.00	16.83	0.00
.35	119.36	0.00	202.	398.	0.00	16.67	0.00
.40	119.74	0.00	211.	499.	0.00	16.58	0.00
.45	120.10	.15	220.	606.	.75	16.50	0.00
.50	120.38	.43	227.	781.	1.33	16.42	0.00
.55	120.58	.63	232.	1020.	1.58	16.33	0.00
.80	121.04	1.09	244.	2059.	2.83	16.08	0.00
1.00	121.25	1.30	249.	2672.	3.92	16.08	0.00


N
DATE
ILME