

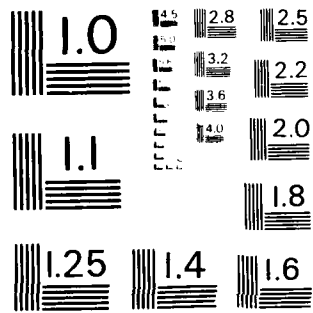
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HOUSATONIC RIVER BASIN
DANBURY CONNECTICUT

PADANARAM RESERVOIR DAM
CT 00067

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Housatonic River Basin Danbury Conn. Padanaram Reservoir Dam		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Padanaram Reservoir is an earth embankment with a stone masonry faced downstream slope that is approx. 325 ft. long and 26.3 ft. high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The spillway is located at the southern abutment of the dam and is 24-foot long channel. There is a lower gate house in the center of the dam for the control of a discharge pipe that passes through the base of the dam. The size of the discharge pipe is unknown and the valve for its operation is inoperable. The drainage area is 3.7 square miles and the reservoir has 52 acre-feet of available storage.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OFF:
NEDED-E

SEP 9 1971

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Padanaram Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Padanaram Reservoir Dam would likely be exceeded by floods greater than 8 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

NEDED-E

Honorable Ella T. Grasso

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. This report has also been furnished to the owner of the project, Mr. John A. Schweitzer, Jr., City Engineer, City of Danbury, Danbury, Connecticut 06810.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for the cooperation extended in carrying out this program.

Sincerely,



MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

PADANARAM RESERVOIR DAM

CT 00067

HOUSATONIC RIVER BASIN

DANBURY, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification Number:	CT 00067
Name:	Padanaram Reservoir Dam
Town:	Danbury
County and State:	Fairfield County, Connecticut
Stream:	Padanaram Brook
Date of Inspection:	April 21, 1980

BRIEF ASSESSMENT

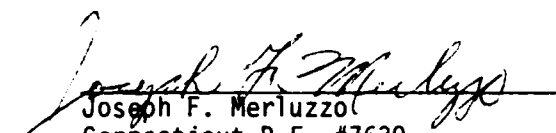
The Padanaram Reservoir Dam is an earth embankment with a stone masonry faced downstream slope that is approximately 325 feet long and 26.3 feet high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The spillway is located at the southern abutment of the dam and is 24-foot long channel. There is a lower gate house in the center of the dam for the control of a discharge pipe that passes through the base of the dam. The size of the discharge pipe is unknown and the valve for its operation is inoperable. The drainage area is 3.7 square miles and the reservoir has 52 acre-feet of available storage.

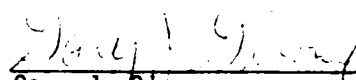
The assessment of the dam is based on the visual inspection, past operational performance and hydraulic/hydrologic computations. The dam is judged to be in fair condition with several areas that require attention. These areas include seepage through the dam and along the toe, vegetation on the stone face and along the toe of the dam and the nonoperating status of the blowoff.

The dam is classified as small and has a high hazard potential in accordance with guidelines established by the Corps of Engineers. The test flood for this dam is 1/2 the Probable Maximum Flood (PMF). The test flood inflow is 3,608 cfs and the routed test flood outflow is 3,460 cfs. The test flood outflow will overtop the dam by 2.3 feet.

It is recommended that the owner engage the services of a qualified registered engineer experienced in the design of dams to investigate the seepage through the dam and prepare a detailed hydraulic/hydrologic study to determine the spillway's adequacy.

Additional recommendations and remedial measures are included in Section 7 and should be implemented within one year after receipt of this Phase I Inspection Report.


Joseph F. Merluzzo
Connecticut P.E. #7639
Project Manager


Gary J. Giroux
Connecticut P.E. #11477
Project Engineer

This Phase I Inspection Report on Padanaram Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Friar
JOE B. FRIAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Inspections. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Inspection; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated Probable Maximum Flood for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and variety of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Inspection does not include an assessment of the need for fences, gates, "no trespassing" signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with Occupational Safety and Hazard Administration's (OSHA) rules and regulations is also excluded.

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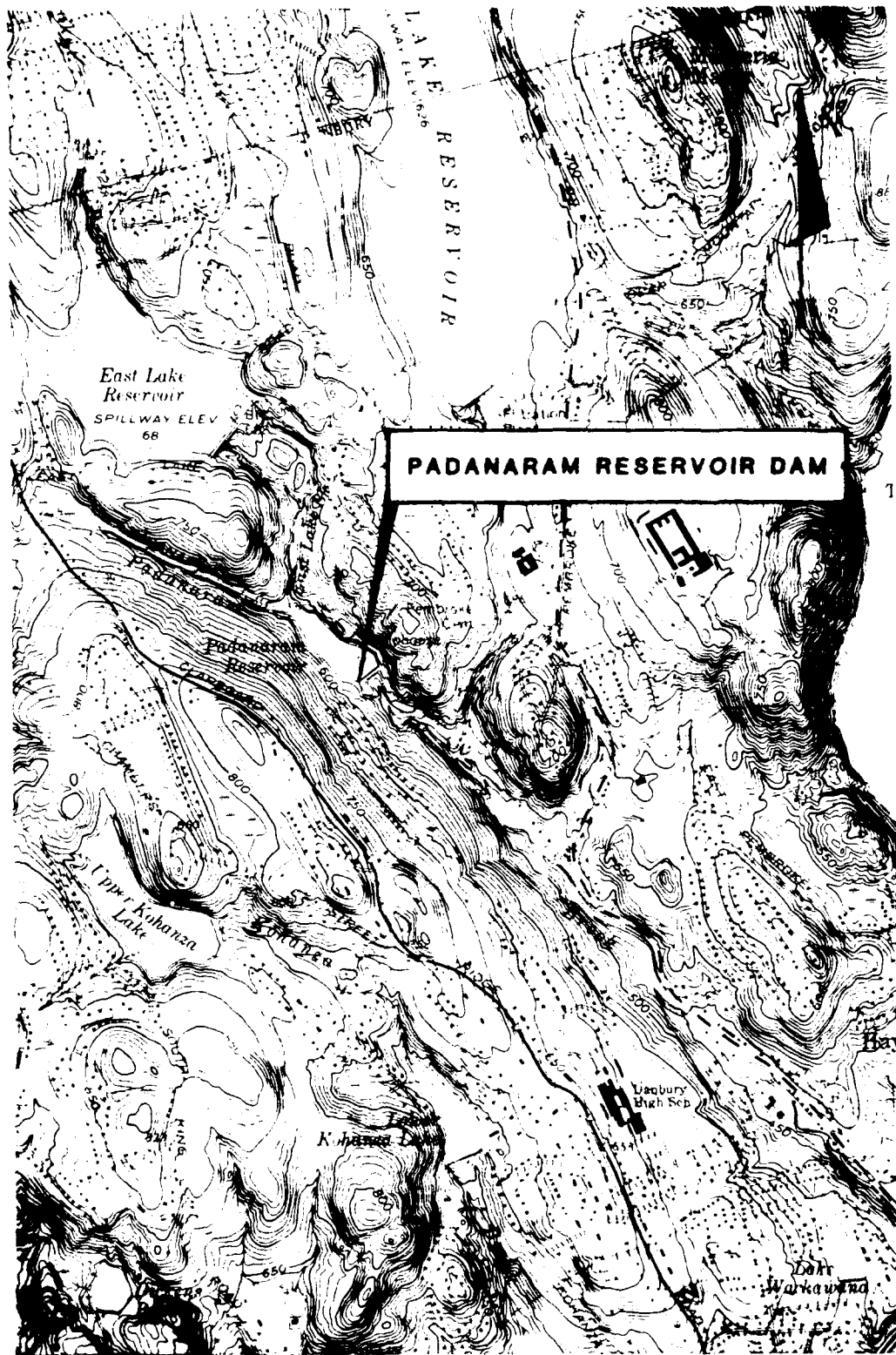
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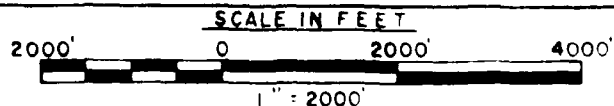


PADANARAM RESERVOIR DAM



QUADRANGLE DANBURY, CT

US ARMY, CORPS OF ENGINEERS
 NEW ENGLAND DIVISION
 WALTHAM, MASS.



LOCATION MAP

PHASE I INSPECTION REPORT
PADANARAM RESERVOIR DAM CT 00067

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspections throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Storch Engineers under a letter of March 6, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0035 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location - The Padanaram Reservoir Dam is located approximately 3 miles northwest of downtown Danbury and 3,700 feet north of the intersection of

Padanaram Road and Pembroke Road in the City of Danbury, Connecticut (See Location Map). The coordinates of the dam are approximately 41°-26' north latitude and 73°-29' west longitude. The dam is located on Padanaram Brook in the Housatonic River Basin.

b. Description of Dam and Appurtenances - The Padanaram Reservoir Dam is an earth embankment with a stone faced downstream slope that is 325 feet long and 26.3 feet high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The top of the dam is capped with concrete, 7 feet wide. The upstream embankment is lined with riprap.

The spillway is located through the southern abutment of the dam and consists of a 24-foot long stone weir and a 24-foot wide downstream spillway channel.

There is a lower gate house at the center of the dam with a valve that controls a discharge pipe that passes through the base of the dam. The size of the pipe is unknown. The valve in the gate house is *not* operable.

c. Size Classification - The Padanaram Reservoir Dam has a maximum height of 26.3 feet and a maximum storage of 132.5 acre-feet at the top of the dam. In accordance with the Recommended Guidelines for Safety Inspection of Dams established by the Corps of Engineers, the dam is classified as small (height less than 40 feet and storage less than 1,000 acre-feet).

d. Hazard Classification - The Padanaram Reservoir Dam is classified as having a high hazard potential. Failure of the dam could result in the loss of more than a few lives. Approximately 1,500 feet downstream are two homes which would be inundated by the flood wave. Estimated flow and water depths just prior to dam failure at this location is 600 cfs at 2 feet and just after dam failure is 12,000 cfs at 11 feet or an increase in depth of 9 feet.

e. Ownership - The Padanaram Reservoir Dam is owned by the City of Danbury, Connecticut.

f. Operator - The person in charge of day-to-day operation of the dam is:

Mr. John A. Schweitzer, Jr.
City Engineer
City of Danbury
Danbury, Connecticut 06810
(203) 797-4641

g. Purpose of Dam - The dam impounds the Padanaram Reservoir which serves as a water supply for the City of Danbury.

h. Design and Construction History - There are no design computations or construction drawings. The Padanaram Reservoir Dam was constructed in 1882.

i. Normal Operational Procedure - There are no operational procedures for the dam. Water impounded by the dam is used only in times of shortage.

1.3 Pertinent Data

a. Drainage Area - The Padanaram Reservoir drainage basin is in the City of Danbury and is irregular in shape. The area of the drainage basin is 3.7 square miles (Appendix D - Plate 3). Approximately 5 percent of the drainage basin is natural storage and more than 60 percent is developed. The topography is rolling with elevations ranging from 1,023 (NGVD) to 577 (NGVD) at the spillway crest. Approximately 45% of the watershed is controlled by East Lake Reservoir, another water supply reservoir.

b. Discharge at Damsite - There are no records available for discharge at the dam.

(1) Outlet works (conduit) size:	unknown
Invert elevation (feet above NGVD):	unknown
Discharge Capacity at top of dam:	unknown
(2) Maximum known flood at damsite:	unknown

(3) Ungated spillway capacity at top of dam:	600 cfs
Elevation (NGVD):	581.3
(4) Ungated spillway capacity at test flood elevation:	1,050 cfs
Elevation (NGVD):	583.6
(5) Gated spillway capacity at normal pool elevation:	N/A
Elevation (NGVD):	N/A
(6) Gated spillway capacity at test flood elevation:	N/A
Elevation:	N/A
(7) Total spillway capacity at test flood elevation:	1,050 cfs
Elevation (NGVD):	583.6
(8) Total project discharge at top of dam:	600
Elevation (NGVD):	581.3
(9) Total project discharge at test flood elevation:	3,460 cfs
Elevation (NGVD):	503.6
c. Elevation (feet above NGVD)	
(1) Streambed at toe of dam:	555
(2) Bottom of cutoff:	unknown
(3) Maximum tailwater:	560
(4) Normal pool:	577
(5) Full flood control pool:	N/A
(6) Spillway crest (ungated):	577

(7) Design surcharge (original design):	unknown
(8) Top of dam:	581.3
(9) Test flood surcharge:	583.6
d. Reservoir (length in feet)	
(1) Normal pool:	1,200
(2) Flood control pool:	N/A
(3) Spillway crest pool:	1,200
(4) Top of dam:	1,250
(5) Test flood pool:	1,300
e. Storage (acre-feet)	
(1) Normal pool:	80.5
(2) Flood control pool:	N/A
(3) Spillway crest pool:	80.5
(4) Top of dam:	132.5
(5) Test flood pool:	159.5
f. Reservoir Surface (acres)	
(1) Normal pool:	9.18
(2) Flood control pool:	N/A
(3) Spillway crest:	9.18
(4) Test flood pool:	13.5
(5) Top of dam:	12
g. Dam	
(1) Type:	earth embankment/stone masonry downstream face
(2) Length:	325 feet
(3) Height:	26.3 feet

(4) Top width:	7 feet
(5) Side slopes:	U/S - 2.25:1 D/S - 1:12
(6) Zoning:	unknown
(7) Impervious core:	unknown
(8) Cutoff:	unknown
(9) Grout curtain:	unknown
(10) Other:	N/A
h. Diversion and Regulating Tunnel	N/A
i. Spillway	
(1) Type:	stone-broad crested
(2) Length of weir:	24 feet
(3) Crest elevation (without flashboard):	577
(4) Gates:	N/A
(5) U/S channel:	riprapped pond bottom
(6) D/S channel:	24-foot riprapped and natural channel
(7) General:	N/A
j. Regulating Outlets	
(1) Invert elevation (NGVD):	unknown
(2) Size:	unknown
(3) Description:	unknown
(4) Control Mechanism	manually operated gate
(5) Other:	gate not operable

SECTION 2 - ENGINEERING DATA

2.1 Design Data

There are no design computations or drawings available. The dam was designed by W. G. Worthington and D. G. Penfield, Engineers.

2.2 Construction Data

The dam was constructed in 1882 by George McKee, Contractors. There are no records or drawings available for the construction of the dam.

2.3 Operation Data

There are no operations at this dam. Water is pumped out during times of shortages. There is a discharge pipe but it is not operating.

2.4 Evaluation of Data

a. Availability - There were no computations or drawings available. There are no operating procedures.

b. Adequacy - The information made available along with the visual inspection, past performance history and hydraulic/hydrologic assumptions were adequate to assess the condition of the facility.

c. Validity - Due to the lack of available data, the conclusions and recommendations found in this report are based on the visual inspection and hydraulic/hydrologic computations.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General - The visual inspection was conducted on April 21, 1980 by members of the engineering staff of Storch Engineers, D. Baugh and Associates, Inc. and Matthews Associates with the help of Mr. Bruce Healy of the City of Danbury, Connecticut. A copy of the visual inspection check list is contained in Appendix A of this report. Selected photos of the dam and appurtenant structures are contained in Appendix C.

In general, the overall appearance and condition of the facility and its appurtenant structures is fair.

b. Dam - The dam is an earth embankment with a stone masonry faced downstream slope. The downstream face of the dam needs repointing in areas where vegetation has been growing from the joints (Photo 1). There appears to be a bulge in the masonry just to the east of the gate house. A closer look at this bulge, however, does not show any distress in the mortared joints. The alignment of the top of the dam is good (Photo 2) and no bulges are apparent. The upstream embankment is brush covered and there are areas where the riprap has moved (Photo 2). The top of the dam is level with no signs of settlement. The stone wingwall is in good condition.

Just below the toe of the dam and to the east of the gate house, there is a steady seepage flow (Photos 7 and 8) which was estimated to be approximately 50 to 75 gallons per minute. This seepage is clear and does not show any signs of particle movement. The estimated quantity of flow is from the entire area as shown on the Photo Location Plan.

c. Appurtenant Structures - The lower gate house (Photo 6) is structurally sound, however, the valve is not operating and the type and size of the discharge pipe is unknown. The discharge pipe outlets approximately 50 feet downstream and is silted-up and has not experienced flow in years.

The spillway is a stone weir that is in fair condition (Photo 3). The approach channel is not well defined and is the natural slope of the bottom of the pond. The training walls of the spillway are also stone masonry and are in fair condition. The downstream channel is a natural channel with riprap in some areas. It is 24 feet wide with steep side slopes (Photo 4). The condition is good except for areas of the channel where debris is cluttered.

d. Reservoir Area - The area immediately adjacent to the facility is steeply sloped and in a natural state. The shoreline shows no signs of sloughing or erosion and there is no development adjacent to the reservoir. A rapid rise in the water level of the reservoir will not endanger any life or property.

e. Downstream Channel - The downstream channel is a natural channel lined with rock and rock outcroppings.

3.2 Evaluation

Overall, the general condition of the dam is fair. The visual inspection revealed items that lead to this assessment, and apparent areas of distress such as:

- a. Seepage from the toe.
- b. Inoperation of the blowoff.
- c. Vegetation on the downstream face along the toe of the dam and the downstream channel.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General - The operation of this facility is for water supply purposes and the reservoir is kept as full as possible. The discharge pipe through the dam cannot be controlled because the valve is frozen shut and is inoperable.

b. Description of any Warning System in Effect - There is no warning system in effect for this dam.

4.2 Maintenance Procedures

a. General - This dam is minimumly maintained.

b. Operating Facilities - Valve to the discharge pipe is not operable.

4.3 Evaluation

The maintenance of the dam is less than adequate in that proper care of the dam embankment should be on a regular basis. The valve to the discharge pipe should be maintained in working order and there should be a proper operating procedure and warning system in effect.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Padanaram Reservoir Dam is an earth embankment with a stone masonry faced downstream slope approximately 325 feet long and 26.3 feet high. The spillway is a stone weir, 24 feet long. The downstream channel is 24 feet wide and is natural ground with some riprap. A discharge pipe passes through the base of the dam. The size of the pipe is not known and the valve is inoperable.

The watershed encompasses 3.7 square miles and is more than 60 percent developed. The topography is rolling with the terrain rising 446 feet from the spillway crest.

The pond has a total capacity of 132.5 acre-feet when the pond is at the top of the dam and 80.5 acre-feet at the spillway crest. Therefore, there is approximately 32 acre-feet of storage available. The test flood outflow for this dam is 3,460 cfs and the spillway capacity is 600 cfs or approximately 17% of the test flood outflow.

5.2 Design Data

No design data is available.

5.3 Experience Data

The Padanaram Reservoir Dam has experienced all the major storms of the 1930's and 1950's and most recently January, 1979. The flood of record in the Danbury area resulted from the storm of October, 1955.

5.4 Test Flood Analysis

Based on the guidelines found in the Recommended Guidelines for Safety Inspection of Dams, the dam is classified as small structure with a high hazard

potential. The test flood for these conditions ranges from 1/2 the Probable Maximum Flood (PMF) to the PMF. One half the PMF was used for this dam because of its size.

Using the guide curves established by the Corps of Engineers (rolling terrain), the test flood inflow is 3,608 cfs. The routing procedure established by the Corps gives an approximate outflow of 3,460 cfs. The spillway capacity is approximately 600 cfs or approximately 17% of the test flood outflow. The test flood will overtop the dam by approximately 2.3 feet.

In the development of the test flood inflow, it was assumed that the East Lake Reservoir Dam had no effect on the peak inflow. Although it does, the actual amount is negligible. This simplified the development of the inflow hydrograph, the routing through the dam and the outflow hydrograph for Padanaram Reservoir Dam.

Storage behind the dam was assumed to begin at the elevation of the spillway crest. Storage was determined by an average area depth analysis. Capacity curves for the spillway assumed weir flow.

5.5 Dam Failure Analysis

A dam failure analysis was performed using the Rule of Thumb method in accordance with guidelines established by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the top of the dam.

The spillway discharge just prior to dam failure is 600 cfs and will produce a depth of flow of approximately 2 feet several hundred feet downstream from the dam. The calculated dam failure discharge is 19,050 cfs and will produce a depth of flow of approximately 10 feet several hundred feet downstream from the dam or an increase in water depth at failure of approximately 8 feet. The failure

analysis covered a distance of approximately 4,700 feet downstream where the depth of flow was calculated to be 4.5 feet or an increase of approximately 2.5 feet.

Failure of the Padanaram Reservoir Dam may result in the loss of more than a few lives and may damage at least two dwellings located approximately 1,500 feet downstream. Flow due to failure at this location will be approximately 12,000 cfs at a depth of 11 feet.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The general structural stability of the dam is good as evidenced by the vertical, horizontal and lateral alignment of the face and top of the dam and by the age of the dam. A bulge was noted on the front face of the dam east of the centerline, extending about 1/4 of the length. This bulge, however, appears to have originated during construction because no cracking of the masonry or mortar was observed. Some joints in the masonry need repointing as evidenced by the vegetative growth from the joints.

The spillway channel is in fair condition. It should be cleared of the accumulated debris and some of the stones realigned.

Some possible problem areas are seepage at the toe of the dam and the cluttered spillway.

6.2 Design and Construction Data

No design data or construction drawings are available.

6.3 Post-Construction Changes

No information on post-construction changes are available.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with Recommended Phase I Guidelines does not warrant a seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - After consideration of the available information, the results of the inspection and hydraulic/hydrologic computations, the general condition of the Padanaram Reservoir Dam is fair.

b. Adequacy of Information - The information available is such that an assessment of the safety of the dam should be based on available data, the visual inspection results, past operational performance of the dam and its appurtenant structures and computations developed for this report.

c. Urgency - It is considered that the recommendations suggested below be implemented within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified registered engineer.

- a. Seepage through the dam and at the toe of the dam should be investigated further to determine its origin and monitored to determine any changes.
- b. Prepare a detailed hydraulic/hydrologic study to determine spillway adequacy and an increase of the total project discharge if necessary.
- c. Trees including stumps and root systems should be removed from the toe and embankment slopes and backfilled with proper material.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures -

(1) Spillway channel should be cleared of debris and relined with the stone available.

(2) Vegetation on the downstream face of the dam and trees along the toe of the dam should be removed. This will facilitate the visual observation of existing and potential seepage.

(3) Discharge valve and pipe should be repaired. Valve for the discharge pipe should be on the upstream side of the embankment.

(4) Plans for a regular program of operation and maintenance of the dam should be initiated.

(5) Plans for around-the-clock surveillance should be developed for periods of unusually heavy rains and a formal downstream warning system should be put into operation for use in the event of an emergency.

(6) A program of annual technical inspection should be established.

7.4 Alternatives

None.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

TIME 11:00 a.m.

WEATHER Clear

W.S. ELEV. _____ U.S. _____ DN.S. _____

PARTY:

- | | |
|---|-----------------------------------|
| 1. <u>John F. Schearer, SE Civil</u> | 6. <u>Peter Austin, DBA Civil</u> |
| 2. <u>John Pozzato, MA Mech.</u> | 7. <u>Bruce Healy, Danbury</u> |
| 3. <u>Kenneth J. Pideler, SE Civil</u> | 8. _____ |
| 4. <u>Gary J. Giroux, SE Hyd/Civil</u> | 9. _____ |
| 5. <u>Michael Haire, SE Struct/Geo.</u> | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	Good
Current Pool Elevation	Fair to good/some erosion
Maximum Impoundment to Date	No information available
Surface Cracks	Minor
Pavement Condition	Good
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	Problem
Vegetation on Slopes	Some through joints - minor
Sloughing or Erosion of Slopes or Abutments	Upstream - some/minor
Rock Slope Protection - Riprap Failures	Minor upstream
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Negligable through dam - some below dam.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

CUTLET WORKS - INTAKE CHANNEL AND
INTAKE STRUCTURE

Underwater

a. Approach Channel

Slope Conditions

Bottom Conditions

Rock Slides or Falls

Log Boom

Debris

Condition of Concrete Lining

Drains or Weep Holes

b. Intake Structure

Condition of Concrete

Stop Logs and Slots

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural Stone masonry	
General Condition	Fair
Condition of Joints	Fair
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staining of Concrete	N/A
Any Seepage or Efflorescence	Minor
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	N/A
Cracks	N/A
Rusting or Corrosion of Steel	N/A
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	None
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - TRANSITION AND CONDUIT

Inaccessible

General Condition of Concrete

Rust or Staining on Concrete

Spalling

Erosion or Cavitation

Cracking

Alignment of Monoliths

Alignment of Joints

Numbering of Monoliths

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
----------------	-----------

OUTLET WORKS - OUTLET STRUCTURE AND
OUTLET CHANNEL

General Condition of Concrete

N/A

Rust or Staining

N/A

Spalling

N/A

Erosion or Cavitation

N/A

Visible Reinforcing

N/A

Any Seepage or Efflorescence

N/A

Condition at Joints

N/A

Drain holes

N/A

Channel

Not well defined

Loose Rock or Trees Overhanging
Channel

Brush and trees in channel

Condition of Discharge Channel

Fair

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
<p>a. Approach Channel</p> <p> General Condition</p> <p> Loose Rock Overhanging Channel</p> <p> Trees Overhanging Channel</p> <p> Floor of Approach Channel</p>	<p>Underwater</p>
<p>b. Weir and Training Walls</p> <p> General Condition of Concrete</p> <p> Rust or Staining</p> <p> Spalling</p> <p> Any Visible Reinforcing</p> <p> Any Seepage or Efflorescence</p> <p> Drain Holes</p>	<p>Dry rubble</p> <p>Fair</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p>
<p>c. Discharge Channel</p> <p> General Condition</p> <p> Loose Rock Overhanging Channel</p> <p> Trees Overhanging Channel</p> <p> Floor of Channel</p> <p> Other Obstructions</p>	<p>Fair</p> <p>Some</p> <p>Some</p> <p>Natural rock - good</p> <p>None</p>

INSPECTION CHECK LIST

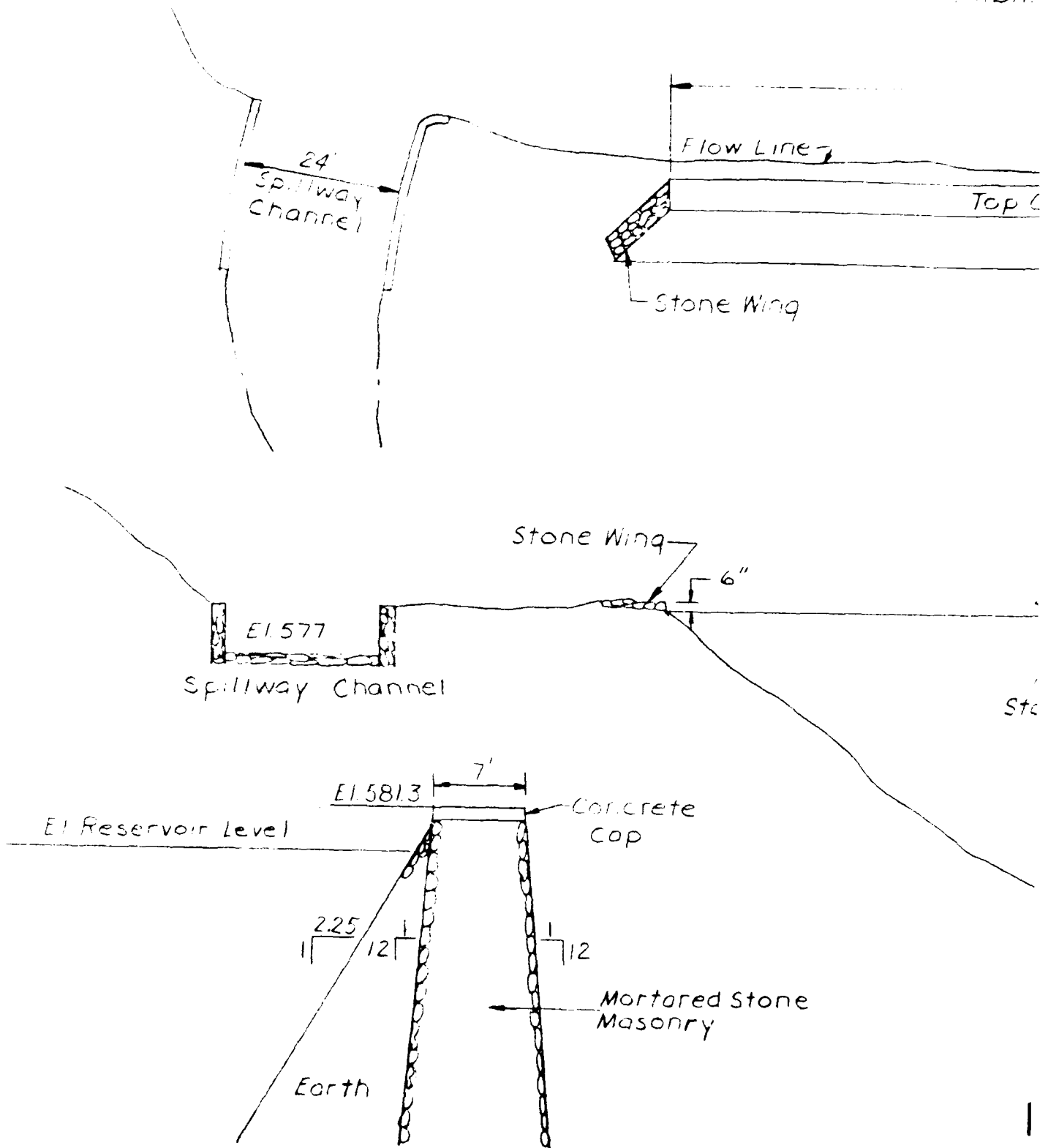
PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SERVICE BRIDGE</u></p> <p>a. Super Structure</p> <ul style="list-style-type: none"> Bearings Anchor Bolts Bridge Seat Longitudinal Members Under Side of Deck Secondary Bracing Deck Drainage System Railings Expansion Joints Paint <p>b. Abutment & Piers</p> <ul style="list-style-type: none"> General Condition of Concrete Alignment of Abutment Approach to Bridge Condition of Seat & Backwall 	<p>N/A</p>

APPENDIX B

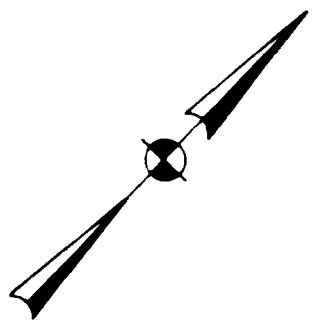
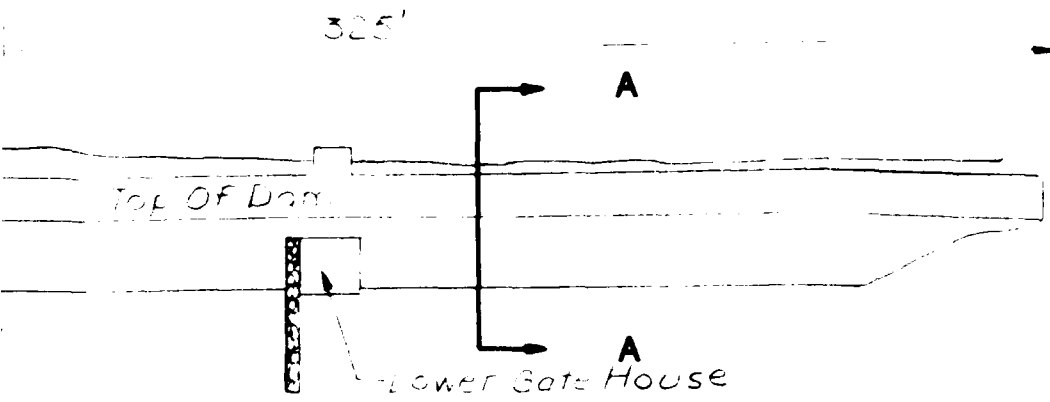
ENGINEERING DATA

PADA

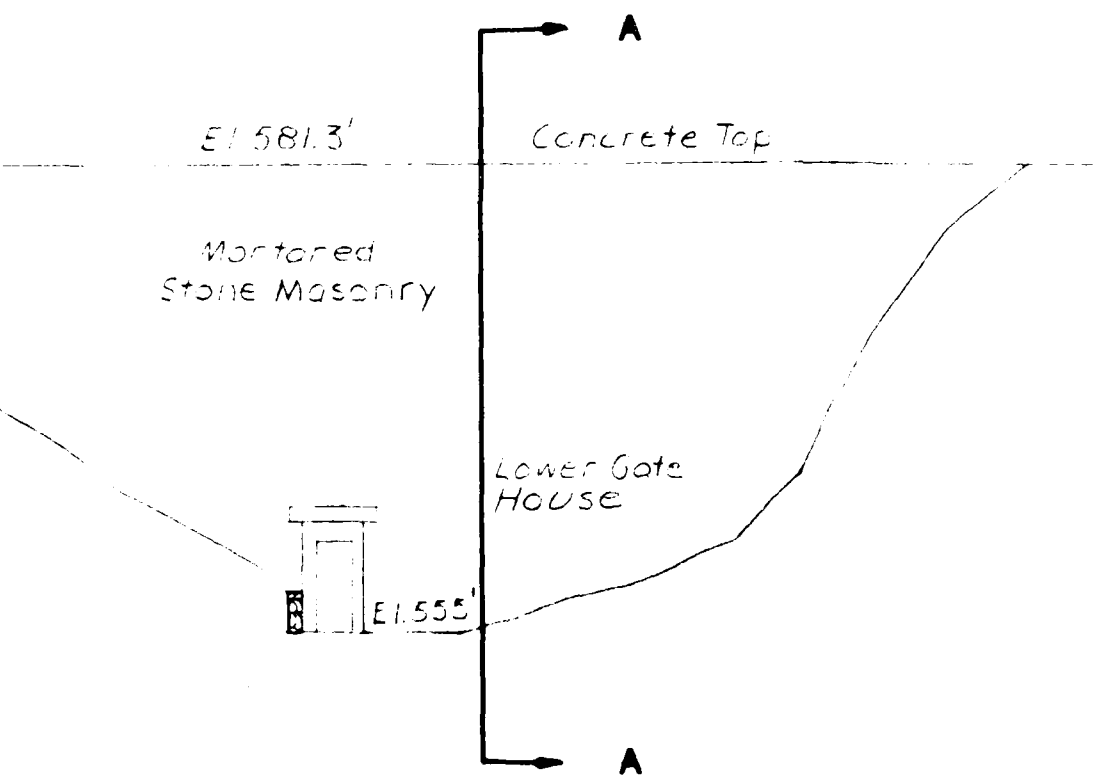


SECTION A A

PADANARAM RESERVOIR



Outlet
PLAN



ELEVATION

PLATE 1

STORCH ENGINEERS WETHERSFIELD CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	
PADANARAM RESERVOIR DAM	
	SCALE AS SHOWN
	DATE JULY 1980

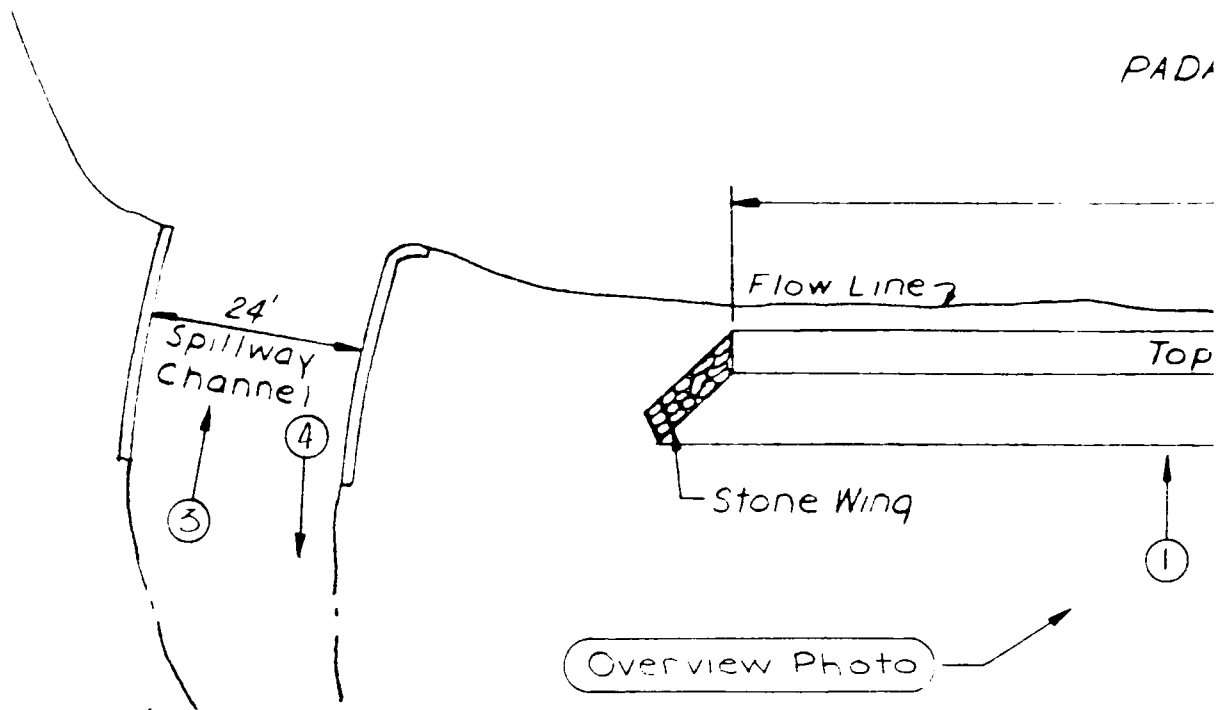
NOT TO SCALE

[Handwritten signature]

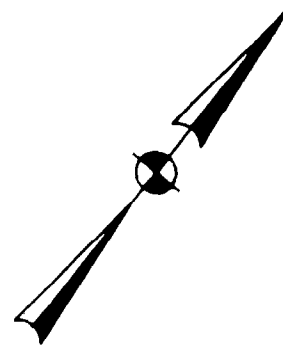
APPENDIX C

PHOTOGRAPHS

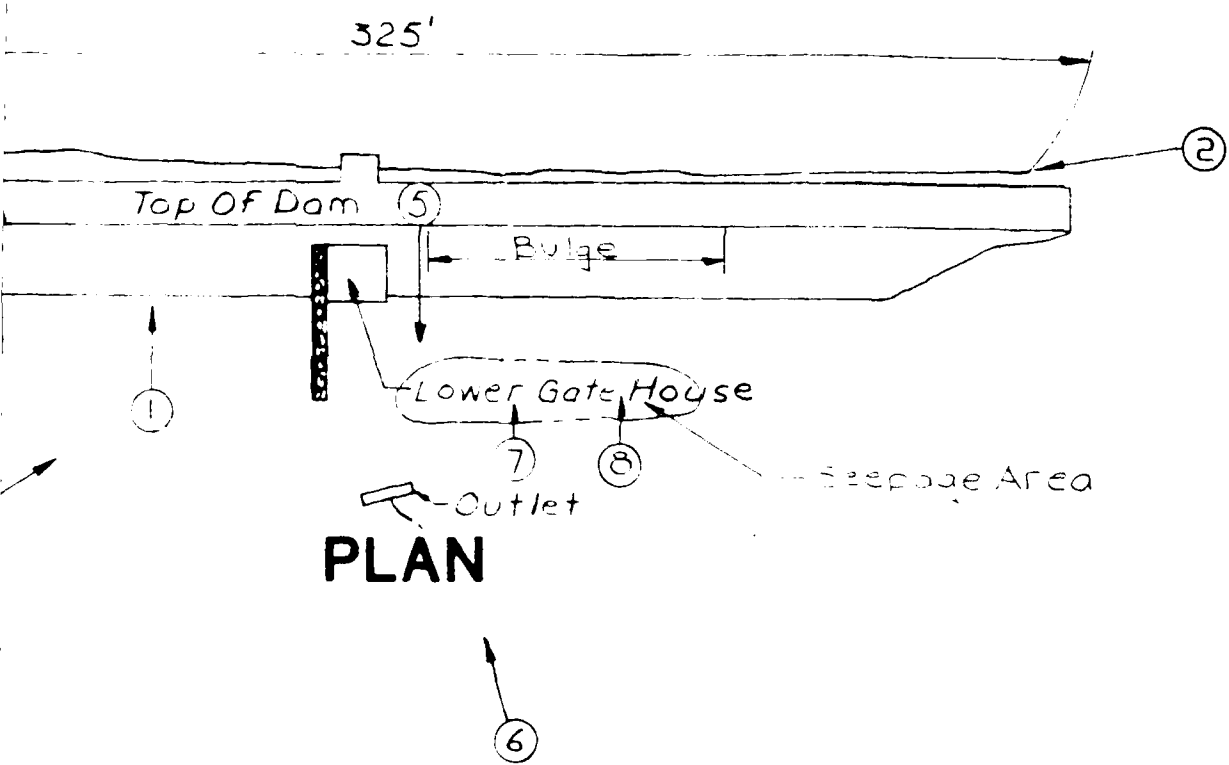
PADA



1



PADANARAM RESERVOIR



PLAN

PHOTO LOCATION PLAN

PLATE 2

STORCH ENGINEERS WETHERFIELD, CONNECTICUT	U.S. ARMY ENGINEERING CENTER CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	
PADANARAM RESERVOIR DAM	
NOT TO SCALE	
SCALE AS SHOWN	
DATE JULY 1980	



PHOTO 1
DOWNSTREAM FACE OF DAM

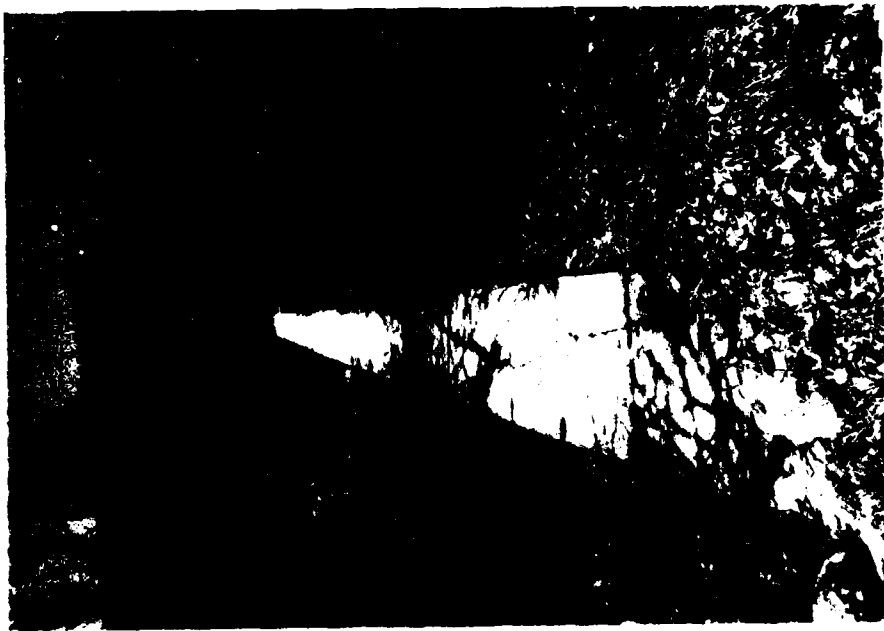


PHOTO 2
CREST OF DAM



PHOTO 3
SPILLWAY-UPSTREAM



PHOTO 4
SPILLWAY CHANNEL-DOWNSTREAM

C-II



PHOTO 5
VIEW LOOKING DOWNSTREAM



PHOTO 6
LOWER GATE HOUSE & OUTLET

C-III



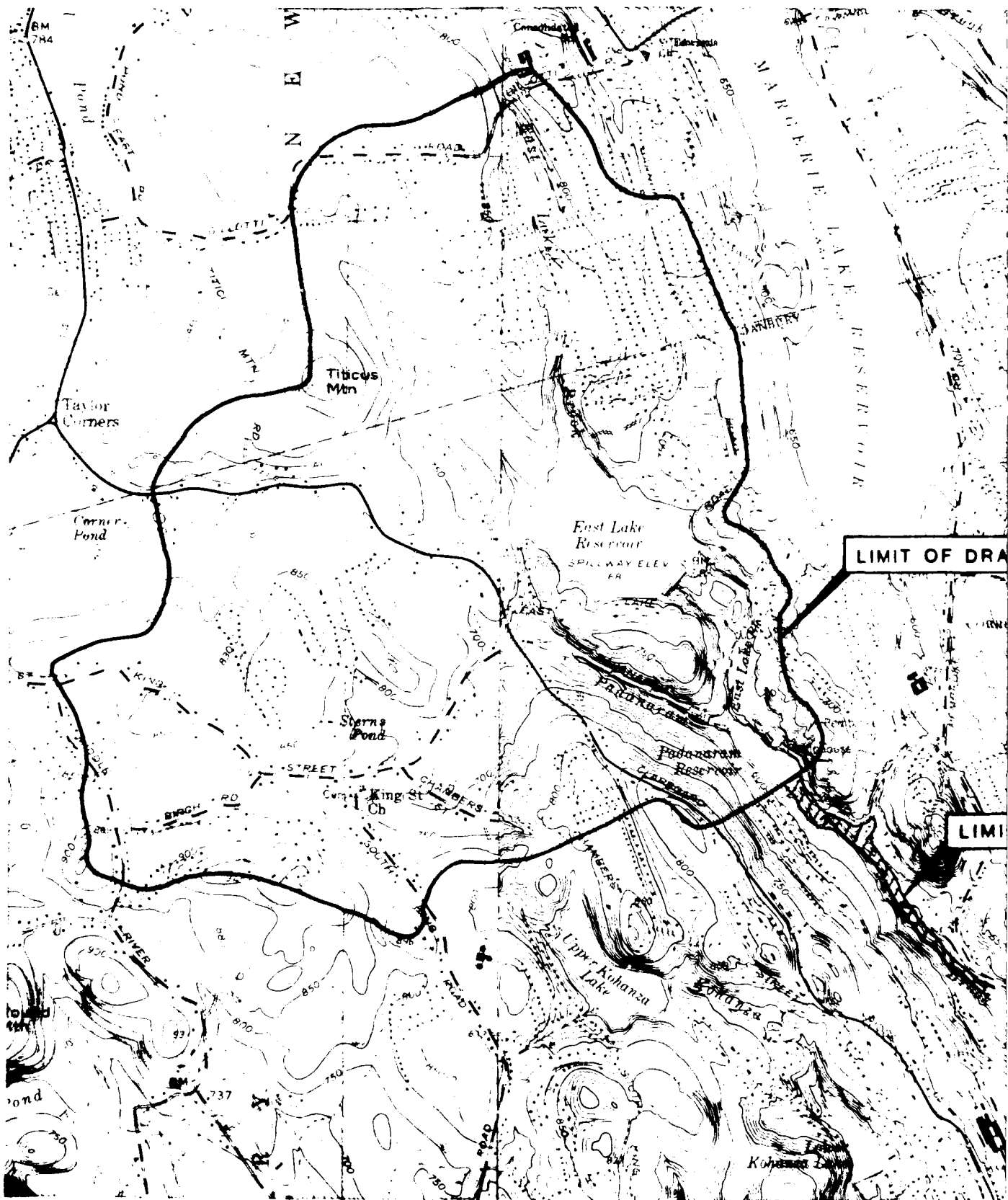
PHOTO 7
SEEPAGE NEAR TOE OF DAM

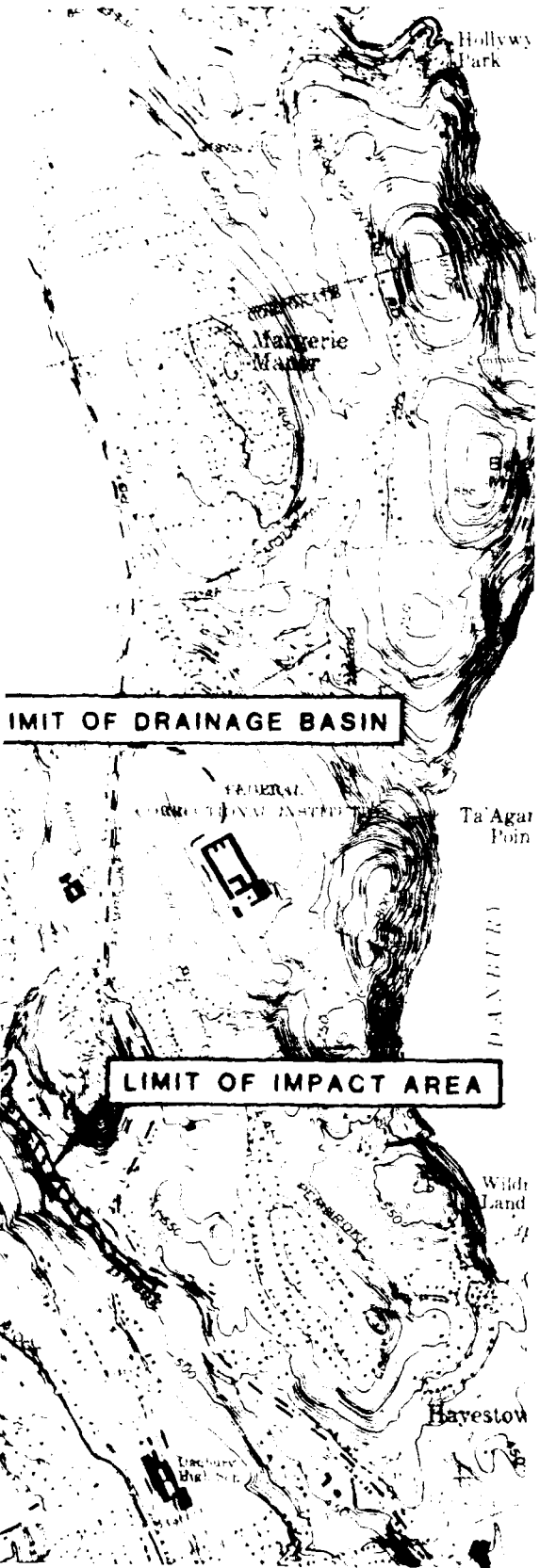


PHOTO 8
SEEPAGE NEAR TOE OF DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS





scale 1:24000

PLATE 3

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIVISION NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	
PADANARAM RESERVOIR DAM	
SCALE AS SHOWN DATE JULY 1980	

STORCH ENGINEERS
 Engineers - Landscape Architects
 Planners - Environmental Consultants

JOB Phase I Dam Inspection - #4463
 SHEET NO 1 OF 10
 CALCULATED BY P.A. DATE 7/25/80
 CHECKED BY P.C. DATE 7/15/80
Determination of PMF

NAME OF DAM PADANARAM RES DAM

DRAINAGE AREA 3.7 SQ MI

INFLOW 975 CFS/SQ MI

$$V_2 \text{ PMF} = (975 \text{ CFS/SQ MI})(3.7 \text{ SQ MI}) = 3608 \text{ CFS}$$

$$Q_{100} = 340 \times A^{.79} = 956 \text{ CFS}$$

Estimating the effect of surcharge storage on the Maximum Probable Discharges

- | | | |
|-----|---|------------------------------|
| 1. | $Q_{p1} = \underline{3608} \text{ cfs}$ | <u>100 YR.</u> |
| 2a. | $H_1 = \underline{6.65'} \text{ (elev.)}$ | <u>956 CFS</u> |
| b. | $STOR_1 = \underline{0.4''}$ | <u>4.97'</u> |
| c. | $Q_{p2} = Q_{p1} (1 - STOR_1 / 9.3) = \underline{3460} \text{ cfs}$ | <u>0.3''</u> |
| 3a. | $H_2 = \underline{6.60}$ | $STOR_2 = \underline{0.4''}$ |
| b. | $STOR_A = \underline{0.4''}$ | <u>900 CFS</u> |
| | $Q_{PA} = \underline{3460} \text{ CFS}$ | <u>4.90'; 0.3''</u> |
| | $H_A = \underline{6.6}$ | <u>0.3</u> |
| | $STOR_A = \underline{0.4''}$ | <u>900 CFS</u> |
| | $PMF = \underline{3460} \text{ cfs}$ | <u>4.9'; 0.3''</u> |
| | | <u>900 CFS</u> |

Capacity of the spillway when the pond elevation is at the top of the dam

$$Q = \underline{600} \text{ cfs or } \underline{17} \% \text{ of the } \frac{1}{2} \text{ PMF}$$

67% OF 100 YR

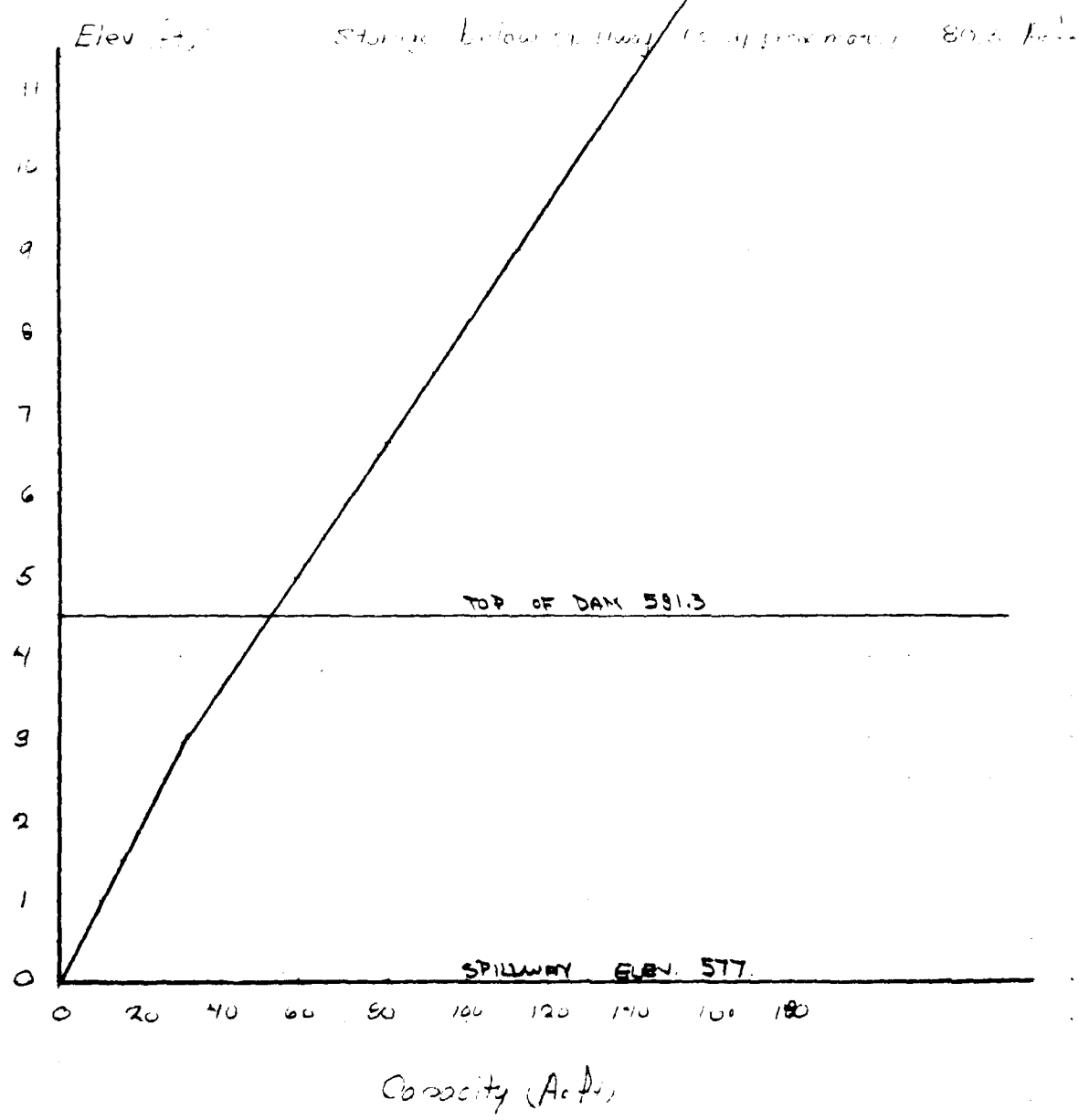
STORCH ENGINEERS
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 Planners - Environmental Consultants

JOB Phase I Dam Inspection 4463
 SHEET NO. 2 OF 10
 CALCULATED BY GJG DATE 4/10/80
 CHECKED BY BDC DATE 7/15/80

AREA - CAPACITY

Name of Dam: PADANARAM RES. DAM

ELEV	DEPTH	AREA	AVG. AREA	VOL	Σ VOL
0		9.18			0
3.0	3.0	11.9	10.5	31.5	31.5
13.0	10.0	15.6	13.5	135.0	166.5



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JOB Phase I Dam Inspection 4463

SHEET NO 3 OF 3

CALCULATED BY T. A. DATE 4/15/80

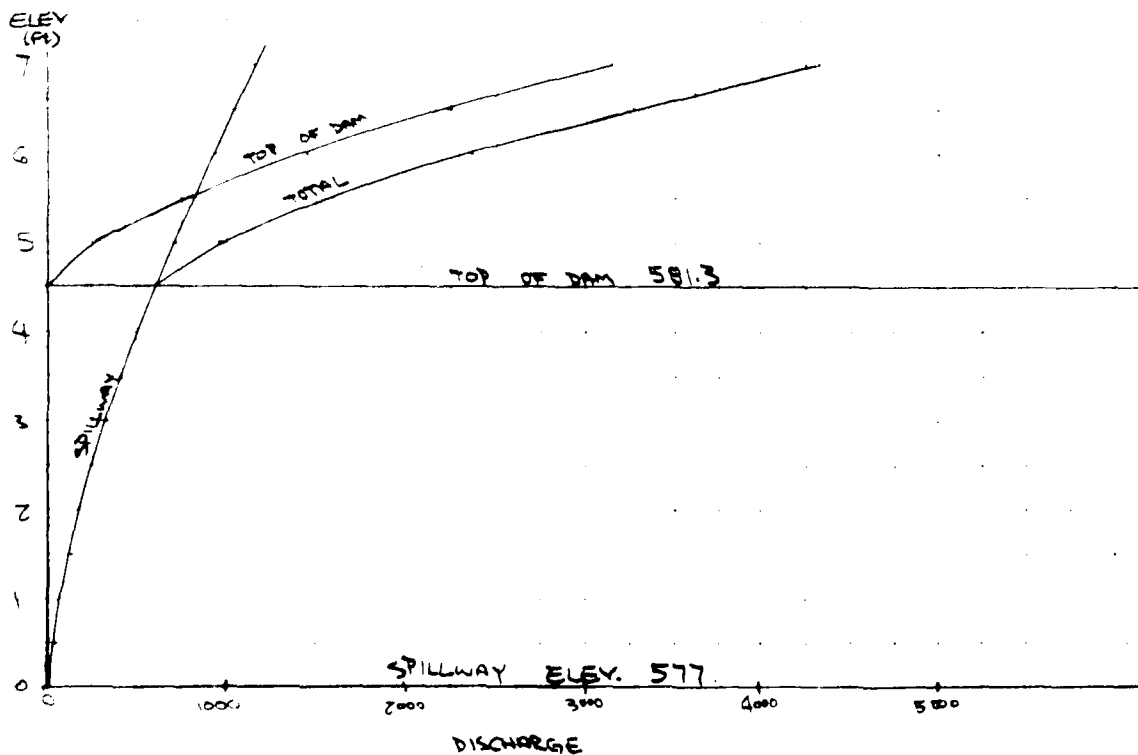
CHECKED BY EDC DATE 7/12/80

SCALE Stage Discharge

NAME OF DAM PADANARAM RES. DAM

$Q = CLH^{3/2}$

Elev	Spillway I				Spillway II				Dam				QT
	C	L	H	Q	C	L	H	Q	C	L	H	Q	
270	24	0.5		23									23
263	24	1.0		63									63
263	24	1.5		116									116
263	24	2.0		179									179
263	24	2.5		250									250
263	24	3.0		328									328
263	24	3.5		413									413
263	24	4.0		505									505
263	24	4.5		603									603
263	24	5.0		706					2.65	300	0.5	231	987
263	24	5.5		814					2.65	300	1.0	795	1609
263	24	6.0		928					2.65	300	1.5	1461	2389
263	24	6.5		1046					2.65	300	2.0	2249	3296
263	24	7.0		1169					2.65	300	2.5	3143	4312



Downstream Hydrographs

"Rule of Thumb" Guidance for Estimating Downstream Failure Hydrographs

NAME OF DAM PADANARAM RES. DAM

Section I at Dam

1. $S_1 = \frac{132}{8/27 W_b \sqrt{g}} \text{ Acft}$
2. $Q_{p1} = (0.27 \times 54') \sqrt{32.2 \text{ feet}} (26.3)^{3/2} = 19050 \text{ cfs}$
3. See Sections

Section II at

- 4a. $H_2 = \underline{11.4'}$ $A_2 = \underline{1150}$ $L_2 = \underline{800}$ $V_2 = \underline{21.1}$ Acft
 - b. $Q_{p2} = Q_{p1} (1 - V_2/S) = \underline{16,100}$ cfs
 - c. $H_2 = \underline{10.5'}$ $A_2 = \underline{1000 \text{ SF}}$
 $A_A = \underline{1075 \text{ SF}}$ $V_2 = \underline{19.7}$ Acft
- $Q_{p2} = 19050 (1 - 19.7/132) = 16200 \text{ cfs}$

Section III at

- 4a. $H_3 = \underline{12.5'}$ $A_3 = \underline{1350 \text{ SF}}$ $L_3 = \underline{1000'}$ $V_3 = \underline{30.9}$ Acft
 - b. $Q_{p3} = Q_{p2} (1 - V_3/S) = \underline{11740}$ cfs
 - c. $H_3 = \underline{11.0'}$ $A_3 = \underline{1080 \text{ SF}}$
 $A_A = \underline{7215 \text{ SF}}$ $V_3 = \underline{27.9}$ Acft
- $Q_{p3} = 16200 (1 - 27.9/132) = 12175 \text{ cfs}$

Section IV at

- 4a. $H_4 = \underline{12.2'}$ $A_4 = \underline{1500 \text{ SF}}$ $L_4 = \underline{1000'}$ $V_4 = \underline{34.4}$ Acft
 - b. $Q_{p4} = Q_{p3} (1 - V_4/S) = \underline{7210}$ cfs
 - c. $H_4 = \underline{9.7'}$ $A_4 = \underline{1000 \text{ SF}}$
 $A_A = \underline{1250 \text{ SF}}$ $V_4 = \underline{28.7}$ Acft
- $Q_{p4} = 12175 (1 - 28.7/132) = 8035 \text{ cfs}$

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JOB Phase I Dam Inspection - #4463
 SHEET NO 5 OF 10
 CALCULATED BY P.A. DATE 4/29/80
 CHECKED BY RSK DATE 7/5/80
 Downstream Hydrographs (Continued)

Section V at

4a. $H_5 = \underline{10.2'}$ $A_5 = \underline{1120 SF}$ $L_5 = \underline{7100'}$ $V_5 = \underline{28.3}$ Acft

b. $Q_{P5} = Q_{P4} (1 - V_5/S) = \underline{3952}$ cfs

c. $H_5 = \underline{7.2}$ $A_5 = \underline{600 SF}$
 $A_A = \underline{860 SF}$ $V_5 = \underline{21.7}$ Acft

$Q_{P5} = 8035 (1 - 21.7/55.7) = 4900 cfs$

Section VI at

4a. $H_6 = \underline{7.0}$ $A_6 = \underline{900 SF}$ $L_6 = \underline{750}$ $V_6 = \underline{15.5}$ Acft

b. $Q_{P6} = Q_{P5} (1 - V_6/S) = \underline{2660}$ cfs

c. $H_6 = \underline{4.5}$ $A_6 = \underline{500 SF}$
 $A_A = \underline{700 SF}$ $V_6 = \underline{12.0}$ Acft

Section VII at $Q_{P6} = 2660 (1 - 12/31) = 2170 cfs$

4a. $H_7 = \underline{5.5}$ $A_7 = \underline{\hspace{2cm}}$ $L_7 = \underline{\hspace{2cm}}$ $V_7 = \underline{\hspace{2cm}}$ Acft

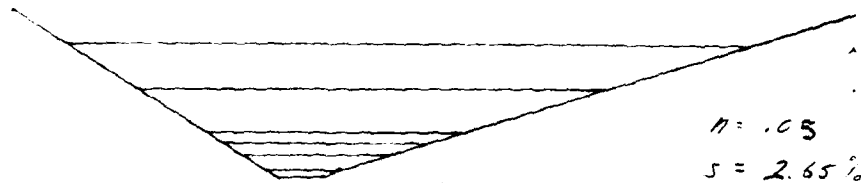
b. $Q_{P7} = Q_{P6} (1 - V_7/S) = \underline{\hspace{2cm}}$ cfs

c. $H_7 = \underline{\hspace{2cm}}$ $A_7 = \underline{\hspace{2cm}}$
 $A_A = \underline{\hspace{2cm}}$ $V_7 = \underline{\hspace{2cm}}$ Acft

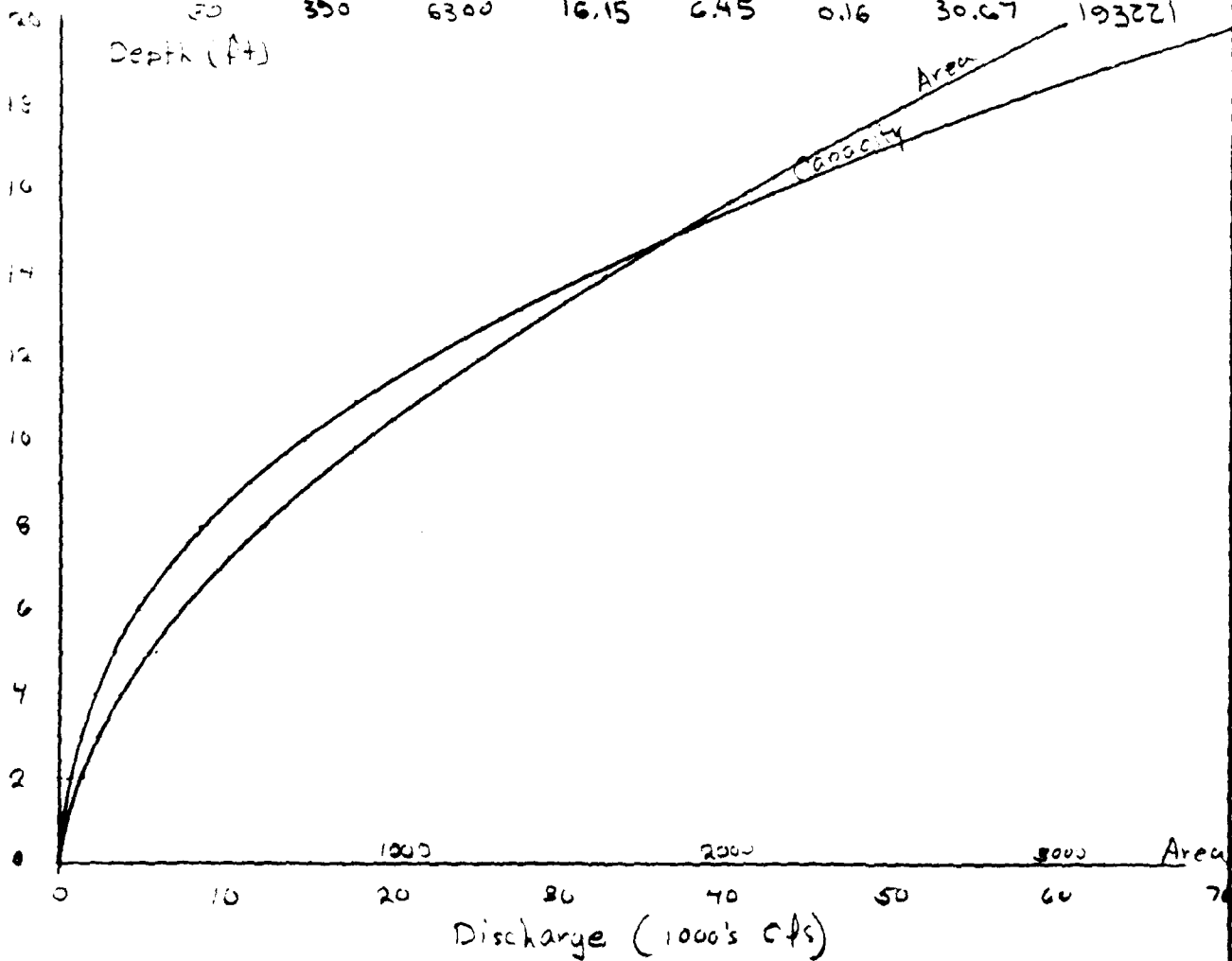
$Q_{P7} = \underline{\hspace{2cm}}$

STORCH ENGINEERS/STORCH ASSOCIATES
 Engineers - Landscape Architects
 Planners - Environmental Consultants

JOB 51153
 SHEET NO. 6 OF 10
 CALCULATED BY E.A.H. DATE 5/25/90
 CHECKED BY B.C.C. DATE 7/15/90
 SCALE 200:1

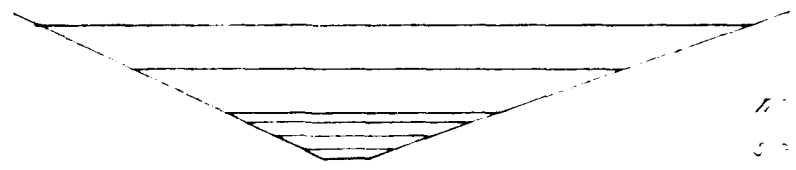


Depth (ft)	Top Width (ft)	Area (ft ²)	Perimeter (ft)	R (ft)	R ²	S ²	V (ft/s)	Q (cfs)
2	40	70	1.75	1.45	0.16	6.90	483	
5	85	288	3.35	2.27	10.75	3108		
8	120	600	5.00	2.94	13.98	8388		
10	150	900	6.00	3.32	15.75	14211		
20	305	2950	11.13	5.03	23.92	70564		
30	350	6300	16.15	6.45	30.67	193221		

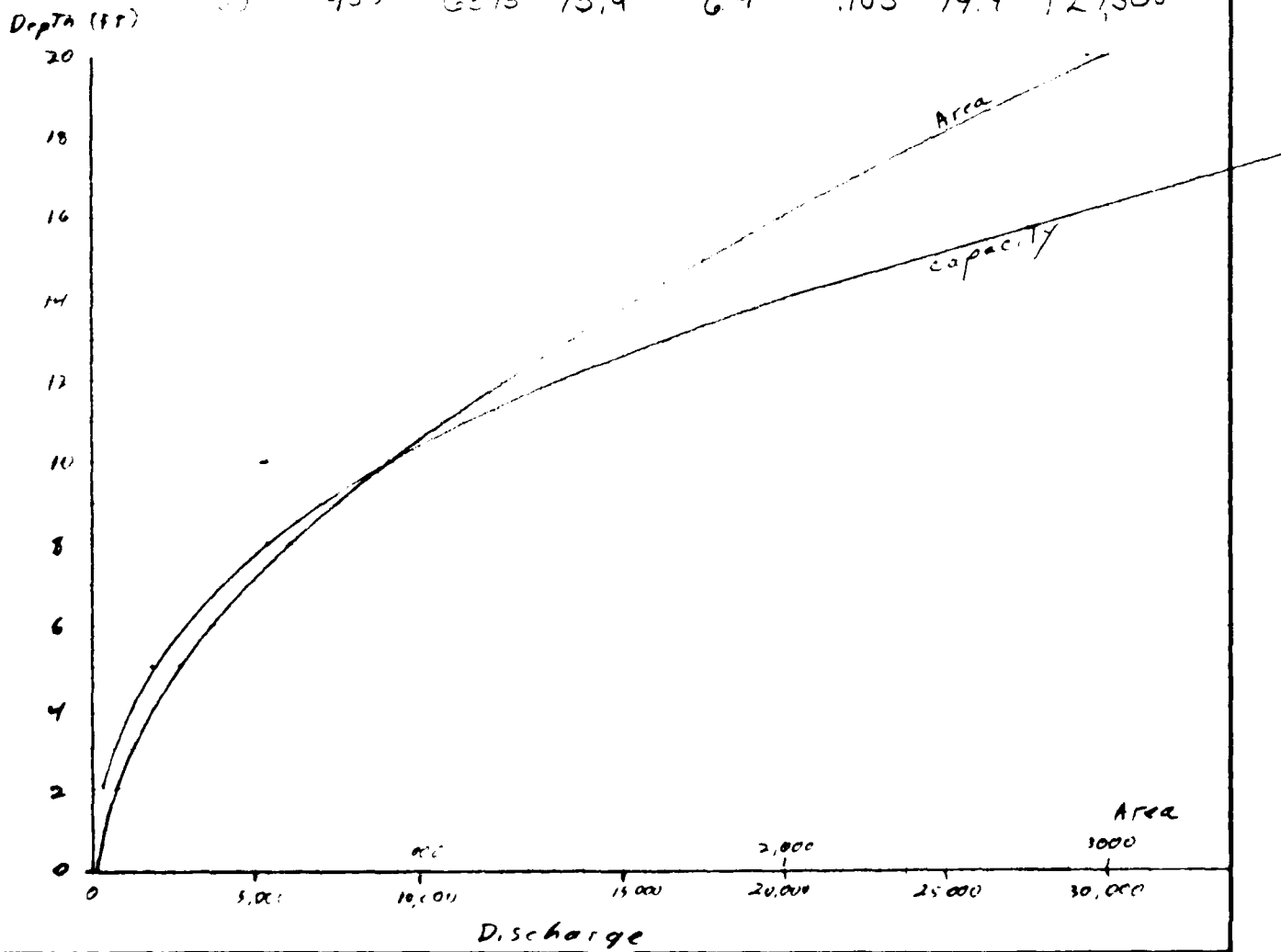


STORCH ENGINEERS/STORCH ASSOCIATES
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 Planners - Environmental Consultants

JOB 4-103
 SHEET NO. 7 OF 10
 CALCULATED BY EAH DATE 5/30/80
 CHECKED BY BCC DATE 7/15/80
 SCALE Section

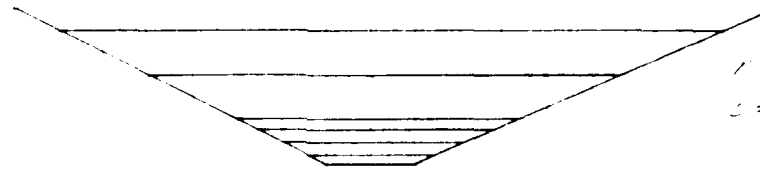


D	W	A	R	V^2	C^2	V	Q
0	50	75	1.5	1.3	.105	4.1	307
5	85	275	3.2	2.2	.105	6.8	1890
10	125	600	4.8	2.86	.105	8.9	5370
15	155	960	5.8	3.2	.105	10.1	9150
20	200	1350	10.8	4.95	.105	15.4	47270
30	400	6375	15.9	6.4	.105	19.9	127500

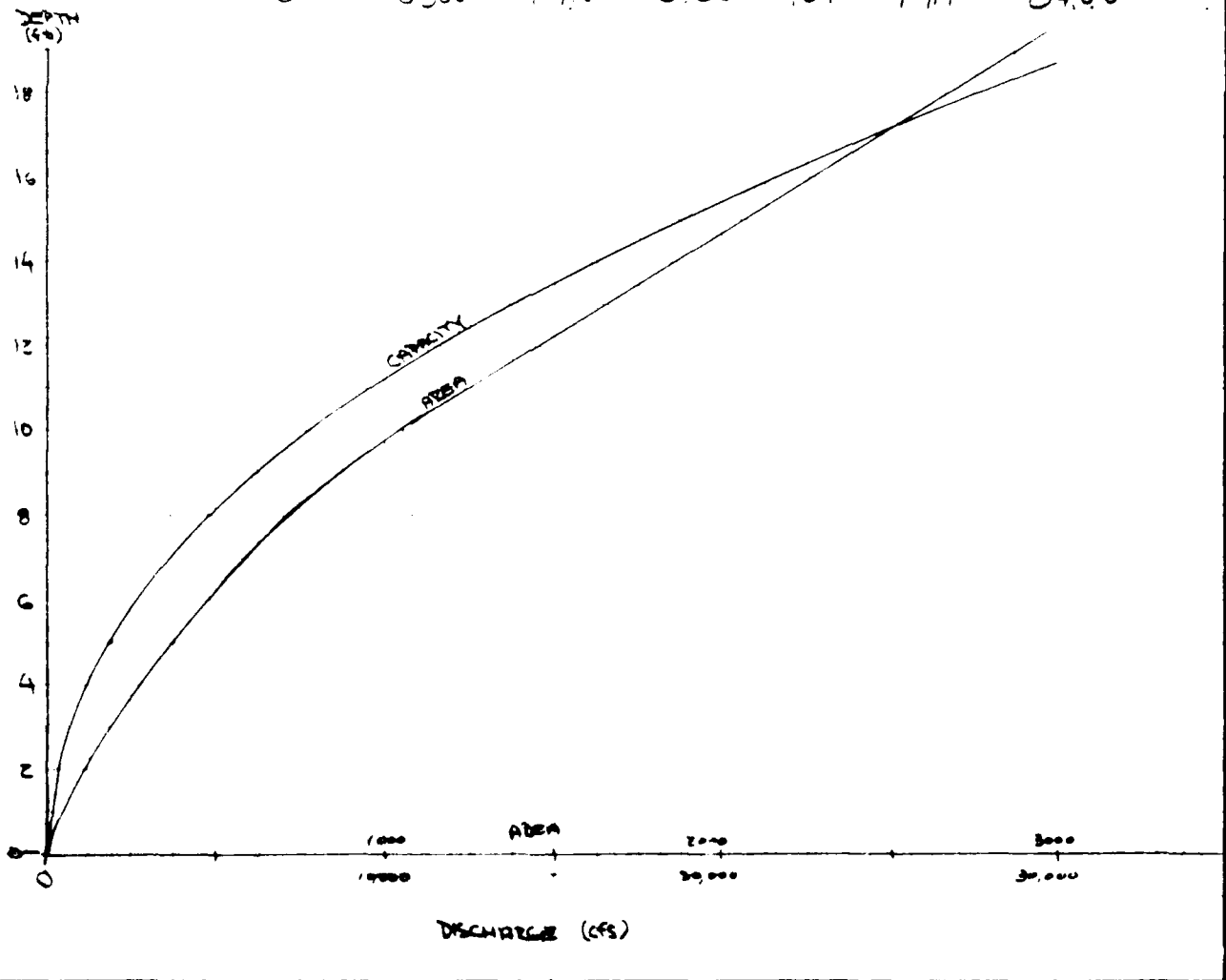


STORCH ENGINEERS/STORCH ASSOCIATES
 Engineers - Landscape Architects
 Planners - Environmental Consultants

JOB 11703
 SHEET NO 5 OF 10
 CALCULATED BY BAH DATE 5/20/80
 CHECKED BY BDC DATE 7/15/80
 SCALE Section III & VI

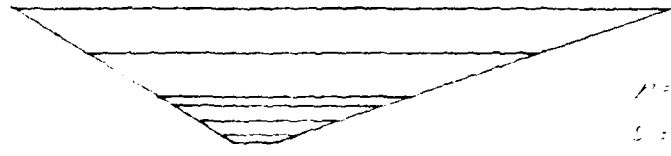


D	K	A	V	V ²	S ²	V	Q
2	70	120	1.71	1.4	.07	3.0	360
3	105	375	3.75	2.4	.07	5.1	1910
4	130	720	5.5	3.4	.07	6.65	4790
5	160	1050	6.6	3.5	.07	7.44	7820
6	200	2100	11.9	5.2	.07	11.1	34725
7	370	6300	17.0	6.65	.07	17.1	39000



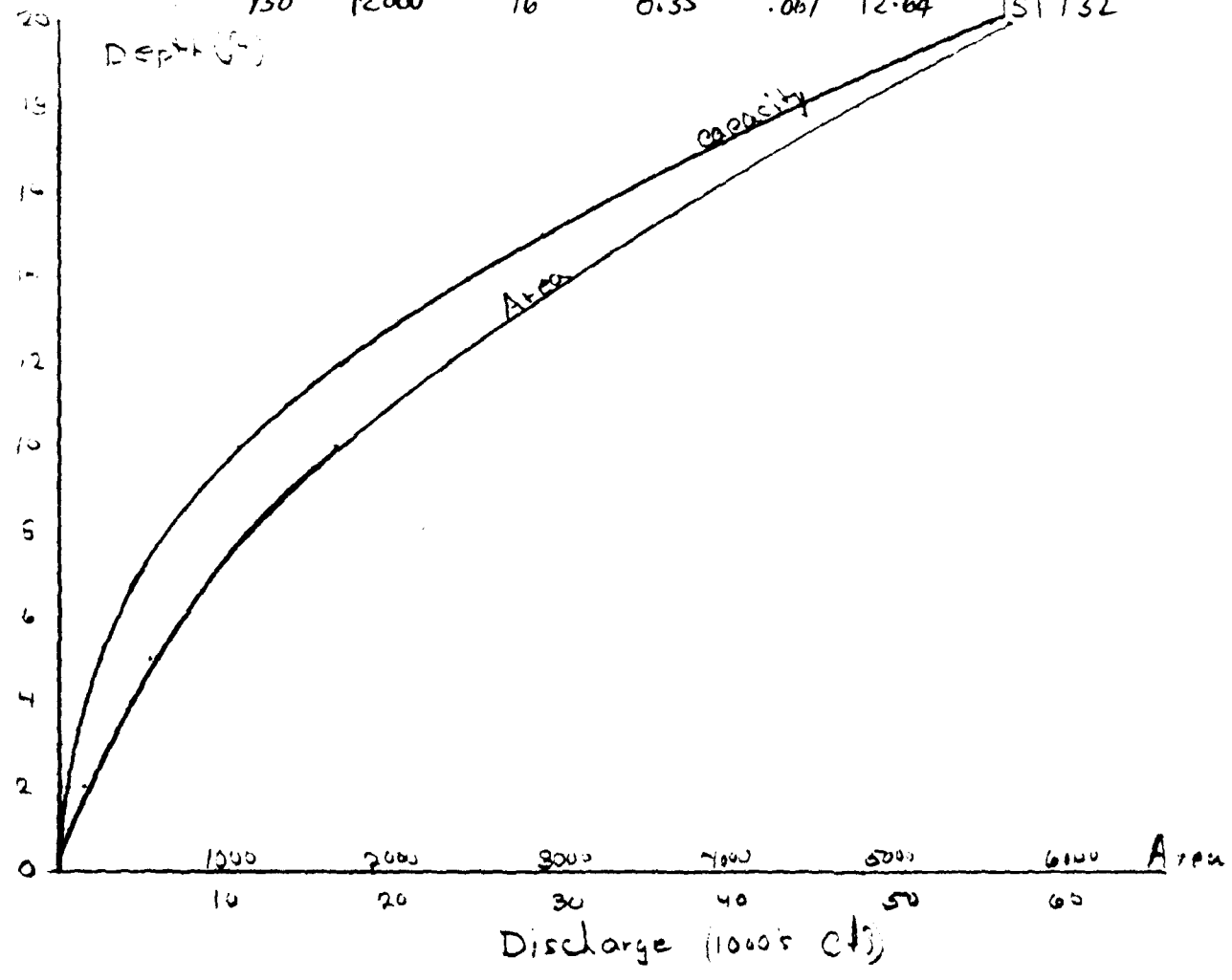
STORCH ENGINEERS/STORCH ASSOCIATES
 Engineers - Landscape Architects
 Planners - Environmental Consultants

JOB: 44,63
 SHEET NO: 9 OF 10
 CALCULATED BY: BAW DATE: 5/20/90
 CHECKED BY: BDC DATE: 7/15/90
 SCALE: Section VI



$n = .05$
 $S = 0.45\%$

Depth (ft)	Area (sq ft)	Perimeter (ft)	Hydraulic Radius (ft)	Velocity (ft/s)	Discharge (cfs)	Capacity (cfs)
85	135	1.59	1.36	.067	2.71	366
160	525	3.28	2.20	.067	4.38	2300
230	1120	4.87	2.87	.067	5.71	6400
280	1650	5.89	3.26	.067	6.49	10,711
510	5600	10.98	4.94	.067	9.84	55,086
750	12,000	16	6.35	.067	12.64	151,732



APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

COUNTY STATE COUNTY DIST CUNGR
 NAME
 PAPANARAM RESERVOIR DAM
 4126.0 7329.0 11 JUL 60

POPULAR NAME PAPANARAM RESERVOIR
 NAME OF IMPOUNDMENT PAPANARAM RESERVOIR
 RIVER OR STREAM NEAREST DOWNSTREAM CITY-TOWN-VILLAGE
 CITY-TOWN-VILLAGE POPULATION
 HAYESTON 2 3000

TYPE OF DAM PURPOSES
 20 24 112 A1 NED N N N N N
 JUST ON FED R PRV/FED SCS A VEN/DATU

REMARKS
 20-25-51-51-51

SPILLWAY MAXIMUM DISCHARGE VOLUME OF DAM POWER CAPACITY INSULATED PRINCIPED NO. LENGTH WPT. LENGTH WITH WPT. LENGTH WPT. LENGTH WITH WPT. WIDTH
 24 1050 8050

OWNER ENGINEERING BY CONSTRUCTION BY
 CITY OF DALLAS A.C. WASHINGTON ENG. GEORGE WCKEE CONTRACTOR

REGION REGULATORY AGENCY OPERATION MAINTENANCE
 CONSTRUCTION NONE
 INSPECTION BY INSPECTION DATE AUTHORITY FOR INSPECTION
 STORCH-ENGINEERS 21 APR 60 PL 92 167

REMARKS

MED
8

