

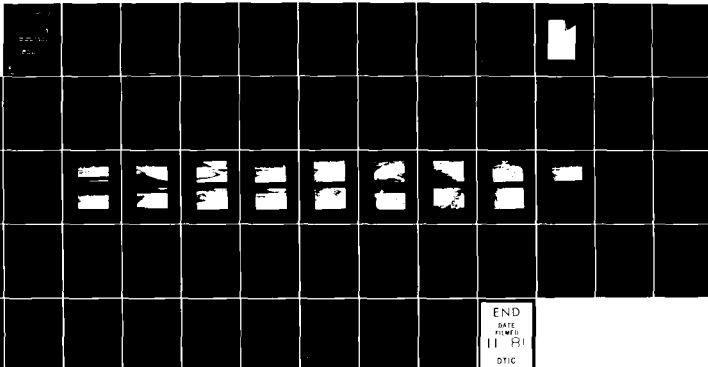
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NATIONAL DAM SAFETY PROGRAM. NEW HORTICULTURAL
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MISSOURI - KANSAS CITY BASIN

NEW HORTICULTURAL FARM DAM

HOWARD COUNTY, MISSOURI

MO. 10790

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**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

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

REPLY TO
ATTENTION OF

SUBJECT: New Horticultural Farm Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the New Horticultural Farm Dam:

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

This dam has been classified as unsafe, non-emergency by the St. Louis District because of the following deficiencies:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood.
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

14 MAR 1980

SUBMITTED BY

Chief, Engineering Division

Date

SIGNED

14 MAR 1980

APPROVED:

Colonel, CE, District Engineer

Date

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NEW HORTICULTURAL FARM DAM
HOWARD COUNTY, MISSOURI
MISSOURI INVENTORY NO. 10790

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
JUNE, 1979



REPLY TO
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- 3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY _____
Chief, Engineering Division Date

APPROVED: _____
Colonel, CE, District Engineer Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	New Horticultural Farm Dam
State Located	Missouri
County Located	Howard County
Stream	Cottonwood Creek Offstream
Date of Inspection	June 1, 1979

New Horticultural Farm Dam 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. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately one mile downstream of the dam. Within the damage zone is the town of Franklin with many dwellings, roads, and commercial buildings.

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 number of residences in the downstream floodplain, the Probable Maximum Flood is the appropriate spillway design flood. The spillway will pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillway will pass 30% 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.

No design data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other than seepage outcrops in the right abutment trough and downstream from the toe, no other deficiencies were found. The dam appears to be in very good condition and is well maintained.

Rey S. Decker
Rey S. Decker
E-3703

Gordon G. Jamison
Gordon Jamison

Michael M. Meekin
Michael McMeekin
E-4776

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



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NEW HORTICULTURAL FARM DAM - MO 10790
HOWARD 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 New Horticultural Farm Dam 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 about 500 feet in length and 26 feet in height. It is located in the greatly rolling loess covered hills just north of the Missouri River.
 - (2) The spillway consists of a vegetated earth channel excavated into the right abutment hillside, leading to a 7.5 foot diameter concrete morning-glory drop inlet, outletting into a 12 inch diameter steel pipe.
 - (3) Pertinent physical data are given in paragraph 1.3 below.

- b. Location. The dam is located in the south central portion of Howard County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SW $\frac{1}{4}$ of Section 29, T49N, R16W. The lake formed behind the dam is shown in the SW $\frac{1}{4}$ of Section 29, T49N, R16W, and the SE $\frac{1}{4}$ of Section 30, T49N, R16W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately one mile downstream of the dam. Within the damage zone is the town of Franklin with many dwellings, roads, and commercial buildings.
- e. Ownership. The dam is owned by the University of Missouri, Room I-43, Agricultural Building, Columbia, Missouri 65211. Attention: Dr. Donald Hegwood.
- f. Purpose of Dam. The dam impounds an 8 acre lake used for supplemental pump irrigation. The dam also provides erosion and flood control.
- g. Design and Construction History. It was reported by Dr. Audrie Hibbard of the University of Missouri that the dam was designed by the Agricultural Engineering Department of the University and that it was constructed in 1954. Mr. Herb Biesemeyer, Farm Manager for the University of Missouri, reported that the riprap on the upstream face had been placed in 1976.
- h. Normal Operating Procedure. There are no operating facilities for this dam.

1.3 PERTINENT DATA

- a. Drainage Area. 86.4 acres (0.135 square miles).

b. Discharge at Damsite.

- (1) All discharges at the damsite are through an uncontrolled modified morning-glory type spillway, funneling down to a 12" CMP conduit. A 535 ft. canal delivers water from the damsite to the principal spillway.
- (2) Estimated maximum flood at damsite--unknown.
- (3) The principal spillway capacity varies from 0 c.f.s. at elevation 635.0 feet to 8.4 c.f.s. at the minimum top of canal berm (elevation 636.3 feet).
- (4) Total spillway capacity at the minimum top of canal berm is 8.4 c.f.s. $\pm$.

c. Elevations (feet above M.S.L.).

- (1) Top of dam - (low point) - 637.6
- (2) Top of canal berm - (low point) - 636.3
- (3) Spillway crest (at canal entrance) - 635.0
- (4) Spillway crest (at morning-glory) - 634.0
- (5) Streambed at centerline - 611.7 $\pm$
- (6) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 1200 $\pm$

e. Storage (Acre-Feet).

- (1) Top of dam - 89 $\pm$
- (2) Spillway crest - 60 $\pm$

f. Reservoir Surface (Acres).

- (1) Top of dam - 13 $\pm$
- (2) Spillway crest - 8 $\pm$

g. Dam.

- (1) Type - earth fill $\pm$
- (2) Length - 500 feet $\pm$
- (3) Height - 26 feet $\pm$

- (4) Top Width - 14 to 15 feet
- (5) Side slopes
 - (a) Downstream - 2.5H on 1V (measured)
 - (b) Upstream - 2H on 1V (measured, exposed)
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout curtain - unknown
- (10) Wave protection - limestone riprap
- (11) Internal drainage - unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

- (a) Type - Vegetated earth channel, leading to a 7.5 foot diameter concrete morning-glory drop inlet, with 12 inch diameter corrugated metal pipe (CMP) outlet.
- (b) Crest (invert) elevation - Earth channel inlet = 635 feet $\pm$, morning-glory crest = 634 feet $\pm$
- (c) Length - Earth canal = 535 feet $\pm$
CMP = 130 feet $\pm$
- (d) Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Dr. Hibbard that the dam was built in 1954. Mr. Biesemeyer reported that the rip-rap on the upstream face was added in 1976.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the New Horticultural Farm Dam was made on June 1, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison, Hydrology; M. McMeekin, Civil Engineer. Mr. Herb Biesemeyer, Farm Manager for the University of Missouri, accompanied the inspection team. Dr. Audrie Hibbard of the University of Missouri was interviewed in Columbia prior to the inspection.
- b. Dam.
 - (1) Geology and Soils (abutment and embankment). Materials on the uplands and on the abutments consist of deep CL loess (probably Winfield and Menfro soils which have silty clay and clay loam subsoils) overlying limestone. No bedrock was exposed in the area, but it probably consists of Osagean cherty limestone of middle Mississippian age. Foundation materials for the dam consist of loess on the abutments and reworked loessial alluvium in the valley. Bedrock in this area does not control the seepage or stability characteristics of the foundation. It was reported by Mr. Biesemeyer that material for the dam was borrowed from the adjacent hillsides and that it was good CL. Borings on the dam showed good CL material to a depth of 3 feet.
 - (2) Upstream Slope. The upstream slope is well covered with limestone riprap. The plating is 2.5 to 3 feet thick with 6 to 8 inch nominal size rock and a good deal of rock at 8 to 12 inches in size. Riprap extends to the top of the dam. The slope looks excellent with no indication of erosion, slumps or deformations.
 - (3) Crest. The crest is well vegetated with adapted grasses. The centerline profile is somewhat irregular with a variance of about 2 feet in elevation. No cracks, pot holes, ruts, rodent holes or deformations were noted on the crest.
 - (4) Downstream Slope. The downstream slope is very well vegetated with adapted grasses. No rodent holes, cracks, slumps or other abnormal deformations were noted. Slight seepage was noted along the center toe of the dam downstream from about stations 2+50 to 3+50.

No boils were observed and all effluent was clear. Total discharge from the left end was estimated at 0.1 gal/min. A considerable amount of seep outcrops in the right abutment trough downstream from stations 3+50 to 4+50. The seep outcrops in the trough at about elevation 620 which is about 8 feet above the floodplain level. The seepage is collected in a drain ditch along the toe of the right abutment hillside. Total effluent, some 50 feet below the dam, was estimated at 1-2 gal/min. All seep is clear and no boils were observed. The drain is iron stained. Borings on the slope some 6 feet above the toe were only moist to a depth of 3 feet. The source of the seepage is unknown but it would appear that most of the seepage is passing through the abutments and under the base of the dam. Seepage from a phreatic zone through the embankment should have produced near saturated soils on the slope which were not observed.

- (5) Miscellaneous. The excellent vegetative cover and the plastic nature of materials in the dam would indicate that it could probably withstand significant overtopping without serious damage.

c. Appurtenant Structures.

- (1) The spillway consists of a vegetated earth channel about 500 feet in length excavated into the right abutment hillside. The spillway outlets into a modified concrete morning-glory drop inlet, exiting into a 12 inch diameter CMP conduit. The earth channel has 10 foot $\pm$ bottom width with side slopes of 6H-7H on 1V and grade of 0.2% $\pm$. The morning-glory drop inlet crest is 7.5 feet in diameter tapering inward to connect with a 12 inch CMP exit 4.5 feet below the crest. The 12 inch pipe conduit exits on a grade of about 25%. The earth channel is very well vegetated with adapted grasses. No slides, slumps or signs of erosion were noted in the channel. The morning-glory inlet is covered with a steel grate trash rack which was clear and open. Concrete in the spillway inlet looked good with no significant deterioration. No deterioration was noted in the corrugated metal pipe (CMP) exit conduit. The CMP outlets into a small stilling basin which is overgrown with grass, shrubs and vines. The scour hole and exit channel appear to be stable. Water in the scour hole shown in photo 15 and grass clipping on the trash rack (photo 11) would indicate that

this section of the spillway has operated. However, such flow through the morning-glory inlet could also be the result of interception of surface runoff by the earth channel section of the spillway system. It was reported by the farm manager, Mr. Biesemeyer, that this spillway had operated one time but there was no indication of recent flows in the vegetated earth channel.

(2) Drawdown facilities. There are no drawdown facilities for this dam.

- d. Reservoir Area. No slide, slumps or signs of significant erosion were noted around the shoreline. The reservoir is bordered by good grass pasture.
- e. Downstream Channel. The channel downstream from the spillway is lined with trees and shrubs. It is well vegetated and appears to be stable.

3.2 EVALUATION

This dam appears to be in very good condition. Additional studies would be required to determine the effect of seepage on the stability of the structure. The excellent vegetative cover and the plastic nature of materials in the dam indicate that it could withstand significant overtopping without serious damage to the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, infiltration, evaporation and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Maintenance on this structure appears to be very good. Vegetative growth is controlled by regular mowing. No trash was observed in the reservoir or spillway. Erosion on the upstream face has been effectively controlled.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Franklin, Missouri 7 1/2 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.
- c. Visual Observations.
 - (1) It was determined from field data that the canal berm on the left side of the spillway canal would overtop before the actual dam would overtop. The berm is lowest in the general area of the morning-glory spillway (low point at station 10+00). The high point of the berm profile was at station 7+00.
 - (2) The limestone riprap on the upstream face of the dam appears to be in very good condition. It appears to be of sufficient size and approximately 3 feet thick.
 - (3) Concrete in the modified morning-glory spillway is good and from the appearance of the CMP conduit at the exit and entrance it is also in good shape.
- d. Overtopping Potential. The spillway is too small to pass 50% of the probable maximum flood without overtopping. The spillway will pass the 100-year flood.

Water will flow over the spillway canal left berm at approximately 0.1 PMF. Water will flow over the berm during the 100-year flood. The dam could probably withstand significant overtopping without serious damage.

The results of the routings through the dam are tabulated in regards to the following conditions:

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 637.6</u>	<u>Time Dam Overtopping Hr.</u>
10 Yr.	170	8	635.9	+ 1.7	-
100 Yr.	320	20	636.6	+ 1.0	-
0.5 PMF	770	570	638.3	- 0.7	2-
PMF	1,540	1,430	638.8	- 1.2	5+
*0.3	420	170	637.6	0	-

*Percent PMF passed by spillway.

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 spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. This dam appears to be structurally stable. The embankment slopes and the CL materials in the dam should provide adequate safety against shear failures for a dam of this height, even with development of the full phreatic line which was not apparent at the time of inspection. Analyses presented in Section 5 of this report indicate that 50% of the Probable Maximum Flood will overtop the dam by 0.7 foot for a period of about 2 hours. The effect of such overtopping on the structural and erosional stability is not known but it would appear that it would not seriously affect the integrity of this structure.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Operating Records. There are no controlled operating facilities for this dam.
- d. Post Construction Changes. It was reported by Mr. Biesemeyer that erosion on the upstream face was repaired and the rip-rap was installed in 1976.
- 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

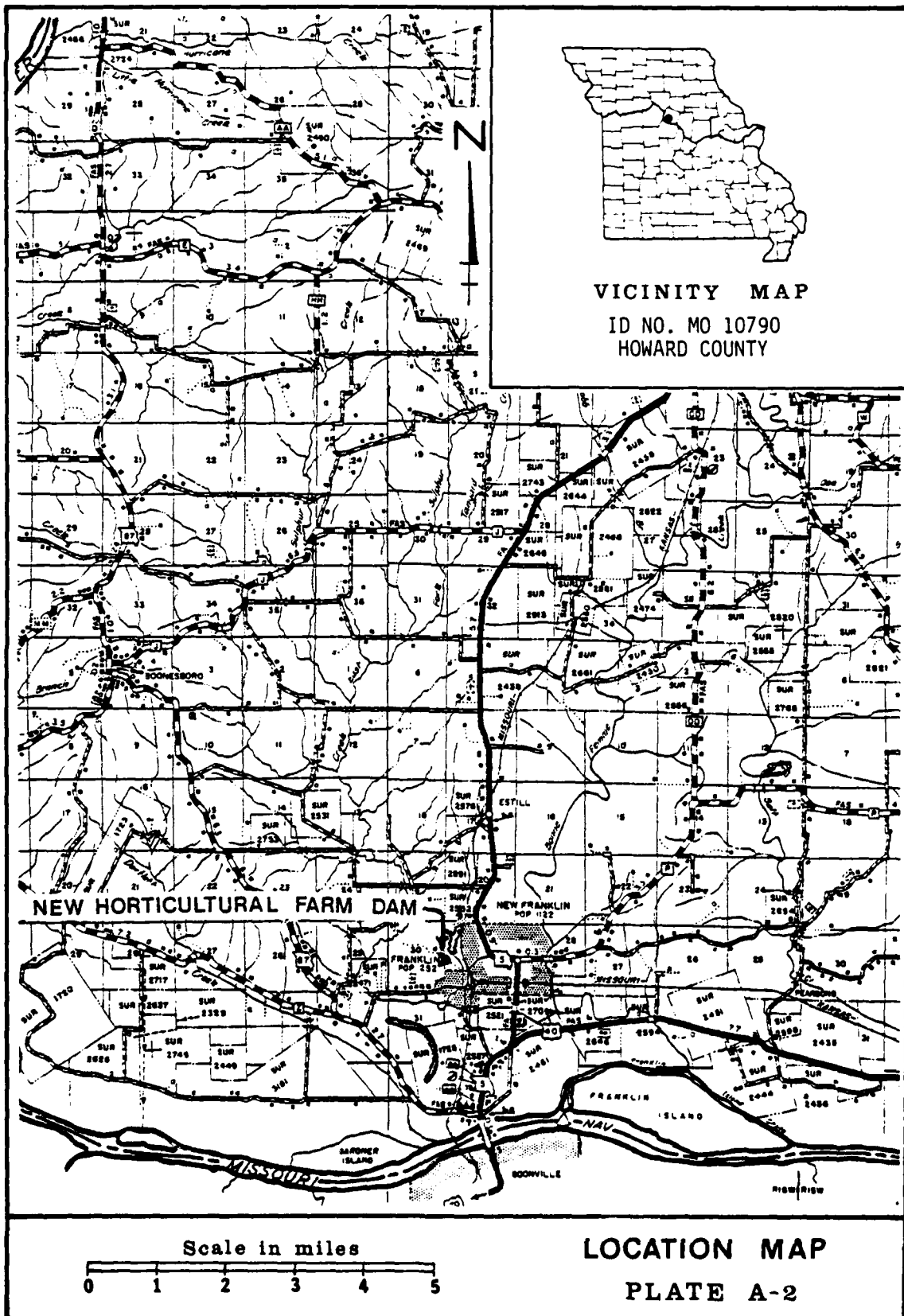
- a. Safety. There does not appear to be any serious potential of failure of this dam. Seepage and stability analysis were not available. Additional studies would be required to determine the source of and the effects of abutment and foundation seepage on structural stability and to determine the effect of overtopping on structural and erosional stability.
- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.
- c. Urgency. The items recommended in paragraph 7.2 should be pursued on a high priority basis.
- d. Necessity for Phase II. Phase II investigation is not considered necessary.
- 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) Additional information should be obtained on the topographic characteristics of the reservoir area. The spillway size and/or height of the dam should be increased to pass the appropriate spillway design flood. The berm or bank along the spillway channel should be raised to prevent overtopping by the 100-year flood.
 - (2) The services of an engineer experienced in the design and construction of dams should be obtained to evaluate the present reservoir storage capacity, to perform seepage and stability analyses of the present dam and to design protective measures, if required.

- b. O & M Procedures. Present maintenance procedures appear to be very good and should be continued. However, it is recommended that measures be taken to monitor the amount and nature of the seepage, along with lake levels, to determine any changes in seepage characteristics

APPENDIX A
MAPS



APPENDIX B
PHOTOGRAPHS

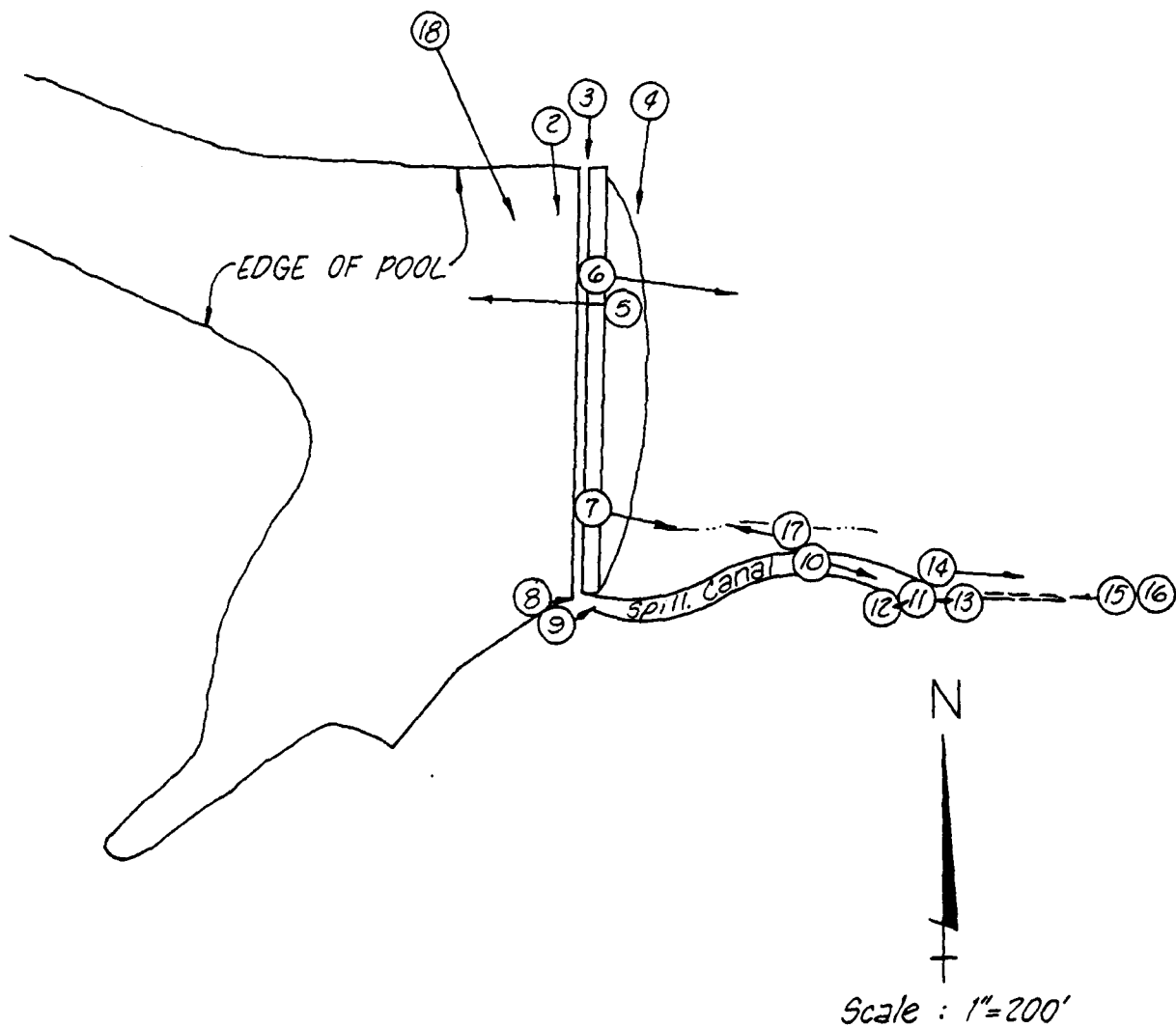


PHOTO INDEX

NEW HORTICULTURAL FARM DAM

HOWARD COUNTY, MISSOURI

MO. 10790

PLATE 8-1



PHOTO NO. 2 - UPSTREAM SLOPE FROM LEFT ABUTMENT



PHOTO NO. 3 - CREST FROM LEFT END



PHOTO NO. 4 - DOWNSTREAM SLOPE FROM LEFT END



PHOTO NO. 5 - LOOKING UPSTREAM FROM STA. 2 + 00



PHOTO NO. 6 - LOOKING DOWNSTREAM FROM STA. 2 + 00



PHOTO NO. 7 - LOOKING DOWNSTREAM AT SEEP AREA FROM STA. 3 + 50



PHOTO NO. 8 - ENTRANCE TO SPILLWAY ON RIGHT SIDE



PHOTO NO. 9 - LOOKING DOWNSTREAM IN SPILLWAY



PHOTO NO. 10 - LOOKING DOWNSTREAM IN SPILLWAY. ROD AT LOCATION
OF MORNING GLORY STRUCTURE



PHOTO NO. 11 - OVERVIEW OF MORNING GLORY STRUCTURE

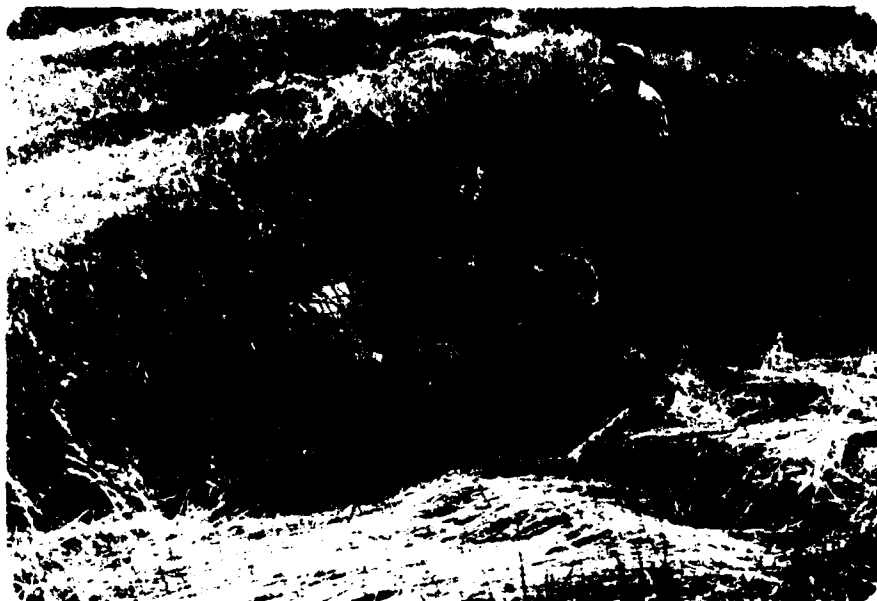


PHOTO NO. 12 - MORNING GLORY ENTRANCE TO PIPE SPILLWAY



PHOTO NO. 13 - LOOKING UPSTREAM IN SPILLWAY FROM END DIKE



PHOTO NO. 14 - LOOKING DOWNSTREAM FROM END DIKE OF EARTH
SPILLWAY TO PIPE OUTLET

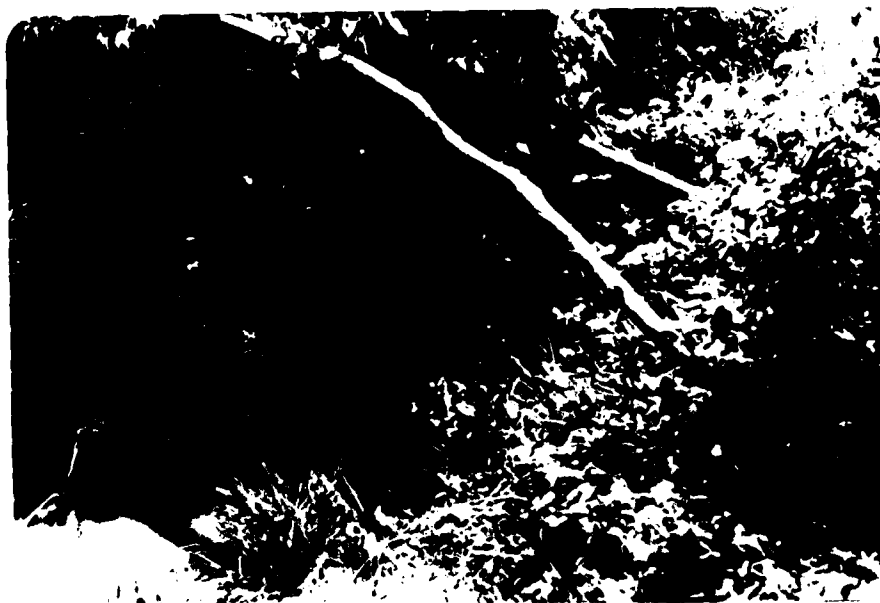


PHOTO NO. 15 - OUTLET END OF PIPE SPILLWAY



PHOTO NO. 16 - LOOKING UPSTREAM PAST OUTLET END OF PIPE SPILLWAY TO DIKE AT END OF EARTH SPILLWAY



PHOTO NO. 17 - SEEPAGE FROM TOE OPPOSITE STA. 4 + 00±



PHOTO NO. 18 - OVERVIEW FROM HIGH ON LEFT ABUTMENT

APPENDIX C
PROJECT PLATES

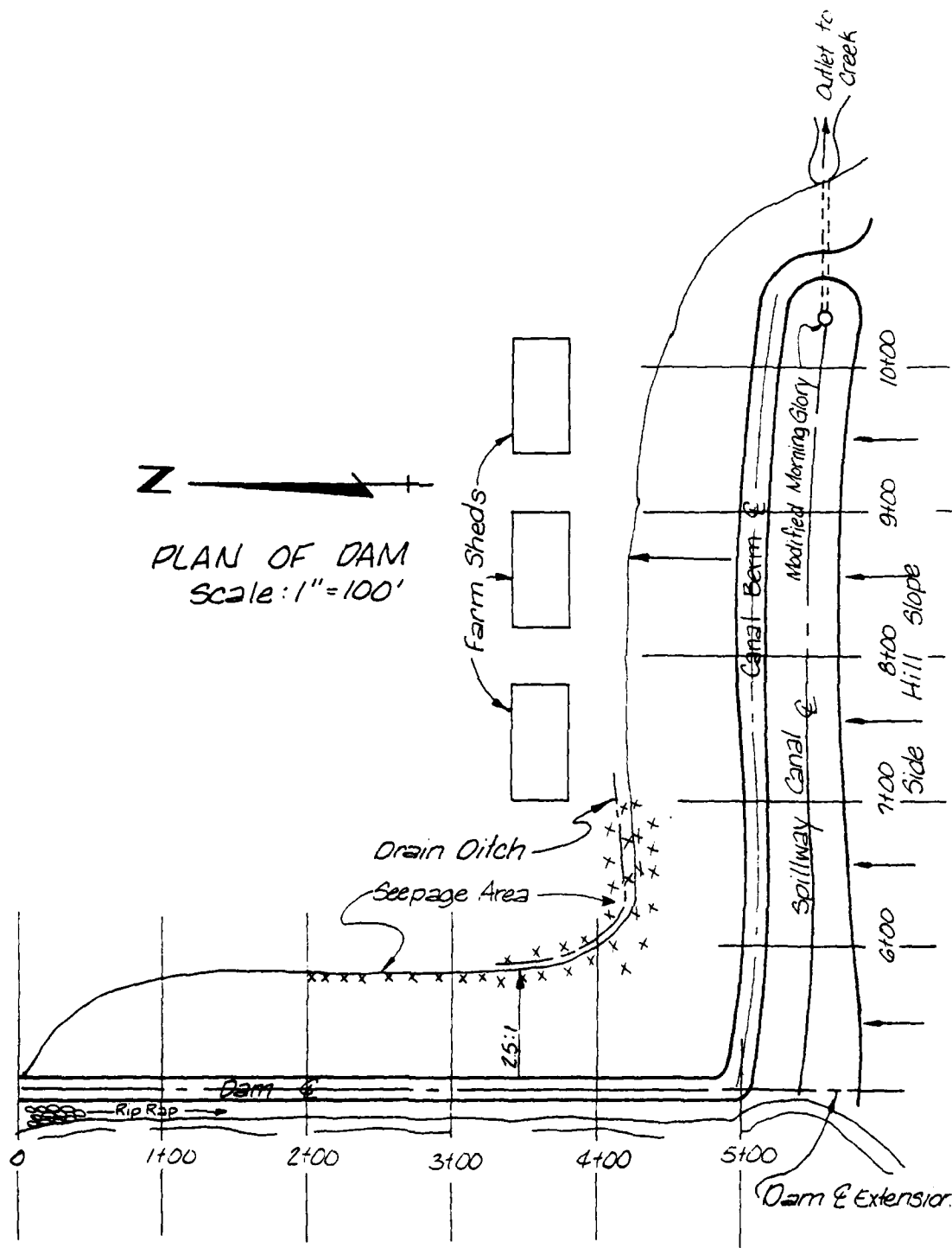
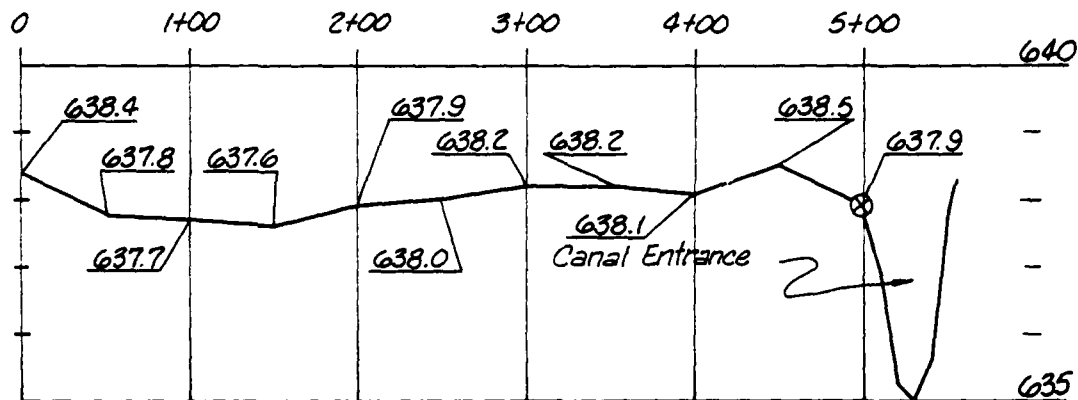
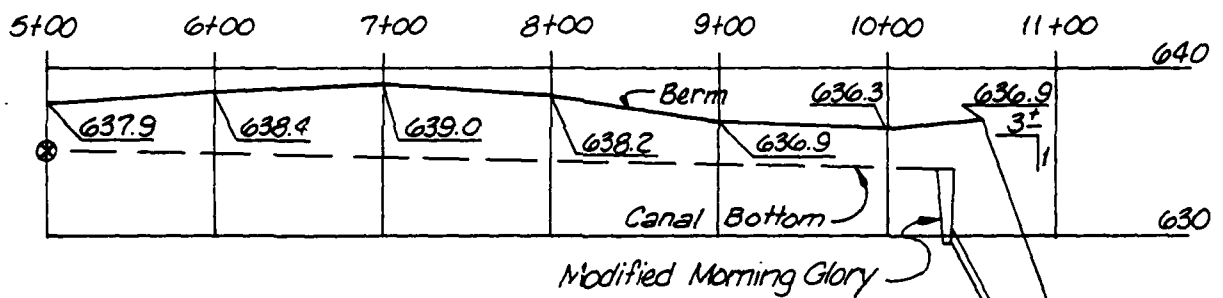


PLATE C-1



DAM CENTERLINE PROFILE

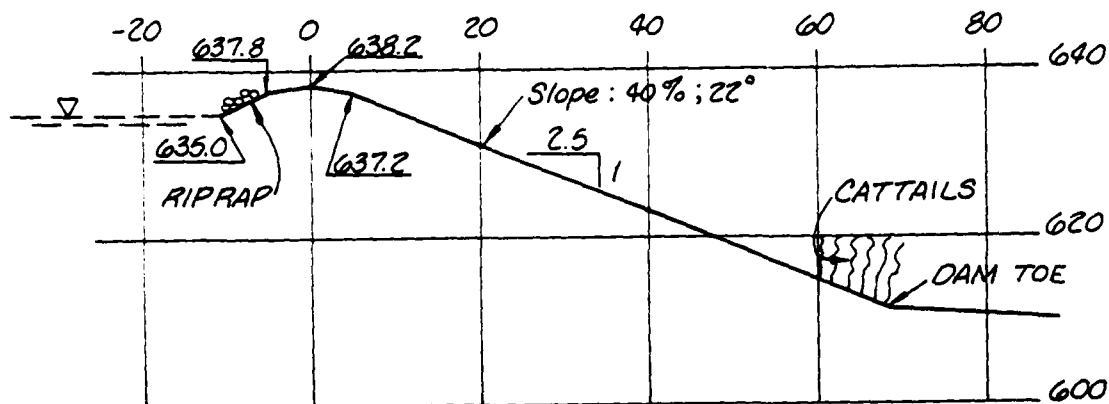
Scale: 1" = 100' H
1" = 2.5' V



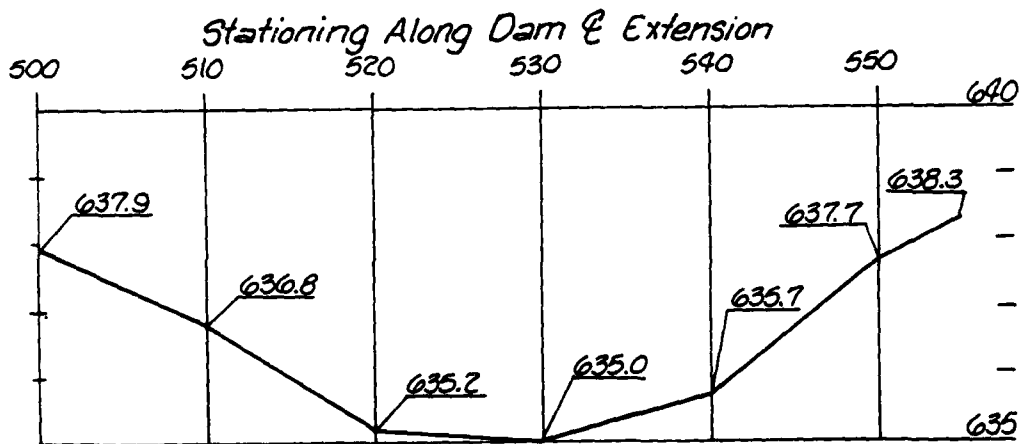
CANAL BANK CENTERLINE PROFILE

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

PLATE C-2



DAM SECTION @ STA. 3+50
 Scale : 1" = 20'



SPILLWAY CANAL SECTION
 (Sta. 5+00)
 Scale : 1" = 10' H
 1" = 25' V

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.
 - a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Jefferson City, Missouri as supplied by the St. Louis District, Corps of Engineers, per their letter dated 6 March 1979. 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 District policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.135 square miles (86.4 acres).
 - c. Time of concentration of runoff = 11 minutes (computed from "Kirpich" formula).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year 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 crest of the spillway canal at the entrance (on $\frac{1}{2}$ of dam).
 - e. The total twenty-four hour storm duration losses for the 100-year storm were 3.56 inches. The total losses for the PMF storm were 2.18 inches. These data are based on SCS runoff curve No. 84 and No. 69 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil groups B and C (Menfro-Lindley-Norris Association); and consists of grass and orchard, of which some is contoured and terraced.
 - f. Average soil loss rates = 0.10 inch per hour approximately.
2. The discharge ratings for the spillway were developed using equations for weir and full conduit flow. They are as follows:

- a. Morning-glory weir flow equation ($Q_w = C2\pi RH^{3/2}$ where $C =$ weir coefficient = 4.0

$R =$ Radius of weir, ft. = 4.25

$H =$ total head, ft.

- b. Full conduit flow equation ($Q = a \sqrt{\frac{2gH}{1 + K_e + K_b + K_p L}}$)

where $a =$ cross-sectional area of pipe, $ft^2 = 0.785$

$H =$ total head, ft.

$K_e =$ coefficient for entrance loss = 0.5

$K_b =$ coefficient for bend loss = 0.75

$K_p =$ coefficient for pipe friction loss = 0.1157

$L =$ length of pipe, ft. = 148.7

The spillway discharge rating was developed as follows. The modified morning-glory weir and conduit ratings were first developed and merged. This rating was then assumed to be in effect at the entrance to the spillway canal. As the canal berm at the downstream end (Sta. 10+00) overtops before the dam does it was necessary to compute flow over the berm and then route it upstream to the entrance of the spillway canal. The weir/conduit rating was then merged with the berm overflow rating to develop a rating for the spillway canal with control at the entrance on center line of actual dam. The berm overflow discharge was routed upstream in the canal using the HEC-2 surface water profile program.

The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program with a discharge coefficient of 2.9 and a value of 1.5 for the head exponent.

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 attached herewith.

NEW HORTICULTURE FARM DAM
NO. NO 10790

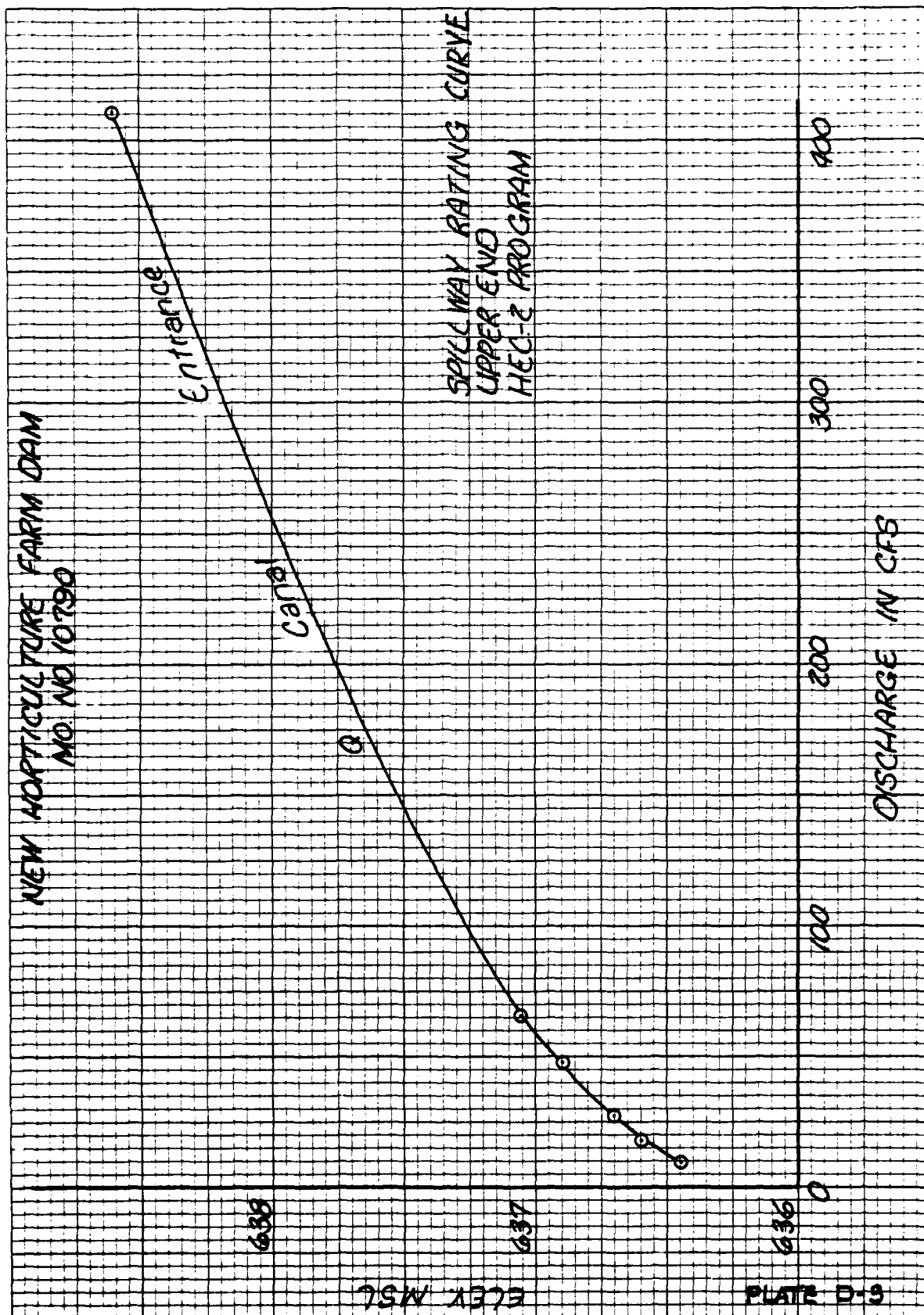
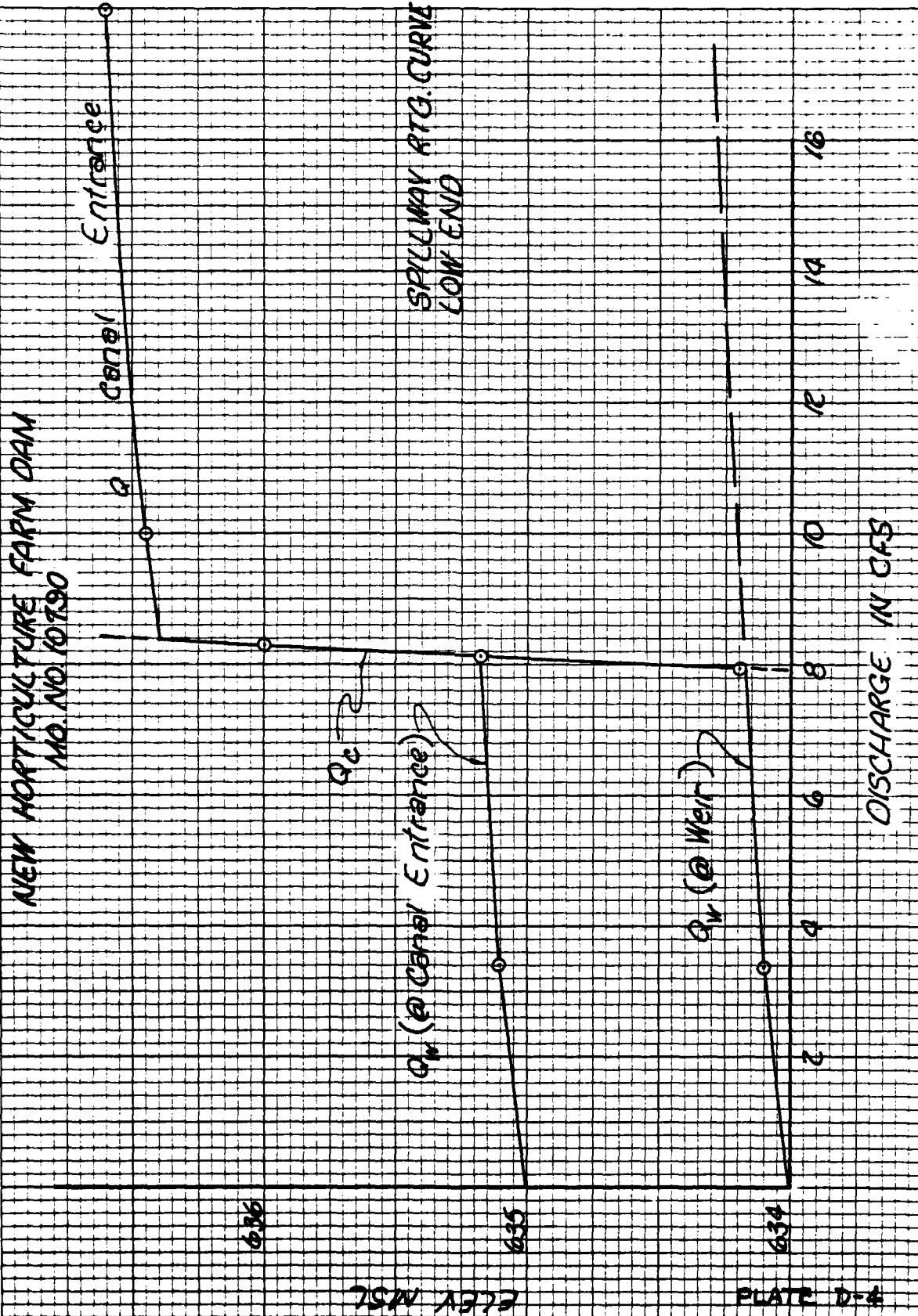
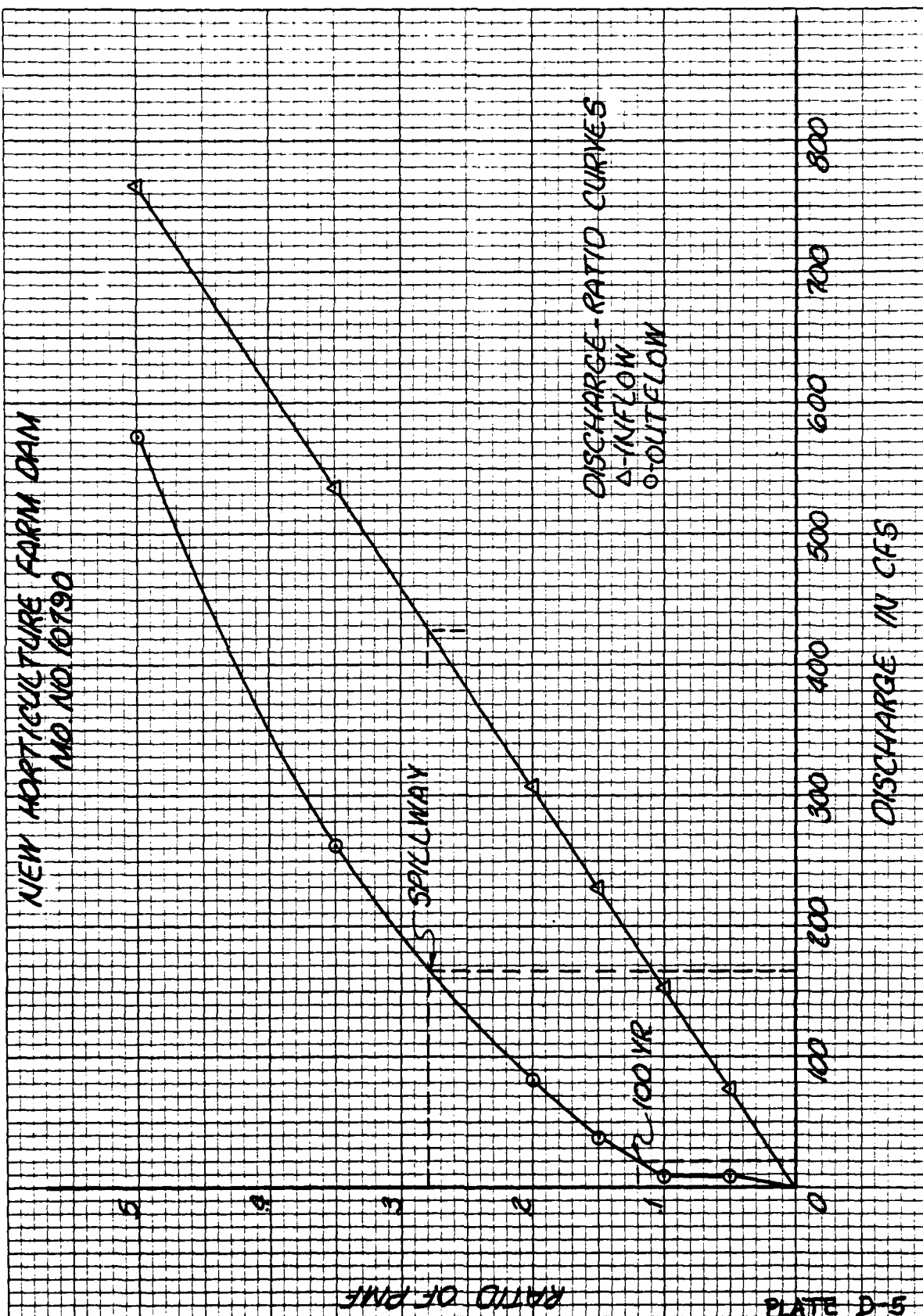


PLATE D-3



NEW HORTICULTURE FARM DAM
NO. NO. 10790



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

RUN DATE 79/08/09.
 TIME 10.36.26.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF NO NAME 437 DAM 10790
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION											
NO	MMR	MMIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	INSTAN		
288	0	5	0	0	0	0	0	0	3	0	
			JOPER	NWT	LROPT	TRACE					
			5	0	0	0					

MULTI-PLAN ANALYSES TO BE PERFORMED

ATIOS= .05 .10 .15 .20 .35 .50 .65 .80 1.00
 RPLAN= 1 RRTIO= 9 LRTIO= 1

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLO HYDRO TO RES 10790

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

HYDROGRAPH DATA

INVOG	LONG	YAREA	SNAP	INSDA	INSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.14	0.00	.14	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.70	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STARR	DLTKR	ATTOL	ERAIN	STKRS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-84.00	0.00	0.00

CURVE NO = -84.00 WETNESS = -1.00 EFFECT CN = 84.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .17

RECESSION DATA

STRTQ= 0.00 QRCN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORIGINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00
 94. 283. 291. 183. 92. 49. 26. 14. 7. 4.
 2. 1.

END-OF-PERIOD FLOW

0

MC-DA	HR-MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO-DA	HR-MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1-01	0-05	1	-01	0-00	-01	0	1-01	12-05	145	-21	-20	-01	76
1-01	0-10	2	-01	0-00	-01	0	1-01	12-10	146	-21	-20	-01	114
1-01	0-15	3	-01	0-00	-01	0	1-01	12-15	147	-21	-20	-01	154
1-01	0-20	4	-01	0-00	-01	0	1-01	12-20	148	-21	-20	-01	179
1-01	0-25	5	-01	0-00	-01	0	1-01	12-25	149	-21	-20	-01	192
1-01	0-30	6	-01	0-00	-01	0	1-01	12-30	150	-21	-20	-01	199
1-01	0-35	7	-01	0-00	-01	0	1-01	12-35	151	-21	-20	-01	203
1-01	0-40	8	-01	0-00	-01	0	1-01	12-40	152	-21	-20	-01	206
1-01	0-45	9	-01	0-00	-01	0	1-01	12-45	153	-21	-20	-01	207
1-01	0-50	10	-01	0-00	-01	0	1-01	12-50	154	-21	-20	-01	208
1-01	0-55	11	-01	0-00	-01	0	1-01	12-55	155	-21	-20	-01	209
1-01	1-00	12	-01	0-00	-01	0	1-01	13-00	156	-21	-20	-01	210
1-01	1-05	13	-01	0-00	-01	0	1-01	13-05	157	-25	-24	-01	214
1-01	1-10	14	-01	0-00	-01	0	1-01	13-10	158	-25	-24	-01	226
1-01	1-15	15	-01	0-00	-01	0	1-01	13-15	159	-25	-24	-01	238
1-01	1-20	16	-01	0-00	-01	0	1-01	13-20	160	-25	-24	-01	246
1-01	1-25	17	-01	0-00	-01	0	1-01	13-25	161	-25	-24	-01	250
1-01	1-30	18	-01	0-00	-01	0	1-01	13-30	162	-25	-24	-01	252
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1-01	1-55	23	-01	0-00	-01	0	1-01	13-55	167	-25	-25	-01	256
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1-01	2-10	26	-01	0-00	-01	0	1-01	14-10	170	-31	-31	-01	280
1-01	2-15	27	-01	0-00	-01	0	1-01	14-15	171	-31	-31	-01	299
1-01	2-20	28	-01	0-00	-01	0	1-01	14-20	172	-31	-31	-01	310
1-01	2-25	29	-01	0-00	-01	0	1-01	14-25	173	-31	-31	-01	316
1-01	2-30	30	-01	0-00	-01	0	1-01	14-30	174	-31	-31	-01	319
1-01	2-35	31	-01	0-00	-01	0	1-01	14-35	175	-31	-31	-01	321
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1-01	2-45	33	-01	0-00	-01	0	1-01	14-45	177	-31	-31	-00	323
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1-01	2-55	35	-01	0-00	-01	0	1-01	14-55	179	-31	-31	-00	324
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1-01	3-10	38	-01	0-00	-01	1	1-01	15-10	182	-38	-38	-00	296
1-01	3-15	39	-01	0-00	-01	1	1-01	15-15	183	-38	-38	-00	314
1-01	3-20	40	-01	0-00	-01	1	1-01	15-20	184	-37	-37	-01	365
1-01	3-25	41	-01	0-00	-01	1	1-01	15-25	185	-67	-66	-01	451
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1-01	4-55	59	-01	0-00	-01	3	1-01	16-55	203	-29	-29	-00	306
1-01	5-00	60	-01	0-00	-01	3	1-01	17-00	204	-29	-29	-00	306

PLATE D-8

1.01	5.05	61	.01	.00	.01	.01	.01	.01	4.	1.01	17.05	205	.23	.23	.00	300.
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1.01	5.30	66	.01	.00	.01	.01	.01	.01	4.	1.01	17.30	210	.23	.23	.00	244.
1.01	5.35	67	.01	.00	.01	.01	.01	.01	4.	1.01	17.35	211	.23	.23	.00	242.
1.01	5.40	68	.01	.00	.01	.01	.01	.01	4.	1.01	17.40	212	.23	.23	.00	241.
1.01	5.45	69	.01	.00	.01	.01	.01	.01	4.	1.01	17.45	213	.23	.23	.00	241.
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1.01	5.55	71	.01	.00	.01	.01	.01	.01	5.	1.01	17.55	215	.23	.23	.00	240.
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1.01	6.05	73	.03	.03	.04	.04	.04	.04	7.	1.01	18.05	217	.02	.02	.00	221.
1.01	6.10	74	.07	.03	.04	.04	.04	.04	13.	1.01	18.10	218	.02	.02	.00	161.
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1.01	6.20	76	.07	.03	.03	.03	.03	.03	25.	1.01	18.20	220	.02	.02	.00	60.
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1.01	6.35	79	.07	.04	.03	.03	.03	.03	33.	1.01	18.35	223	.02	.02	.00	25.
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1.01	6.45	81	.07	.04	.03	.03	.03	.03	37.	1.01	18.45	225	.02	.02	.00	21.
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1.01	6.55	83	.07	.04	.02	.02	.02	.02	40.	1.01	18.55	227	.02	.02	.00	19.
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1.01	7.05	85	.07	.04	.02	.02	.02	.02	42.	1.01	19.05	229	.02	.02	.00	19.
1.01	7.10	86	.07	.04	.02	.02	.02	.02	43.	1.01	19.10	230	.02	.02	.00	19.
1.01	7.15	87	.07	.04	.02	.02	.02	.02	44.	1.01	19.15	231	.02	.02	.00	19.
1.01	7.20	88	.07	.04	.02	.02	.02	.02	45.	1.01	19.20	232	.02	.02	.00	19.
1.01	7.25	89	.07	.05	.02	.02	.02	.02	46.	1.01	19.25	233	.02	.02	.00	19.
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1.01	7.35	91	.07	.05	.02	.02	.02	.02	48.	1.01	19.35	235	.02	.02	.00	19.
1.01	7.40	92	.07	.05	.02	.02	.02	.02	49.	1.01	19.40	236	.02	.02	.00	19.
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1.01	7.50	94	.07	.05	.02	.02	.02	.02	50.	1.01	19.50	238	.02	.02	.00	19.
1.01	7.55	95	.07	.05	.02	.02	.02	.02	50.	1.01	19.55	239	.02	.02	.00	19.
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1.01	8.05	97	.07	.05	.01	.01	.01	.01	51.	1.01	20.05	241	.02	.02	.00	19.
1.01	8.10	98	.07	.05	.01	.01	.01	.01	52.	1.01	20.10	242	.02	.02	.00	19.
1.01	8.15	99	.07	.05	.01	.01	.01	.01	53.	1.01	20.15	243	.02	.02	.00	19.
1.01	8.20	100	.07	.05	.01	.01	.01	.01	53.	1.01	20.20	244	.02	.02	.00	19.
1.01	8.25	101	.07	.05	.01	.01	.01	.01	54.	1.01	20.25	245	.02	.02	.00	19.
1.01	8.30	102	.07	.05	.01	.01	.01	.01	54.	1.01	20.30	246	.02	.02	.00	19.
1.01	8.35	103	.07	.05	.01	.01	.01	.01	54.	1.01	20.35	247	.02	.02	.00	19.
1.01	8.40	104	.07	.05	.01	.01	.01	.01	55.	1.01	20.40	248	.02	.02	.00	19.
1.01	8.45	105	.07	.05	.01	.01	.01	.01	55.	1.01	20.45	249	.02	.02	.00	19.
1.01	8.50	106	.07	.05	.01	.01	.01	.01	56.	1.01	20.50	250	.02	.02	.00	19.
1.01	8.55	107	.07	.05	.01	.01	.01	.01	56.	1.01	20.55	251	.02	.02	.00	19.
1.01	9.00	108	.07	.05	.01	.01	.01	.01	56.	1.01	21.00	252	.02	.02	.00	19.
1.01	9.05	109	.07	.05	.01	.01	.01	.01	57.	1.01	21.05	253	.02	.02	.00	19.
1.01	9.10	110	.07	.06	.01	.01	.01	.01	57.	1.01	21.10	254	.02	.02	.00	19.
1.01	9.15	111	.07	.06	.01	.01	.01	.01	57.	1.01	21.15	255	.02	.02	.00	19.
1.01	9.20	112	.07	.06	.01	.01	.01	.01	58.	1.01	21.20	256	.02	.02	.00	19.
1.01	9.25	113	.07	.06	.01	.01	.01	.01	58.	1.01	21.25	257	.02	.02	.00	19.
1.01	9.30	114	.07	.06	.01	.01	.01	.01	58.	1.01	21.30	258	.02	.02	.00	19.
1.01	9.35	115	.07	.06	.01	.01	.01	.01	58.	1.01	21.35	259	.02	.02	.00	19.
1.01	9.40	116	.07	.06	.01	.01	.01	.01	58.	1.01	21.40	260	.02	.02	.00	19.
1.01	9.45	117	.07	.06	.01	.01	.01	.01	59.	1.01	21.45	261	.02	.02	.00	19.
1.01	9.50	118	.07	.06	.01	.01	.01	.01	59.	1.01	21.50	262	.02	.02	.00	19.
1.01	9.55	119	.07	.06	.01	.01	.01	.01	59.	1.01	21.55	263	.02	.02	.00	19.
1.01	10.00	120	.07	.06	.01	.01	.01	.01	59.	1.01	22.00	264	.02	.02	.00	19.
1.01	10.05	121	.07	.06	.01	.01	.01	.01	60.	1.01	22.05	265	.02	.02	.00	19.
1.01	10.10	122	.07	.06	.01	.01	.01	.01	60.	1.01	22.10	266	.02	.02	.00	19.

PLATE D-9

1.01 10.15	123	.07	.06	.01	60.	1.01 22.15	267	.02	.02	.00	19.
1.01 10.20	124	.07	.06	.01	60.	1.01 22.20	268	.02	.02	.00	19.
1.01 10.25	125	.07	.06	.01	60.	1.01 22.25	269	.02	.02	.00	19.
1.01 10.30	126	.07	.06	.01	61.	1.01 22.30	270	.02	.02	.00	19.
1.01 10.35	127	.07	.06	.01	61.	1.01 22.35	271	.02	.02	.00	19.
1.01 10.40	128	.07	.06	.01	61.	1.01 22.40	272	.02	.02	.00	19.
1.01 10.45	129	.07	.06	.01	61.	1.01 22.45	273	.02	.02	.00	19.
1.01 10.50	130	.07	.06	.01	61.	1.01 22.50	274	.02	.02	.00	19.
1.01 10.55	131	.07	.06	.01	61.	1.01 22.55	275	.02	.02	.00	19.
1.01 11.00	132	.07	.06	.01	62.	1.01 23.00	276	.02	.02	.00	19.
1.01 11.05	133	.07	.06	.01	62.	1.01 23.05	277	.02	.02	.00	19.
1.01 11.10	134	.07	.06	.01	62.	1.01 23.10	278	.02	.02	.00	19.
1.01 11.15	135	.07	.06	.01	62.	1.01 23.15	279	.02	.02	.00	19.
1.01 11.20	136	.07	.06	.01	62.	1.01 23.20	280	.02	.02	.00	19.
1.01 11.25	137	.07	.06	.01	62.	1.01 23.25	281	.02	.02	.00	19.
1.01 11.30	138	.07	.06	.01	62.	1.01 23.30	282	.02	.02	.00	19.
1.01 11.35	139	.07	.06	.01	62.	1.01 23.35	283	.02	.02	.00	19.
1.01 11.40	140	.07	.06	.01	63.	1.01 23.40	284	.02	.02	.00	19.
1.01 11.45	141	.07	.06	.00	63.	1.01 23.45	285	.02	.02	.00	19.
1.01 11.50	142	.07	.06	.00	63.	1.01 23.50	286	.02	.02	.00	19.
1.01 11.55	143	.07	.06	.00	63.	1.01 23.55	287	.02	.02	.00	19.
1.01 12.00	144	.07	.06	.00	63.	1.02 0.00	288	.02	.02	.00	19.
SUM 32.11 29.93 2.18 31217.											
(816.11 760.11 55.11 883.97)											
HYDROGRAPH AT STAAD0001 FOR PLAN 1, RTIO 1											
PEAK	1535.	357.	108.	108.	3.	31222.					
CFS	108.	108.	3.	3.	884.						
CMS	43.	10.	3.	3.	29.88						
INCHES	24.57	29.88	29.88	29.88	758.97						
MM	624.01	758.97	758.97	758.97	215.						
AC-FT	177.	215.	215.	215.	265.						
THOUS CU N	278.	265.	265.	265.							
HYDROGRAPH AT STAAD0001 FOR PLAN 1, RTIO 2											
PEAK	77.	18.	5.	5.	1561.						
CFS	2.	1.	0.	0.	44.						
CMS	1.23	1.49	1.49	1.49	1.49						
INCHES	31.20	37.95	37.95	37.95	37.95						
MM	9.	11.	11.	11.	11.						
AC-FT	11.	13.	13.	13.	13.						
THOUS CU N											
HYDROGRAPH AT STAAD0001 FOR PLAN 1, RTIO 2											
PEAK	153.	36.	11.	11.	3122.						
CFS	4.	1.	0.	0.	88.						
CMS	2.46	2.99	2.99	2.99	2.99						
INCHES	62.40	75.90	75.90	75.90	75.90						
MM	18.	22.	22.	22.	22.						
AC-FT	22.	27.	27.	27.	27.						
THOUS CU N											

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
230.	53.	16.	16.	4683.		
CFS						
1.	2.	0.	0.	133.		
INCHES	3.69	4.48	4.48	4.48		
MM	93.60	113.64	113.64	113.64		
AC-FT	27.	32.	32.	32.		
THOUS CU M	33.	40.	40.	40.		
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
307.	71.	22.	22.	6244.		
CFS						
4.	2.	1.	1.	177.		
INCHES	4.91	5.98	5.98	5.98		
MM	124.80	151.79	151.79	151.79		
AC-FT	35.	43.	43.	43.		
THOUS CU M	44.	53.	53.	53.		
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6 0.5 PMF						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
537.	125.	38.	38.	10928.		
CFS						
15.	4.	1.	1.	309.		
INCHES	8.60	10.46	10.46	10.46		
MM	218.40	265.64	265.64	265.64		
AC-FT	62.	75.	75.	75.		
THOUS CU M	76.	93.	93.	93.		
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
767.	178.	54.	54.	15611.		
CFS						
22.	5.	2.	2.	442.		
INCHES	12.28	14.94	14.94	14.94		
MM	312.00	379.48	379.48	379.48		
AC-FT	88.	108.	108.	108.		
THOUS CU M	109.	133.	133.	133.		
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
998.	232.	70.	70.	20294.		
CFS						
28.	7.	2.	2.	575.		
INCHES	15.97	19.42	19.42	19.42		
MM	405.60	493.33	493.33	493.33		
AC-FT	115.	140.	140.	140.		
THOUS CU M	142.	172.	172.	172.		
HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9						
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
1228.	285.	87.	87.	24978.		
CFS						

CMS 35. 8. 2. 2. 707.
 INCHES 19.65 23.90 23.90 23.90
 MA 499.21 607.17 607.17 607.17
 AC-FY 141. 172. 172. 172.
 THOUS CU M 174. 212. 212. 212.

HYDROGRAPH AT STA000001 FOR PLAN 1, RATIO 9 **PMF**

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 CFS 1535. 357. 108. 108. 31222.
 CMS 43. 10. 3. 84.
 INCHES 24.57 29.88 29.88 29.88
 MA 624.01 758.97 758.97 758.97
 AC-FY 177. 215. 215. 215.
 THOUS CU M 218. 265. 265. 265.

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RES 10790

ISTAQ ICOMP IECON ITAPE JPLI JPRT INAME ISTAGE IAUTO
 000002 1 0 0 2 0 1 0 0
 ROUTING DATA
 QLOSS CLOSS AVG IRES ISAME IOPT IPMP ISIR
 0.0 0.000 0.00 1 1 0 0 0
 NSTPS NSTOL LAG AMSKK K TSK STORA ISPRAT
 1 0 0 0.000 0.000 0.000 -635. -1

STAGE 635.00 635.10 635.20 635.50 636.00 636.40 636.60 636.70 636.90
 637.10 637.50 638.00 638.50
 FLOW 0.00 3.40 8.10 8.20 8.30 8.40 10.00 18.00 28.00 48.00
 13.00 145.00 257.00 385.00

CAPACITY= 0. 5. 11. 16. 22. 28. 34. 40.
 ELEVATION= 635. 636. 637. 637. 638. 638. 639.

LREF SPNTD EDOM EXPN ELEV COQL CAREA EXPL
 635.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA
 TOPEL COQD EXPD DAMWID
 637.6 2.9 1.5 530.

CREST LENGTH 160. 430. 530.
 AT CR BELOW 637.9 638.2 638.5
 ELEVATION

STATION 000002, PLAN 1, RATIO 1
 -- ENG-OF-PERIOD HYDROGRAPH ORDINATES

PMF

STATION 00002, PLAN 1, RATIO 9
END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible][illegible]

[illegible]

STATION 0000002

INFLOW(1), OUTFLOW(1) AND OBSERVED FLOW(1)

0.	200.	400.	600.	800.	1000.	1200.	1400.	1600.	0.	0.	0.	0.	0.
.05													
.10													
.15													
.20													
.25													
.30													
.35													
.40													
.45													
.50													
.55													
.60													
.65													
.70													
.75													
.80													
.85													
.90													
.95													
1.00													
1.05													
1.10													
1.15													
1.20													
1.25													
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1.60													
1.65													
1.70													
1.75													
1.80													
1.85													
1.90													
1.95													
2.00													
2.05													
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2.80													
2.85													
2.90													
2.95													
3.00													
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4.65													
4.70													
4.75													
4.80													
4.85													
4.90													
4.95													
5.00													

4.45 571
4.50 581
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
5.50 701
5.55 711
6.00 721
6.05 731
6.10 7401
6.15 7501
6.20 7601
6.25 7701
6.30 7801
6.35 7901
6.40 8001
6.45 8101
6.50 8201
6.55 8301
7.00 8401
7.05 8501
7.10 8601
7.15 8701
7.20 8801
7.25 8901
7.30 9001
7.35 9101
7.40 9201
7.45 9301
7.50 9401
7.55 9501
8.00 9601
8.05 9701
8.10 9801
8.15 9901
8.20 10001
8.25 10101
8.30 10201
8.35 10301
8.40 10401
8.45 10501
8.50 10601
8.55 10701
9.00 10801
9.05 10901
9.10 11001
9.15 11101
9.20 11201
9.25 11301
9.30 11401
9.35 11501
9.40 11601
9.45 11701
9.50 11801

9.551190 |
10.001200 |
10.051210 |
10.101220 |
10.151230 |
10.201240 |
10.251250 |
10.301260 |
10.351270 |
10.401280 |
10.451290 |
10.501300 |
10.551310 |
11.001320 |
11.051330 |
11.101340 |
11.151350 |
11.201360 |
11.251370 |
11.301380 |
11.351390 |
11.401400 |
11.451410 |
11.501420 |
11.551430 |
12.001440 |
12.051450 |
12.101460 |
12.151470 |
12.201480 |
12.251490 |
12.301500 |
12.351510 |
12.401520 |
12.451530 |
12.501540 |
12.551550 |
13.001560 |
13.051570 |
13.101580 |
13.151590 |
13.201600 |
13.251610 |
13.301620 |
13.351630 |
13.401640 |
13.451650 |
13.501660 |
13.551670 |
14.001680 |
14.051690 |
14.101700 |
14.151710 |
14.201720 |
14.251730 |
14.301740 |
14.351750 |
14.401760 |
14.451770 |
14.501780 |
14.551790 |
15.001800 |

PLATE D-17

15-05181.
 15-10182.
 15-15183.
 15-20184.
 15-25185.
 15-30186.
 15-35187.
 15-40188.
 15-45189.
 15-50190.
 15-55191.
 16-01192.
 16-05193.
 16-10194.
 16-15195.
 16-20196.
 16-25197.
 16-30198.
 16-35199.
 16-40200.
 16-45201.
 16-50202.
 16-55203.
 17-00204.
 17-05205.
 17-10206.
 17-15207.
 17-20208.
 17-25209.
 17-30210.
 17-35211.
 17-40212.
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 17-50214.
 17-55215.
 18-00216.
 18-05217.
 18-10218.
 18-15219.
 18-20220.
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 18-30222.
 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.
 19-40236.
 19-45237.
 19-50238.
 19-55239.
 20-00240.
 20-05241.
 20-10242.

PLATE D-48

20.15243.10
 20.20244.10
 20.23245.10
 20.30246.10
 20.35247.10
 20.40248.10
 20.45249.10
 20.50250.10
 20.55251.10
 21.00252.10
 21.05253.10
 21.10254.10
 21.15255.10
 21.20256.10
 21.25257.10
 21.30258.10
 21.35259.10
 21.40260.10
 21.45261.10
 21.50262.10
 21.55263.10
 22.00264.10
 22.05265.10
 22.10266.10
 22.15267.10
 22.20268.10
 22.25269.10
 22.30270.10
 22.35271.10
 22.40272.10
 22.45273.10
 22.50274.10
 22.55275.10
 23.00276.10
 23.05277.10
 23.10278.10
 23.15279.10
 23.20280.10
 23.25281.10
 23.30282.10
 23.35283.10
 23.40284.10
 23.45285.10
 23.50286.10
 23.55287.10
 0.00288.10

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	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	
				.05	.10	.15	.20	.35	.50	.65	.80	1.00	
HYDROGRAPH AT	000001	.14	1	77.	153.	230.	307.	537.	767.	998.	1228.	1535.	
		.35		2.17	4.35	6.52	8.69	15.21	21.73	28.25	34.77	43.46	
ACUTED TO	000002	.14	1	8.	9.	38.	81.	261.	574.	870.	1107.	1432.	
		.35		.23	.25	1.08	2.29	7.40	16.25	24.62	31.34	40.54	

PLATE D-20

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		635.00		635.00		637.60			
OUTFLOW		0.		0.		29.			
		0.		0.		167.			
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		
.05	635.60	0.00	6.	8.	0.00	18.17	0.00		
.10	636.41	0.00	15.	9.	0.00	18.25	0.00		
.15	636.80	0.00	20.	38.	0.00	17.33	0.00		
.20	637.14	0.00	24.	81.	0.00	16.25	0.00		
.35	637.97	.37	34.	261.	1.00	16.00	0.00		
.50	638.31	.71	38.	274.	1.83	15.83	0.00		
.65	638.49	.89	40.	270.	3.50	15.83	0.00		
.80	638.61	1.01	41.	1107.	6.42	15.83	0.00		
1.00	638.76	1.16	43.	1432.	5.25	15.75	0.00		

END

DATE
FILMED

11-81

DTIC