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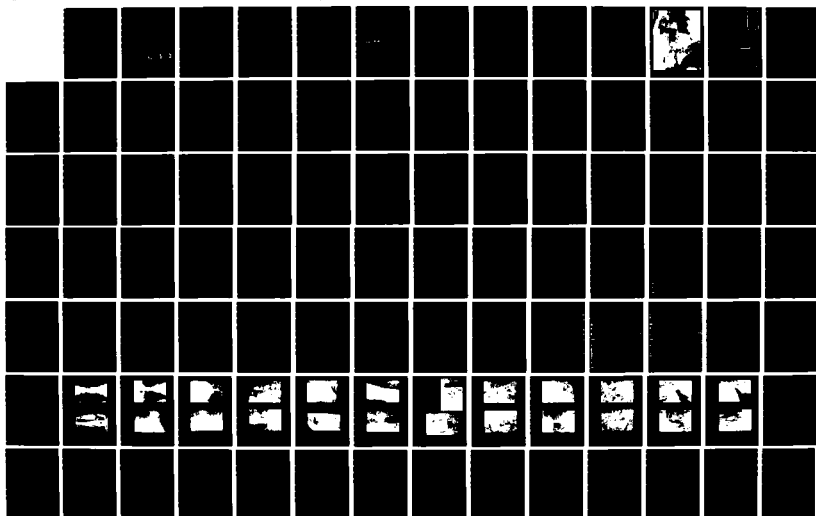
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INSTITUTE POND DAM (V. (U) CORPS OF ENGINEERS WALTHAM
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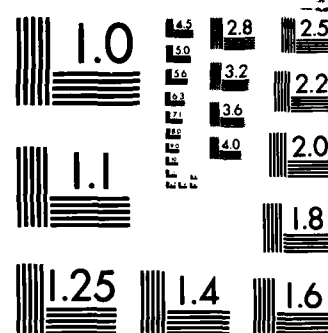
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AD-A157 627

CONNECTICUT RIVER BASIN
LYNDON, VT

INSTITUTE POND DAM
VT 00216

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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ELECTE
JUL 19 1985
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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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DECEMBER 1980

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

APR 06 1981

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

Inclosed is a copy of the Institute Pond Dam (VT-00216) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, Philip Mathewson, Lyndon Center, Vermont 05850.

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

I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION
BRIEF ASSESSMENT

Identification Number: VT00216
Name of Dam: Institute Pond Dam
Town: Lyndon
County and State: Caledonia, Vermont
Stream: Passumpsic River tributary
Date of Inspection: September 30, 1980

Institute Pond Dam is a 250-foot long, 26-foot high earth embankment with an upstream slope of 2.6H:1V and a downstream slope of 2.6H:1V. A 10-foot wide, 106-foot long concrete chute spillway with crest elevation 4.5 feet below top of dam is located near the right abutment. The spillway is ungated. State Aid Highway 9 divides the impounded water. The two ponds, pond #1 (downstream) and pond #2 (upstream) are connected by a 48-inch diameter culvert which runs under the road.

Visual inspection of the dam indicated the dam is in poor condition. The inspection revealed potential structural problems, such as, the encroachment of flora growth on the earth dam, an actively discharging seepage area at the toe of the dam and the erosion of the concrete on the chute spillway.

Based on the small size of the dam and its High hazard classification and in accordance with Corps of Engineers Guidelines, the test flood inflow should be of a magnitude ranging from the $\frac{1}{2}$ Probable Maximum Flood to the Probable Maximum Flood (PMF). The PMF was used for the test flood inflow resulting in a discharge at the earth embankment of 726 cfs, at which time the dam would be overtopped by 0.7 feet. With a water level at the crest of the dam, the capacity of the concrete chute spillway is 305 cfs which is 42 per cent of the routed test flood outflow. Furthermore, in routing the PMF test flood for the upper pond, pond #2, through the 48-inch culvert, the road embankment (State Aid Highway 9) would be overtopped by 2.7 feet.

The owner should engage a qualified registered engineer to investigate the seepage problems of the earth dam and the discharge capacity of the project. Other recommendations and remedial measures are described in Section 7 and should be addressed within one year after receipt of this Phase I Inspection Report.

Very truly yours,

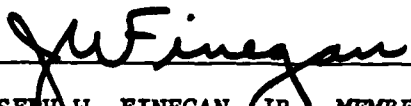
DuBois & King, Inc.

Robert J. Wernecke
Robert J. Wernecke, P.E.
Project Manager

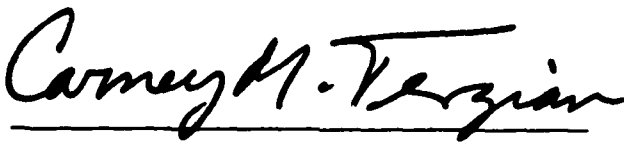
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Attachments



This Phase I Inspection Report on Institute Pond Dam (VT-00216) 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 judgement and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR. MEMBER
Water Control Branch
Engineering Division

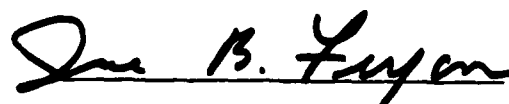

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division


CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

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APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these Guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation 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 investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; 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 rarity 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 aid 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 investigation 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 OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Letter of Transmittal	
Brief Assessment	
Review Board Page	
Preface	
Table of Contents	i
Overview Photo	iii v
Location Map	

REPORT

1. PROJECT INFORMATION

1.1 General

a. Authority	1
b. Purpose of Inspection	1

1.2 Description of Project

a. Location	1
b. Description of Dam and Appurtenances	1
c. Size Classification	2
d. Hazard Classification	2
e. Ownership	2
f. Operator	2
g. Purpose	2
h. Design and Construction History	2
i. Normal Operational Procedure	3

1.3 Pertinent Data

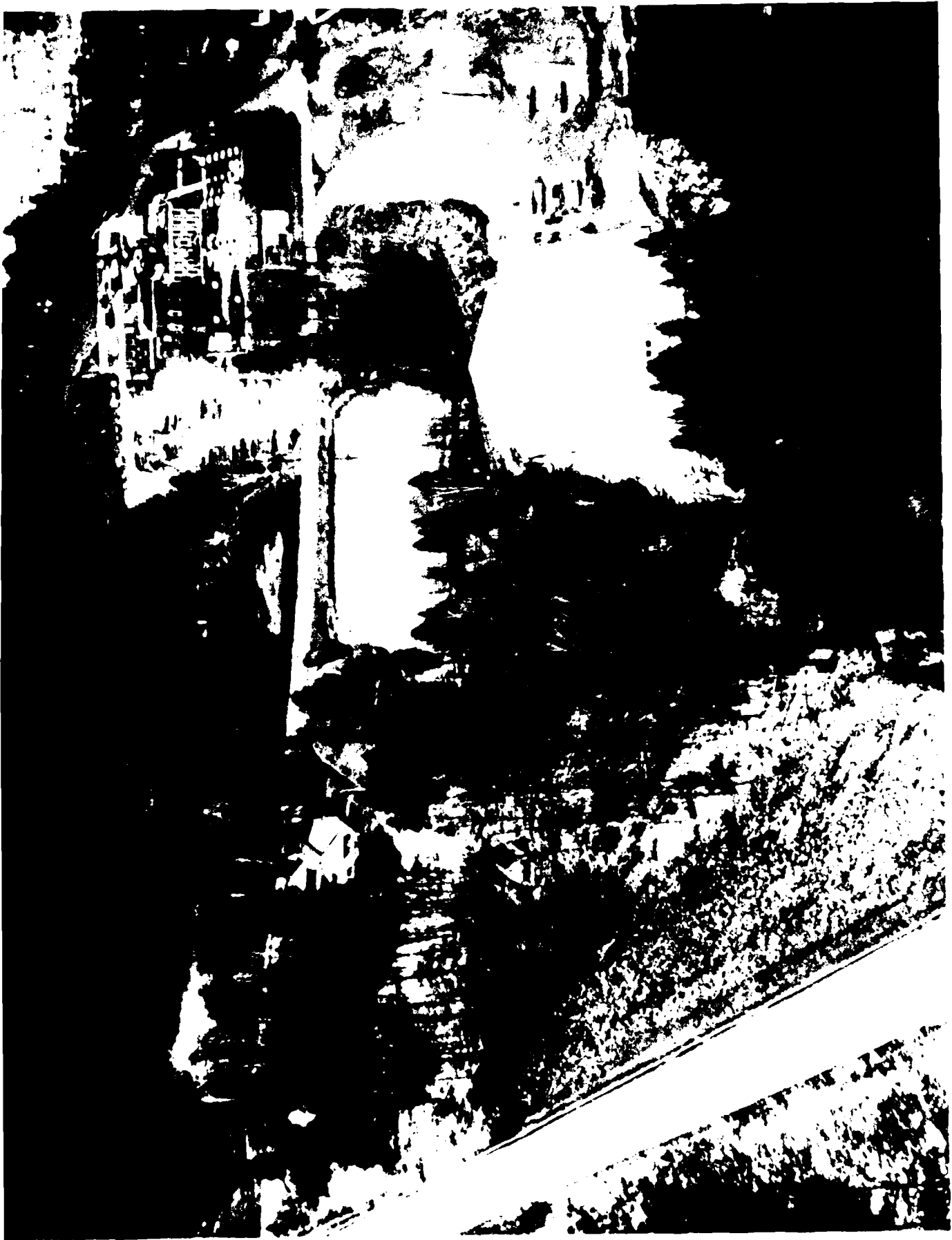
a. Drainage Area	3
b. Discharge at Dam Site	3
c. Elevation	5
d. Reservoir	5
e. Storage	5
f. Reservoir Surface	6
g. Dam	6
h. Diversion and Regulatory Tunnel	6
i. Spillway	7
j. Regulating Outlets	7

<u>Section</u>	<u>Page</u>
2. ENGINEERING DATA	8
2.1 Design Data	8
2.2 Construction Data	8
2.3 Operation Data	8
2.4 Evaluation of Data	8
a. Availability	8
b. Adequacy	8
c. Validity	8
3. VISUAL INSPECTION	9
3.1 Findings	9
a. General	9
b. Dam	9
c. Appurtenant Structures	10
d. Reservoir Area	11
e. Downstream Channel	11
3.2 Evaluation	12
4. OPERATIONAL AND MAINTENANCE PROCEDURES	13
4.1 Operational Procedure	13
a. General	13
b. Description of any Warning System in Effect	13
4.2 Maintenance Procedures	13
a. General	13
4.3 Evaluation	13
5. EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES	14
5.1 General	14
5.2 Design Data	14
5.3 Experience Data	14
5.4 Test Flood Analysis	14
5.5 Dam Failure Analysis	15

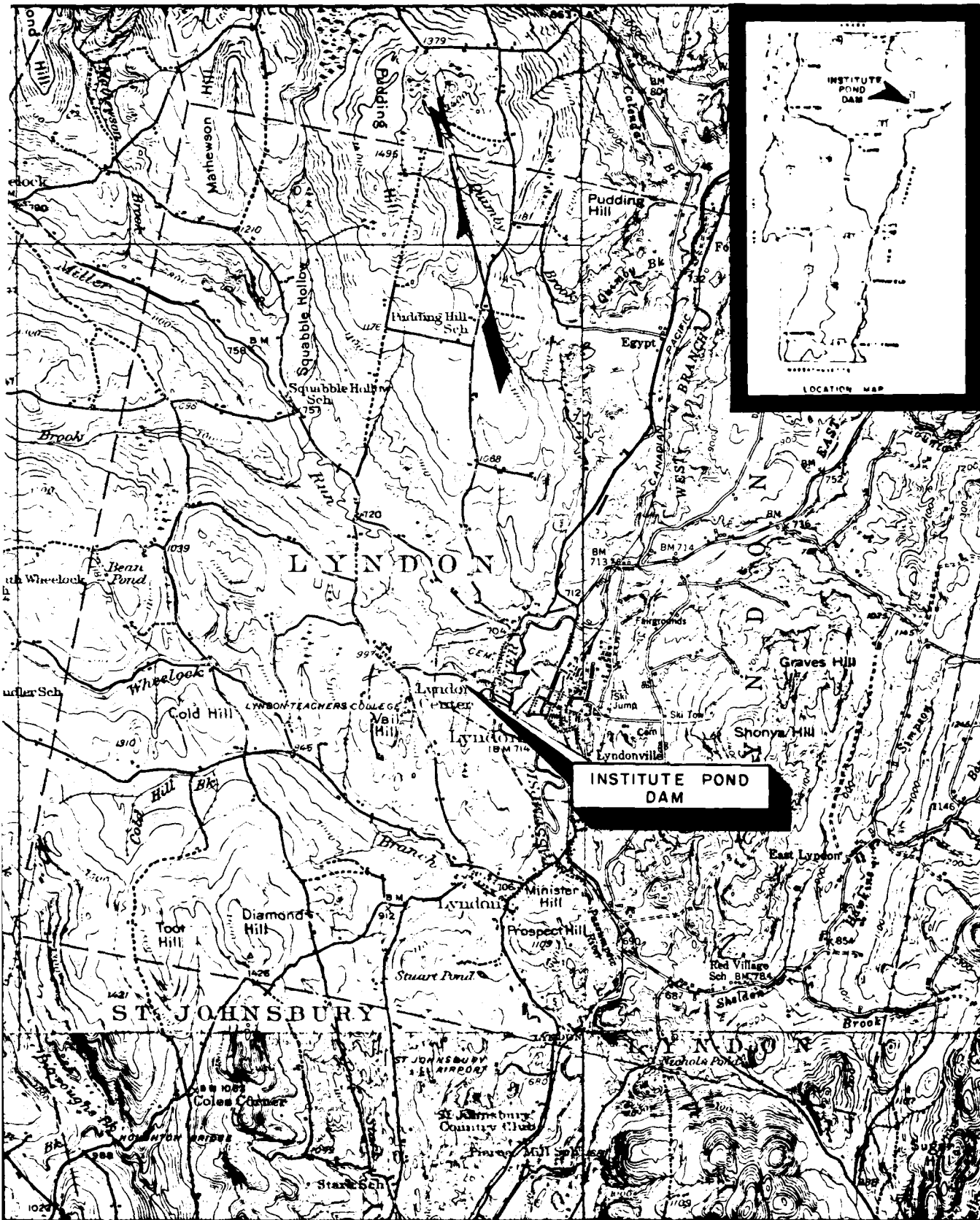
<u>Section</u>	<u>Page</u>
6. EVALUATION OF STRUCTURAL STABILITY	17
6.1 Visual Observation	17
6.2 Design and Construction Data	17
6.3 Post-Construction Changes	18
6.4 Seismic Stability	18
7. ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	19
7.1 Dam Assessment	19
a. Condition	19
b. Adequacy of Information	20
c. Urgency	20
7.2 Recommendations	20
7.3 Remedial Measures	20
a. Operation and Maintenance Procedures	20
7.4 Alternatives	21

APPENDICES

- APPENDIX A - INSPECTION CHECKLIST
- APPENDIX B - ENGINEERING DATA
- APPENDIX C - PHOTOGRAPHS
- APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS
- APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL
INVENTORY OF DAMS



OVERVIEW PHOTOGRAPH - INSTITUTE POND DAM



DuBois & King^{INC}

engineering and environmental services
RANDOLPH VERMONT CORCORAN NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

INSTITUTE POND DAM
LOCATION MAP

USGS QUAD — LYNDONVILLE, VT

DRAWN BY	DATE
SJT	12-80
CHECKED BY	PROJ. NO.
CJK	90853
PROJ. ENG.	DRAW. NO.

SCALE: 1"=62500'

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Institute Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
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18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Lyndon, VT. Passumpsic River Tributary		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is a 250 ft. long, 26 ft. high earth embankment with an upstream slop of 2.6H:1V and a downstream slope of 2.6H:1V. The dam is in poor condition. The inspection revealed potential structural problems. It is small in size with a high hazard potential. The owner should engage a qualified engineer to investigate the seepage problems of the earth dam and the discharge capacity of the project.		

SECTION 5 EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Institute Pond Dam is an earth dam with a length of approximately 250 feet and a structural height of 26 feet. The appurtenant works consist of a concrete chute spillway 10 feet wide and 106 feet long. There is also a concrete valve box on the downstream toe of the dam which controls an unknown sized drainage system for the dam.

The spillway has an ungated elevation of 96 feet. At the top of the dam, the spillway can convey 305 cfs.

The watershed of Lyndon Institute Pond is relatively steep, mountainous terrain with half the land forest and the other half open land. Development in the watershed is limited mainly to Lyndon Institute located on the shore of the pond and Lyndon State College situated near the headwaters.

The surface area of the two ponds (3 acres at maximum pool), represents approximately 2% of the basin area.

5.2 Design Data

Data on the hydrologic design of Institute Pond Dam is not available.

5.3 Experience Data

There are no recorded experiences of overtopping but, a witness recalls that during the 1927 flood, the water level rose to within one foot of the top of the dam at the low spot on the left abutment. Also during the 1973 flood the road embankment (State Aid Highway #9) at Pond #2 was almost overtopped due to the discharge capacity of the 48-inch culvert. It should be noted that the dam failure in 1911 apparently was not due to flood flows.

5.4 Test Flood Analysis

Institute Pond Dam is 26 feet high and has a storage capacity of 44.6 acre-feet. In accordance with Article 2.1.1. of the "Recommended Guidelines for Safety Inspection of Dams", the dam is Small in Size based upon its height, which is greater than 25 feet and less than 40 feet. The hazard potential classification was determined to be High because failure of Institute Pond Dam is likely to endanger more than a few lives in a number of dwellings along the tributary and in the area of the culvert under State Route 122. In accordance with "Recommended Guidelines for Safety

SECTION 4 OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Institute Pond Dam creates an impoundment of water which is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert. Both ponds are controlled by Pond #1's concrete chute spillway which has a crest elevation of 96.0 feet. Pond #2 is further controlled by the 48-inch culvert with an invert elevation of 95.4 feet. The two ponds are used primarily for aesthetics. There is reportedly a drainage system for the dam, but has not been used in many years and it is not known whether the valve is operable.

b. Warning System. There is no formal warning system to alert downstream residents in case of an emergency at the dam.

4.2 Maintenance Procedures

a. General. There is no set program for maintaining the dam. Neither the present owner, Mr. Mathewson, or the Lyndon Institute, who are jointly responsible for operation and maintenance of the dam according to the deed, have performed any maintenance in the recent past. This is evidenced by the growth of trees and brush on the dam and the fact that the drain has not been operated in many years.

4.3 Evaluation

There was no evidence that any maintenance had occurred for a period of years. The general operational and maintenance procedures can be described as poor to non-existent. There is a possibility of serious problems developing as implied from Section 3.2.

The owner should establish written procedures for operating and maintaining the structure. Also a formal downstream flood warning and surveillance plan should be adopted, including round-the-clock monitoring during heavy precipitation.

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in poor condition. The following features, if left unattended, could result in further deterioration of this dam.

Major seepage occurring at the downstream toe near the right end of the dam could result in a piping failure of the dam or instability of the downstream slope. Soft ground along the contact between the downstream slope and the left abutment is indicative of a seepage condition that might result in instability of the dam. Trees and brush which are growing on the crest, upstream slope and downstream slope of the dam may cause serious erosion and seepage problems if trees remain growing, fall over and pull out its roots, or if trees die and its roots rot. An animal burrow which was observed on the downstream slope of the dam could be a focus for seepage and piping which might result in breaching of the dam.

There is no erosion protection other than vegetation on the upstream slope and some evidence that erosion has occurred in the past near the waterline. If erosion is not controlled, it could lead to breaching of the dam.

The concrete-valve box structure near the downstream toe of the dam requires a more detailed inspection to assure that the piping system through the dam is not under pressure. If a pressure conduit condition exists this condition should be remedied. The downstream slope of the dam appears to have subsided or eroded on the downstream and right edges of the concrete-valve box structure, either of which phenomena could potentially endanger the stability of the downstream slope.

The large number of trees overhanging the chute spillway could potentially endanger the discharge capacity of the spillway if fallen trees or limbs accumulate in the spillway. A large tree growing adjacent to the chute spillway could break the spillway if it falls over and pulls out its roots.

Erosion of the fill against a training wall at the downstream end of the concrete-chute spillway has taken place and could result in a failure of the training wall if the erosion is not controlled.

The concrete spillway efflorescence will probably result in eventual scaling of concrete surfaces. The erosion of concrete near the joints or the spillway chute could result in holes through the concrete spillway. The deterioration of the concrete near the drop structure might result in the collapse of a short section of concrete wall into the channel.

The presence of trees, brush, and coarse vegetation on the embankment and a pile of cut brush and small trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.

It is not evident whether the low elevation of the fill on the right and downstream edges is due to erosion, settlement, or the fill's having been placed that way at the time of construction.

There is a 4-inch cast iron pipe (Photo 21) discharging freely into the stream about 40 feet downstream of the drop structure of the spillway. The source of the water is unknown, but the pipe appears to be a part of the valve box and may be either part of the drain system or of the old water supply.

d. Reservoir Area. The water impounded by the dam is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert (Photos 2 & 3, see Possible Flood Damage Map - Appendix D). The water appears to be rather shallow in both ponds, as a result of sedimentation. The storage volume and surface area of the two ponds combined, at spillway crest elevation are 28.6 acre-feet and 2.6 acres, respectively and are divided almost equally between the ponds (see Appendix D, page 2 of 31). Trees are overhanging the right side of the pond next to the approach channel for the spillway at the right end of the dam.

e. Downstream Channel. The downstream channel below the training wall of the drop structure is the natural streambed. The channel is significantly obstructed by fallen trees (Photo 22); however, due to its location (40 feet downstream of the dam) it poses no threat to the dam.

Water is discharging from the right bank of the downstream channel about 150 feet downstream of the downstream end of the spillway. It appears that this is a natural spring discharging groundwater from the side of the valley, and that it is not associated with seepage from the reservoir. There is a similar discharge, also believed to be unassociated with the reservoir on the left bank of the downstream channel about 175 feet downstream from the downstream end of the spillway.

The bottom of the natural valley on the left bank of downstream channel is covered with a few inches of gray silt in the vicinity of the skating rink which was constructed on fill higher up on the left side of the valley. This silt appears to be the result of erosion of the fill on which the skating rink was built, probably exacerbated by the large quantity of rainfall runoff from the roof of the skating rink. There were several erosion channels and sinkholes up to about 5 feet in diameter along the top edge of the fill between the skating rink and the valley bottom (Photos 23 and 24). There is no evidence to indicate that the erosion and sinkholes are associated with seepage from the pond.

The area immediately downstream of the toe near the right end of the dam was actively discharging seepage at an estimated rate of 10 to 15 gallons per minute at the time of the inspection. Standing water was also observed (Photo 7) between the toe of the dam and the downstream end of the concrete chute-spillway and drop structure, which carries the overflow about 40 feet downstream of the toe of the dam along the right side of the valley before discharging it into the natural stream channel. The seepage water was rusty but showed no evidence that it was carrying suspended soil particles.

Abutments. Both abutments of the dam appear to consist of soil. The left abutment consists of a ridge, the downstream side of which has been excavated for development of an indoor skating rink. The area between the skating rink building floor and the ridge is about 10 feet lower than the crest of the dam and is covered with sand and gravel. It showed no sign of seepage or wetness at the time of the inspection, but it is reported that some seepage occurred in that area when the excavation was made during construction of the skating rink and before the sand and gravel fill was placed.

c. Appurtenant structures. The concrete chute spillway located on the right side of the dam is completely concealed by overhanging trees. The concrete chute spillway (Photo 8) shows evidence of efflorescence in the training walls near the crest of the spillway (Photos 9 & 10). Water probably leaks through the training walls to cause the appearance.

The training walls and channel bottom erosion of the concrete chute spillway has occurred at many of the construction joints and shrinkage cracks (Photos 11, 12 & 13). Concrete erosion and deterioration has also occurred at the spillway drop structure (Photos 14 & 15) and at the base of the right side training wall downstream of the drop structure (Photo 16).

On the left (downslope) edge of the concrete chute spillway there is a 4-foot diameter, hollow maple tree with a large animal burrow near its base (Photo 17). It is close enough to the chute spillway that it could damage the spillway if it falls over and pulls out its roots.

The downstream end of the concrete chute spillway (Photo 18) and of the concrete drop-structure consists of a concrete training wall which is approximately perpendicular to the right bank of the downstream channel. The fill on the downstream side of this training wall has been eroded 1-2 feet below the top of the wall and there are logs, brush, and debris in the eroded area (Photo 19). It appears that the erosion and the accumulation of logs brush, and debris may be the result of spillway discharge water flowing over the top of the training wall.

There is a concrete-valve box structure with a steel plate cover about 65 feet from the left training wall of the chute spillway and 5 feet above the downstream toe (Photo 20). The structure is about 5½ feet square in plan view. Along the downstream and left (right in Photo 20 which is looking upstream) edges of the structure, the embankment is within about 6-inches of the top of the structure.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Institute Pond Dam was performed on September 30, 1980. The weather was overcast. The inspection team included personnel from DuBois & King, Inc., Geotechnical Engineers, Inc., and Knight Consulting Engineers, Inc. A copy of the inspection checklist as completed during the field inspection is included as Appendix A. At the time of the inspection the water level was at the spillway crest (elevation 96 feet). Consequently, no assessment could be made of the upstream face of the structure below normal pool elevation.

b. Dam. The dam is a 26-foot high earth embankment with a length of 250 feet and a 10 foot top width (Photo 1). The water impounded by the dam is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert (Photos 2 & 3).

Crest of dam. The crest of the dam is somewhat irregular but no evidence of slumping was observed. The crest of the dam is covered with grass, extensive brush, and small trees, most of which are less than about 4-inches in diameter (Photo 4). Near the right end of the crest there is a stump of a tree, about 12 inches in diameter, which was recently cut.

Upstream slope of dam. The upstream slope of the dam is about 1H:2.6V and is covered with grassy vegetation, brush, and small trees. There is a terrace-like feature on the upstream slope, about 3 to 4 feet wide and about 1/2 foot above the pond level at the time of the inspection (Photo 5). No evidence of active erosion on this terrace was observed.

Downstream slope of dam. The downstream slope of the dam is about 1H:2.6V and is covered with grassy vegetation, brush, and some trees up to about 4 inches in diameter (Photo 6). The growing brush and a pile of cut brush and trees on the downstream slope near the right end of the dam make it impossible to inspect the downstream slope adequately. There is one animal burrow on the downstream slope 10 feet from the left training wall of the chute spillway and halfway between the crest and toe of the dam. The lower part of the downstream slope in the central section of the dam is covered with waterborne vegetation, although the slope itself in that area was not wet or soft at the time of the inspection.

The contact between the downstream slope and the left abutment was soft and showed some evidence (small grass-covered channels) of past erosion but no evidence of active seepage at the time of the inspection.

SECTION 2 ENGINEERING DATA

2.1 Design

There is no design information available for either the original construction of the dam or its reconstruction following its failure in the year 1911.

2.2 Construction Data

All information is from photographs taken during the two construction periods before and after the failure in 1911.

2.3 Operation

No operating manual exists for Institute Pond Dam. The drain valve has not been operated in many years. The Vermont Department of Water Resources has on file records of past inspections performed by its personnel.

2.4 Evaluation

a. Availability. The available information is not sufficient for stability analyses of the dam or the appurtenant structures. The only background data which could be located consisted of construction photographs and inspection reports by the Department of Water Resources of the State of Vermont.

b. Adequacy. The lack of engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data. All assessments were based primarily on visual inspection, eye witness accounts of past performance, previous inspections, and sound hydrologic and structural engineering judgment.

c. Validity. Not applicable.

i. Spillway

- | | |
|------------------------|----------------------------|
| (1) Type | concrete chute
spillway |
| (2) Length of weir | 10-feet |
| (3) Crest Elevation | 96.0 |
| (4) Gate | None |
| (5) Upstream Channel | N/A |
| (6) Downstream Channel | natural river bed |

j. Regulating Outlets

- | | |
|-----------------------|---------------------------------------|
| (1) Invert | Unknown |
| (2) Size (Conduit) | Unknown |
| (3) Description | Unknown |
| (4) Control Mechanism | Valve Box on
downstream embankment |

- | | | |
|-----|-----------------|------|
| (4) | Top of dam | 41.3 |
| (5) | Test flood pool | 43.6 |
- f. Reservoir Surface (acres) (Ponds #1 and #2 combined)
- | | | |
|-----|--------------------------|-----|
| (1) | Normal pool | 2.6 |
| (2) | Flood-control pool | N/A |
| (3) | Spillway crest (ungated) | 2.6 |
| (4) | Test flood pool | 3.1 |
| (5) | Top of dam | 3.0 |
- g. Dam
- | | | |
|-----|-----------------|--|
| (1) | Type | Earth Dam |
| (2) | Length | 250 feet |
| (3) | Height | 26 feet |
| (4) | Top Width | 10 feet |
| (5) | Side Slopes | |
| | Upstream | 1:2.6 |
| | Downstream | 1:2.6 |
| (6) | Zoning | Unknown |
| (7) | Impervious Core | Unknown. Photos of the 1911 pre-construction and 1911 breach of Institute Pond Dam all indicate that the dam had a concrete core wall at least part of its length. |
| (8) | Cutoff | Unknown |
| (9) | Grout curtain | Unknown |
- h. Diversion and Regulating Tunnel
- Not applicable

5. Total Project Discharge

The total project discharge at the top of the dam is 305 cfs at elevation 100.5 feet. During the test flood, the inflow and the outflow are both 726 cfs at elevation 101.2 feet.

c. Elevation (feet)

(1) Streambed at toe of dam	74.5
(2) Bottom of cutoff	N/A
(3) Maximum tailwater	N/A
(4) Normal pool	96
(5) Full flood control pool	N/A
(6) Spillway crest (ungated)	96
(7) Design surcharge (Original Design)	Not known
(8) Top of dam	100.5
(9) Test flood design surcharge	101.2
(10) Top of State Aid Highway 9	102.3

d. Reservoir Length (feet) (Ponds #1 and #2 combined)

(1) Normal pool el. 96.0	650
(2) Flood control pool	N/A
(3) Spillway crest pool el. 96.0	650
(4) Top of dam el. 100.5	850
(5) Test flood pool el. 101.2	880

e. Storage (acre-feet) (Ponds #1 and #2 combined)

(1) Normal pool	28.6
(2) Flood control pool	N/A
(3) Spillway crest pool (ungated)	28.6

2. Maximum Known Flood. There are no available records, but according to a witness, the worst flood was in 1927. Reportedly the water level rose to within one foot of the top of dam at the lowest spot on the left abutment during the 1927 flood. Also during the 1973 flood the road embankment (State Aid Highway 9) at Pond #2 was almost overtopped, due to the limited discharge capacity of the 48-inch culvert, which replaced an arch bridge in 1968.
3. Spillway Capacity at Top of Dam
 - (a) Pond #1 - The principle spillway is a 10-foot wide rectangular chute. It is 106 feet long and has a 90° bend near the bottom of the chute. The end of the chute drops 11 feet vertically to the streambed. The capacity of the spillway at the top of the dam elevation of 100.5 is approximately 305 cfs. This represents the total discharge at the top of the dam.

A separate analysis was performed on the spillway chute. It was found that the chute will carry 305 cfs without overtopping the training walls as long as the chute is kept clear of debris. If the training walls are overtopped dangerous erosion may occur on the downstream slope of the dam. The water will flow over the wall at the 90° turn in the chute during normal high flows. This does not appear to create a hazard since the bend is below the toe of the dam.

- (b) Pond #2 - There is no spillway for pond #2, but State Aid Highway 9 acts as a broad crested weir when the water surface elevation rises above the road elevation.

4. Spillway Capacity at Test Flood Elevation

- (a) Pond #1 - The full PMF test flood for the 0.25 square miles is 726 cfs inflow. There is no reduction of the peak outflow due to the small amount of surcharge storage. Therefore, the peak outflow is also 726 cfs at an elevation of 101.2 feet; this represents an overtopping of the dam by 0.7 feet. The spillway will contribute 379 cfs (52%) of the total project discharge of 726 cfs.

- (b) Pond #2 - The full PMF test flood for the 0.23 square miles is 692 cfs inflow. There is no reduction of the peak outflow due to the small amount of surcharge storage. Therefore, the peak outflow is also 692 at an elevation of 105.0 feet; this represents an overtopping of the road by 2.7 feet. Due to the topography of the site it is possible, for a portion of the discharge that flows over the road to bypass Pond #1. It will be assumed for purposes of this report that all of the outflows of pond #2 discharge directly into pond #1.

State Aid Highway 9 which divided the impounded water. In the same year, 1911, the dam was breached. Water reportedly reached the second floor of a house downstream of the dam. There was no loss of life or injury due to the breach. The dam was reconstructed some time after the dam failed. At one time the dam was used for water supply. The 4-inch pipe at the toe of the dam may be remnant of the distribution system. The valve box controls a drain for the dam, but may have also controlled the water supply system. The bridge on State Aid Highway 9 was replaced in 1968 by a 48-inch culvert.

Ownership of the dam was transferred from Mr. Vail to the Lyndon Institute and then to Mr. Mathewson.

i. Normal Operating Procedure. The valve box as previously noted is connected to a drain for the pond. It has not been used for a number of years and may be inoperable. The spillway maintains normal pool level and does not have flashboards or stop logs to control the water level. There is no operation procedure at the present time.

1.3 Pertinent Data

a. Drainage Area. The drainage basin of Institute Pond Dam has an area of 0.25 square miles. The terrain varies in elevation from 750 to 1140 feet and the land use is approximately one-half woodlands and one-half open land. Lyndon Institute is located on the eastern shore of the pond. Also Lyndon State College is located in the headwater of the watershed.

The reservoir area at the top of the dam is 3 acres and represents approximately 2% of the total drainage area. The predominate soils in the watershed are Woodstock - Colrain and Colrain - Woodstock Associations.

b. Discharge at the Dam Site.

1. Outlet Works

(a) Pond #1 - The spillway which controls the normal pool elevation is an ungated, concrete chute spillway. The weir is 4.5 feet below the top of the dam. The discharge at the top of the dam is 305 cfs.

There is also a valve box on the downstream toe of the dam. It reportedly regulates the drain pipe of the dam. The size of this pipe is unknown.

(b) Pond #2 - Pond #2's outflow discharges into Pond #1 through a 48-inch corrugated metal culvert. The invert elevation on the upstream end of the culvert is 95.4* or 0.6 feet below the spillway crest of the dam downstream. The discharge of the culvert at the top of road elevation is 108 cfs.

*NOTE: Elevations of the dam and appurtenant structures are based on an assumed datum with an elevation of 100 feet at the top of the left training wall of the spillway.

and the size of the pipe or pipes it controls is unknown. There is also a 4-inch cast iron pipe discharging freely into the stream below the dam (Photo 20). The source of this water is not known.

c. Size Classification. Institute Pond Dam is 26 feet high and has a storage capacity of 44.6 acre-feet. In accordance with Article 2.1.1. of the Recommended Guidelines for Safety Inspection of Dams, the dam is Small in size based upon its height, which is greater than 25 feet and less than 40 feet.

d. Hazard Classification. The dam has a hazard classification of High. Development downstream of Institute Pond Dam which would be affected is concentrated near State Route 122 where the tributary passes under the road. This development includes 3 to 4 dwellings, a plumbing and heating supply store, elementary school and a playground located close enough to the stream to receive damage. There is also an ice hockey arena located immediately downstream of the dam (Photos 8, 21).

The flood wave generated by a breach of the Institute Pond Dam would be approximately 11 feet high in the vicinity of the ice hockey arena. Some damage may occur to the ice hockey arena, depending on breach location.

The wave would be approximately 14.4 feet high when it reaches the State Route 122 culvert or 3.9 feet above the road. The resultant flood wave would cause appreciable damage to State Route 122 and 3 to 4 structures in the area adjacent to the culvert with flood levels up to 4 feet above the first floor of these dwellings. It is probable that other housing units located in the fringe areas of the valley would suffer lesser damage from the resultant flood. The playground by the elementary school which is frequently used by children would be completely inundated. Downstream of State Route 122 is uninhabited therefore no damage will occur in that area. The energy of the flood wave would be greatly dissipated when it reaches the Passumpsic River 0.4 miles downstream of the dam. It is possible that more than a few lives may be lost if the dam is breached.

e. Ownership. The dam is owned by Philip Mathewson, Lyndon Center, Vermont 05850; telephone (802) 626-5193. During the winter months his address is Casa del Ray Mobile Court, 5249 Fifth Street Circle West, Bradenton, Florida 33507.

f. Operator. According to the deed for the dam, operation and maintenance is the responsibility of both Mr. Mathewson and Lyndon Institute.

g. Purpose. The dam is used only for aesthetic purposes. At one time it was reportedly used for water supply.

h. Design and Construction History. Based on construction photographs and information given by Mr. Mathewson, the dam was built by Mr. Vail in the year 1911. Photographs taken during the construction of the dam seem to indicate a partial concrete core wall. There was originally a bridge on

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
LYNDON INSTITUTE POND DAM

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 Inspection 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. DuBois & King, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to DuBois & King, Inc., under a letter of September 11, 1980, from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACQ33-80-C-0003 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

(1) to 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) To encourage and prepare the states to quickly initiate 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. Institute Pond Dam is located in the Town of Lyndon, Caledonia County, Vermont. The dam is located on a tributary of the Passumpsic River, approximately 0.4 miles upstream of the confluence. The dam is shown on the 15 minute U.S.G.S. quadrangle for Lyndonville, Vermont, with coordinates approximately 72° 1.1' west longitude, 44° 32.2' north latitude. The location of Institute Pond Dam is shown on the Location Map immediately preceeding this page.

b. Description of Dam and Appurtenances. Institute Pond Dam is an earth embankment approximately 250 feet long and 26 feet high. The impounded water is separated by State Aid Highway 9 into two connected ponds. Pond #1 is downstream of Pond #2. The principal spillway which controls the normal water level is a concrete chute spillway. There is a concrete valve box located near the downstream toe of the dam. It has not been used recently

Inspection of Dams," the test flood is the full Probable Maximum Flood (PMF). The HEC-1 computer program (Hydrologic Engineering Center-Flood Hydrograph Package) was utilized to calculate the PMF discharge and route the PMF inflow hydrograph through the structure. The PMF test flood for Pond #2 (drainage area = 0.23 square miles) is 692 cfs. Due to the small amount of surcharge storage in Pond #2 no reduction to the inflow hydrograph occurred during the routing process through the 48 inch culvert. The test inflow was routed through Pond #2 assuming the water surface to be initially at elevation 96.0 feet (normal pool). During the test flood, the road embankment (State Aid Highway #9) will be overtopped by 2.7 feet (elevation 105.0). Due to the topography of the site it is possible, for a portion of the discharge that overtops the road to bypass Pond #1. It will be assumed for the purposes of this report that all of the outflow of Pond #2 discharges directly into Pond #1. The 48-inch culvert can pass 108 cfs at the top of the road embankment (State Aid Highway #9) (elevation 102.3) or 16 percent of the routed test flood outflow. The $\frac{1}{2}$ PMF flood of 346 cfs would have an outflow of 346 cfs, which overtops the road embankment (State Aid Highway #9) by 2.0 feet (elevation 104.3). The PMF test flood for Pond #1 was calculated by combining the inflow hydrograph at Pond #1 and the outflow hydrograph from Pond #2. The PMF test flood for Pond #1 is 726 cfs. Due to the small amount of surcharge storage in Pond #1 no reduction to the inflow hydrograph occurred during the routing process through the 10-foot concrete chute spillway. The test inflow was routed through Pond #1 assuming the water surface to be initially at elevation 96.0 feet (normal pool). During the test flood, the earth dam will be overtopped by 0.7 feet (elevation 101.12). The 10-foot concrete chute spillway can pass 305 cfs at the top of dam (elevation 100.5) or 42 percent of the routed test flood outflow. The $\frac{1}{2}$ PMF flood for Pond #1 of 363 cfs would have an outflow of 363 cfs, which overtops the dam by 0.1 feet (elevation 100.6).

5.5 Dam Failure Analysis

Utilizing the Corps' April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs," a dam failure analysis was performed for Institute Pond Dam. Prior to failure, it was assumed, the water level was at the crest of the dam (100.5 feet), the chute spillway was discharging 305 cfs and the storage volume behind the dam was equal to the combined storage of the two ponds at elevation 100.5 (41.3 acre-feet). A breach width of 100 feet (40% of length of the dam) and breach height of 26 feet were used in the Saint-Venant equation to compute an instantaneous discharge of 22,290 cfs. The total discharge would be the instantaneous discharge plus the chute spillway discharge just prior to break or 22,595 cfs. The breach outflow would produce a 11.3 foot flood wave immediately downstream of the dam in the vicinity of the ice hockey rink. The hockey rink is approximately 15 feet above the streambed. The water stage above the streambed prior to the dam failure just downstream of the dam would be 1.1 feet. Approximately 1,450 feet downstream of the dam the outlet channel passes under State Route 122, through a concrete culvert. This constriction in the outlet channel increases the height of this flood wave to 14.4 feet which overtops the road by 3.9

feet. This is expected to flood approximately 5 to 6 dwellings, located in the proximity of the State Route 122 (See Possible Flood Damage Area Map in Appendix D), producing water levels about four feet above first floor level and inundate an elementary school playground frequently occupied by children. The stage prior to the dam failure at the State Route 122 concrete culvert would be 7.4 feet. The hockey rink may also be subject to severe flood damage if the dam break were to occur on the left abutment end of the embankment which is located immediately above the rink.

No development exists approximately 100 feet downstream of State Route 122; therefore, no structural damage will occur below this area. See appendix D, for the Possible Flood Damage Area Map.

The lives of more than a few persons would be endangered in the vicinity of State Route 122, therefore, the dam is classified as High hazard.

SECTION 6 EVALUATIONS OF STRUCTURAL STABILITY

6.1 Visual Observations

Based on visual observations there are several features of this dam that present potential structural problems.

Seepage appears to be the major potential structural problem. As mentioned in Section 3.1 there was an active discharging seepage area at the time of inspection, at the toe of the dam. There was also a wet zone in the contact area between the downstream face and the left abutment, indicating a seepage condition.

Another potential structural problem which can lead to additional seepage problems is the flora growth on the dam. As can be seen from the aerial photograph and the individual photographs (Photos 4, 5, 6, 7 & 17) the plant and tree growth does appear to be a potential problem. Seepage and erosion problems can develop along the root systems of trees and structural disturbances may occur due to trees being blown over.

The concrete erosion and deterioration of the chute spillway appears to be a potential structural problem. Concrete deterioration can lead to piping problems through this dam and also to structural collapse of sections of the chute spillway, which in turn could cause a dam failure.

Other areas of possible potential structural problems are:

- 1) The lack of erosion protection on the upstream slope;
- 2) The possibility of subsidence or erosion along the concrete-gate box structure on the downstream slope;
- 3) The possibility a pressure conduit condition may exist through the dam; and
- 4) Rodent burrows on the downstream slope of the dam.

The presence of trees, brush, and coarse vegetation on the embankment and a pile of cut brush and trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.

6.2 Design and Construction Data

There is no design or construction data available except for construction photographs. (Construction photographs are the property of the owner, Philip Mathewson)

6.3 Post-Construction Changes

There are no post-construction changes to the dam recorded. However, the bridge on State Aid Highway 9 was replaced by a 48 inch culvert in 1968.

6.4 Seismic Stability

This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Institute Pond Dam is in poor condition. The major concerns with respect to the integrity of the dam are:

- (1) Major seepage at the downstream toe of the dam, which could lead to a piping failure of the dam or to instability of the downstream slope and the area immediately downstream of the toe of the dam.
- (2) Trees and brush growing on the embankment could lead to seepage and erosion problems if a tree falls over and pulls out its roots or if a tree dies or is cut and its roots rot.
- (3) A wet zone along the contact between the downstream face and the left abutment indicates a seepage condition that might result in instability of the dam.
- (4) Subsidence or erosion of the downstream-slope fill along two edges of the concrete-valve box on the downstream slope may be indicative of a condition that could adversely effect the stability of the slope.
- (5) Lack of erosion protection on the upstream slope could result in severe erosion and breaching of the dam.
- (6) A large tree growing adjacent to the chute spillway could break the spillway if it falls over and pulls out its roots.
- (7) Erosion of the fill against a training wall at the downstream end of the chute spillway could result in failure of the wall and the spillway.
- (8) Concrete deterioration could result in holes through the spillway bottom or collapse of sections of spillway wall.
- (9) The drainage system has not been operated in many years and may be inoperable. The conduit size is also unknown. This system may be under pressure, due to the impounded water, which could result in a piping failure of the structure.
- (10) Rodent burrows on the downstream slope of the dam could lead to piping failure of the dam.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection. The presence of trees, brush, and other coarse vegetation on the dam embankment and a pile of cut brush and trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.

c. Urgency. The owner should implement the recommendations in 7.2 and 7.3 within one year after receipt of this Phase I report.

7.2 Recommendations

The following investigations and needed corrections should be performed under the direction of a registered engineer qualified in the design and construction of dams.

- (1) Specify and oversee procedures for the removal of trees and their root systems from the embankment, a zone 25 feet wide at the downstream toe of the dam, and on each side of the concrete-chute spillway.
- (2) Investigate the seepage near the downstream toe of the dam and the soft wet area along the contact between the downstream slope and left abutment, and design remedial measures.
- (3) Investigate the cause of the subsidence or erosion of the downstream slope adjacent to the concrete-valve box structure and design remedial measures. Also investigate the concrete valve box structure for a possible pressure conduit condition that may exist through the dam. If a pressure conduit condition exists upstream control should be provided.
- (4) Design erosion protection for the upstream face of the dam.
- (5) Investigate the concrete in the spillway and downstream retaining wall. Design repairs and/or replacement of concrete sections as necessary.
- (6) Perform a detailed hydrologic - hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should implement a systematic maintenance program consisting of the following items:

- (1) Cut and remove brush on the dam embankment.
- (2) Visually inspect the dam and appurtenant structures once a month.
- (3) A technical inspection program should be initiated and continued on a yearly basis.
- (4) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency.
- (5) Establish a procedure for rodent control.

7.4 Alternatives

Removing Institute Pond Dam and draining the upper pond (Pond #2) by lowering the culvert, may be considered as an alternative to the recommendations of Section 7.2 and 7.3.

APPENDIX A
VISUAL CHECKLIST WITH COMMENTS

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

TIME 0930

WEATHER Overcast

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

PARTY:

1. Robert Wernecke, D & K

6. _____

2. Charles J. Kissel, D & K

7. _____

3. Stephen Knight, KCF

8. _____

4. Ronald Hirschfeld, GEI

9. _____

5. _____

10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Earth Dam</u>	<u>R. Hirschfeld</u>	
2. <u>Concrete & Appurtenances</u>	<u>S. Knight</u>	
3. <u>Hydrology/Hydraulics</u>	<u>R. Wernecke & C. Kissel</u>	
4. _____		
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

NOTE: All elevations used in this report are assumed based on an elevation of 100 feet at the top of the left training wall on the top of the dam.

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VTDATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan KnightNAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	100.5
Current Pool Elevation	96.0
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	Crest elevation is slightly irregular
Lateral Movement	None observed
Vertical Alignment	Slightly irregular
Horizontal Alignment	Slightly irregular
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Minimal
Sloughing or Erosion of Slopes or Abutments	Small terrace 3-4-ft-wide and $\frac{1}{2}$ -ft above pond level on upstream slope, apparently due to wave erosion. Now covered with vegetation. Apparent erosion of embankment on right side of gate structure on downstream slope
Rock Slope Protection - Riprap Failures	No riprap

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED

CONDITIONS

DAM EMBANKMENT-continued

Unusual Movement or Cracking at or
Near Toe

None observed

Unusual Embankment or Downstream
Seepage

Major seepage at downstream toe of
right half of dam. Left contact of
downstream slope and abutment is soft
and shows some signs of erosion but no
active seepage.

Piping or Boils

None observed

Foundation Draniage Features

None observed

Toe Drains

None observed

Instrumentation System

None

Vegetation

Trees, up to 12-inch - dia. and some
grass vegetation on upstream slope,
and downstream slope. One 12-in.dia.
stump crest.

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>DIKE EMBANKMENT</u>	No Dike
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	Intake not visible beneath pond surface.
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 CHECKLIST

PROJECT Institute Pond Dam, VTDATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan KnightNAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - CONTROL TOWER</u>	No Tower - See Outlet Structure
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	

State of Vermont
Agency of Environmental Conservation
Department of Water Resources
Montpelier, VT 05602

DAM INSPECTION REPORT

INSTITUTE Pond DWR No. 119-1
LYNDON NDS No. VT00 216
Inspector Philip Mathewson Inspection Date 5-23-80
Address Lyndon Center, VT. Last Inspected 10-30-75
Telephone 826-5793 Hazard Class 2
Size Category III

PERSONS PRESENT AT INSPECTION (Name and Organization):

Inspecting Party A. P. Barranco, Jr. - Dept. of Water Resources
J. R. Guilmette - Facilities Engineering

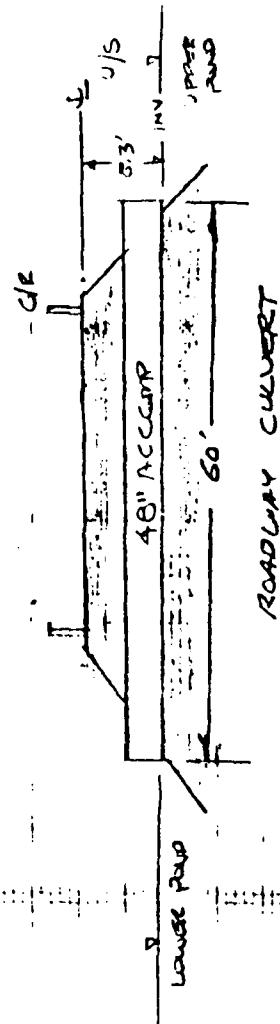
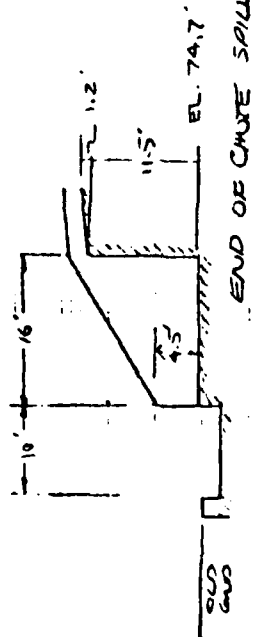
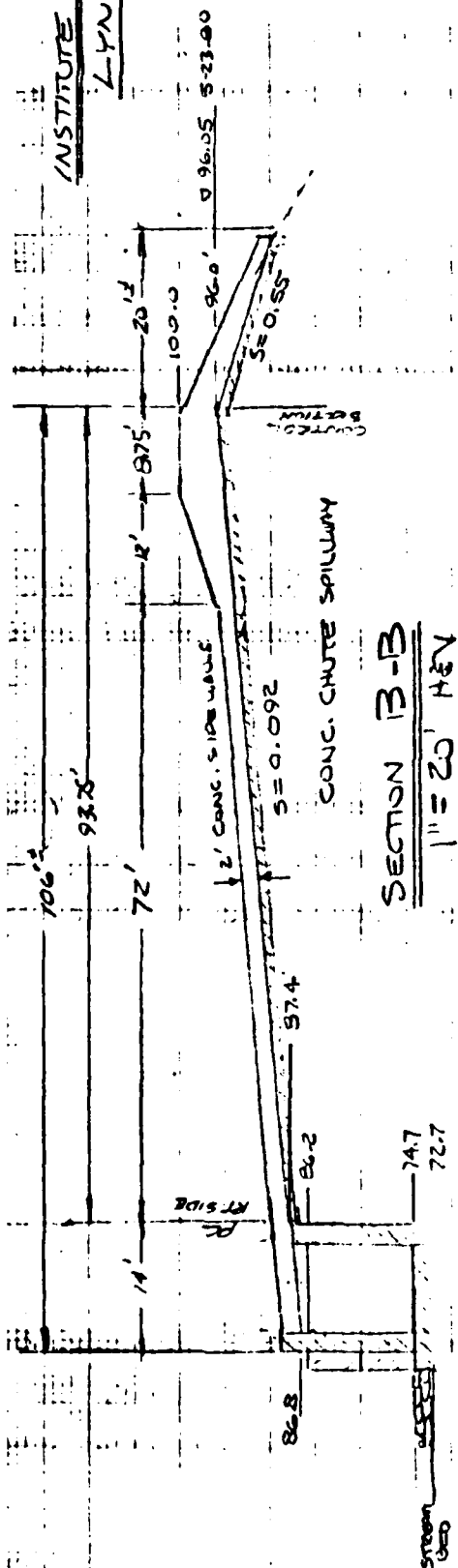
Remarks rs

General Conditions at Time of Inspection

Weather Hazy, 80° Ground Conditions Dry
Water Surface Elevation + 0.05' Datum crest of spillway
Accessibility Fully accessible but inspection of embankment
difficult because of brush and tree growth
Reservoir Area

Remarks AIK/A VAIL Pond

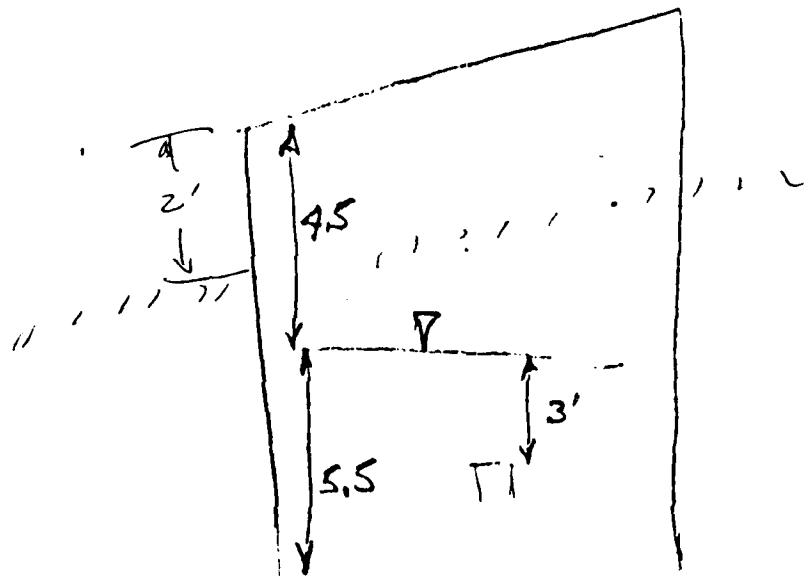
INSTITUTE POND DAM
MON-4-7.



Drawn, 7-22-80 APB

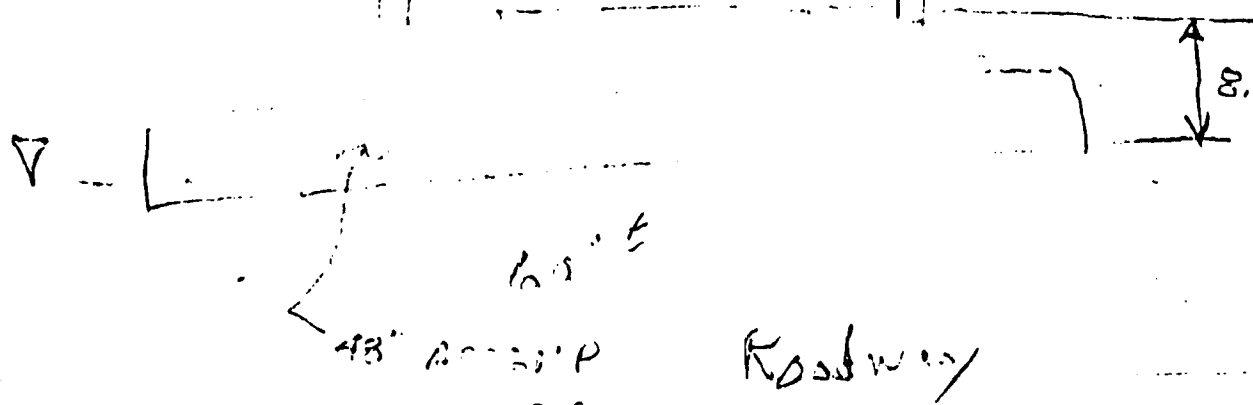
5/22.

192



-Typ Valve Box

Mr. Matheson would like to know if
his should still be in the balance
vase box + not be done because of possible blowout of foundation, due to
extent of seepage + possibly quick conditions. Advised need
a well designed filter/drainage system. ASD



71

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5/22/80

INSTITUTE (WAIL) JR Guilmette
POND DAM - Lydon P. Barranco

Mary 5-8" bass

Large population of snails at outlet

Heavy growth of trees brushy

5.5' x 5.5' outside
Concrete valve box

2004/05/15
2004/05/15

Infantry

2' high

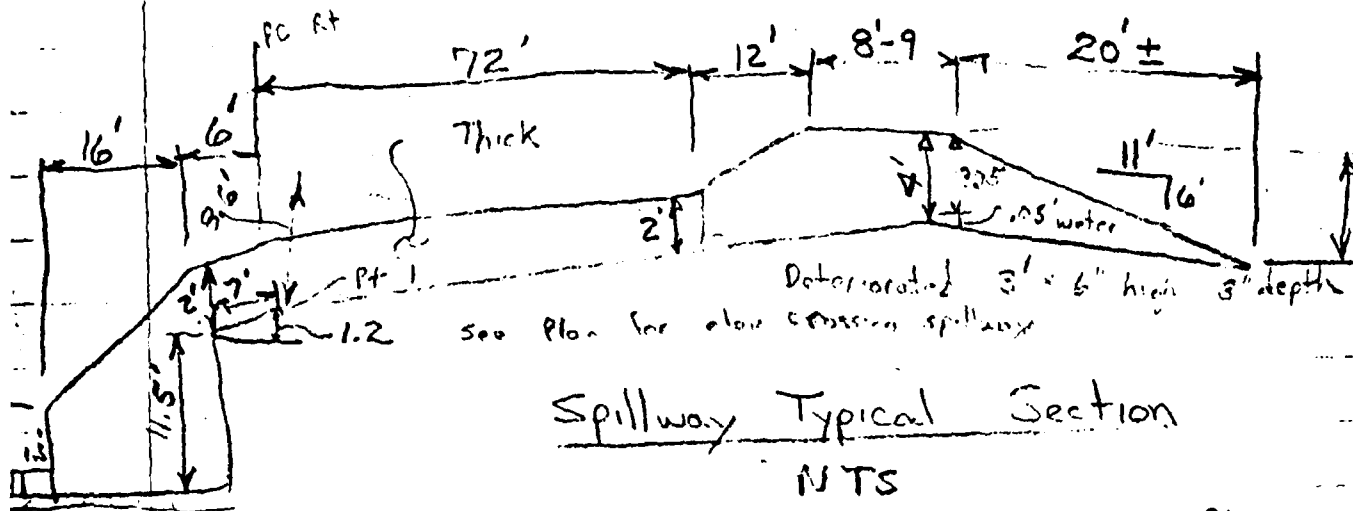
12" cast iron pipe
Inset 1.5' below co.
wall

Differ $4.6'$ $\frac{1}{2}$ $\frac{1}{2}$
 $14 + 13.75'$

Only Polysaccharide agar
4 x 15" in const. J4

5/22/80

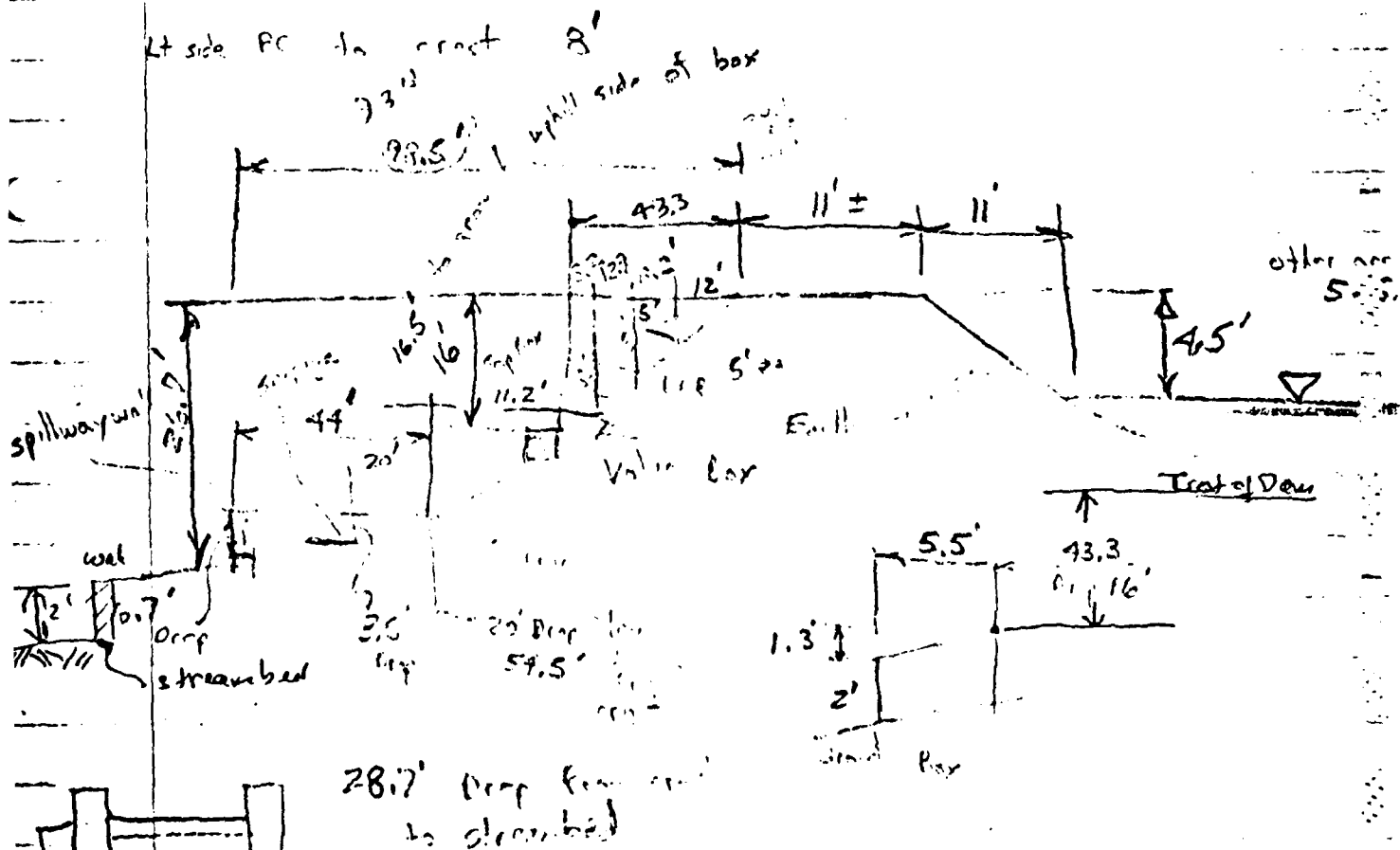
Institute Pond



Spillway Typical Section

NTS

Looking Westerly Rt wing



Dam Typical Section

NTS

Looking westerly

4. When the dam breached in 1911, water was at the second floor level in a house downstream but no loss of life or injury occurred.

5. Water has seeped into the basement of one of the Institute buildings on the left side of the pond above the road. This apparently is a fill area. Mr. Mathewson surmises it might be from the pond.

Other ~~notes~~ remarks by the writer:

1. The old photographs show the original bridge where the 48" ACCUM now is. This bridge appeared to provide a sizeable waterway connecting the upper and lower portions of the pond. A failure of the dam with the old bridge would have been more serious because the entire pond would drain rapidly. The road and 48" culvert in effect form a dam which would greatly restrict ~~drain~~ the rapidity of drawdown of the upper pond. Consequently, it is the writer's opinion that failure of the dam would for all practical purposes ^{only} involve ^{sudden} release of the lower pond.

2. Downstream conditions were not checked beyond the new ice arena and an additional downstream channel survey is needed. It does not appear that the ice arena would be seriously affected by a failure of the dam.

To: File

(From: APB)

Subj: Institute (Vail) Pond Dam - Lyndon

On May 23^e the writer and John Guillette inspected subject dam. The dam is judged to be in poor condition because of the seepage at the toe, possibly quick conditions downstream of the toe and the heavy cover of trees and brush on crest and both slopes. (See inspection report).

Dimensions and photographs were obtained.

The writer and John Guillette met the owner, Mr. Mathewson, who provided information on the history of the dam. Mr. Mathewson showed us several photographs of the dam during its construction in June and July, 1911. The photographs showed details of construction of the chute spillway and the embankment. It appears that a partial concrete core wall is incorporated in the design, although no evidence of it was visible during the inspection. Mr. Mathewson said the dam washed out (apparently during or shortly after construction and the breach area was repaired by a steel plate. One of the photographs apparently shows the breach (near the spillway where there appears to be a gap in the core wall).

Other historical notes provided by Mr. Mathewson:

1. The dam was built by Mr. Vail.
2. The Mathewsons acquired the dam from Lyndon Institute. The deed makes the owner and Lyndon Institute jointly responsible for its maintenance,
3. * During the 1927 flood the dam did not overtop but was ^{nearly} flanked at a low spot at the left abutment.

APPENDIX B
ENGINEERING DATA

<u>Description</u>	<u>Location</u>
1. Lyndon Institute Pond Design Records	None Available
2. Past Inspection Records A. Two inspections in the year 1980 B. Others	Appendix B, pages B2-B21 Vermont Department of Water Resources State Office Building Montpelier, Vermont 05602
3. Plans A. Original plans B. General Plans	None Available Figure B-1, pg. B-22 Figure B-2, pg. B-23
4. Subsurface Soils Information	None Available

APPENDIX B
ENGINEERING DATA

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - SERVICE BRIDGE</u>	No Bridge
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
----------------	------------

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel

General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees overhang channel
Floor of Approach Channel	Appears to be soil

b. Weir, Training Walls and Concrete Chute Spillway

General Condition of Concrete	Fair
Rust or Staining	Some staining
Spalling	Eroded & spalled concrete at joints & cracks
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Efflorescence at dam & at drop structure
Drain Holes	None observed
Trees Overhanging Channel	Many trees overhang chute

c. Discharge Channel

General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Many trees overhang channel
Floor of Channel	Sand and gravel
Other Obstructions	Many logs in channel, especially below right-angle bend in channel at drop-structure

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE Sept. 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	5½' x 5½' Box in good condition
Rust or Staining	Moderate staining & moss growth
Spalling	None
Erosion or Cavitation	Moderate erosion of soil to right of concrete box
Visible Reinforcing	None
Any Seepage or Efflorescence	None visible
Condition at Joints	Good
Drain holes	None
Channel	
Loose Rock or Trees Overhanging Channel	Trees overhang discharge channel
Condition of Discharge Channel	Poor; many logs in channel and trees overhanging channel.

INSPECTION CHECKLIST

PROJECT Institute Pond Dam, VT

DATE September 30, 1980

PROJECT FEATURE _____

NAME Robert Wernecke

DISCIPLINE _____

NAME Stephan Knight

NAME Ronald Hirschfeld

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	Not Visible
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

II. Condition of Main Structure

Type of Construction Earth fill, possibly with concrete
core wall built June-July 1911

A. Upstream Face or Slope

1. Vegetative Cover Dense growth of brush and trees
2. Erosion Not severe
3. Slumps, Slides, Cracks none observed but slope
somewhat irregular
4. Animal Burrows none observed
5. Slope Protection none
6. Debris minor
7. Structural n/a
8. Abutments low area at left abutment, right abutment
not checked
9. Alignment too much brush to tell
10. Movement none apparent
11. Remarks (a) inspection limited by brush and trees
(b) poor condition

B. Downstream Face or Slope and Toe

1. Vegetative Cover heavy growth brush and trees (up to 10' h),
- wet type vegetation entire slope
2. Erosion not significant
3. Slumps, Slides, Cracks none observed - slope irregular
4. Animal Burrows none observed
5. Slope Protection none
6. Debris none
7. Seepage ① Slopes damp but no seepage observed @ toe below valve box. A/S
substantial seepage and standing water (rust colored). Most
seepage enters d/s channel below chute spillway - estimate flows 1-3 gpm.
Another seep located along left stream bank. 20' d/s/o end of framing
well below chute.
8. Piping none observed but difficult to tell at toe (see #7).
9. Boils Area below valve box may be quick.
10. Toe Drains none observed
11. Scour some at end of framing walls below chute.
12. Structural valve box is only structural item
13. Abutments low area at left abutment; right abutment
not checked

14. Alignment difficult to tell because of brush and trees

15. Movement none apparent

16. Remarks ① serious concern about seepage at fore and downstream of toe. ② generally in poor condition

C. Crest

1. Vegetative Cover dense brush and trees

2. Erosion none significant

3. Evidence of Overtopping none

4. Settlement, Cracks none observed - crest is irregular in elevation (1-2') and width (0-11').

5. Animal Burrows none observed

6. Debris none

7. Use of crest (road, trail, etc.) foot path

8. Structural no structural items

9. Abutments low area at left abutment, right abutment not checked

10. Alignment can't tell because of brush and trees

11. Remarks poor condition

III. Condition of Outlet Works

A. Principal Spillway

Type Broad crested triangular weir with chute spillway (concrete)

Controlled or Uncontrolled uncontrolled - no provision for flashboards or stop logs

1. Approach Channel appears clear

2. Transition clear - settled somewhat

3. Control Section small amount debris - concrete good

4. Discharge Channel (chute) Side walls vertical. Some deterioration of concrete walls 20' d/s/o control section + deterioration of concrete at construction joints here and at d/s and just before turn. Side walls below overfall and d/s training walls badly deteriorated and undermined

5. Intake Structure not visible N/A

6. Conduit 12" Ø CIP (inv. 45' below top right training wall) visible for 5'. Alignment does not go to drive box. Could trace pipe but possibly road debris

7. Outlet Structure see Nos. 1-4

8. Trash Racks none

9. Anti-vortex Devices N/A

10. Stop Logs, Flash Boards not provided for

11. Remarks Except for part below 14.5' overfall and
deteriorated sections in floor and sidewalls, spillway
is in fair shape for its age.

B. Emergency Spillway

Type none

Controlled or Uncontrolled _____

1. Approach Channel _____

2. Transition _____

3. Control Section _____

4. Discharge Channel _____

5. Remarks _____

C. Drawdown Facilities, Gates, Drains, Appurtenances, Etc.

1. Drawdown Facility ^{W.D.} A 5.5 x 5.5 x 10' deep concrete valve
box with T handle for valve located on d/s slope near
Condition from size of pipe(s) unknown. Possibly
12" ϕ CIP noted in spillway outlet concrete. The owner
did not know what size pipe it was. He had never
opened valve. Valve box was filled to 6.5' with water.

2. Other Gates, Drains, Appurtenances A 3" IP (Flowing full) enters the outlet stream about 40' d/s/o and of chute. Alignment of exposed pipe goes towards valve box.
Condition But is partially blocked either by a screen or debris. Owner does not know where it comes from.
3. Remarks Owner has never used pond drain and it is not known if it is operable.

IV. Operation and Maintenance

No operational procedures. No maintenance has been provided for some time. The owner found it difficult to keep up with clearing the brush. Now the brush and trees form a screen to block the view of the new ice arena from the owner's house.

V. Inspection Summary

A. Information Obtained

1. Photographs ✓
2. Dimensions ✓
3. Other _____

B. Additional Information Needed

- ① Check d/s channel further down. ② Re-examine seepage ③ Re-examine owner's photos ④ Check right end of dam and abutment

C. Overall Condition of Dam

Poor

VI. General Comments

Seepage at toe and downstream is of serious concern. Possible quick conditions present.

Report By

A. Peter Barranco, Jr.

Date

5-23-80

A. Peter Barranco, Jr. PE
Dam Safety Engineer DWR

Attachments:

- ① Photos
- ② Dimensions
- ③ Photogrametric map of reservoir area
- ④ Memo re: inspection and conversation with Mr. Matthews.

7-22-80

To: F.I.C

From: APB

Subject: Institute Pond Dam - Lyndon

On 7-22-80 the writer investigated downstream channel conditions below the Institute Pond Dam. The outlet stream from the pond crosses under TH via an 6.5x8' concrete culvert about 1500' below the dam. One 1 1/2 story frame house on the ups side of the culvert has its first floor only 8' above stream, but and would be flooded if dam were to fail. (This house had water up to the 2nd floor when the dam failed in 1911, however, due to reduction in pond volume subject to quick release during a failure now, flood stages should be much less). Two other buildings (residences) might be subjected to some damage. SEE SKETCH

Stopped by the Mathewson's home and spoke with Mr. Mathewson.

1) Discussed seepage at toe of dam. Recommended against digging channel to drain seepage as this might disturb delicate balance if area is quick and lead to failure of foundation by piping. Advised that a well designed drainage/filter system was needed.

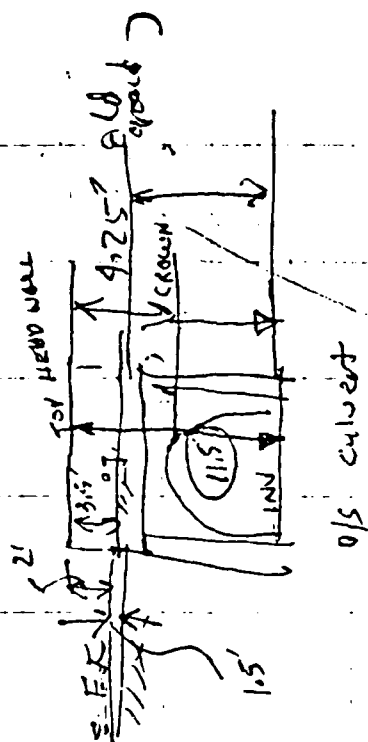
(2) My primary concerns with dam were brush and tree growth and seepage problem.

(3) Advised dam may again be inspected. (By Corps under Phase I).

(4) Mr. Mathewson said that during high flows water had gone

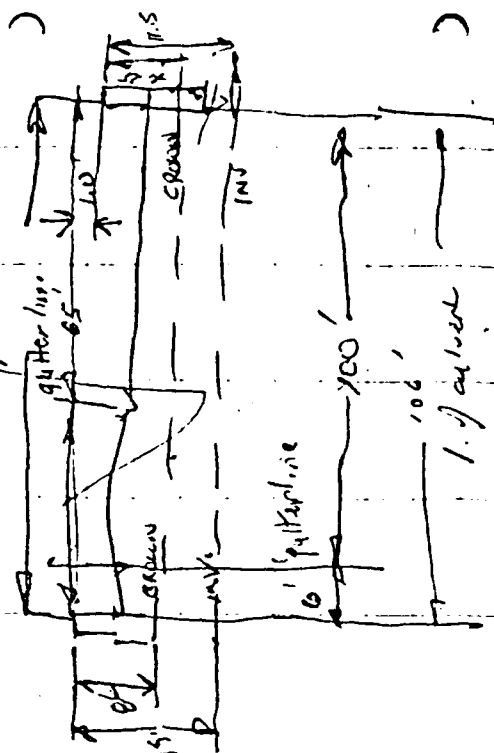
around right end of sidewalk wall. He has tried to fill this area with brush and other material. Did not look at this area today but should be checked out.

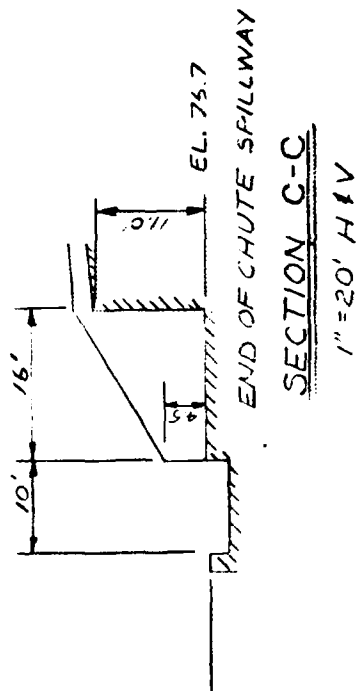
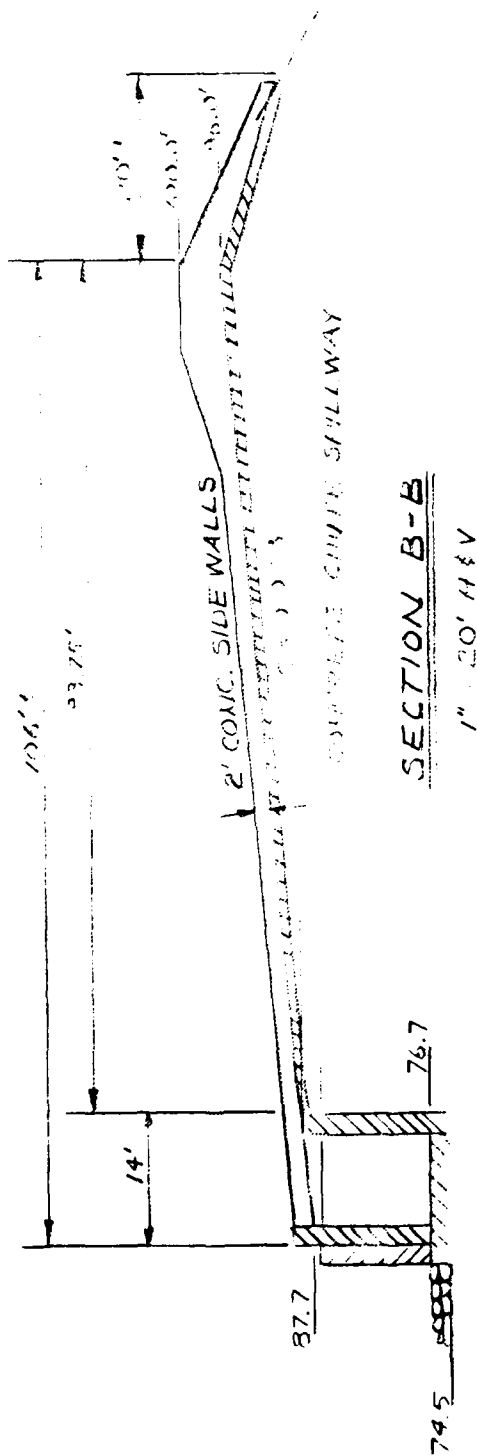
- (5) Mr. Mathewson said the soil below the old ground on the left side of the dam would act like jelly when they were excavating for the ice area. Also bunks appeared in the parking ~~lot~~ lot and drive before they covered it with gravel.
- (6) Plans of dam are not known to exist. Would not be in Lynden Institute records.
- (7) According to Mr. Mathewson, the deed for the dam has a provision that the Institute is partially responsible for upkeep of the dam.
- (8) Mr. Mathewson will try to get copies of the construction photos (1911) made for the Dept.



Δ ELEV.

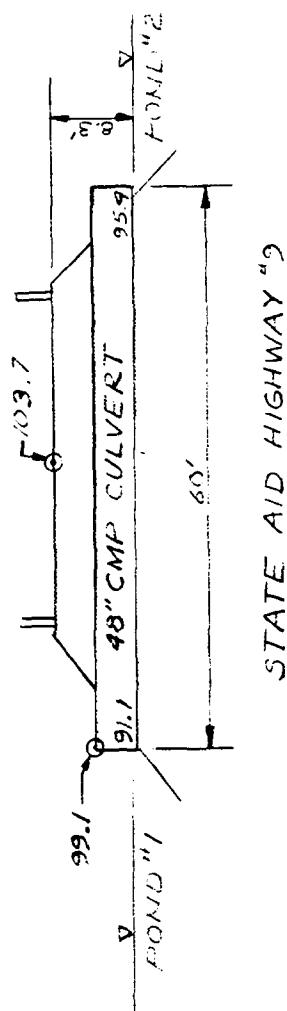
TOP HEADWALL 4/5 TO P/S = 1.0





LEGEND

○ POINT ELEVATION



DuBois & King, Inc.

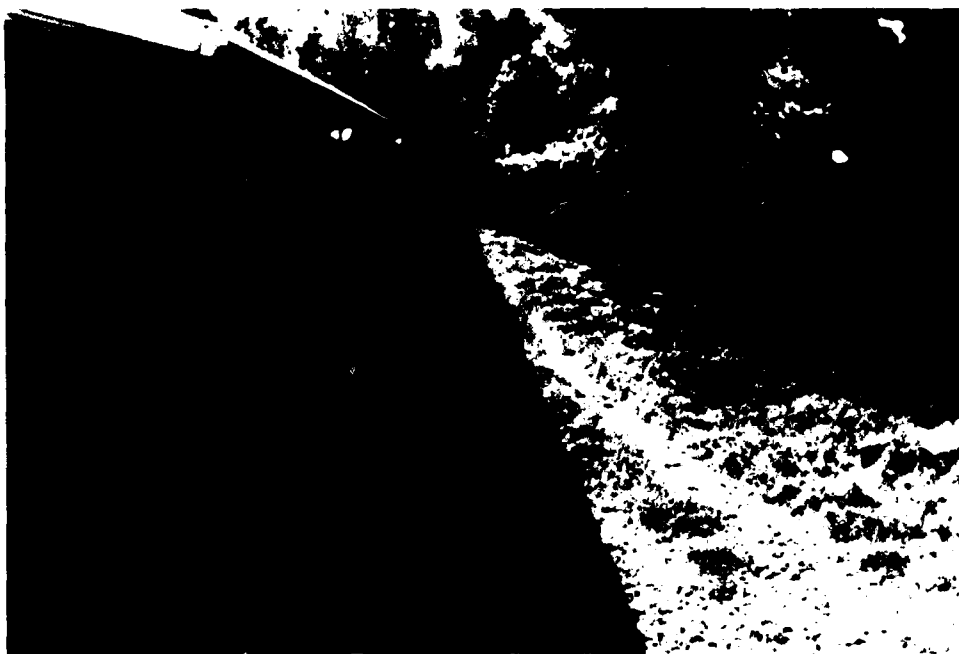
ENGINEERS AND ARCHITECTS
1000 BROADWAY, NEW YORK, N.Y. 10018

Department of the Army
New England Division
Corps of Engineers
Waltham, MA 02154

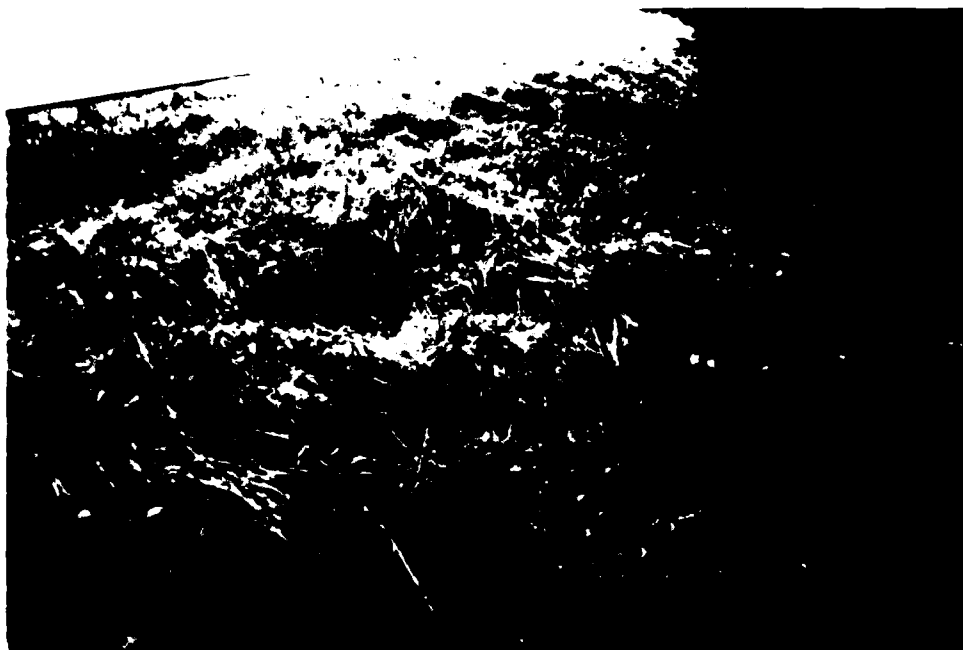
National Dam Inspection Program
Institute Pond Dam
Lyndon, Vermont
General Plan

DESIGNED BY	DATE
SJT	12-80
CHECKED BY	PROJ. NO.
CJK	90853
PLotted BY	DATE
	8-2

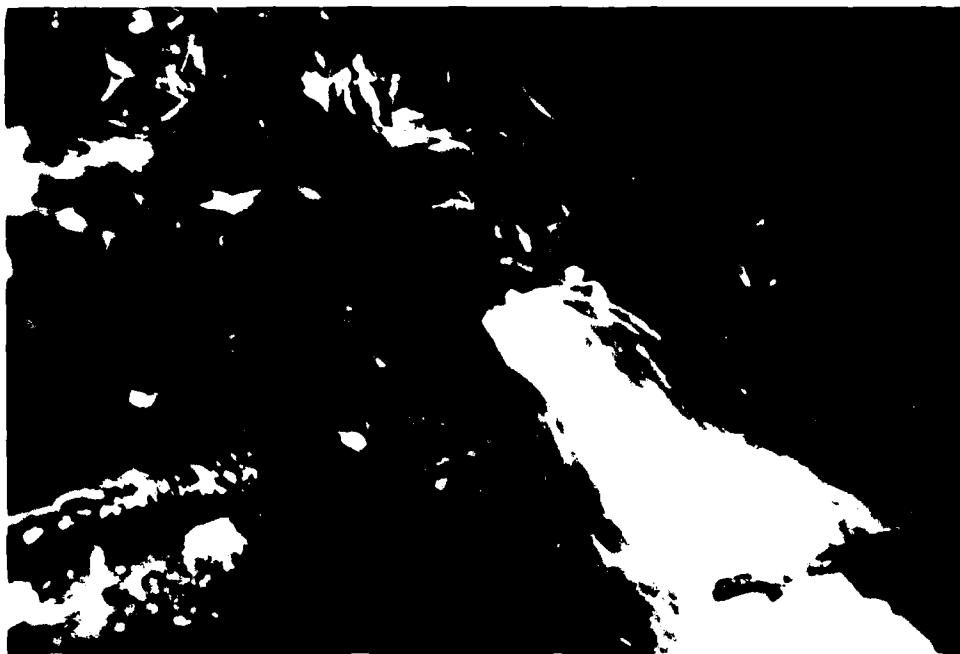
APPENDIX D
HYDROLOGIC & HYDRAULIC CALCULATIONS



#23 - Ice hockey arena downstream of dam, (photo location on Possible Flood Damage Area Map - Appendix D)



#24 - Sink holes near Ice hockey arena (photo location on Possible Flood Damage Area Map - Appendix D)



#21 - Discharge from 4 inch pipe about 40 feet downstream
of drop structure



#22 - View of Downstream Channel



#19 - Logs and brush downstream side of drop structure



#20 - Concrete-box-gate structure with steel plate
cover near downstream toe of dam



#17 - 4-foot-diameter hollow maple tree about 10 feet
left of chute spillway



#18 - Downstream end of chute spillway before drop
structure

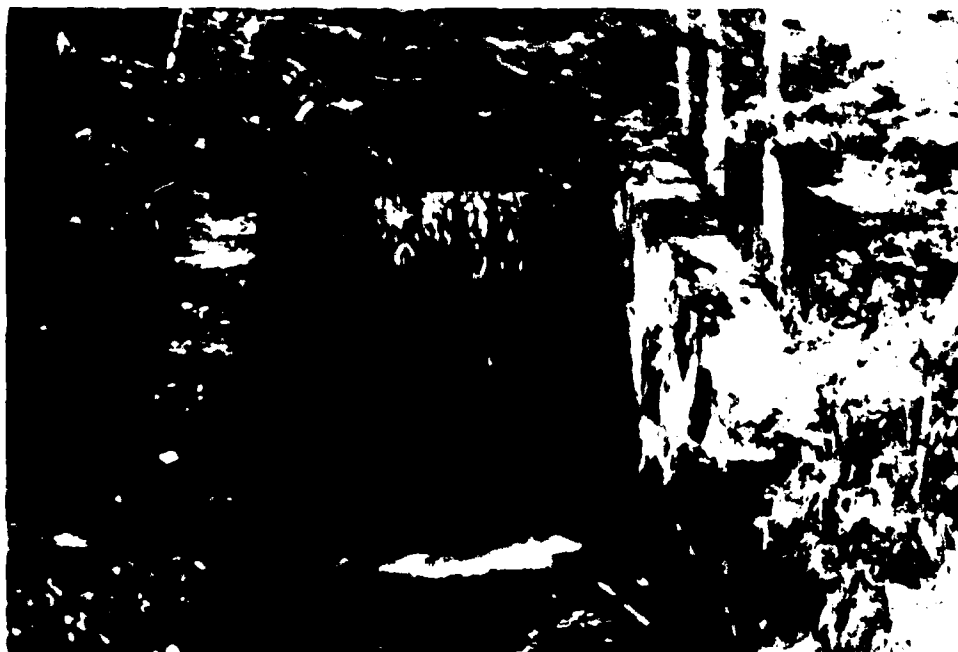


#15 - Left wall at spillway drop structure
(Notice concrete erosion)



#16 - Right training wall downstream of drop structure
(notice concrete erosion)

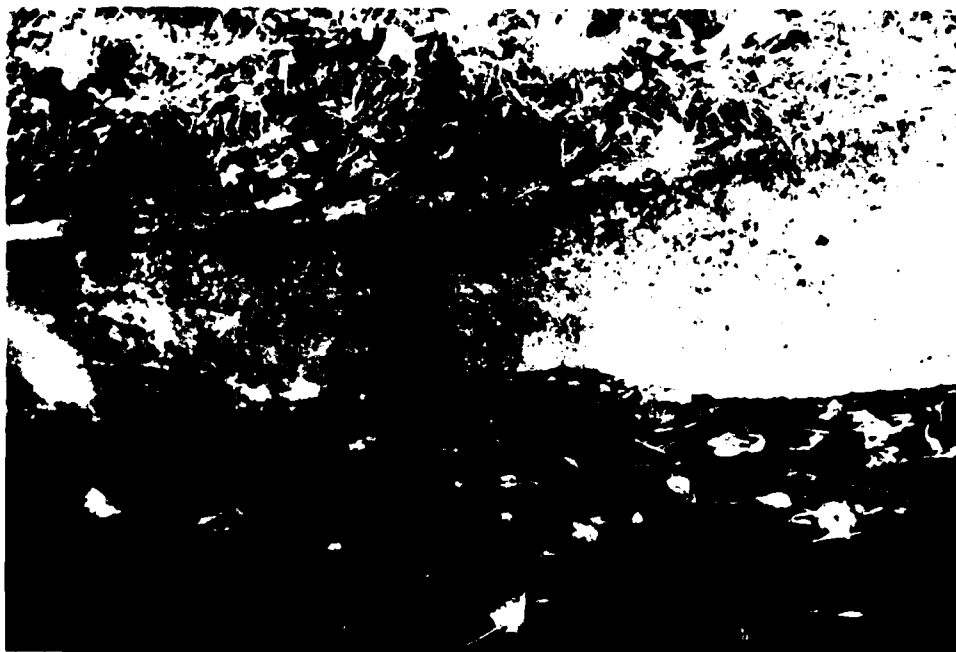
#13 - Right wall of chute
spillway (notice
shrinkage crack and
bottom erosion)



#14 - Drop structure at end of chute spillway (notice
concrete erosion)



#11 - Left wall of chute spillway, 10 feet downstream of crest (notice shrinkage cracks)



#12 - Right wall of chute spillway, 10 feet downstream of crest (notice shrinkage cracks)



#9 - Looking downstream at chute spillway



#10 - Left wall of chute spillway at crest of dam
(notice efflorescence)



#7 - Major seepage area at downstream toe



#8 - Looking downstream at crest of concrete chute spillway



#5 - Upstream slope of dam looking toward right abutment



#6 - Downstream slope of dam looking right



#3 - Road Embankment, State Aid Highway #9, upstream side of road (notice 48 inch culvert)(Photo location on Possible Flood Damage Area Map - Appendix D)



#4 - Crest of dam looking toward right abutment



#1 - Crest of Dam, from State Aid Highway #9(notice
48 inch culvert, discharge end, lower left corner)
(photo location on Possible Flood Damage Area Map-
Appendix D)



#2 - Road Embankment, State Aid Highway #9, from crest of
Dam (notice 48 inch culvert)

APPENDIX C

PHOTOGRAPHS

FOR LOCATIONS OF PHOTOS, SEE FIGURES B-1
AND POSSIBLE FLOOD DAMAGE AREA MAP
LOCATED IN APPENDIX B AND D

Job No. 90852 Sheet 1 of 31
Project Trustee Pond Dam Date 10/15/80
Subject Drainage Area By WVS Ch'k. by

From U.S.G.S. Lyndonville, Vt.
scale 1:62500

Planimeter Readings

0.25
0.51 0.255 $0.255 \text{ in}^2 (0.973) = 0.25 \text{ mi}^2$

Ave. Reading = 0.255 in^2

Drainage Area = 0.25 mi^2

Job No. 90552 Sheet 2 of 31
 Project INSTITUTE Pond Dam Date 10-27-80
 Subject Hydrology - Hydrology By Ch'k. by

STAGE - AREA DATA — STAGE - STORAGE DATA

ELEVATION (FT)	INSTITUTE Pond			STORAGE		TOTAL STORAGE (AC-FT)
	Pond #1 (ACRES)	Pond #2 (ACRES)		Pond #1 AC-FT	Pond #2 AC-FT	
SPILLWAY CREST - 96.0	1.2 ^①	1.4 ^①		0	0	0
Top of Dam 100.5	1.4 ^②	1.6 ^③		5.9	6.8	12.7
101.5				7.3	8.4	15.7
102.5				8.7	10.0	18.7
103.5				10.1	11.6	21.7

① AREA COMPUTATIONS TAKEN FROM AERIAL PHOTO OBTAINED FROM THE VERMONT DEPT. OF HIGHWAYS, DATED 1 MAY 17, 1975.
 (FLIGHT LINE + PHOTO NO. 23-101)

② AREA COMPUTATIONS BASED ON FIELD SURVEYS

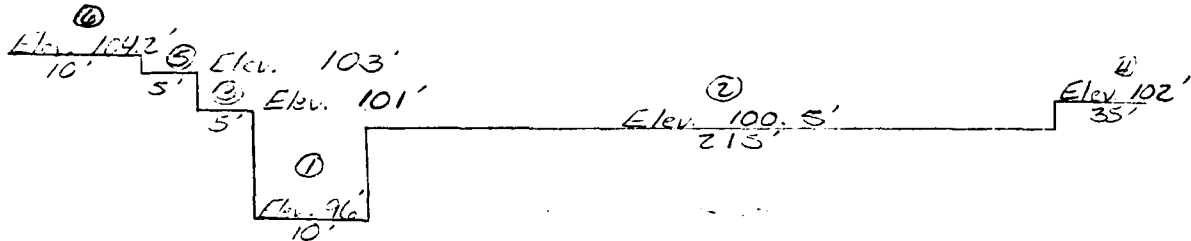
③ Pond #2 AREA INCREASED AT THE SAME RATE AS Pond #1

THE ASSUMPTION WILL BE MADE THAT BOTH PONDS ARE 11 FEET DEEP. STORAGE BELOW SPILLWAY CREST IS ASSUMED TO BE THE FOLLOWING:

Pond #1	Pond #2	TOTAL	ELEVATION
AC-FT	AC-FT	AC-FT	(FT)
13.2	15.4	28.6	96.0

Job No. _____ Sheet 4 of 31
 Project Intermittent Pond Date 10/20/80
 Subject Discharge Rating Curve By JRS Ch'k. by _____

OUTLET FOR POND #1



Wier Section #	Length	Elev.	Coeff.*
①	10'	96'	3.2
②	215'	100.5'	2.5
③	5'	101'	2.5
④	35'	102'	2.5
⑤	5'	103'	2.5
⑥	10'	104.2'	2.5

The above information is a simplification of the actual dam profile taking into account effective flow over the crest of the dam.

* Coefficient was taken from the "Handbook of Hydraulics" by Brater & King.

Job No. 90857
 Project INSTITUTE Pond Dam
 Subject Hydraulic - Hydrology

Sheet 5 of 31
 Date 10-27-80
 By JL Ch'k. by

Stage - Discharge Curve - Pond #1

Elevation	Weir #1	Weir #2	Weir #3	Weir #4	Weir #5	Weir #6	Total Discharge
96	—						32
97	32						91
98	91						166
99	166						305
100.5	305	—					548
101.0	358	190	—				955
101.5	413	538	4				1470
102	470	987	13	—			2104
102.5	530	1520	23	31			2841
103	593	2125	35	88	—		3664
103.5	657	2793	49	161	4		4568
104.0	724	3519	65	247	13		8910
106.0	1012	6933	140	700	65	60	

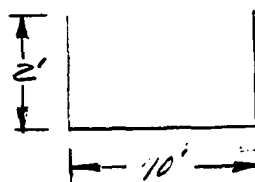
Job No. COR-1 Sheet 6 of 31
 Project INSTITUTE Pond Dam Date 11-16-80
 Subject HYDROLOGIC - HYDROLOGIC By JL Ch'k. by

THE MAXIMUM DISCHARGE THAT THE SPILLWAY FOR INSTITUTE POND DAM (AT POND #1) IS 305 CFS. AN ANALYSIS FOR THE SPILLWAY CHUTE IS NECESSARY TO CHECK IF THE MAXIMUM DISCHARGE IN THE SPILLWAY CHUTE WILL GET OUT OF BANK.

CONCRETE SPILLWAY CHUTE

SLOPE = 0.078

$m = 0.015$



$$Q = \frac{1.49}{0.55} \cdot 10(d) \left(\frac{10(d)}{10+2d} \right)^{3/2} (0.078)^{1/2}$$

$$305 = 27.74 \cdot 10(d) \left(\frac{10(d)}{10+2d} \right)^{3/2}$$

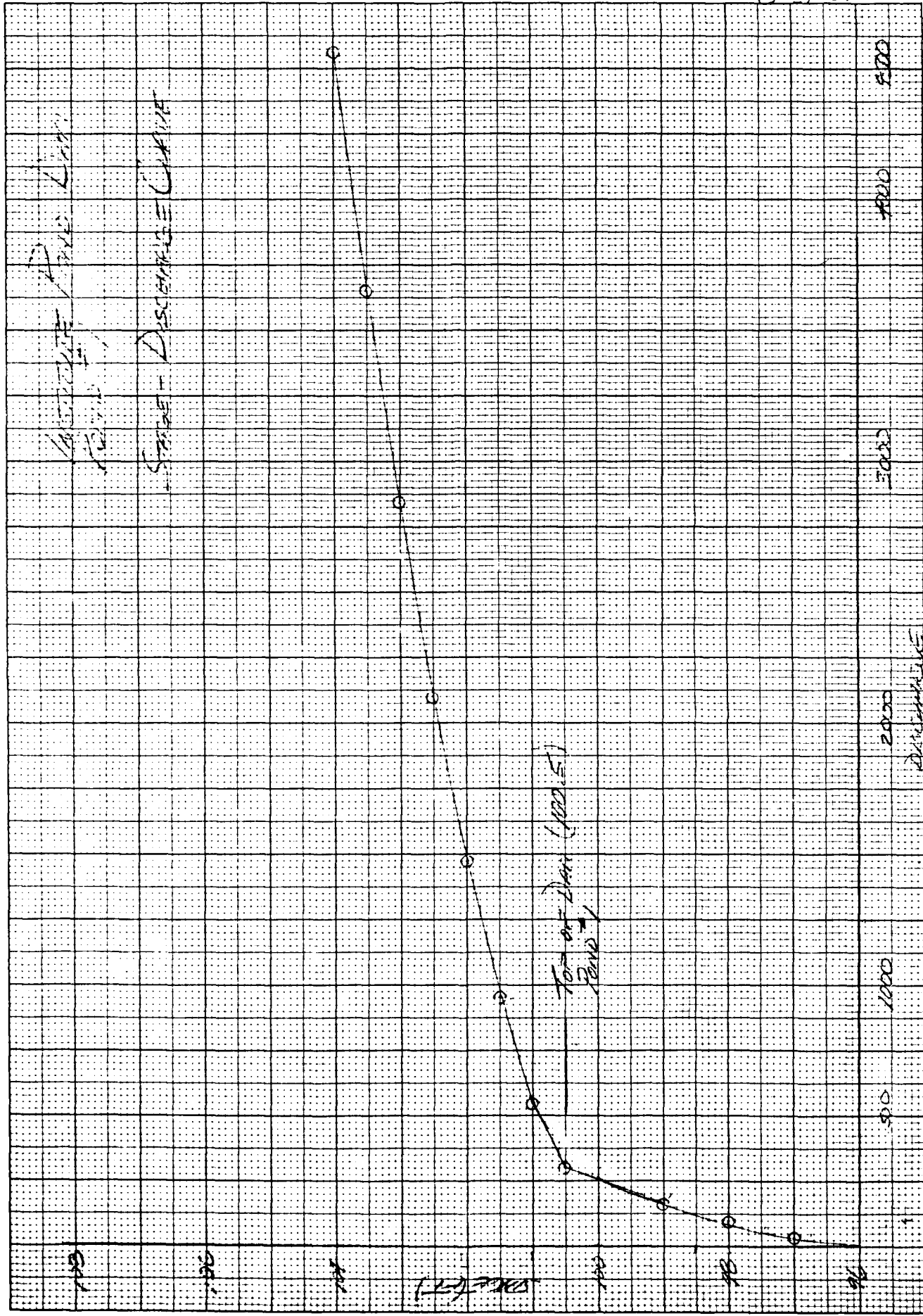
d	Q	$\frac{V^2}{2g}$
0.5	16.	1.2
1.0	246.	9.4
1.5	458	14.5
2.0	704	19.2

THE SPILLWAY CHUTE HAS THE CAPACITY TO CONTAIN THE MAXIMUM DISCHARGE OF THE SPILLWAY, 305 CFS, THE DEPTH IN THE SPILLWAY CHUTE WILL BE APPROXIMATELY EQUAL TO 1.2 FEET. THIS IS 0.8 FEET BELOW TOP OF CHUTE. THE SPILLWAY CHUTE MUST REMAIN CLEAR, IF DEBRIS GETS LODGED IN THE CHUTE IT IS POSSIBLE FOR THE WATER TO GET OUT OF BANK AND TRAVEL DOWN THE DOWNSTREAM FACE OF THE DAM. THIS IS DUE TO THE HIGH VELOCITIES IN THE SPILLWAY CHUTE.

Job No. 10853 Sheet 7 of 31
 Project INSTITUTE Pond Dam Date 11-6-80
 Subject HYDRAULIC - HYDROLOGY By JK Ch'k. by

ANALYSIS OF CHUTE SPILLWAY (CONT)

AT THE DOWNSTREAM END OF THE CHUTE SPILLWAY, WHERE THE CHUTE SPILLWAY TAKES A 90° BEND, THE DISCHARGE WILL GET OUT OF BANK, HOWEVER THIS WILL NOT AFFECT THE DOWNSTREAM FACE OF THE DAM, BECAUSE THE CHUTE SPILLWAY DISCHARGES APPROXIMATELY 20 FEET DOWNSTREAM OF THE TOE OF DAM.



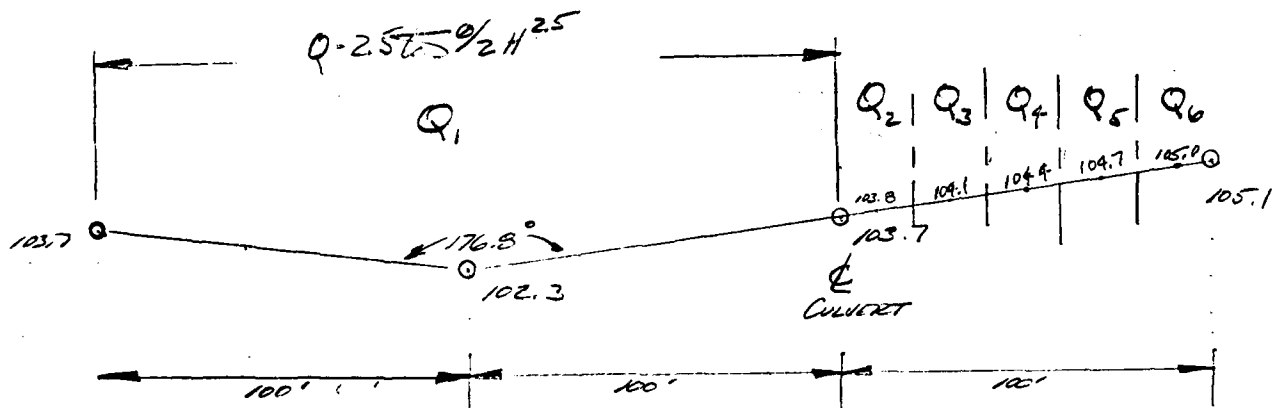
Job No. 90853 Sheet 9 of 31
 Project INSTITUTE Pond Date 10-27-80
 Subject HYDRAULIC - HYDROLOGY By OK Ch'k. by

POND #2

WEIR FLOW OVER ROAD

$$Q = CLH^{3/2} \quad \text{ASSUME } C = 2.5$$

$$Q = 2.5 \text{ to } \frac{1}{2} H^{2.5}$$



(SEE FOLLOWING PAGE FOR COMPUTATIONS)

Job No. 9055 Sheet 10 of 31
 Project INSTITUTE Pond Dam Date 10-27-80
 Subject HYDRAULICS - HYDROLOGY Pond #2 By SKL Ch'k. by

WING (FT)	Y1 (CFS)	Y2 (CFS)	Y3 (CFS)	Y4 (CFS)	Y5 (CFS)	T6 (CFS)	TOTAL (CFS)
103.3	45	—	—	—	—	—	45
103.7	104	—	—	—	—	—	104
104.0	169	4	—	—	—	—	173
104.5	322	29	13	2	—	—	366
105.0	537	66	43	23	3	—	677
105.5	821	111	83	58	36	10	1127
106.0	1180	163	131	101	74	50	1699
108.0	3475	430	285	342	300	260	5192
110.0	7370	772	717	663	610	559	10691
111.0	10,002	966	906	848	791	735	14248

$$Q_1 = 2.5 \frac{H}{\left(\frac{176.8}{2}\right)^{2.5}}$$

$$Q_1 = 89.5 H^{2.5}$$

REDUCE COEFF BY 50%
 V-NOTCH IS NOT SHARP
 CRESTED

$$Q_1 = 44.8 H^{2.5}$$

$$Q_1 = CLH^{1.5}$$

$$Q_2 = 2.5(20)H^{1.5}$$

$$Q_2 = 50H^{1.5}$$

$$Q_3 = 50H^{1.5}$$

$$Q_4 = 50H^{1.5}$$

$$Q_5 = 50H^{1.5}$$

$$Q_6 = 50H^{1.5}$$

PROJECT: 10-27-83

DATE: 10-27-83

HYDROLOGIC AND CHANNEL INFORMATION

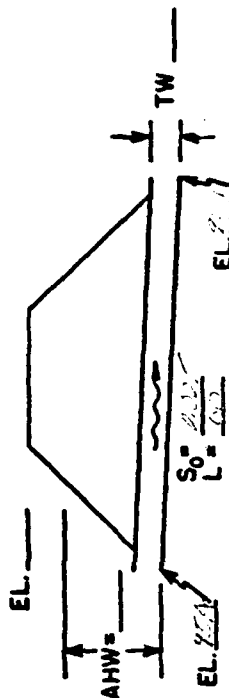
ONLY OUTLET FROM Box 1
IS 43" C.M.P. CULVERT.

$Q_1 =$ $TW_1 =$
 $Q_2 =$ $TW_2 =$

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
 Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION:



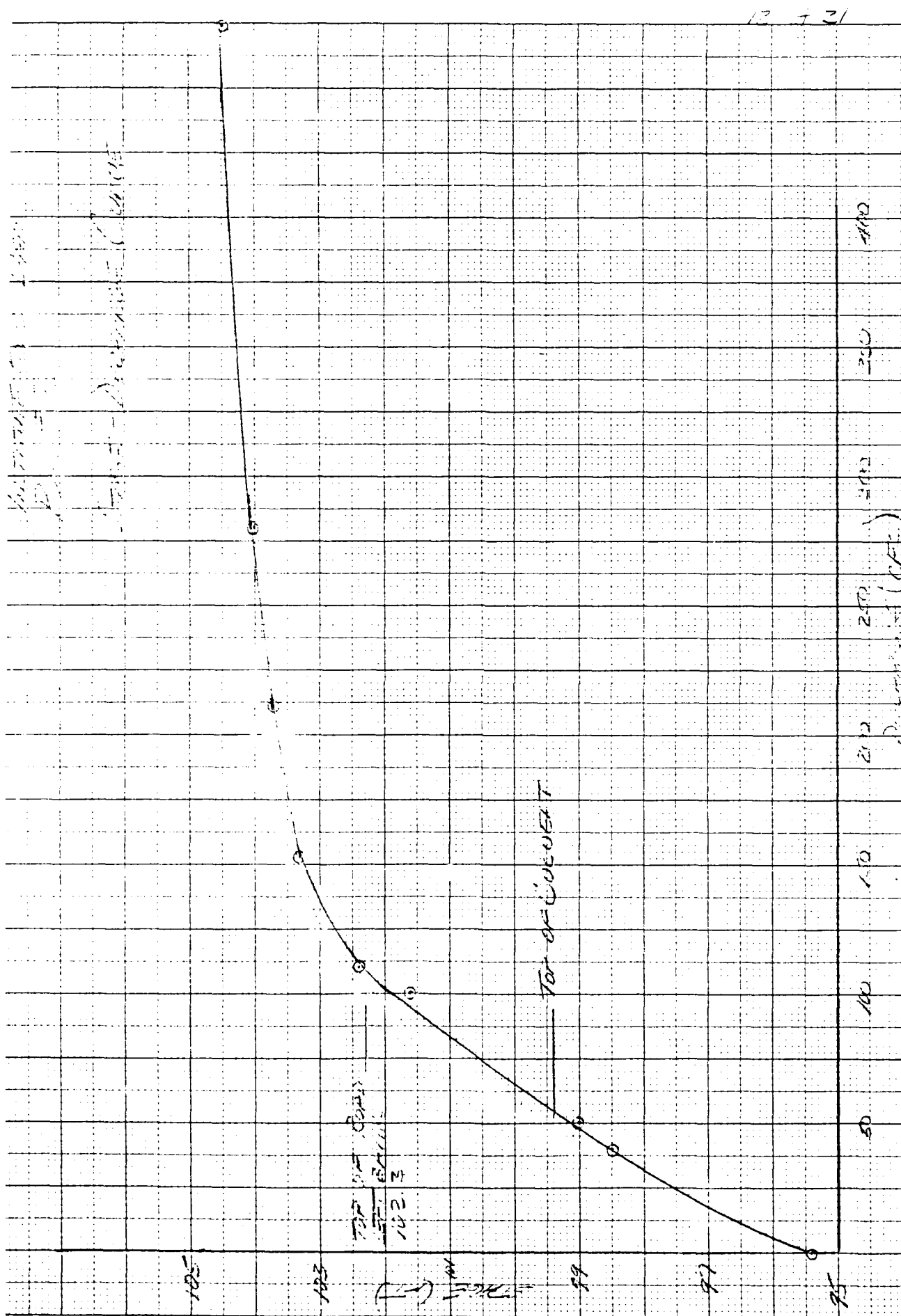
MEAN STREAM VELOCITY =
MAX. STREAM VELOCITY =

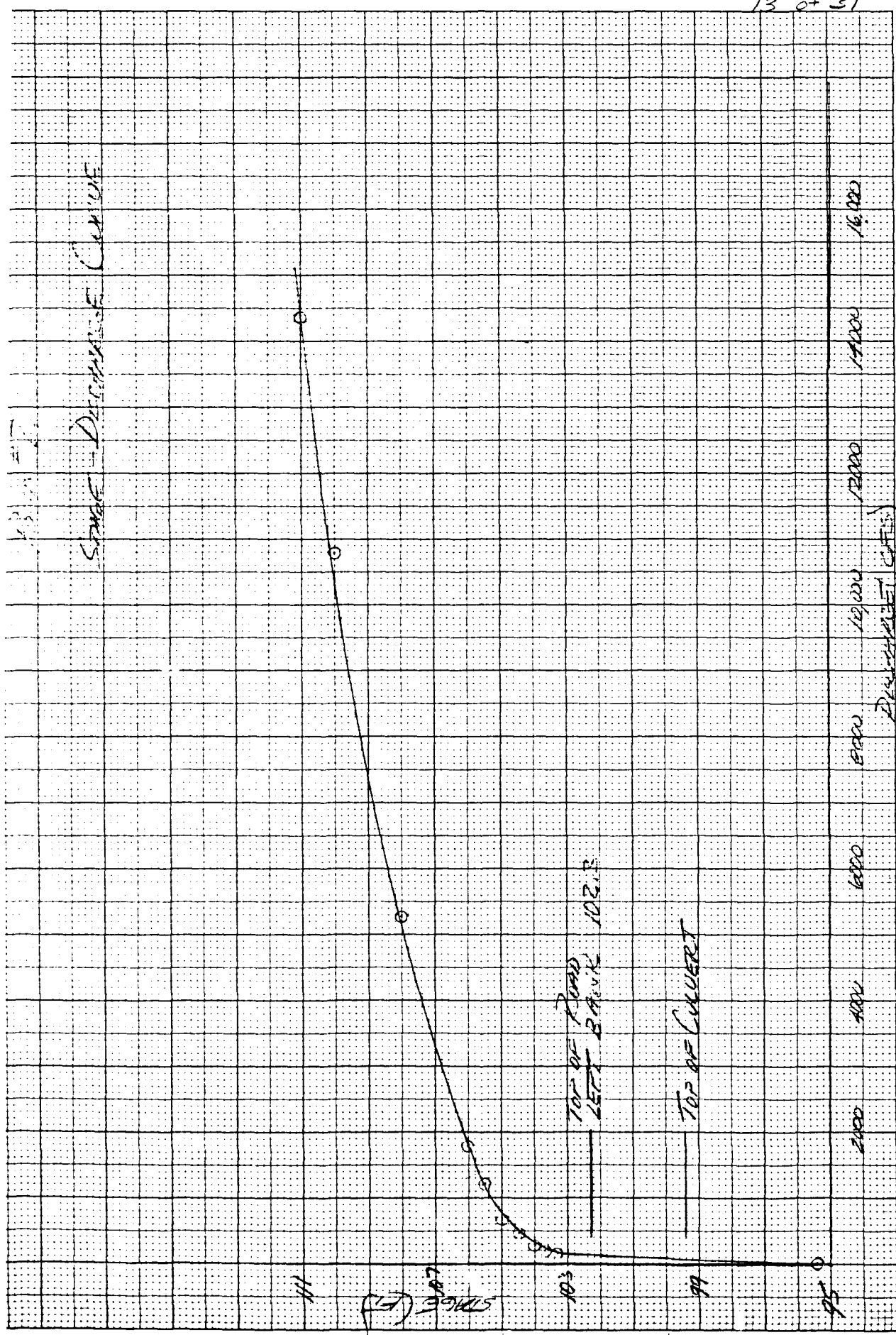
CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION											CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL						HW=H + h ₀ - LS ₀						
			HW D	HW	K ₀	H	d _c	d _c +D 2	TW	h ₀	LS ₀	HW					
C.M.P.	40	48"	1.53	3.1	2.5	1.46	1.9	2.95	1.2	2.95	0.3	3.1	3.1			93.5	
	50		1.53	3.3		0.15	2.25	3.13	2.4	3.12	0.3	3.6	3.6			99.0	
	100		1.46	5.9		3	3.0	3.5	3.1	3.1	0.3	6.2	6.2			101.6	
	110	↓	1.57	6.7	↓	3.7	3.1	3.6	3.2	3.2	0.3	7.0	7.0			101.4	

SUMMARY & RECOMMENDATIONS:

TW = THICKNESS, IN - 1/2 IN. FROM STAGE-DISCHARGE CURVE FOR PUMP #1

NOTE: COMPUTATIONS TAKEN FROM Hydraulic Computations for the Section of Highway Culverts, American Engineering Council, Inc.





90853

INSTITUTE POND POND

HEL-1 DATA

Sheet 14 of 31

Date 10-20-80

By GR Ch'k. by

WAGE AREA = 0.25 mi^2

RATES DATA TAKEN FROM DESIGN OF SMALL DAMS

DATA TAKEN FROM GENERAL SOILS MAP, CALEDONIA COUNTY, VT (NOV 1974)

SOIL - COLUMBIA

W - WOODCHUCK

N - GROUP C

SOIL - SOIL GROUP NOT LISTED, ASSUMED GROUP C

LAND IS 50% WOODCHUCK
50% PASTURE

LANDS (p 537)

REQUIRE 3 INCHES OF HEAD

FIG. A-2(a) HC = 3

FIG. A-2(b) CN = 72 (HYC-II)

PERCENT	CN	
50%	72	36.5
50%	79	39.5

25 (p 536) - FAIR CONDITION

CN = 79 (HYC-II)

CN = 76 FOR
INSTITUTE POND
WATERSHED

INITIAL ABSTRACTION = 0.63 IN. (p 543)

NET LOSS RATE = 0.12 "/hr (p 64)

DESIGN OF SMALL DAMS (p 48+49)

= $19.5 \text{ (GAL)} (10.71^2)$

= 100

= 111

120

AD-A157 627

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
INSTITUTE POND DAM (V. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV DEC 80

2/2

UNCLASSIFIED

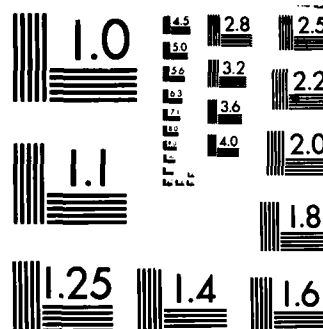
F/G 13/13

NL

END

Full text

BYU



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Job No. 90853
 Project INSTITUTE POND
 Subject HEC-1 DATA

Sheet 15 of 31
 Date 10-20-80
 By STK Ch'k. by _____

SYNDER METHOD

$$t_p = C_t (L L_{CA})^{0.3}$$

$$t_p = \text{lag time}$$

L = LENGTH OF MAIN WATERCOURSE TO
UPSTREAM LIMIT OF DRAINAGE AREA

L_{CA} = LENGTH ALONG MAIN WATERCOURSE TO POINT
OPPOSITE THE CENTROID OF THE
DRAINAGE BASIN = 0.66 MILES

C_t = SYNDER'S BASIN COEFFICIENT = 2.0 (ASSUMED AVERAGE)

C_p = SYNDER'S PEAKING COEFFICIENT = 0.63
(FROM CHOW'S HANDBOOK OF
APPLIED HYDROLOGY)

DATA TAKEN FROM U.S.G.S MAPS (SCALE 1:62500)

SUB-AREA FOR POND #2

DRAINAGE AREA = 0.23

L = 1.09 MILES

L_{CA} = 0.57 MILES

$$t_p = C_t (L L_{CA})^{0.3} \\ = 2.0 [(1.09)(0.57)]^{0.3}$$

t_p = 1.7 HRS.

$$\text{ALTERNATE } (t_p) = \frac{\text{FLOW LENGTH}}{\text{VELOCITY}} \\ = \frac{5752}{2}$$

t_p = 0.8

$$t_{p \text{ AVE}} = 0.8 + 1.7 / 2 = 1.25$$

SUB-AREA FOR POND #1

DRAINAGE AREA = 0.02

L = 0.05 MILES

L_{CA} = 0.025 MILES

$$t_p = 2.0 [(0.05)(0.025)]^{0.3} = 0.27 \text{ HRS}$$

$$\text{ALTERNATE } (t_p) = \frac{264 \text{ FT}}{0.5 \text{ FT/SEC}}$$

t_p = 0.15 HRS

$$t_{p \text{ AVE}} = 0.21 \text{ HR}$$

Job No. 90953 Sheet 16 of 31
 Project INSTITUTE POND DAM Date 10-30-80
 Subject HYDRAULICS - HYDROLOGY By RL Ch'k. by

SUMMARY OF BASIC DATA

INSTITUTE POND DAM

THE DAM IS LOCATED IN THE TOWN OF LYNDON, VERMONT

CLASSIFICATION

SIZE - SMALL (BASED UPON IMPOUNDMENT HEIGHT)

Hazard - HIGH (BASED ON 3 OR 4 RESIDENTIAL STRUCTURES
AND SCHOOL BUILDING IN THE
DOWNSTREAM AREA)

POND #1

NORMAL POOL ELEVATION - 96.0 FT
STORAGE - 13.2 AC-FT

MAXIMUM POOL ELEVATION - 100.5 FT
STORAGE - 19.4 AC-FT

POND #2

NORMAL POOL ELEVATION - 96.0 FT
STORAGE - 15.4 AC-FT

MAXIMUM POOL ELEVATION - 102.3 FT
STORAGE - 25.2 AC-FT

Job No. 70852 Sheet 17 of 31
Project INSTITUTE Pond Dam Date 10-30-80
Subject HYDRAULICS - HYDROLOGY By JK Ch'k. by

SUMMARY OF BASIC DATA

DAM - FOR POND #1 THE DAM IS EARTH FILL

FOR POND #2 THE ROAD EMBANKMENT ACTS
AS A DAM

OUTLET - FOR POND #1 - A CHUTE SPILLWAY IS USED
AS AN OUTLET

POND #2 - A 48" CIP CULVERT IS USED AS AN
OUTLET

INSTITUTE POND IS A SERIES OF TWO POND, THE PONDS
ARE SEPARATED BY A ROAD EMBANKMENT. THE TWO PONDS
ARE CONNECTED BY A 48 INCH CIP CULVERT UNDER THE
ROAD EMBANKMENT. INSTITUTE POND DAM IS LOCATED
ON THE POND DOWNSTREAM OF 48" CULVERT

Job No. 90853 Sheet 18 of 31
 Project INSTITUTE POND DAM Date 10-30-80
 Subject HYDRAULICS - HYDROLOGY By JK Ch'k. by

HEL-1 WAS USED TO CALCULATE THE DESIGN FLOOD FOR INSTITUTE POND DAM.

CLASSIFICATION

SIZE - SMALL

HAZARD - HIGH

DESIGN FLOOD

HYDROLOGIC EVALUATION GUIDELINES RECOMMENDS THE DESIGN FLOOD BE EITHER $\frac{1}{2}$ P1IF OF FULL P1IF.

SEE TABLE 1 FOR SUMMARY OF HEL-1 COMPUTER RUNS.

CONCLUSIONS

POND #1 + POND #2 STORAGE CAPABILITIES, DO NOT REDUCE THE DISCHARGE PEAKS FOR EITHER THE FULL P1IF OR THE $\frac{1}{2}$ P1IF.

THE SPILLWAY FOR POND #1 CAN ONLY PASS 30 SCFS BEFORE THE DAM OVERTOPS. THE 48" CIP CULVERT FOR POND #2 CAN ONLY PASS 10 SCFS BEFORE THE ROAD EMBANKMENT OVERTOPS.

THE P1IF DESIGN FLOOD WILL RESULT IN THE DAM FOR POND #1 BEING OVERTOPPED BY 0.7 FEET. POND #2 ROAD EMBANKMENT WILL BE OVERTOPPED BY 2.7 FEET FOR THE P1IF.

THE $\frac{1}{2}$ P1IF WILL RESULT IN THE DAM FOR POND #1 BEING OVERTOPPED BY 0.1 FEET. POND #2 ROAD EMBANKMENT WILL BE OVERTOPPED BY 2.0 FEET FOR THE $\frac{1}{2}$ P1IF.

Job No. 90822 Sheet 19 of 31
 Project INSTITUTE Pond Dam Date 10-30-80
 Subject Hydrology - Hydrology By JLK Ch'k. by

TABLE #1

TABLE #1

DESIGN STORMS	Pond #2		Pond #3		Pond #1		Pond #1	
	Pond Discharges (CFS)	Outflow (CFS)	Stage FT	Pond Discharges (CFS)	Conserved Storage (CFS)	Outflow (CFS)	Stage FT	Conserved Storage (CFS)
FULL PMF	692	692	105	94	726	726	101.2	
1/2 PMF	346	346	104.3	47	363	363	100.6	

RESULTS TAKEN FROM HEC-1 COMPUTER RUNS.

Job No. 10052Project INSTITUTE POND DAMSubject HYDRAULIC - HYDROLOGYSheet 20 of 31Date 10-27-80By SK Ch'k. by DAM FAILURE ANALYSISASSUMPTIONS

- 1) THE WATER LEVEL IN BOTH POND #1 + POND #2, IS AT TOP OF DAM, ELEVATION 100.5; JUST PRIOR TO DAM FAILURE. ALSO THE INITIAL STORAGE, JUST PRIOR TO DAM FAILURE WILL BE ASSUMED EQUAL TO THE COMBINED STORAGE OF BOTH PONDS.
- 2) THE DISCHARGE JUST PRIOR TO DAM FAILURE IS FULL SPILLWAY CAPACITY, 305 CFS.
- 3) BREACH WIDTH (W_b) IS EQUAL TO 40% OF EFFECTIVE DAM LENGTH APPROXIMATELY EQUAL TO 250 FEET,
 $W_b = 100$ FT.

POND DISCHARGE AT TIME OF DAM FAILURE

$$Q_p = 0.27 W_b \sqrt{g} y_o^{3/2}$$

 W_b = BREACH WIDTH g = ACCELERATION DUE TO GRAVITY y_o = TOTAL HEIGHT FROM LEVEL POOL (TOP OF DAM) TO THE DOWNSTREAM TOE OF THE DAM, 26 FT

$$Q_p = 0.27 (100) \sqrt{32.2} (26)^{3/2}$$

$$Q_p = 22,290 \text{ CFS}$$

DISCHARGE JUST PRIOR TO DAM FAILURE EQUAL 305 CFS.

TOTAL DISCHARGE WHEN DAM FAILS = $22,290 + 305 = 22,595$ CFS

Job No. 9853 Sheet 21 of 31
 Project INSTITUTE Pond Dam Date 10-28-80
 Subject HYDRAULIC - HYDROLOGY By SK Ch'k. by

DAM FAILURE ANALYSIS

DOWNSTREAM OF DAM, THE "RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS, AND STAGE-DISCHARGE CURVES DEVELOPED BY USING MANNINGS EQUATION, WILL BE UTILIZED TO DETERMINE THE EFFECTS ON THE FLOOD WAVE AS IT MOVE DOWNSTREAM. TYPICAL CROSS-SECTIONS TAKEN DURING THE FIELD INSPECTION AND FLOOD CONTOUR MAPS OBTAINED FROM THE VERMONT STATE HIGHWAY DEPARTMENT WILL BE USED IN CONJUNCTION WITH MANNINGS EQUATION TO DEVELOP THE STAGE-DISCHARGE CURVES.

MANNINGS EQUATION

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

"n" = COMPOSITE "n" VALUE

A = AREA

R = $\frac{A}{P}$

S = SLOPE OF REACH

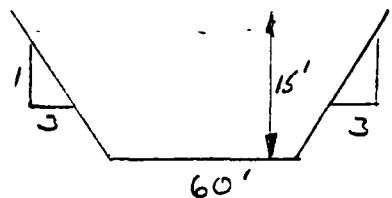
Job No. 90853
 Project INSTITUTE DAM POND
 Subject HYDRAULICS - HYDROLOGY

Sheet 22 of 31
 Date 10-28-80
 By CK Ch'k. by

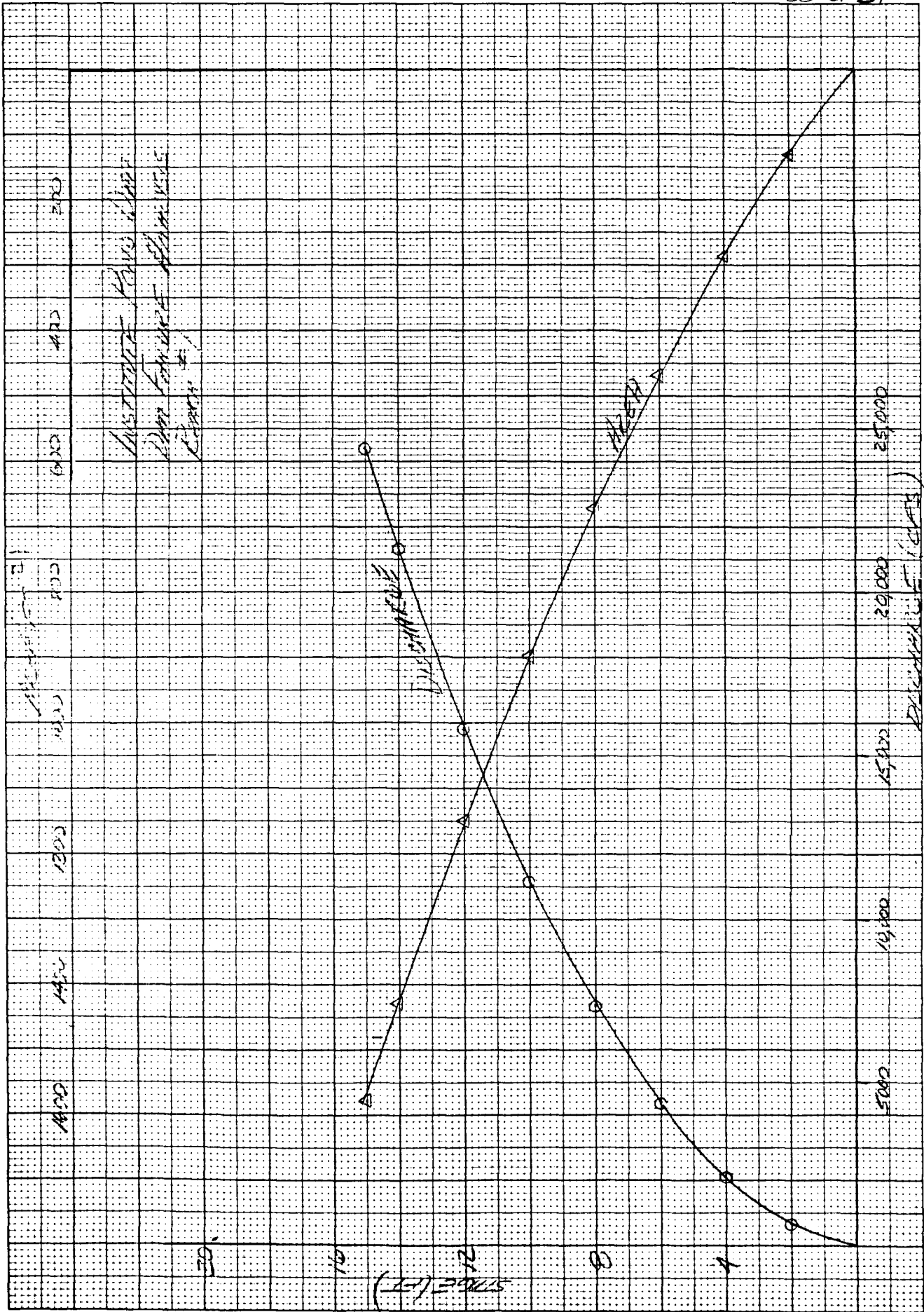
DAM FAILURE ANALYSIS

REXH #1

LENGTH 550 FT
 SLOPE = 0.024
 COMPOSITE "n" = 0.07
 $Q = 3.298 AR^{2/3}$



DEPTH	P_H	$R^{2/3}$	A_{LEFT}	Q
2	66.9	1.54	132	670
4	85.3	2.25	288	2139
6	97.9	2.84	468	4381
8	110.6	3.33	672	7384
10	123.2	3.77	900	11,180
12	135.9	4.16	1152	15,807
14	148.5	4.52	1428	21,309
15	154.9	4.69	1575	24,401



Job No. 90853

Sheet 24 of 31

Project INSTITUTE Pond Dam

Date 10-28-80

Subject HYDRAULICS - HYDROLOGY

By JK Ch'k. by _____

Dam Failure Analysis

Reach #2

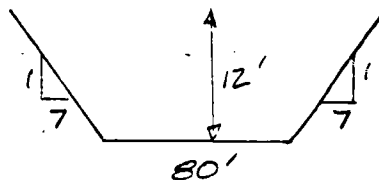
LENGTH = 600

SLOPE = 0.0059

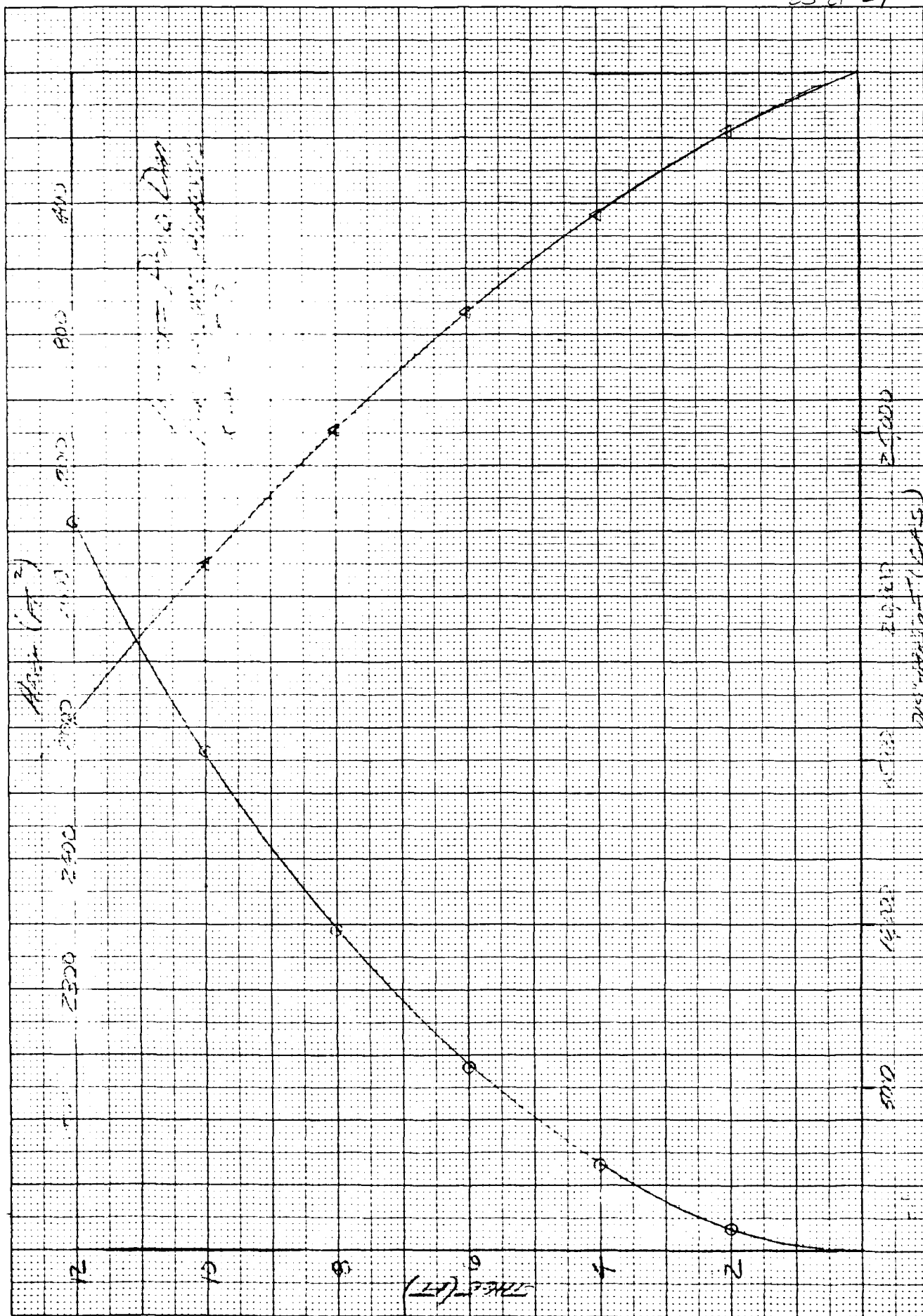
COMPOSITE "n" = 0.09

$$Q = \frac{1.49}{n} AK^{2/3} S^{1/2}$$

$$Q = 2.86 AK^{2/3}$$



DEPTH	P_w	$R^{3/2}$	A_{eff}	Q
2	108.3	1.4	180	723
4	136.6	2.16	432	2663
6	164.9	2.70	732	5659
8	193.1	3.17	1088	9857
10	221.4	3.58	1500	15,369
12	249.7	3.96	1968	22,306



Job No. 90552 Sheet 26 of 31
 Project INTEGRITY ROAD DIST. Date 10-29-80
 Subject HYDRAULICS - HYDROLOGY By JR Ch'k. by

DAM FAILURE ANALYSIS (CON'T)

BOX #3 LENGTH = 300 FT

BOX #3 INCLUDES THE CULVERT WHICH CRISSES
 TOWN HIGHWAY #122. THE CULVERT IS A CONCRETE-ARCH
 WHICH IS 8 FT X 6.5 FT (SPAN X RISE)

THE DISCHARGE THROUGH THE CULVERT AND OVER
 THE ROAD WILL BE CALCULATED TO OBTAIN STAGES
 FOR THIS VICINITY.

THE WEIR EQUATION(S) WILL BE USED TO MODELLED
 THE FLOW OVER THE ROAD.

$Q = CLH^{3/2}$ ASSUME $C = 2.5$
 EFFECTIVE WEIR LENGTH = 275 FT

$$Q = 687.5 H^{3/2}$$

H	Q	STAGE	DISCHARGES THROUGH THE CULVERT WILL BE APPROXIMATED FROM HYDRAULIC CHARTS (SEE FOLLOWING PAGE)
1	688	11.5	
2	1945	12.5	
3	3572	13.5	
4	5500	14.5	
5	7686	15.5	
6	10,104	16.5	

[illegible]

SUB-AREA RUNOFF COMPUTATION

INSTITUTE	POND	DAM	EL	RUNOFF	COMPS	JPLT	JPRT	INAME
ISTAQ	ICOMP	IECCN	ITAPE					
0	0	0	0	0	0	1	0	1

HYDROGRAPH DATA				PRECIP DATA				LOSS DATA											
IRYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL	STRKW	DLTKR	RTICL	ERAIN	STRKS	RTIOK	STRIL	CNSTL	ALSMX	RTIMP
1	1	.02	0.00	0.00	1.00	0.000	0	0	0	0.00	0.00	1.00	0.00	0.00	1.00	.63	.12	0.00	0.00
				R12 R24 W48 R72 R96															
				0.00 111.00 120.00 0.00 0.00 0.00															
				SPFE PMS R6															
				0.00 19.50 100.00															

UNIT HYDROGRAPH DATA
TP= .21 CP= .63 NTA= 0

RECESSION DATA
STRIO= 1.00 QRCN= -.10 RTIOH= 1.50
CLIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.58 AND R= .26 INTERVALS
UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .21 HOURS, CP= .63 VOL= 1.00
20. 34. 18. 5. 1. 0.

TIME	RAIA	EXCS	COMP
0	.02	0.00	1.
10	.02	0.00	1.
20	.02	0.00	1.
30	.02	0.00	1.
40	.02	0.00	1.
50	.02	0.00	1.
60	.02	0.00	1.
70	.02	0.00	1.
80	.02	0.00	1.
90	.02	0.00	1.
100	.02	0.00	1.
110	.02	0.00	1.
120	.02	0.00	1.
130	.02	0.00	1.
140	.02	0.00	1.
150	.02	0.00	1.
160	.02	0.00	1.
170	.02	0.00	1.
180	.02	0.00	1.
190	.02	0.00	1.
200	.02	0.00	1.
210	.02	0.00	1.
220	.02	0.00	1.
230	.02	0.00	1.
240	.02	0.00	1.
250	.02	0.00	1.
260	.02	0.00	1.
270	.02	0.00	1.
280	.02	0.00	1.
290	.02	0.00	1.
300	.02	0.00	1.
310	.02	0.00	1.
320	.02	0.00	1.
330	.02	0.00	1.
340	.02	0.00	1.
350	.02	0.00	1.
360	.02	0.00	1.
370	.02	0.00	1.
380	.02	0.00	1.
390	.02	0.00	1.
400	.02	0.00	1.
410	.02	0.00	1.
420	.02	0.00	1.
430	.02	0.00	1.
440	.02	0.00	1.
450	.02	0.00	1.
460	.02	0.00	1.
470	.02	0.00	1.
480	.02	0.00	1.
490	.02	0.00	1.
500	.02	0.00	1.
510	.02	0.00	1.
520	.02	0.00	1.
530	.02	0.00	1.
540	.02	0.00	1.
550	.02	0.00	1.
560	.02	0.00	1.
570	.02	0.00	1.
580	.02	0.00	1.
590	.02	0.00	1.
600	.02	0.00	1.
610	.02	0.00	1.
620	.02	0.00	1.
630	.02	0.00	1.
640	.02	0.00	1.
650	.02	0.00	1.
660	.02	0.00	1.
670	.02	0.00	1.
680	.02	0.00	1.
690	.02	0.00	1.
700	.02	0.00	1.
710	.02	0.00	1.
720	.02	0.00	1.
730	.02	0.00	1.
740	.02	0.00	1.
750	.02	0.00	1.
760	.02	0.00	1.
770	.02	0.00	1.
780	.02	0.00	1.
790	.02	0.00	1.
800	.02	0.00	1.
810	.02	0.00	1.
820	.02	0.00	1.
830	.02	0.00	1.
840	.02	0.00	1.
850	.02	0.00	1.
860	.02	0.00	1.
870	.02	0.00	1.
880	.02	0.00	1.
890	.02	0.00	1.
900	.02	0.00	1.
910	.02	0.00	1.
920	.02	0.00	1.
930	.02	0.00	1.
940	.02	0.00	1.
950	.02	0.00	1.
960	.02	0.00	1.
970	.02	0.00	1.
980	.02	0.00	1.
990	.02	0.00	1.
1000	.02	0.00	1.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	692.	416.	127.	127.	18228.
INCHES		16.83	20.48	20.48	20.48
AC-FT		206.	251.	251.	251.

1	0.01	0.01	0.01
2	0.01	0.01	0.01
3	0.01	0.01	0.01
4	0.01	0.01	0.01
5	0.01	0.01	0.01
6	0.01	0.01	0.01
7	0.01	0.01	0.01
8	0.01	0.01	0.01
9	0.01	0.01	0.01
10	0.01	0.01	0.01
11	0.01	0.01	0.01
12	0.01	0.01	0.01
13	0.01	0.01	0.01
14	0.01	0.01	0.01
15	0.01	0.01	0.01
16	0.01	0.01	0.01
17	0.01	0.01	0.01
18	0.01	0.01	0.01
19	0.01	0.01	0.01
20	0.01	0.01	0.01
21	0.01	0.01	0.01
22	0.01	0.01	0.01
23	0.01	0.01	0.01
24	0.01	0.01	0.01
25	0.01	0.01	0.01
26	0.01	0.01	0.01
27	0.01	0.01	0.01
28	0.01	0.01	0.01
29	0.01	0.01	0.01
30	0.01	0.01	0.01
31	0.01	0.01	0.01
32	0.01	0.01	0.01
33	0.01	0.01	0.01
34	0.01	0.01	0.01
35	0.01	0.01	0.01
36	0.01	0.01	0.01
37	0.01	0.01	0.01
38	0.01	0.01	0.01
39	0.01	0.01	0.01
40	0.01	0.01	0.01
41	0.01	0.01	0.01
42	0.01	0.01	0.01
43	0.01	0.01	0.01
44	0.01	0.01	0.01
45	0.01	0.01	0.01
46	0.01	0.01	0.01
47	0.01	0.01	0.01
48	0.01	0.01	0.01
49	0.01	0.01	0.01
50	0.01	0.01	0.01
51	0.01	0.01	0.01
52	0.01	0.01	0.01
53	0.01	0.01	0.01
54	0.01	0.01	0.01
55	0.01	0.01	0.01
56	0.01	0.01	0.01
57	0.01	0.01	0.01
58	0.01	0.01	0.01
59	0.01	0.01	0.01
60	0.01	0.01	0.01

SUM 23.40 20.52 18551.

CFS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
INCHES	692.	418.	129.	129.	18553.
AC-FT		16.92	20.84	20.84	20.84
		208.	256.	256.	256.

HYDROGRAPH ROUTING

ROUTING THRU	48 IN.	CMP CULVERT				
ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	1
		ROUTING DATA				
	GLOSS	CLOSS	AVG	IRES	ISAME	
	0.0	0.000	0.00	1	0	
NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	0.	2.	6.	10.	11.	12.	13.	14.	15.	16.
OUTFLC=	0.	19.	58.	105.	133.	223.	432.	850.	1350.	2500.

TIME	EOP	STOR	AVG	IN	EOP	OUT
00	0.	0.	1.	1.	1.	1.
05	0.	0.	1.	1.	1.	1.
10	0.	0.	1.	1.	1.	1.
15	0.	0.	1.	1.	1.	1.
20	0.	0.	1.	1.	1.	1.
25	0.	0.	1.	1.	1.	1.
30	0.	0.	1.	1.	1.	1.
35	0.	0.	1.	1.	1.	1.
40	0.	0.	1.	1.	1.	1.
45	0.	0.	1.	1.	1.	1.
50	0.	0.	1.	1.	1.	1.
55	0.	0.	1.	1.	1.	1.
60	0.	0.	1.	1.	1.	1.
65	0.	0.	1.	1.	1.	1.
70	0.	0.	1.	1.	1.	1.
75	0.	0.	1.	1.	1.	1.
80	0.	0.	1.	1.	1.	1.
85	0.	0.	1.	1.	1.	1.
90	0.	0.	1.	1.	1.	1.
95	0.	0.	1.	1.	1.	1.
100	0.	0.	1.	1.	1.	1.
105	0.	0.	1.	1.	1.	1.
110	0.	0.	1.	1.	1.	1.
115	0.	0.	1.	1.	1.	1.
120	0.	0.	1.	1.	1.	1.
125	0.	0.	1.	1.	1.	1.
130	0.	0.	1.	1.	1.	1.
135	0.	0.	1.	1.	1.	1.
140	0.	0.	1.	1.	1.	1.
145	0.	0.	1.	1.	1.	1.
150	0.	0.	1.	1.	1.	1.
155	0.	0.	1.	1.	1.	1.
160	0.	0.	1.	1.	1.	1.
165	0.	0.	1.	1.	1.	1.
170	0.	0.	1.	1.	1.	1.
175	0.	0.	1.	1.	1.	1.
180	0.	0.	1.	1.	1.	1.
185	0.	0.	1.	1.	1.	1.
190	0.	0.	1.	1.	1.	1.
195	0.	0.	1.	1.	1.	1.
200	0.	0.	1.	1.	1.	1.
205	0.	0.	1.	1.	1.	1.
210	0.	0.	1.	1.	1.	1.
215	0.	0.	1.	1.	1.	1.
220	0.	0.	1.	1.	1.	1.
225	0.	0.	1.	1.	1.	1.
230	0.	0.	1.	1.	1.	1.
235	0.	0.	1.	1.	1.	1.
240	0.	0.	1.	1.	1.	1.
245	0.	0.	1.	1.	1.	1.
250	0.	0.	1.	1.	1.	1.
255	0.	0.	1.	1.	1.	1.
260	0.	0.	1.	1.	1.	1.
265	0.	0.	1.	1.	1.	1.
270	0.	0.	1.	1.	1.	1.
275	0.	0.	1.	1.	1.	1.
280	0.	0.	1.	1.	1.	1.
285	0.	0.	1.	1.	1.	1.
290	0.	0.	1.	1.	1.	1.
295	0.	0.	1.	1.	1.	1.
300	0.	0.	1.	1.	1.	1.
305	0.	0.	1.	1.	1.	1.
310	0.	0.	1.	1.	1.	1.
315	0.	0.	1.	1.	1.	1.
320	0.	0.	1.	1.	1.	1.
325	0.	0.	1.	1.	1.	1.
330	0.	0.	1.	1.	1.	1.
335	0.	0.	1.	1.	1.	1.
340	0.	0.	1.	1.	1.	1.
345	0.	0.	1.	1.	1.	1.
350	0.	0.	1.	1.	1.	1.
355	0.	0.	1.	1.	1.	1.
360	0.	0.	1.	1.	1.	1.
365	0.	0.	1.	1.	1.	1.
370	0.	0.	1.	1.	1.	1.
375	0.	0.	1.	1.	1.	1.
380	0.	0.	1.	1.	1.	1.
385	0.	0.	1.	1.	1.	1.
390	0.	0.	1.	1.	1.	1.
395	0.	0.	1.	1.	1.	1.
400	0.	0.	1.	1.	1.	1.
405	0.	0.	1.	1.	1.	1.
410	0.	0.	1.	1.	1.	1.
415	0.	0.	1.	1.	1.	1.
420	0.	0.	1.	1.	1.	1.
425	0.	0.	1.	1.	1.	1.
430	0.	0.	1.	1.	1.	1.
435	0.	0.	1.	1.	1.	1.
440	0.	0.	1.	1.	1.	1.
445	0.	0.	1.	1.	1.	1.
450	0.	0.	1.	1.	1.	1.
455	0.	0.	1.	1.	1.	1.
460	0.	0.	1.	1.	1.	1.
465	0.	0.	1.	1.	1.	1.
470	0.	0.	1.	1.	1.	1.
475	0.	0.	1.	1.	1.	1.
480	0.	0.	1.	1.	1.	1.
485	0.	0.	1.	1.	1.	1.
490	0.	0.	1.	1.	1.	1.
495	0.	0.	1.	1.	1.	1.
500	0.	0.	1.	1.	1.	1.
505	0.	0.	1.	1.	1.	1.
510	0.	0.	1.	1.	1.	1.
515	0.	0.	1.	1.	1.	1.
520	0.	0.	1.	1.	1.	1.
525	0.	0.	1.	1.	1.	1.
530	0.	0.	1.	1.	1.	1.
535	0.	0.	1.	1.	1.	1.
540	0.	0.	1.	1.	1.	1.
545	0.	0.	1.	1.	1.	1.
550	0.	0.	1.	1.	1.	1.
555	0.	0.	1.	1.	1.	1.
560	0.	0.	1.	1.	1.	1.
565	0.	0.	1.	1.	1.	1.
570	0.	0.	1.	1.	1.	1.
575	0.	0.	1.	1.	1.	1.
580	0.	0.	1.	1.	1.	1.
585	0.	0.	1.	1.	1.	1.
590	0.	0.	1.	1.	1.	1.
595	0.	0.	1.	1.	1.	1.
600	0.	0.	1.	1.	1.	1.
605	0.	0.	1.	1.	1.	1.
610	0.	0.	1.	1.	1.	1.
615	0.	0.	1.	1.	1.	1.
620	0.	0.	1.	1.	1.	1.
625	0.	0.	1.	1.	1.	1.
630	0.	0.	1.	1.	1.	1.
635	0.	0.	1.	1.	1.	1.
640	0.	0.	1.	1.	1.	1.
645	0.	0.	1.	1.	1.	1.
650	0.	0.	1.	1.	1.	1.
655	0.	0.	1.	1.	1.	1.
660	0.	0.	1.	1.	1.	1.
665	0.	0.	1.	1.	1.	1.
670	0.	0.	1.	1.	1.	1.
675	0.	0.	1.	1.	1.	1.
680	0.	0.	1.	1.	1.	1.
685	0.	0.	1.	1.	1.	1.
690	0.	0.	1.	1.	1.	1.
695	0.	0.	1.	1.	1.	1.
700	0.	0.	1.	1.	1.	1.
705	0.	0.	1.	1.	1.	1.
710	0.	0.	1.	1.	1.	1.
715	0.	0.	1.	1.	1.	1.
720	0.	0.	1.	1.	1.	1.
725	0.	0.	1.	1.	1.	1.
730	0.	0.	1.	1.	1.	1.
735	0.	0.	1.	1.	1.	1.
740	0.	0.	1.	1.	1.	1.
745	0.	0.	1.	1.	1.	1.
750	0.	0.	1.	1.	1.	1.
755	0.	0.	1.	1.	1.	1.
760	0.	0.	1.	1.	1.	1.
765	0.	0.	1.	1.	1.	1.
770	0.	0.	1.	1.	1.	1.
775	0.	0.	1.	1.	1.	1.
780	0.	0.	1.	1.	1.	1.
785	0.	0.	1.	1.	1.	1.
790	0.	0.	1.	1.	1.	1.
795	0.	0.	1.	1.	1.	1.
800	0.	0.	1.	1.	1.	1.
805	0.	0.	1.	1.	1.	1.
810	0.	0.	1.	1.	1.	1.
815	0.	0.	1.	1.	1.	1.
820	0.	0.	1.	1.	1.	1.
825	0.	0.	1.	1.	1.	1.
830	0.	0.	1.	1.	1.	1.
835	0.	0.	1.	1.	1.	1.
840	0.	0.	1.	1.	1.	1.
845	0.	0.	1.	1.	1.	1.
850	0.	0.	1.	1.	1.	1.
855	0.	0.	1.	1.	1.	1.
860	0.	0.	1.	1.	1.	1.
865	0.	0.	1.	1.	1.	1.
870	0.	0.	1.	1.	1.	1.
875	0.	0.	1.	1.	1.	1.
880	0.	0.	1.	1.	1.	1.
885	0.	0.	1.	1.	1.	1.
890	0.	0.	1.	1.	1.	1.
895	0.	0.	1.	1.	1.	1.

MEC-1 VERSION DATED JAN 1973
 UPDATED AUG 74
 CHANGE NO. 01

INSTITUTE POND DAM U.S. ARMY CORPS OF ENGINEERS
 LYNDON VERMONT 1980
 DESIGN STORM

JOB SPECIFICATION
 NO NHR NMN IDAY IFR IMIN METRC IPLT IPRT NSTAN
 144 0 10 1 0 0 0 2 0 0
 JOPER 3 NWT 0

SUB-AREA RUNOFF COMPUTATION

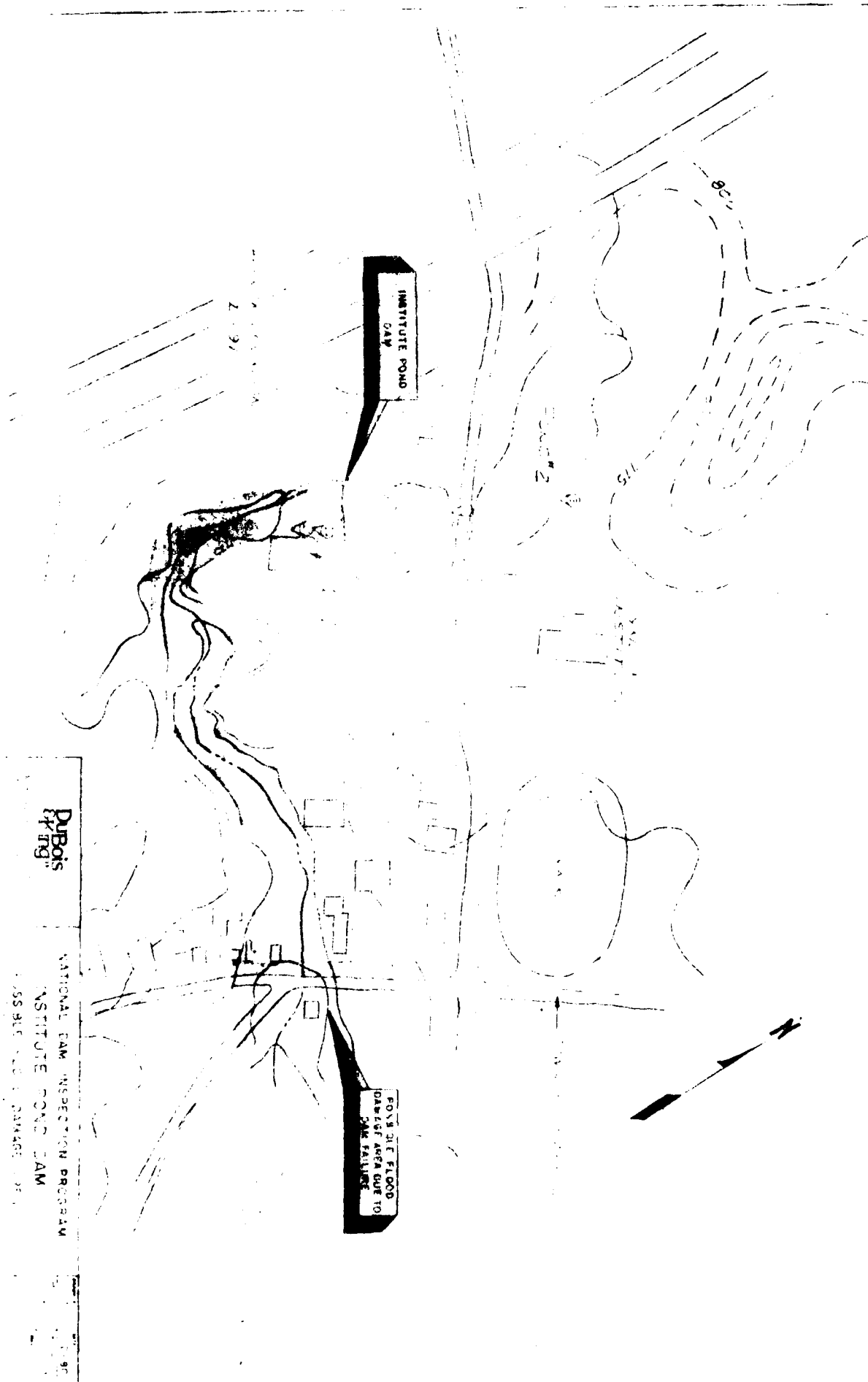
INSTITUTE POND E2		RUNOFF COMPS		ITAPE		JPLT	JPRT	INAME
ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME		
0	0	0	0	0	1	0	1	
HYDROGRAPH DATA								
IHYDG	IUNG	TAPEA	SNAP	TRSDA	TRSHC	RATIO	ISNOW	ISAME
1	1	.23	0.00	0.00	1.00	0.000	0	0
PRECIP DATA								
SPFE	PMS	P6	R12	R24	R48	R72	R96	
0.00	19.50	100.00	111.00	120.00	0.00	0.00	0.00	
LOSS DATA								
STRKH	DLTKR	RTICL	ERAIN	STRKS	WTIOK	STRTL	CNSTL	ALSMX
0.00	0.00	1.00	0.00	0.00	1.00	.63	.12	0.00
UNIT HYDROGRAPH DATA								
TP=	1.25	CP=	.63	NTA=	0			

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.66 AND R= 6.76 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORIGINATES, LAG= 1.26 HOURS, CP= .64 VOL= 1.00

3.	13.	25.	39.	54.	66.	73.	76.	73.	65.
56.	48.	41.	36.	31.	27.	23.	20.	17.	15.
13.	11.	9.	8.	7.	6.	5.	4.	4.	3.
1.	2.	2.	2.	2.	1.	1.	1.	1.	1.

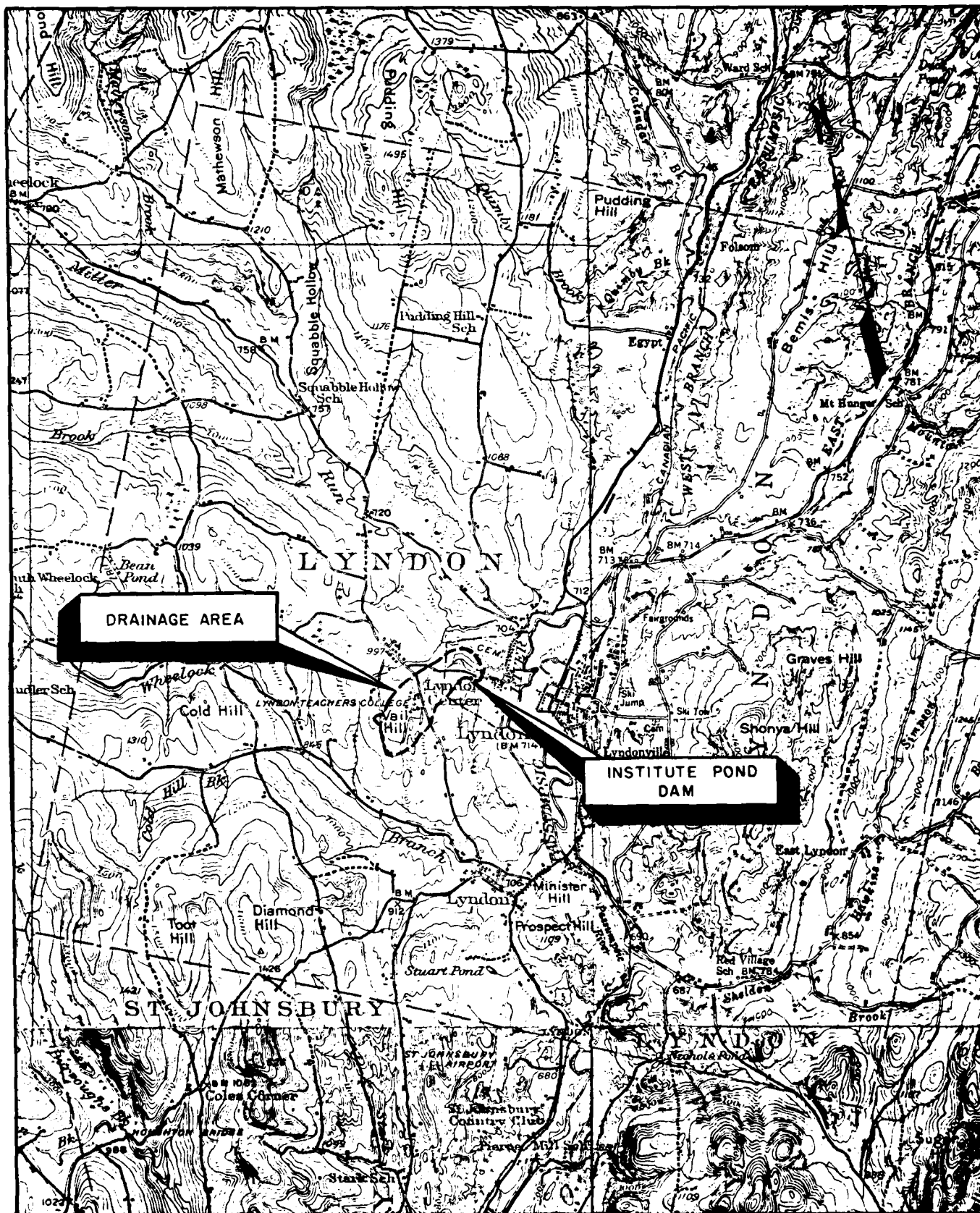
TIME	END-OF-PERIOD FLOW	COMP Q
	RAIN	EXCS
0 10	.02	0.00
0 20	.02	0.00
0 30	.02	0.00
0 40	.02	0.00
0 50	.02	0.00
0 60	.02	0.00
1 10	.02	0.00
1 20	.02	0.00
1 30	.02	0.00
1 40	.02	0.00
1 50	.02	0.00
2 00	.02	0.00
2 10	.02	0.00
2 20	.02	0.00
2 30	.02	0.00
2 40	.02	0.00
2 50	.02	0.00
3 00	.02	0.00
3 10	.02	0.00
3 20	.02	0.00
3 30	.02	0.00
3 40	.02	0.00
3 50	.02	0.00
4 00	.02	0.00
4 10	.02	0.00
4 20	.02	0.00
4 30	.02	0.00
4 40	.02	0.00
4 50	.02	0.00
5 00	.02	0.00
5 10	.02	0.00



DuBois
Spring

NATIONAL DAM INSPECTION PROGRAM
INSTITUTE POND DAM
POSSIBLE CAUSE OF DAMAGE

1990



**DuBois
& King^{INC}**

engineering and environmental services
RANDOLPH VERMONT CONCORD NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

INSTITUTE POND DAM

DRAINAGE AREA

USGS QUAD — LYNDONVILLE, VT

DRAWN BY	SJT	DATE	12-80
CHECKED BY	CJK	PROJ NO	90853
PROJ ENG		DRAW NO	
SCALE: 1"=62500'			

Job No. 90852 Sheet 30 of 31
 Project INSTITUTE ROAD Dm. Date 10-30-80
 Subject HAZARDOUS - HAZARDOUS By Ch'k. by

DRAIN FAILURE ANALYSIS

REACH #3 LENGTH = 300 FT

BRUSH $Q_{P3} = 8749$ CFS $\rightarrow$ STAGE = 15.8 FT

W_{STAGE} AT 15.8 FT $\rightarrow$ AREA = 2420 ft^2 $\rightarrow$ VOLUME = 16.7K-FT

BRUSH $Q_{P4} = 8749(1 - \frac{16.7}{41.3}) = 5211$ CFS $\rightarrow$ STAGE = 14.3 FT

W_{STAGE} AT 14.3 FT $\rightarrow$ AREA = 2090 ft^2 $\rightarrow$ VOLUME = 14.4K-FT

BRUSH $Q_{P4} = 8749(1 - \frac{15.8+14.4}{2 \cdot 41.3}) = 5455$ $\rightarrow$ STAGE = 14.4 FT

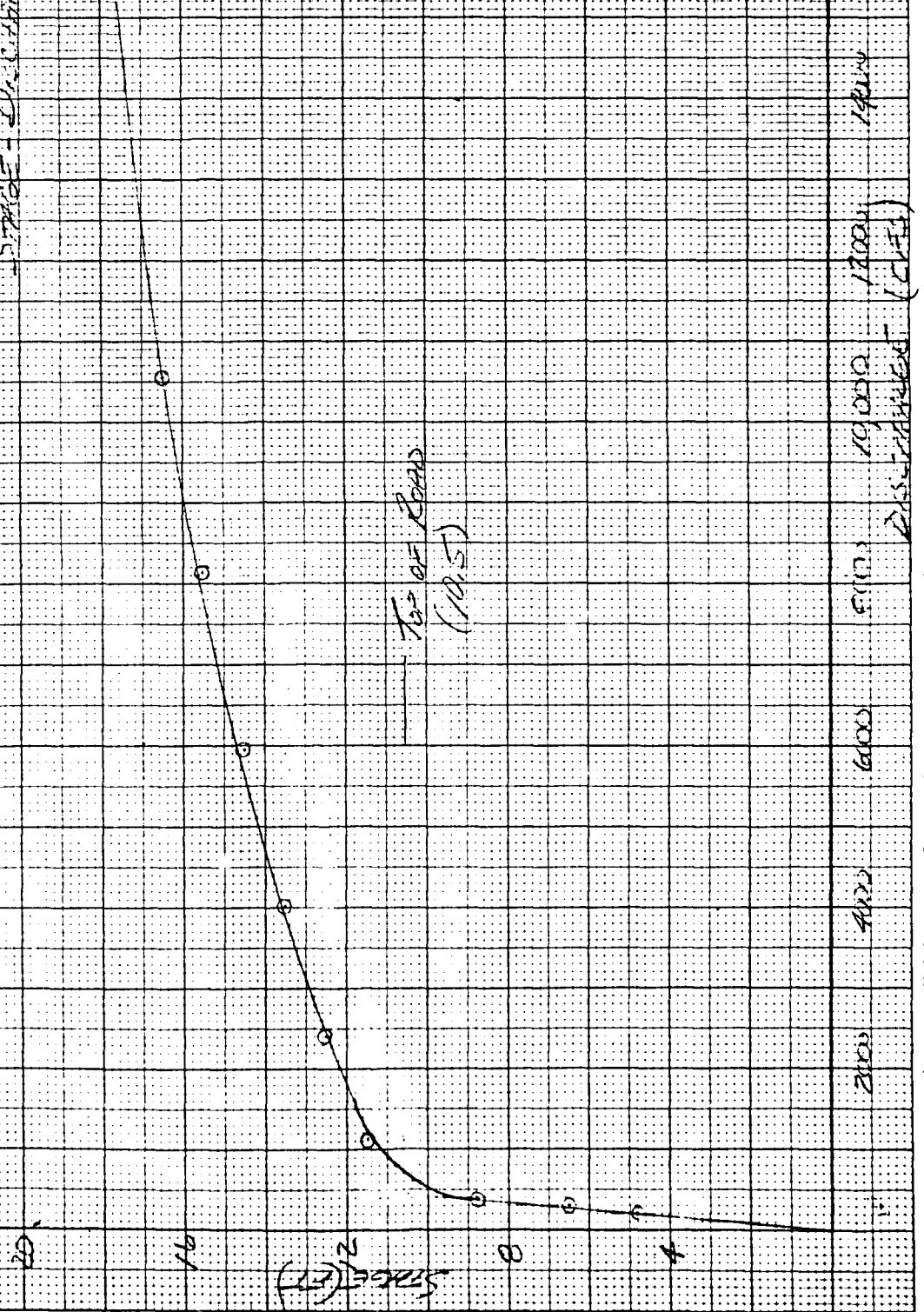
STAGE OF FLOOD WAVE IN REACH #3 = 14.4 FT

STAGE PRIOR TO FLOOD WAVE IN REACH #3 = 7.9 FT

THE STAGE IN REACH #3 INCREASES DUE TO THE CULVERT UNDER TOWN HIGHWAY #122, WHICH SIMULATES A DAM TYPE STRUCTURE. THE STAGE IN THE VICINITY OF TOWN HIGHWAY #122 WAS CALCULATED TO BE 3.9 FT OVER THE ROAD. DOWNSTREAM OF THE CULVERT THE AREA IS UNINHABITED, AND REMAINS UNINHABITED UNTIL REACHING THE PASSUMPSIC RIVER.

Job No. 90853Project INSTITUTE Pond DamSubject HIDALGO'S - HYDROLOGYSheet 29 of 31Date 10-30-80By CK Ch'k. by DAM FAILURE ANALYSIS (CONT)RENCH #1 LENGTH 50 FTRENCH Q_{P1} = 22,595 CFS $\rightarrow$ STAGE = 14.4 FTW/STAGE AT 14.4 FT $\rightarrow$ AREA = 1480 FT² $\rightarrow$ VOLUME = 18.6 AC-FTRENCH Q_{P2} (TRUNC) = 22,595 $(1 - \frac{18.6}{41.3})$ = 12,419 $\rightarrow$ STAGE = 10.6 FTW/STAGE AT 10.6 FT $\rightarrow$ AREA = 975 FT² $\rightarrow$ VOLUME = 12.3 AC-FTRENCH Q_{P2} = 22,595 $(1 - \frac{18.6 + 12.3/2}{41.3})$ = 14,142 CFSSTAGE OF FLOOD WAVE IN RENCH #1 = 11.3 FTSTAGE PRIOR TO FLOOD WAVE IN RENCH #1 = 1.1 FTRENCH #2 LENGTH = 600RENCH Q_{P1} = 14,142 CFS $\rightarrow$ STAGE 9.6 FTW/STAGE AT 9.6 FT $\rightarrow$ AREA = 1420 FT² $\rightarrow$ VOLUME = 19.6 AC-FTRENCH Q_{P2} (TRUNC) = 14,142 $(1 - \frac{19.6}{41.3})$ = 7431 CFS $\rightarrow$ STAGE 6.8 FTW/STAGE AT 6.8 FT $\rightarrow$ AREA = 870 FT² $\rightarrow$ VOLUME = 11.9 AC-FTRENCH Q_{P2} = 14,142 $(1 - \frac{19.6 + 11.9/2}{41.3})$ = 8749 CFSSTAGE OF FLOOD WAVE IN RENCH #2 = 7.5 FTSTAGE PRIOR TO FLOOD WAVE IN RENCH #2 = 1.4 FT

WATER FLOW AND
STAGE - DISCHARGE CURVE



PROJECT: INSTITUTE ROAD 2000

DESIGNER: _____

DATE: 10-29-80

REACH = 3

STATION: _____

SKETCH

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

Q₁ = _____ TW₁ = _____

Q₂ = _____ TW₂ = _____

(Q₁ = DESIGN DISCHARGE, SAY Q₂₅
Q₂ = CHECK DISCHARGE, SAY Q₅₀ OR Q₁₀₀)

CONCRETE CULVERT

BMTX 5.5 FT

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
			INLET CONT.		OUTLET CONTROL						HW - LS ₀						
			HW/D	HW	K ₀	H	d _c	d _c +D/2	TW	h ₀	LS ₀	HW					
	50		0.4	2.1	0.5												
	100		0.59	3.1													
	200		0.91	4.8		0.9	3.3	4.4				4.4	2.5	2.8	4.8		
	300		1.24	6.5		2	3.6	4.7				4.7	2.6	4.2	6.5		
	400		1.68	8.8		3.6	4.5	5				5	2.5	6.1	8.8		TOP OF ROAD 9.5 FT
	500		2.25	11.8		5.05	4.8	5.2				5.2	2.5	8.5	11.8		
	600		3.0	15.8		8.3	5.2	5.4				5.4	2.5	11.2	15.8		

SUMMARY & RECOMMENDATIONS:

NOTE: WITHIN THE EXACT DIMENSIONS OF THE CULVERT VARIED SLIGHTLY IN THE CHARTS USED FOR COMPUTATIONS, THE DIMENSIONS AND STAGES ARE WITHIN THE ACCURACY NEEDED.

NOTE: COMPUTATIONS TAKEN FROM HYDRAULIC CHARTS AND THE SECTION OF HIGHWAY CURVE, HYDRAULIC ENGINEERING CIRCULAR NO. 5.

Figure 7

COMBINING FLOWS INSTITUTE POND #1 AND POND #2 JPRY INAME
ISTAG ICOMP IECCN ITAPE JPLT
0 2 0 0 1 0

Figure 1 consists of five sub-graphs labeled (a) through (e), each showing the percentage of correct responses for a different group across five conditions. The y-axis for all graphs represents the percentage of correct responses, ranging from 0 to 100. The x-axis represents five conditions, labeled 1 through 5. The data points are represented by different symbols for each group: (a) 100% correct (solid circles), (b) 90% correct (open circles), (c) 80% correct (solid squares), (d) 70% correct (open squares), and (e) 60% correct (solid triangles). The graphs show that the percentage of correct responses generally increases from condition 1 to condition 5, with the highest performance (100%) achieved in condition 5 for all groups.

ROUTING THRU PRIMARY SPILLWAY AT POND #1 JPLT JHPT INAME
ISTAQ ICOMP IECON ITAPE 0 0 1
0 1 0 0

TIME	EOP	STOP	AVG	IN	EOP	OUT
00	10	00.		2.	2.	2.
00	20	00.		2.	2.	2.
00	30	00.		2.	2.	2.
00	40	00.		2.	2.	2.
00	50	00.		2.	2.	2.
00	60	00.		2.	2.	2.
00	70	00.		2.	2.	2.
00	80	00.		2.	2.	2.
00	90	00.		2.	2.	2.
00	100	00.		2.	2.	2.
00	110	00.		2.	2.	2.
00	120	00.		2.	2.	2.
00	130	00.		2.	2.	2.
00	140	00.		2.	2.	2.
00	150	00.		2.	2.	2.
00	160	00.		2.	2.	2.
00	170	00.		2.	2.	2.
00	180	00.		2.	2.	2.
00	190	00.		2.	2.	2.
00	200	00.		2.	2.	2.
00	210	00.		2.	2.	2.
00	220	00.		2.	2.	2.
00	230	00.		2.	2.	2.
00	240	00.		2.	2.	2.
00	250	00.		2.	2.	2.
00	260	00.		2.	2.	2.
00	270	00.		2.	2.	2.
00	280	00.		2.	2.	2.
00	290	00.		2.	2.	2.
00	300	00.		2.	2.	2.
00	310	00.		2.	2.	2.
00	320	00.		2.	2.	2.
00	330	00.		2.	2.	2.
00	340	00.		2.	2.	2.
00	350	00.		2.	2.	2.
00	360	00.		2.	2.	2.
00	370	00.		2.	2.	2.
00	380	00.		2.	2.	2.
00	390	00.		2.	2.	2.
00	400	00.		2.	2.	2.
00	410	00.		2.	2.	2.
00	420	00.		2.	2.	2.
00	430	00.		2.	2.	2.
00	440	00.		2.	2.	2.
00	450	00.		2.	2.	2.
00	460	00.		2.	2.	2.
00	470	00.		2.	2.	2.
00	480	00.		2.	2.	2.
00	490	00.		2.	2.	2.
00	500	00.		2.	2.	2.
00	510	00.		2.	2.	2.
00	520	00.		2.	2.	2.
00	530	00.		2.	2.	2.
00	540	00.		2.	2.	2.
00	550	00.		2.	2.	2.
00	560	00.		2.	2.	2.
00	570	00.		2.	2.	2.
00	580	00.		2.	2.	2.
00	590	00.		2.	2.	2.
00	600	00.		2.	2.	2.
00	610	00.		2.	2.	2.
00	620	00.		2.	2.	2.
00	630	00.		2.	2.	2.
00	640	00.		2.	2.	2.
00	650	00.		2.	2.	2.
00	660	00.		2.	2.	2.
00	670	00.		2.	2.	2.
00	680	00.		2.	2.	2.
00	690	00.		2.	2.	2.
00	700	00.		2.	2.	2.
00	710	00.		2.	2.	2.
00	720	00.		2.	2.	2.
00	730	00.		2.	2.	2.
00	740	00.		2.	2.	2.
00	750	00.		2.	2.	2.
00	760	00.		2.	2.	2.
00	770	00.		2.	2.	2.
00	780	00.		2.	2.	2.
00	790	00.		2.	2.	2.
00	800	00.		2.	2.	2.
00	810	00.		2.	2.	2.
00	820	00.		2.	2.	2.
00	830					

 MEC-1 VERSION DATED JAN 1973
 UPDATED AUG 74
 CHANGE NO. 01

INSTITUTE POND DAM U.S. ARMY CORPS OF ENGINEERS
 LYNDON, VERMONT 1980
 DESIGN STORM

JOB SPECIFICATION
 NO NHR NMN IDAY IHR IMIN METHC IPLI IPRT NSTAN
 144 0 10 1 0 0 0 2 0 0
 JOPER 3 NWT 0

***** SUB-AREA RUNOFF COMPUTATION *****

INSTITUTE POND E2 RUNOFF COMPS
 ISTAG 0 ICOMP 0 IECCN 0 ITAPE 0 JPLI 1 JPRT 0 INAME 1

HYDROGRAPH DATA		PRECIP DATA		LOSS DATA		RATIO		ISNOW		ISAME		LOCAL	
IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	R12	R24	R48	R72	R96	STKR	DLTKR	RTIOL
1	1	.23	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SPFE	PMS	R6	R12	R24	R48	R72	R96						
0.00	19.50	100.00	111.00	120.00	0.00	0.00	0.00						
STKR	DLTKR	RTIOL	ERAIN	STKRS	RTIOL	STRTL	CNSTL	ALSMX	RTIMP				
0.00	0.00	1.00	0.00	0.00	1.00	.63	.12	0.00	0.00				

UNIT HYDROGRAPH DATA
 TP= 1.25 CP= .63 NTA= 0

RECESSION DATA
 STRIQ= 1.00 ORCSN= -.10 RTIOR= 1.50
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDES CP AND TP ARE TC= 8.66 AND R= 6.76 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAG= 1.26 HOURS, CP= .64 VOL= 1.00

3.	13.	25.	39.	54.	66.	73.	76.	73.	65.
56.	48.	41.	36.	31.	27.	23.	20.	17.	15.
13.	11.	9.	8.	7.	6.	5.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.									

TIME	RAIN	EXCS	COMP
0 10	.02	0.00	1.
0 20	.02	0.00	1.
0 30	.02	0.00	1.
0 40	.02	0.00	1.
0 50	.02	0.00	1.
0 60	.02	0.00	1.
1 10	.02	0.00	1.
1 20	.02	0.00	1.
1 30	.02	0.00	1.
1 40	.02	0.00	1.
1 50	.02	0.00	1.
2 00	.02	0.00	1.
2 10	.02	0.00	1.
2 20	.02	0.00	1.
2 30	.02	0.00	1.
2 40	.02	0.00	1.
2 50	.02	0.00	1.
3 00	.02	0.00	1.
3 10	.02	0.00	1.
3 20	.02	0.00	1.
3 30	.02	0.00	1.
3 40	.02	0.00	1.
3 50	.02	0.00	1.
4 00	.02	0.00	1.
4 10	.02	0.00	1.
4 20	.02	0.00	1.
4 30	.02	0.00	1.
4 40	.02	0.00	1.
4 50	.02	0.00	1.
5 00	.02	0.00	1.

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2.7.
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3.0.
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3.9.
4.1.
5.6.
7.1.
8.8.
10.8.
12.9.
15.0.
16.9.
18.8.
20.5.
22.1.
23.6.
25.2.
26.7.
28.2.
29.8.
31.3.
33.6.
36.7.
40.8.
45.7.
51.4.
57.3.
62.6.
66.6.
69.7.
73.0.
76.5.
80.0.
82.5.
85.0.
87.5.
90.0.
92.5.
95.0.
97.5.
100.0.

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ROUTING THRU 48 IN. CMP CULVERT ITAPE JPLT JPRT INAME  
ISTAG 0 ICOMP 1 IECCN 0 ITRNO DATA 0  
GLSSS 0.0 CLSSS 0.000 AVG IRES 1 ISAME 0  
NSTPS 0 NSTDL 0 LAG 0 AMSKA 0.000 X TSK STORA -1.  
0.000 0.000
```

STORAGE =	0.	2.	6.	10.	11.	12.	13.	14.	15.	16.
OUTFLOW	0.	19.	58.	109.	133.	223.	432.	850.	1350.	2500.

TIME	POP	STOR	AVG	IN	POP	OUT
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	0	0	0	0	0	0
30	0	0	0	0	0	0
31	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	0	0	0	0	0	0
45	0	0	0	0	0	0
46	0	0	0	0	0	0
47	0	0	0	0	0	0
48	0	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0
63	0	0	0	0	0	0
64	0	0	0	0	0	0
65	0	0	0	0	0	0
66	0	0	0	0	0	0
67	0	0	0	0	0	0
68	0	0	0	0	0	0
69	0	0	0	0	0	0
70	0	0	0	0	0	0
71	0	0	0	0	0	0
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	0	0	0	0	0	0
79	0	0	0	0	0	0
80	0	0	0	0	0	0
81	0	0	0	0	0	0
82	0	0	0	0	0	0
83	0	0	0	0	0	0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	346.	202.	63.	63.	908.
INCHES		8.19	10.22	10.22	10.22
AC-FT		100.	125.	125.	125.

OVA*

SUB-AREA RUNOFF COMPUTATION

INSTITUTE	POND	DAM	IECON	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1	0	1
INYDG	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME
1	1	.02	0.00	0.00	1.00	.500	0	0
SPFE	PMS	R6	R12	R24	R48	R72	R96	
0.00	19.50	100.00	111.00	120.00	0.00	0.00	0.00	
STWKR	DLTKR	RTIOL	ERAIN	STRKS	RTICK	STRTL	CNSTL	ALSMX
0.00	0.00	1.00	0.00	0.00	1.00	.63	.12	0.00

UNIT HYDROGRAPH DATA
TP= .21 CP= .63 NTA= 0

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.58 AND R= .26 INTERVALS
UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .21 HOURS, CP= .63 VOL= 1.00
20. 34. 18. 5. 1. 0.

TIME	RAIA	EXCS	COMP
0 10	.02	0.00	1.
0 20	.02	0.00	1.
0 30	.02	0.00	1.
0 40	.02	0.00	1.
0 50	.02	0.00	1.
0 60	.02	0.00	1.
1 10	.02	0.00	1.
1 20	.02	0.00	1.
1 30	.02	0.00	1.
1 40	.02	0.00	1.
1 50	.02	0.00	1.
2 00	.02	0.00	1.
2 10	.02	0.00	1.
2 20	.02	0.00	1.
2 30	.02	0.00	1.
2 40	.02	0.00	1.
2 50	.02	0.00	1.
3 00	.02	0.00	1.
3 10	.02	0.00	1.
3 20	.02	0.00	1.
3 30	.02	0.00	1.
3 40	.02	0.00	1.
3 50	.02	0.00	1.
4 00	.02	0.00	1.
4 10	.02	0.00	1.
4 20	.02	0.00	1.
4 30	.02	0.00	1.
4 40	.02	0.00	1.
4 50	.02	0.00	1.
5 00	.02	0.00	1.
5 10	.02	0.00	1.
5 20	.02	0.00	1.
5 30	.02	0.00	1.
5 40	.02	0.00	1.
5 50	.02	0.00	1.
6 00	.02	0.00	1.
6 10	.02	0.00	1.
6 20	.02	0.00	1.
6 30	.02	0.00	1.
6 40	.02	0.00	1.
6 50	.02	0.00	1.
7 00	.02	0.00	1.
7 10	.02	0.00	1.
7 20	.02	0.00	1.
7 30	.02	0.00	1.
7 40	.02	0.00	1.
7 50	.02	0.00	1.
8 00	.02	0.00	1.

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APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

(a)	(b)	(c)	(d)	(e)	(f)
POPULAR NAME	NAME OF IMPONDMENT				
	INSTITUTE POND				
REGION	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE		DIST FROM DAM (MI.)	POPULATION
10	TRAPASSUMPSIC	LYNDON CENTER		0	246

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC. HEIGHT (FT.)		HYDRAU. HEIGHT (FT.)		IMPOUNDING CAPACITIES (ACRE-FT.)		DIST	OWN	FED R	PRV/FED	SCS
			MAX	MIN	MAX	MIN	MAX	MIN					
0545	1911	0	26		26		41	29	NED	N	N	N	N

REMARKS
250451-1110

(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
NOIS HAS	SPELLWAY	CRT. LENGTH	TYPE	WIDTH	DISCHARGE (FT.)	VOLUME OF DAM (CU YD)	POWER CAPACITY INSTALLED (MW)	PROPOSED POWER CAPACITY (MW)	NO. OF TURBINES	PLANT TYPE	NAVIGATION LOCKS	WATERWAY CHARACTERISTICS	DESIGN SPEED (KNOTS)	DESIGN DRAUGHT (FEET)
1	P50	1	10	305								LOWEST WATER FILL TO HIGH WATER FILL WITH LOWEST WATER		

OWNER	ENGINEERING BY	CONSTRUCTION BY
MATHEWSON & LONDON, INSTYT	UNKNOWN	UNKNOWN

	REGULATORY AGENCY			
	DESIGN	CONSTRUCTION	OPERATION	
NONE		NONE	VT DNR	VT DNR

(S) INSPECTION BY DUMMOIS & KING INC	(M) INSPECTION DATE DAY MO YR		(M) AUTHORITY FOR INSPECTION PL 92-367

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END

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