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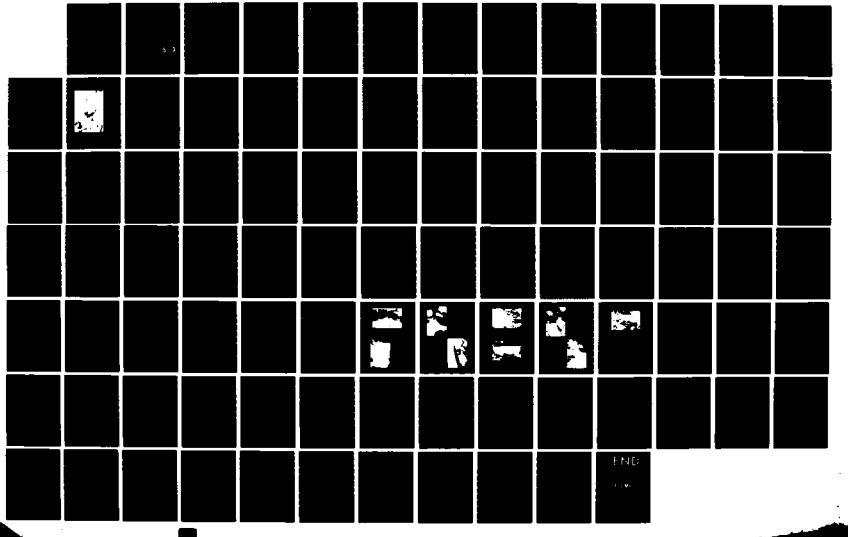

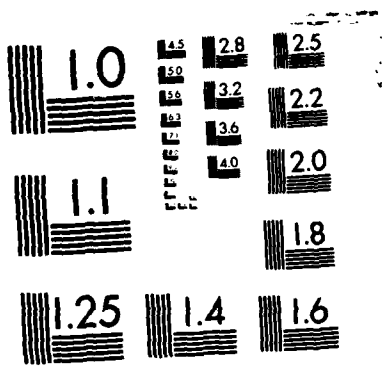

RICHELIEU RIVER BASIN
BELMONT VERMONT

STAR LAKE DAM
VT00010

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

AUGUST 1978

AD A 156 683

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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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,
Richelieu River Basin
Belmont, VT.

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

TXe dam is about 15 ft. high and 220 ft. long. Tbe condition of the dam is fair to poor. The dam has been overtopped in the past. The spillway will not pass the test flood (½PMF) and overtopping of the dam will result. The spillway flume is cracked and has settled, and the outlet gate is inoperable. It is recommended that the downstream face of the dam be redesigned and rebuilt to preclude erosion and to eliminate the potential instability.A regular maintenance and operation program should be instituted.

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

REPLY TO
ATTENTION OF:
NEDED-E

SEP 24 1979

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

Dear Governor Snelling:

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

The preliminary hydrologic analysis has indicated that the spillway capacity for the Star Lake Dam would likely be exceeded by floods greater than 6 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

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

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

NEDED-E
Honorable Richard A. Snelling

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

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. This report has also been furnished to the owner of the project, Belmont Playground Society, Belmont, Vermont.

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

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

Sincerely,

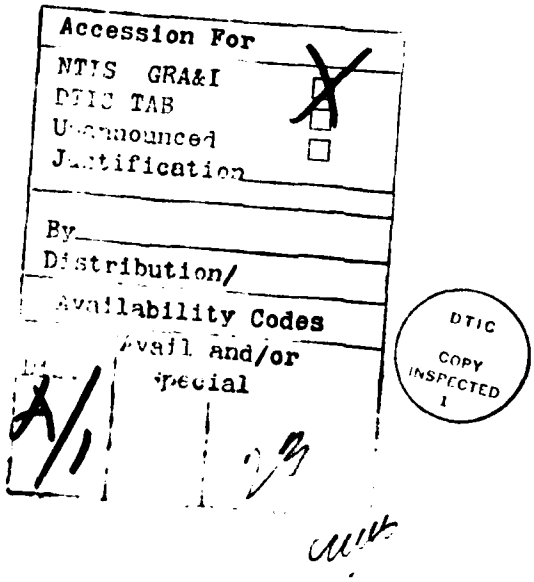
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

STAR LAKE DAM

VT00010

BELMONT VILLAGE, MOUNT HOLLY, VERMONT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: VT00010
Name of Dam: Star Lake
Town: Belmont Village, Mount Holly
County and State: Rutland County, Vermont
Stream: Unnamed
Date of Inspection: June 20, 1978

STATEMENT OF SIGNIFICANT FINDINGS AND BRIEF ASSESSMENT

This earth dam is about 15 feet high, 220 feet long and has a crest width at the outlet structure of about 29 feet. The upstream slope is about 2H:1V and has a vertical concrete wall about 4 feet high at the top. The downstream face is a vertical, dry rubble wall. A concrete spillway and stop log structure in the middle of the dam is used to maintain the pond level about 2.8 feet below the crest of the dam. The outlet structure is a gated, 2-foot diameter conduit that passes under the spillway. The hazard potential is high since ten dwellings and a commercial establishment downstream will be endangered by a failure. The condition of this dam is fair to poor.

This dam has been overtopped in the past, and calculations show that based on the size and hazard classification in accordance with the Corps' guidelines the test flood falls between the 1/2 Probable Maximum Flood (PMF) and the PMF. The spillway will not pass the test flood (1/2 PMF) and overtopping of the dam will result.

Due to the overtopping and rainfall, erosion of the embankment through the downstream stone wall has been extensive. This erosion will continue and can lead to failure, particularly during subsequent overtopping.

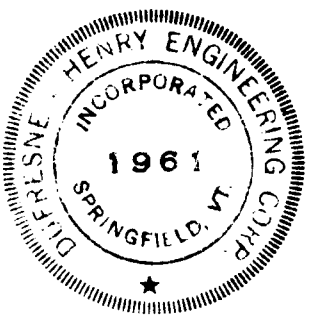
In addition, the downstream stone wall is bulged outward, indicating a condition of marginal stability. The spillway flume is cracked and has settled, and the outlet gate is inoperable.

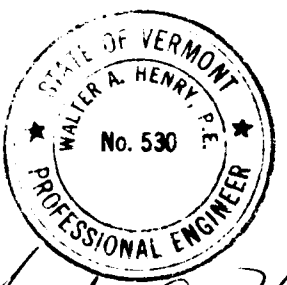
STATEMENT OF RECOMMENDED ACTION

We recommend that the downstream face of the dam be redesigned and rebuilt to preclude erosion and to eliminate the potential instability. In addition, the spillway should be redesigned and rebuilt to accommodate the runoff from a substantial rainfall event or other means of passing flood flows. The outlet gate should be reconstructed so that it is operable.

The above recommendations should be carried out within one year.

Subsequently a regular maintenance and operation program should be instituted.





Walter A. Henry

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

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

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.

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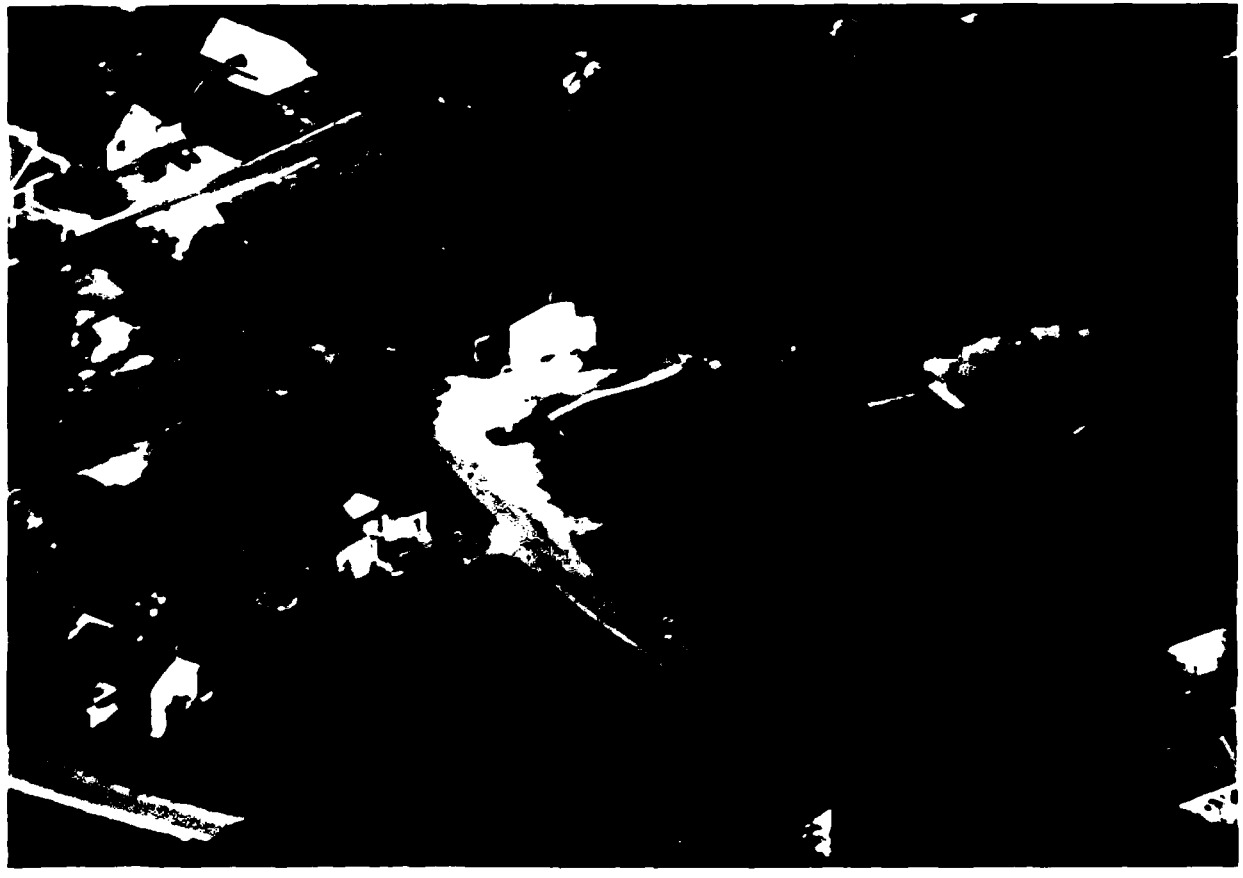
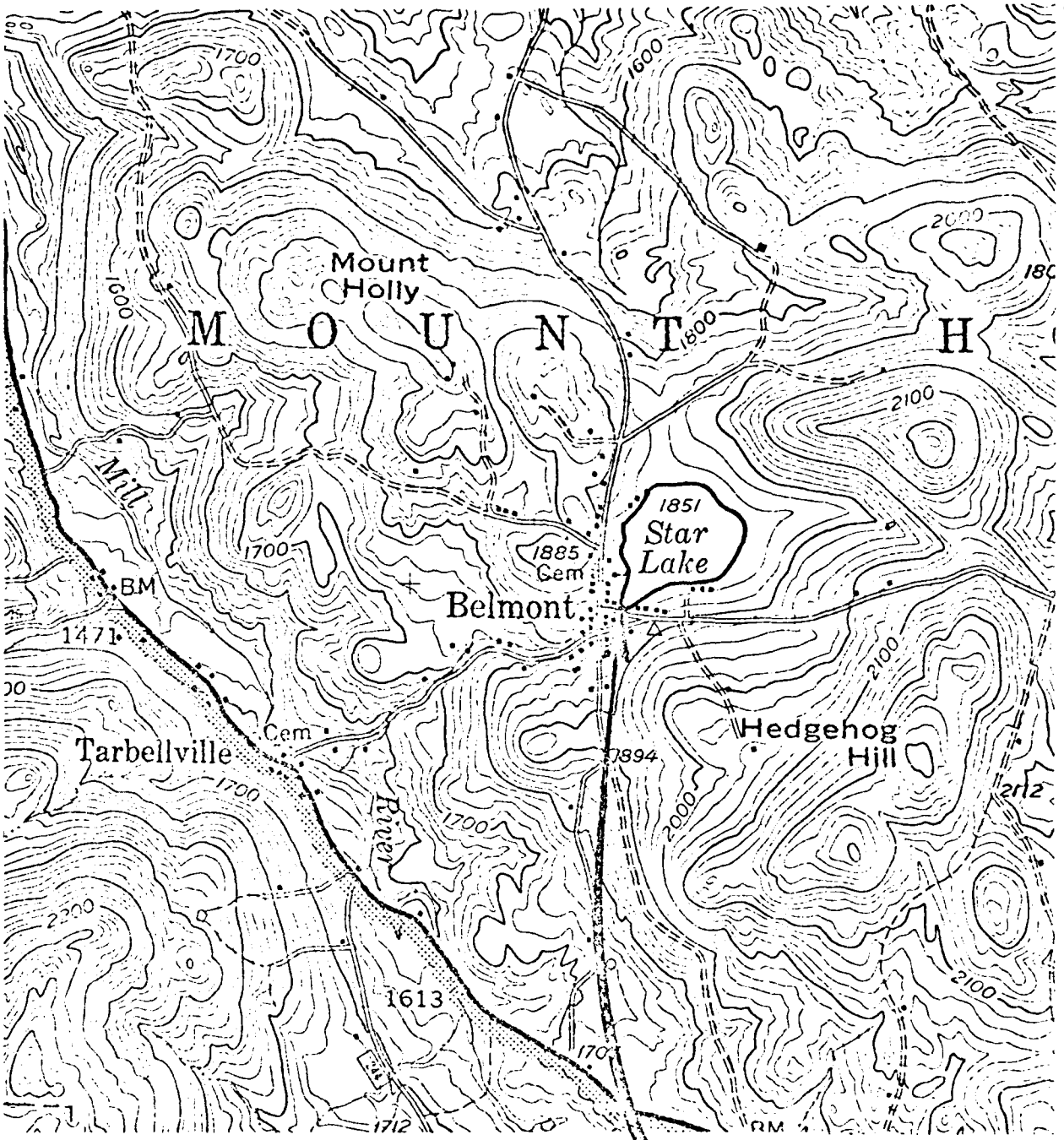


STAR LAKE DAM

BELMONT, VERMONT



SOURCE OF MAP:
U.S. GEOLOGICAL SURVEY
WALLINGFORD N.E., VERMONT
SCALE: 1"=2640'
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U.S. FOREST SERVICE, EASTERN REGION

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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
NAME OF DAM: STAR LAKE

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Authorization for the project was derived from the Dam Inspection Act Public Law 92-367 which authorized the Secretary of the Army through the Corps of Engineers to initiate a program of safety inspection of dams throughout the United States. The work was performed under Contract No. DACW33-78-C-0341 between the New England Division of the Army Corps of Engineers and Dufresne-Henry Engineering Corporation of North Springfield, Vermont.

b. Purpose

The purpose of this project is to accomplish a technical inspection and evaluation of Star Lake Dam to identify conditions which may threaten the public safety and thus permit correction in a timely manner by nonfederal interests. Secondly, this project will serve to encourage and prepare the State to initiate an effective dam safety program. Thirdly, the project will update, verify and complete the Inventory of Dams for Star Lake.

1.2 Description of Project

a. Location

Star Lake Dam is located in the unincorporated Village of Belmont in the Town of Mount Holly, Rutland County, in the central region of Vermont.

The site is located in the Richelieu River Basin on an unnamed stream which is a tributary to the Mill River and 1.1 miles from the confluence of the two water courses.

b. Description of Dam and Appurtenances

The dam is an earth fill that is about 217 feet long, 15 feet high, with a crest width of 29 feet. A 16-20-inch thick concrete retaining wall is on the upstream face and a dry stone masonry wall on the downstream face. The top of the concrete wall (being the crest of the dam) varies in elevation 0.5 feet on the right and one foot on the left. The normal spillway is a concrete flume with an opening 8 feet horizontal x 3.6 feet vertical. Stop boards are usually in place to control lake elevation; normal free board fluctuates but is usually not less than 2 feet.

A gated 24-inch diameter pipe was installed under the spillway. The invert of this pipe is 4.1 feet below the elevation of the crest of the spillway.

c. Size Classification

Star Lake has a size classification of "small" with a surface area of 62 acres. The maximum height at the centerline of the spillway is 15 feet. The impoundment has approximately 525 acre-feet storage capacity.

d. Hazard Classification

Star Lake is in the "high" hazard category. The Village of Belmont is directly downstream of the pond. Ten dwellings and a commercial establishment in the village would be endangered by the failure of the dam.

e. Ownership

Star Lake is owned by the Belmont Playground Society, Inc.

f. Operator

There is no one individual responsible or appointed to provide the daily maintenance and operation of Star Lake Dam. President of the Belmont Playground Society is Mr. Allen A. Devereux of Belmont, Vermont. Telephone is 802-259-2425.

g. Purpose

The impoundment is used solely for recreational purposes - swimming, boating and fishing.

h. Design and Construction History

There are no records of any design or plans for this structure and the history during the construction is unknown. No original plans are available for review. The age of the dam is not known.

i. Normal Operational Procedures

The normal operational procedure is to remove the stop boards in the fall of the year.

1.3 Pertinent Data

a. Drainage Area

The drainage area above the dam consists of 1.10 square miles of gently sloping to moderately steep forested hillsides. Due

to the configuration and size of the watershed, there is no well-defined principal watercourse upstream of Star Lake.

Soils in this area, as documented by the Soil Conservation Service, consist of a well drained glacial till with a hardpan or bedrock within three feet of the surface. Permeability varies from moderate to moderately rapid and available moisture capacity is generally low. Erosion is a severe hazard on steep slopes.

b. Discharge at Dam Site

(1) Outlet Works

The outlet works consist of a 2-foot diameter, gated steel pipe located under the spillway section of the dam. The type of gate is unknown and was inoperable at the time of inspection. The gate stem was rotted and broken. The upstream invert is at elevation 1845.9 feet m.s.l., approximately 4.1 feet below the ungated spillway crest.

(2) Maximum Known Flood at Dam Site

There are no records of past flood discharges at the dam, however, verbal accounts of past flooding indicate the dam has been overtopped several times and has withstood floods of November 1927, March 1936 and September 1938.

(3) Spillway Capacity

At top of dam elevation (approximately 1852.8 feet m.s.l.) the gated spillway capacity (assuming three 6-inch high stop logs in place, totaling 18 inches high) is 37 cfs. The ungated spillway capacity is 116 cfs.

c. Elevation Data

	Elevation (assumed) (ft. m.s.l.)
Top of Dam	1852.8
Test Flood 1/2 PMF	1852.8
Recreation (Normal) Pool	1851.0
Spillway Crest (Gated)	1851.5
Spillway Crest (Ungated)	1850.0
Upstream Outlet Pipe Invert	1845.9
Downstream Outlet Pipe Invert	1843.9
Streambed at Centerline of Dam	1837.8

d. Reservoir Data

	Feet
Length of Maximum Pool	2500
Length of Recreation (Normal) Pool	2500

e. Storage Data

	Acre-Feet
1/2 PMF Pool	525
Top of Dam	525
Recreation (Normal) Pool	413

f. Reservoir Surface Area

	Acres
Top of Dam	62
1/2 PMF	62
Recreation Pool	62
Spillway Crest	50

g. Dam

(1) Type

This dam, based on visual inspection only, is a homogeneous earth fill, with a vertical stone wall downstream, and a sloping upstream face that appears to be covered with rip-rap. The uppermost portion of the upstream face is a vertical concrete wall about 4 feet high.

(2) Length

The length of the concrete portion which forms the crest of the dam is 217 feet.

(3) Height

The crest of the concrete portion of the dam at its highest point has an elevation of 1852.8. The crest elevation fluctuates as much as 1 foot over its length.

(4) Top Width

The total top width at the narrowest portion of the dam adjacent to the spillway is 29 feet. The upstream concrete wall is 18 inches thick.

(5) Side Slopes

The downstream wall is vertical. The upstream wall is vertical for a height of 4 feet below the crest. The upstream slope is about 2H:1V underwater. The slope was not measured.

(6) Zoning

There is no evidence of any zoning of this dam, except for the stone wall downstream.

(7) Impervious Core

There is no impervious core evident or known.

(8) Cutoff

There is no cutoff evident or known.

(9) Grout Curtain

There is no grout curtain known to exist.

i. Spillway

(1) Type

The spillway is an open concrete flume, located near the center of the dam, with a stop log gate installed on the upstream end.

(2) Length of Weir

The flume has a width of 8.0 feet.

(3) Crest Elevation

Ungated spillway crest elevation is 1850 feet m.s.l., which is 2.8 feet below the top of the dam.

(4) Gates

The stop log gate consists of three 6-inch high, horizontal timbers spanning the flume entrance and inserted in concrete grooves on both sides. The stop logs are raised and lowered by hand and there is usually much leakage between the timbers. The top of the stop logs is normally maintained about 1.5 feet above the crest of the spillway.

(5) Upstream Channel

There is no upstream channel as the flume entrance borders on the pond itself. The spillway crest is approximately 3 feet above the bottom of the pond at this point.

(6) Downstream Channel

There is a drop of about 9 feet from the downstream end of the flume (1847.3 m.s.l.) to the bed of the downstream channel. Water is discharged onto riprap at the toe of the spillway. A steep gradient takes the channel 250 to 300 feet to a culvert running diagonally under the Belmont-Mt. Holly Road.

j. Regulating Outlets

General - The specific type of gate is unknown but appears to be either a shear or slide gate with a wooden stem. The stem was broken off at the water surface and the gate was inoperable at the time of inspection.

(1) Invert

The entrance invert is at elevation 1845.9 feet m.s.l., approximately 4.1 feet below the ungated spillway crest.

(2) Size

The regulating outlet consists of a gated, 2-foot diameter steel pipe located beneath the spillway section of the dam.

(3) Description

The pipe falls approximately 2.0 feet through the dam and discharges freely into the downstream channel.

(4) Control Mechanism

An inoperable gate, which is currently closed, was installed to control flow from the outlet structure. The type of gate is not known, since it was covered with water and debris at the time of inspection. An upright square timber at the upstream end of the pipe serves as the gate stem. This stem is now broken.

SECTION 2: ENGINEERING DATA

2.1 Design

There is no engineering data available from which to judge the design of this dam.

2.2 Construction

There is no data available concerning the construction of this dam.

2.3 Operation

The stop logs are removed prior to winter. Maintenance consists of mowing the grass area on the dam.

2.4 Evaluation

a. Availability

No data is available.

b. Adequacy

The lack of engineering data precludes a thorough review. Therefore the adequacy of this dam, structurally and hydraulically, can not be assessed from the standpoint of review of design calculations, but must be based primarily on the visual inspection, past performance history and engineering judgment.

c. Validity

Not applicable.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

In general the condition of Star Lake Dam is fair to poor.

The concrete retaining wall is in generally good repair. There is no significant cracking or spalling of the concrete which forms the upstream face of the dam.

b. Dam

The dam has a cross section approximately as shown in Figure 3.

Considerable erosion has taken place from the earth that forms the dam through the openings between the stones of the downstream wall. Major erosion has occurred, to a depth of about 6 feet below the crest, on the right side of the spillway. The erosion is somewhat less pronounced on the left side of the spillway.

As noted on the checklist in Appendix A, a zone of the downstream stone face to the left of the spillway and about 4 feet above the toe of the dam is bulged outward, downstream, about 1.5 feet. This bulge does not appear to have been built into the wall. In some locations stones have fallen out of the downstream wall (see photo #8).

Vegetation grows profusely on the downstream side of the crest and downstream of the toe. The trees on the dam itself are now relatively small, perhaps up to 10 years old.

At the time of inspection, the water was passing between the stop logs into the spillway flume off the downstream end and down into the cracked floor of the flume to emanate from the rocks below the toe. This flow was eliminated temporarily during inspection by tightening the stop logs. The flow out of the downstream side of the dam decreased and continued to decrease for about one hour. During this period no water was flowing over the downstream end of the concrete flume that forms the spillway discharge channel. Thus the water observed downstream after one hour was either flowing through the body of the dam below the floor of the flume, or was simply draining from the body of the dam beneath the flume.

c. Appurtenant Structures

The appurtenant structures associated with this facility are generally in poor condition.

The concrete lined flume which leads from the weir is seriously cracked and misaligned. This in turn allows a substantial flow to enter the body of the dam below, which supports the deepest section of the dam.

Erosion through this section will continue and the situation may become more critical.

In addition, spalling has taken place on the right support for the stop board angle (see photo #3) and also the railing at the bridge. Both have the minimal reinforcing (bolts and scrap metal) exposed.

Erosion has also taken place along the left wall of the flume. This extends from midpoint of the bridge to the end of the flume approximately 27 feet (see photo #4).

The 2-foot diameter outlet pipe is in good condition. The gate is inoperable both by siltation and that the gate mechanism is broken.

d. Reservoir Area

The reservoir area consists of about 62 acres at the normal pool level. Aquatic growth and shoreline vegetation were visible around most of the lake. Sediment deposition at the spillway and the concrete wall extending along the front of the dam was apparent.

e. Downstream Channel

The downstream channel of the spillway and the low-level discharge is a natural bedrock streambed with profuse trees and shrubs on both sides. Just below the spillway there is a pile of large rocks, in the 500 lb. to 1000 lb. size, apparently dumped there to act as energy dissipators (see photo #9).

From the toe of the spillway for a distance of 250 to 300 feet downstream, the stream has a steep gradient with no vegetation in the channel and trees and brush along both banks. The channel bottom contains cobbles with a few boulders. The downstream portion of this section is lined, in part, with dry masonry walls. On the right side of the channel, downstream from the dam about 40 feet, the stone wall has collapsed into the stream-

bed. There is an accumulation of debris in this portion of the channel which may accumulate at downstream culverts during high flows and reduce the flow-carrying capacity of these structures. The stream enters a 4.5 x 5.0-foot concrete box culvert near the side of a house and proceeds diagonally under the Belmont-Mt. Holly Road. After passing under the front corner of another house, the stream exits the culvert and flows against the foundation of another house approximately 30 feet downstream. After this point the stream flows through a rather wide, uninhabited flood plain area (see photos #6 and #7).

3.2 Evaluation

The erosion that has taken place through the downstream stone wall makes it evident that there was no satisfactory filter material placed between the earth of the dam and the stone wall. Thus this erosion will continue due to rainfall or due to occasional overtopping, which has occurred in the past.

The erosion that has occurred to date has produced cavities behind the downstream face and apparently has caused settlement and cracking of the spillway apron and the adjacent training walls.

The cause of the bulge in the downstream stone face is not known. It may be due to continual frost action or to erosion-related movements. In any case, this wall can be only marginally stable and subject to failure as the process which formed the bulge continues.

Any loss of storage due to sedimentation would have very little effect on the surcharge height produced by the test flood, therefore, this potential problem is of little concern in evaluation of dam overtopping.

Backwater flooding due to the test flood (one-half the probable maximum flood) would not result in loss of habitable buildings.

The downstream channel area contains debris which may accumulate at culverts during flood stages resulting in reduced flow-carrying capacity. Present capacity of the culvert under the Belmont-Mt. Holly Road is about 200 cfs before overtopping of the road occurs. This is considerably less than the test flood and blockage of the culvert would increase the flood damage potential.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The only operational procedure undertaken is that of removing the stop boards prior to the winter months.

4.2 Maintenance of Dam

Mowing the grass on the dam is the only maintenance undertaken.

4.3 Maintenance of Operating Facilities

Operating facilities such as the gate works have not received any maintenance in the recent past and as a result are inoperable.

4.4 Description of any Warning System in Effect

There is no warning system in effect.

4.5 Evaluation

As a result of the lack of maintenance and operational procedures the spillway is in very poor condition.

Repairs should be undertaken to make the gate operable and the spillway restored to a stable condition. An individual should be appointed, instructed and made responsible for the maintenance of the facilities.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

Design data for Star Lake Dam are not available.

b. Experience Data

Accounts of flooding at the dam indicate that it has been overtopped several times in the past; however, estimates of peak discharges were not available.

c. Visual Observations

Erosion on the downstream side of the embankment and along the right concrete spillway side wall are indications of the effects of overtoppings, the most recent of which occurred in 1973 and 1976. Rills and gullies in two low-lying areas on the right embankment were readily apparent upon inspection. Extensive erosion had taken place behind the dry masonry wall facing the downstream side of the embankment in these areas. Erosion along the right spillway sidewall and the footbridge abutment was also visible. The foundation at the northeast corner of the Odd Fellows Hall on the left side of the spillway showed signs of damage from past overtopping.

d. Overtopping Potential

This dam carries small classification for size with a high hazard potential. As such it must be capable of passing 1/2 PMF Probable Maximum Flood. This test flood was computed by determining the watershed drainage area from USGS maps in combination with Corps' HEC 1 Computer Program.

Storm runoff from the 1.1 sq. mi. drainage area will result in an approximate discharge of 900 cfs (820 csm) passing the dam. This 1/2 PMF discharge will result in the dam being overtopped by about 1.1 ft. (elev. 1853.9±). With the reservoir level at 1852.8 the spillway discharge is only 115 cfs with all stop logs removed and about 50 cfs with 3 stop logs in place.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There is evidence of structural instability of this dam in the form of a substantial bulge in the downstream wall to the left of the spillway. Also, as noted in Section 3, this dam will erode continually because the downstream side is not protected from erosion that takes place due to rainfall and intermittent overtopping.

b. Design and Construction Data

There are no design or construction data available on which to base an evaluation of structural stability.

c. Operating Records

There are no operating records for this dam.

d. Post-Construction Changes

The only post-construction change known from the records is the construction of the vertical concrete wall on the upstream face, which would have a beneficial effect, if any, on the stability of this dam.

e. Seismic Stability

This dam is in Seismic Zone 2 and need not be analyzed for seismic stresses, according to USCE guidelines.

SECTION 7: ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

Computations and past experience indicate a high overtopping potential of the dam embankment. In the event of a test flood an average surcharge height of 1.1 feet above the top of the dam embankment would occur. Even without failure of the dam, the test flood would greatly exceed downstream channel capacity causing extensive damage to at least houses in the Village of Belmont. Failure of the dam, considering the small drainage area and relatively rapid runoff, would possibly result in the loss of human life due to the short warning time.

The soil from the dam is continually eroding through the openings between the stones of the downstream face due to normal flow, rainfall and overtopping. A bulge in the downstream face indicates a condition of marginal stability.

b. Adequacy of Information

Even though calculations are of a preliminary nature and the accumulated information is not of great detail, it is obvious that the spillway capacity does not meet the Corps of Engineers' screening criteria and that a significant overtopping potential exists. All conclusions presented herein are based principally on visual observations.

c. Urgency

This dam will continue to erode. The rate will depend upon the intensity and frequency of rainfall. It is entirely possible that the dam will be washed out the next time it is overtopped. The recommendations given in Section 7.2 should be carried out within one year.

d. Necessity for Additional Investigations

The recommendations given in Section 7.2 should be carried out.

7.2 Recommendations

The Owner should engage a qualified engineer to carry out the following work:

(1) a. Determine how to increase the spillway capacity and the discharge channel capacity through and beyond the Village.

b. Investigate the potential of alternative emergency spillway locations.

(2) Redesign the downstream face to make it stable against erosion and/or collapse.

(3) Make designs to renovate the outlet gate and the bridge across the spillway.

7.3 Operational and Maintenance Procedures

Cut all trees and shrubs from the dam and for a short distance downstream. Maintain grass on the crest or pave it to prevent erosion of zones where pedestrian traffic is concentrated. Institute a regular maintenance program.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT STAR LAKE DAM

DATE June 20, 1978

TIME 0915 - 1130

WEATHER Partly sunny, 63° F. 5-10 MPH, SW

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

PARTY:

1. Walter Henry D&H
2. Michael Peloso D&H
3. Dave Froehlich D&H
4. Steve Poulos GEI
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

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

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE NAME

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	1852.8' MSL (Top of dam)
Current Pool Elevation	1851' MSL (Recreational)
Maximum Impoundment to Date	
Surface Cracks	None observed.
Pavement Condition	No pavement. Grassed surface.
Movement or Settlement of Crest	Crest eroded on d.s. side near rt. wall of spillway and behind d.s. stone wall. Much erosion on right side, less on left side.
Lateral Movement	See horizontal alignment.
Vertical Alignment	No misalignment observed.
Horizontal Alignment	Downstream stone wall bulged out about 1.5 ft. at about 4' above d.s. toe on left side of spillway.
Condition at Abutment and at Concrete Structures	No seepage observed at abutment contacts. Stones have fallen out of d.s. wall near spillway.
Indications of Movement of Structural Items on Slopes	Spillway discharge channel settled and cracked. Training walls also settled; d.s. stone wall has many stones missing. See horizontal alignment.
Trespassing on Slopes	Free access. Pedestrians walk on crest regularly to use beach.
Sloughing or Erosion of Slopes or Abutments	Stones of downstream wall have fallen out and erosion of soil behind is extensive.
Rock Slope Protection - Riprap Failures	Upstream side has vertical concrete wall from crest to about 1' below water. Then riprap, in good condition, slopes away under water.
Unusual Movement or Cracking at or Near Toes	None observed.
Unusual Embankment or Downstream Seepage	Seepage from d.s. continued at significant rate after flow through spillway was essentially stopped. Flow slowed down over 1 hour period but appeared to be greater than flow passing stop logs.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE NAME

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Piping or Boils	None observed.
Foundation Drainage Features	None found.
Toe Drains	None found.
Instrumentation System	None found.
Vegetation	Many trees up to 12' high, chiefly on d.s. side near spillway.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	None.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal 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	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Not observable - underwater.
Bottom Conditions	Not observable - underwater.
Rock Slides or Falls	None.
Log Boom	None.
Debris	None.
Condition of Concrete Lining	Not observable.
Drains or Weep Holes	Not applicable.
b. Intake Structure	
Condition of Concrete	Spalling of concrete which supports slot channels.
Stop Logs and Slots	2" x 6" hemlock planks.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE NAME

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	Spalling at right support for stop log.
Visible Reinforcing	Reinforcing visible in this section.
Rusting or Staining of Concrete	Not discernible.
Any Seepage or Efflorescence	Not observable.
Joint Alignment	Not applicable.
Unusual Seepage or Leaks in Gate Chamber	Not applicable.
Cracks	None observed.
Rusting or Corrosion of Steel	Not applicable.
b. Mechanical and Electrical	
Air Vents	Not applicable.
Float Wells	Not applicable.
Crane Hoist	Not applicable.
Elevator	Not applicable.
Hydraulic System	Not applicable.
Service Gates	Sheargate for steel conduit is not operable. Wood stem is broken.
Emergency Gates	Not applicable.
Lightning Protection System	Not applicable.
Emergency Power System	Not applicable.
Wiring and Lighting System	Not applicable.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Good - conduit is 24" diameter steel pipe.
Rust or Staining on Concrete	None observed.
Spalling	None observed.
Erosion or Cavitation	Not applicable.
Cracking	None observed.
Alignment of Monoliths	Not applicable.
Alignment of Joints	Not applicable.
Numbering of Monoliths	Not applicable.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE NAME M. R. Peloso

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Poor. Serious cracking of channel floor, see page 8 b.
Rust or Staining	None observed.
Spalling	None observed.
Erosion or Cavitation	None observed.
Visible Reinforcing	None observed.
Any Seepage or Efflorescence	None observed.
Condition at Joints	Not applicable.
Drain Holes	N.A.
Channel	
Loose Rock or Trees Overhanging Channel	Numerous loose stones in downstream channel walls. Maples up to 2.5' Ø beside channel immediately d.s. of dam. Rt. channel wall has been toppled by flow around dam during a previous high water.
Condition of Discharge Channel	Poor. Natural streambed was walled off, and walls are toppled in places. Loose rock is in channel.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Underwater
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Underwater
b. Weir and Training Walls	
General Condition of Concrete	Water flowing over concrete discharge channel, beyond stop logs, drops into cracks, apparently eroding soil through d.s. wall and causing settlement of floor of channel. Left side settled about 1" below rt. and caused crack in floor. In almost complete disrepair.
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	N/A
Drain Holes	None, but cracks in wall act as drains.
c. Discharge Channel	(Same as outlet channel, see page 8)
General Condition	Poor
Loose Rock Overhanging Channel	Many stones from stone walls in imminent likelihood of falling in.
Trees Overhanging Channel	Many trees on both sides, up to 2.5 ft. diameter.
Floor of Channel	Poor. Natural streambed partly obstructed
Other Obstructions	by stones from lateral walls. A pile of large stones is just d.s. of spillway. May have been energy dissipator. One large 1500 lb. rock apparently fell out of wall that forms d.s. face of dam.

PERIODIC INSPECTION CHECK LIST

PROJECT STAR LAKE DAM DATE June 20, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	Foot Bridge over spillway
a. Super Structure	
Bearings	Timbers tie back into abutments - 9".
Anchor Bolts	N/A
Bridge Seat	Good
Longitudinal Members	Good
Under Side of Deck	Good
Secondary Bracing	Not applicable.
Deck	Good
Drainage System	Not applicable.
Railings	Spalling with visible reinforcing.
Expansion Joints	None
Paint	None
b. Abutment & Piers	
General Condition of Concrete	Poor
Alignment of Abutment	Some settlement obvious.
Approach to Bridge	Good
Condition of Seat & Backwall	Not applicable.

APPENDIX B

1. 1961 Anderson-Nichols Company Report on Star Lake Dam.

2. State of Vermont, Management Engineering Inspection Report on Star Lake Dam.

3. Figure 1 - Plan of Star Lake Dam

   2 - Details of Spillway and Flume

   3 - Cross Section of Dam

STAR LAKE DAM

1. General - History of major floods in Vermont indicates that loss of life and extensive property damage have been experienced. Structural failure of many existing dams has contributed significantly to peak flood flows and associated flood losses. In general, these failures resulted from inadequacies in spillway capacities, structural design and maintenance repair. To minimize flood damages associated with possible future dam failures, the Vermont Water Conservation Board is directed to undertake a program of periodic inspection of existing dams. The Board has retained the engineering firm of Anderson-Nichols to assist it in performing these inspections and evaluating the adequacy of the structures. A visual examination of the Star Lake Dam site was made on 15 November 1960. The gate at the bottom of the structure was closed and only a small amount of water was passing over the spillway. Photographs were taken, and are appended to this report.

2. Purpose - The purpose of this report is to

(a) Summarize the investigations of the Star Lake Dam on an unnamed brook in the Town of Mount Holly, Rutland County, Vermont.

(b) Evaluate the adequacy of the structure.

(c) Recommend to the Board appropriate action to be taken in view of any flood hazard associated with the existing dam.

3. Scope - The scope of this investigation includes a field inspection of the structure site to ascertain the physical characteristics and the condition of the dam, studies to determine the adequacy of the spillway and outlets to pass flood flows that might reasonably be anticipated, and a report summarizing the investigations.

4. Watershed Description - The watershed upstream of the dam comprises 1.15 square miles of drainage area, which consists of the slopes of Hedgehog Hill, Mount Holly and other hills of the mountainous terrain of south central Vermont. Due to the configuration and small size of the watershed, there is no well-defined principal water course upstream of Star Lake, but rather a series of small peripheral streams flowing into the Lake.

5. Site Description - The dam is located on an unnamed brook in the Village of Belmont, at a point approximately 1.1 miles upstream of its junction with Mill River, a tributary of Otter Creek. At spillway crest elevation, the pond created by the dam, roughly circular in shape, has a surface area of about 50 acres, and is presently used for recreational purposes. Immediately downstream of the dam, the area adjacent to the stream is occupied by various residential and commercial buildings, comprising the Village of Belmont.

6. Structure Description - The dam is of earth fill construction, built in a fairly narrow gully which has a depth of about 15 feet. The dam is supported by a dry masonry wall on the downstream side. There is a low concrete wall extending along the upstream side of the dam and the adjacent banks of the pond. The outlet works, consisting of a concrete flume and a gated waste pipe, are located near the center of the dam. The principal features and approximate dimension of the structure are shown on Exhibits I and II.

7. The flume, which functions as an overflow spillway, is eight feet wide and about 29 feet in length. A wooden footbridge spans the upper portion of the flume and incorporates provisions for flashboards. There is a drop of 2.7 feet in the total length of the flume, and a drop of about nine feet from the end of the flume to the bed of the stream.

8. A steel pipe, two feet in diameter, extends through the spillway section of the dam and is controlled by a gate at the upper end of the pipe with an upright square timber which functions as a gate stem. However, no provisions for operating the gate stem are apparent. The gate was closed at the time of inspection, and under three or more feet of water and debris, thereby precluding its detailed examination.

9. The terrain to the north of the spillway for a distance of about 50 feet is quite flat, and only a few tenths of a foot higher than the top of the concrete wall at the northerly edge of the flume entrance. The terrain to the south of the spillway is also relatively flat, and at the approximate elevation of the top of the wall at the southerly edge of the flume entrance. However, there is a section of the wall about 48 feet to the left of the spillway which is several tenths of a foot lower than the elevation of the top of wall at the flume. According to a resident, flood flows in the past have overtopped the low portion of the wall, passing down the dirt road, and ultimately returned to the brook several hundred feet downstream.

10. The attached photographs, taken on 15 November 1960, show the following:

Photograph 1 - Lower portion of pond showing outlet, footbridge and general topography as viewed from left bank.

Photograph 2 - Downstream face of dam showing flume and outlet pipe as viewed from left bank.

Photograph 3 - Entrance to flume showing flashboard, footbridge and rectangular gate stem as viewed from left bank.

Photograph 4 - Looking westerly at dirt road immediately downstream of dam. Flood flows are said to have passed down the road to the left of Odd Fellows Hall.

11. Structural Condition - The following observations are based solely on visual examination of the structure without benefit of detailed plans and design data.

(a) The embankment of the dam appears to be designed with an adequate section and in good repair.

(b) No erosion of the embankment is apparent.

(c) The concrete in the flume and the walls adjacent to the pond are in good condition.

(d) While the size and operating condition of the gate were not determinable due to the water level, leakage through the gate was insignificant.

(e) The footbridge is apparently in sound condition, and safe for pedestrian traffic.

12. Adequacy of Spillway - Based on conversations with residents, and on visual high-water marks, it appears that the pond is normally maintained at an elevation about 1.4 feet above spillway crest during the recreation season. At the time of inspection, only one flashboard was in place, with the pond level about 0.5 feet above the spillway crest, to prepare for winter conditions and spring runoff.

13. The discharge capacity of the spillway with all flashboards removed is approximately 65 cubic feet per second with one foot of freeboard, and about 115 cubic feet per second with no freeboard.

The discharges with and without freeboard correspond to unit rates of runoff of 56 and 100 cfs per square mile, respectively. It is noted that the surcharge storage at maximum pool elevation represents 75 acre feet, or about 1.25 inches of runoff from the drainage area, and would have an insignificant effect in reducing flood peaks. Although the gated outlet could provide additional discharge capacity, the time of concentration of flood development is so short that it is highly unlikely the gate would be opened during the period of high flood flows.

14. As flood records were not available for this brook, an analysis was made of the maximum floods of record on nearby watersheds with similar hydrologic characteristics. The unit rates of runoff for the 1927 and 1938 flood peaks were plotted against drainage area on logarithmic paper and an envelope curve was developed. The resulting runoff for a 1.15 square mile drainage area was about 700 cfs per square mile, which is nearly eight times the unit rate of discharge capacity of the present spillway (paragraph 13). Since floods of similar magnitude to the floods of record can reasonably be anticipated to recur, it is concluded that the present spillway discharge capacity at the dam is highly inadequate.

15. Recommendations - In view of the inadequate spillway discharge capacity of the dam, it is recommended that modifications to the dam be made to provide a minimum discharge capacity of 800 cubic feet per second, with a minimum freeboard at the dam and abutting area of at least one foot.

Harry M Nelson
Project Engineer

Registered Professional
Engineer - Vermont No. 120

Herman J. Kropper
Vice-President
Anderson-Nichols & Company, Inc.

Registered Professional
Engineer - Vermont No. 773

ROUTING		
GENERAL		
TO	NOTED	DATE
ar		8/26
dm	AJR	9/3/75
dhe	CHS	8-26-75
SUSPEND TO		
FILE		

FILE COPY

MANAGEMENT & ENGINEERING DIVISION

August 26, 1975

Belmont Playground Society
Belmont
Vermont 05730

Dear Sirs:

An engineer from this Department recently inspected the dam on Star Lake in Mt. Holly. The inspection report indicates the dam is in stable condition, but notes some minor maintenance is required. For instance, there is some erosion occurring along the northerly retaining wall of the spillway. This could be fixed by some regrading and reseeding or possibly filling in with small stones. Some leakage was noted coming out of the drain pipe and the operating handle on the drain gate is gone. Therefore, it might be well to consider replacing the present gate.

If you have any questions, please contact this office. If you wish, a joint field visit could be arranged with one of the staff engineers.

Sincerely yours,

Andre J. Roulenu
Assistant Director

AJR/CHS/lsw

AGENCY OF
ENVIRONMENTAL
CONSERVATION
MONTPELIER

AGENCY MEMORANDUM

SUBJECT

Star Lake Dam-Mt. Holley

TO: File

FROM: Donald Spies

DATE: July 16, 1973

On July 9, 1973, this writer made an inspection of the subject structure. The dam suffered some minor erosion at the north end of the bridge. The downstream wall appears to be stable. There was some undermining of the foundation of the building just below the dam, but it doesn't appear to be serious.

DHS:lwd

ROUTING

GENERAL TO	NEED	DATE
DHS	Comm	7/16
AGR	ASIC	7/16
JCC		

SOMETHING

FILE

A C SM 1-72

AGENCY OF
ENVIRONMENTAL
CONSERVATION
MONTPELIER

ROUTING		
GENERAL		
TO	NOTED	DATE
DHS AJR	AJR	1-30-73
SUSPEND TO		
FILE		

AGENCY MEMORANDUM

SUBJECT

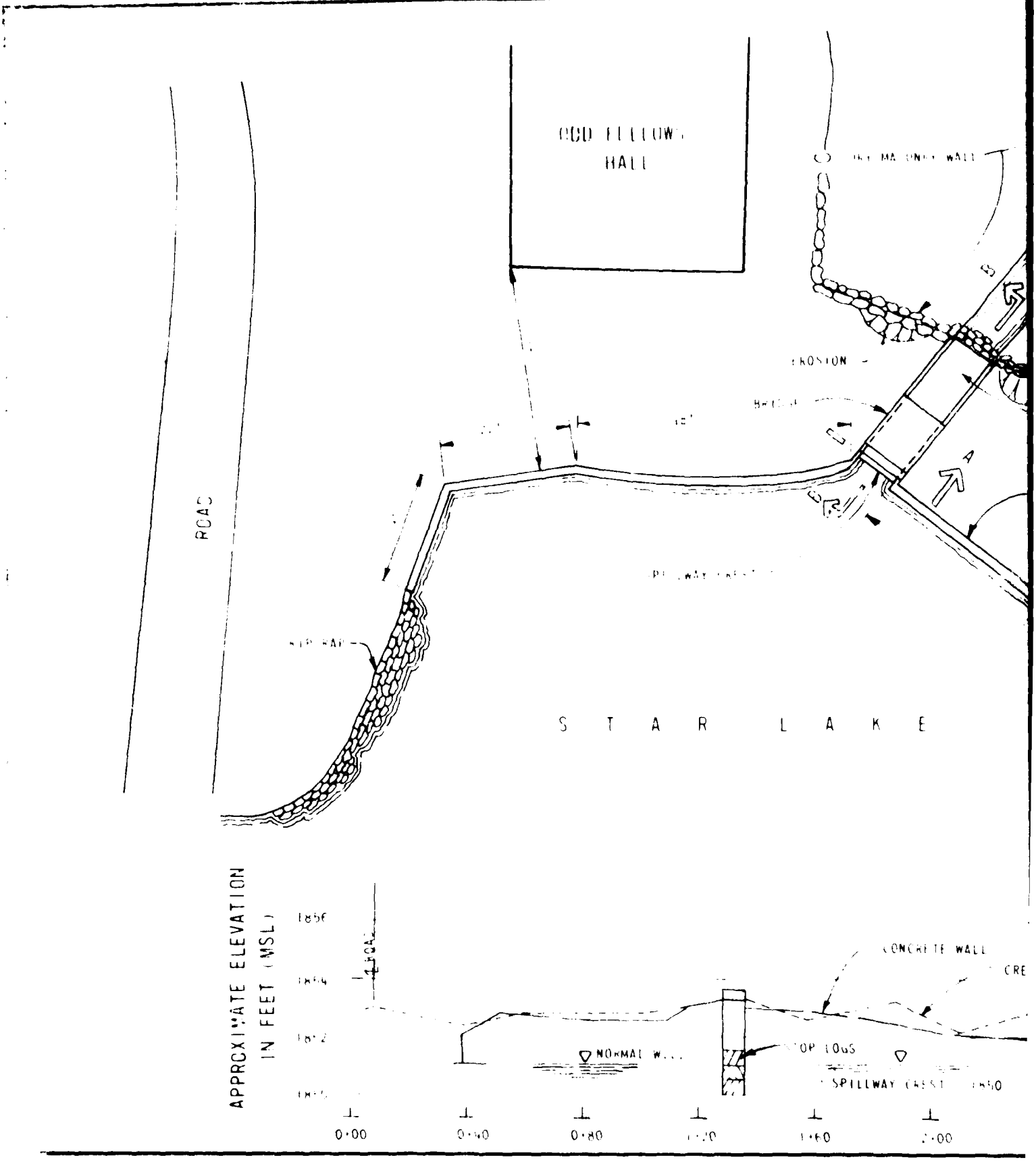
Star Lake Dam - Mt. Holly

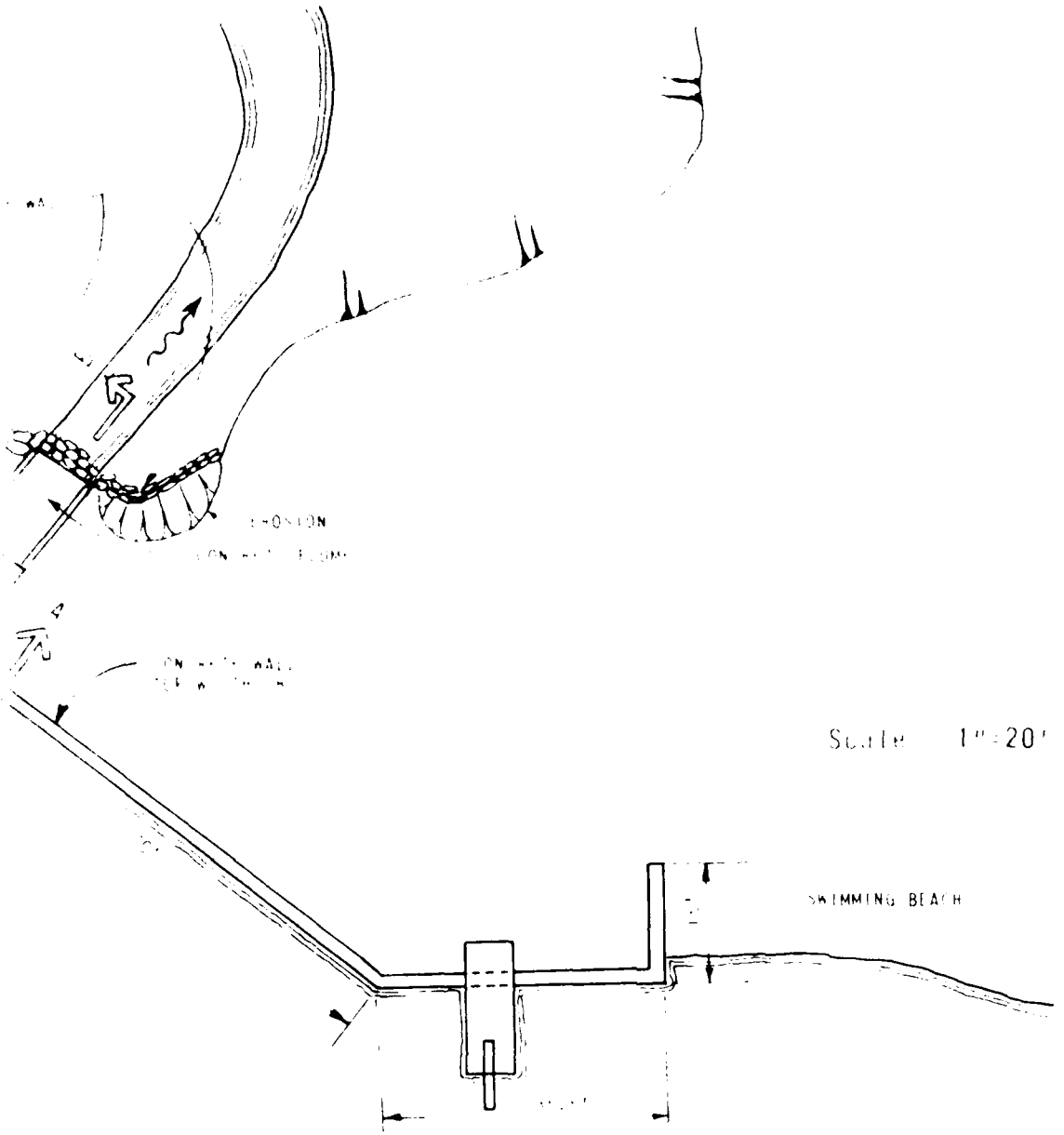
TO: File

FROM: Don Spies

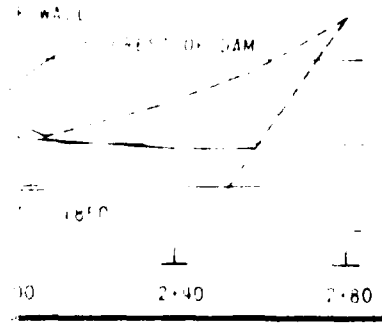
DATE: January 30, 1973

The writer inspected the subject structure on January 22, 1973. The dam is basically unchanged from the Anderson-Nichols report of 1961. The handle to the waste gate has rotted off and some of the floor boards on the footbridge have deteriorated.



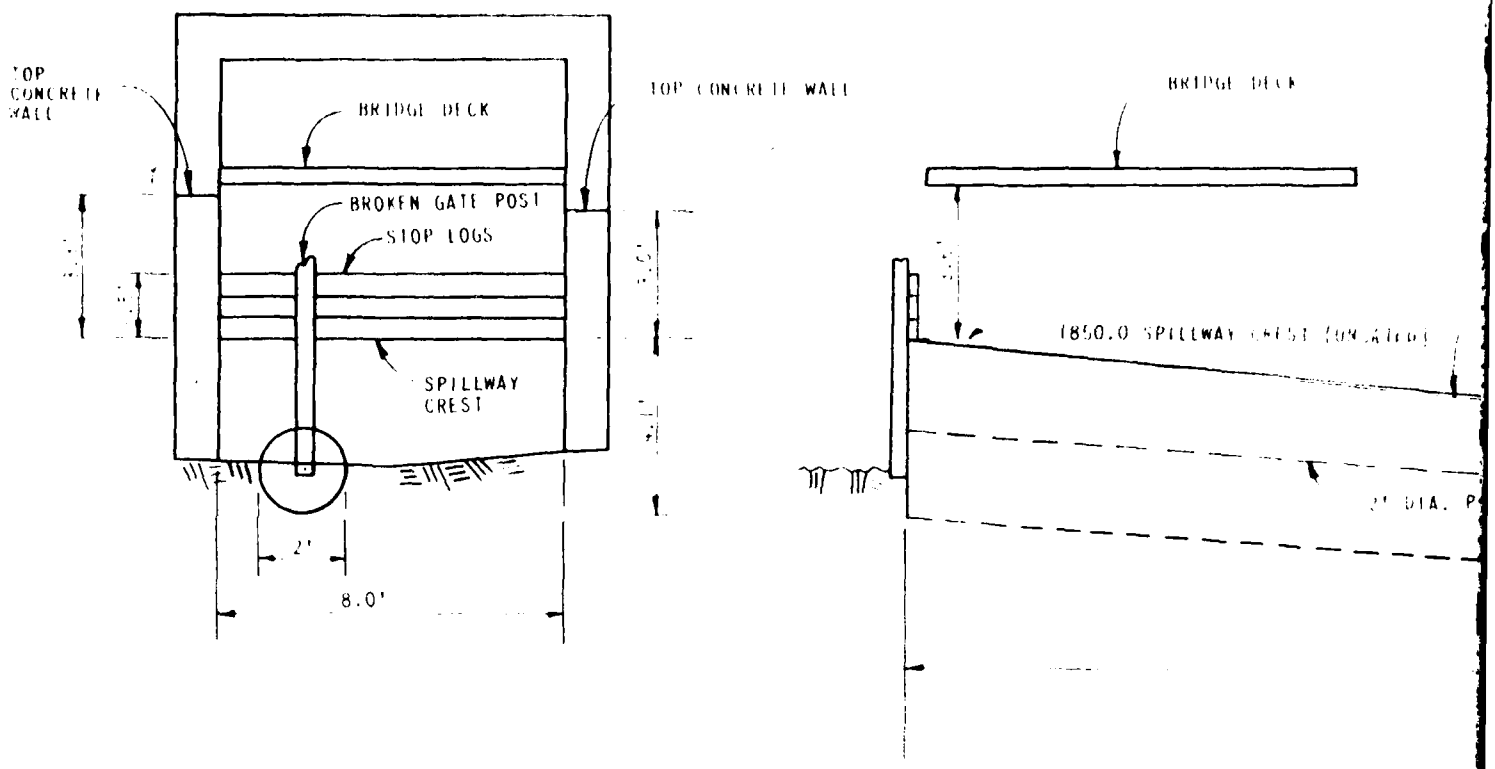


Scale 1"=20'



DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEER			U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
STAR LAKE DAM			
DRAWN	RB		SCALE AS SHOWN
ENGR.	MRP		DATE JULY 1978

2 of 2

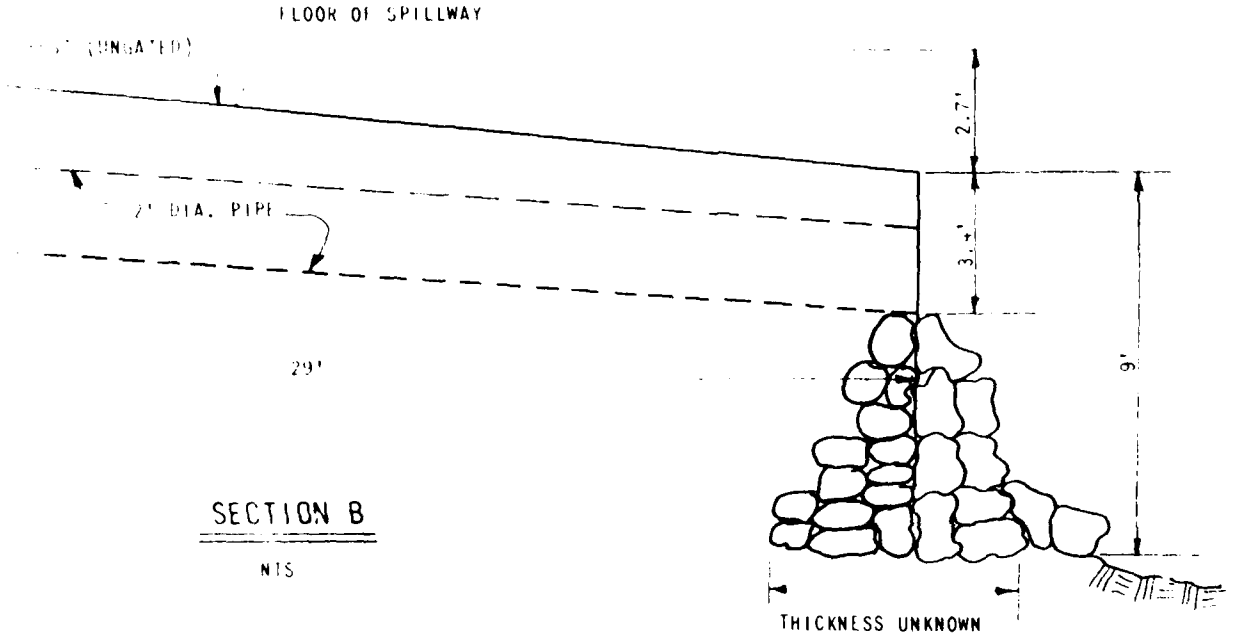


SECTION A

NTS

SE

NOTE DIMENSIONS BASED ON APPROXIMATE FIELD MEASUREMENTS



SECTION B

NTS

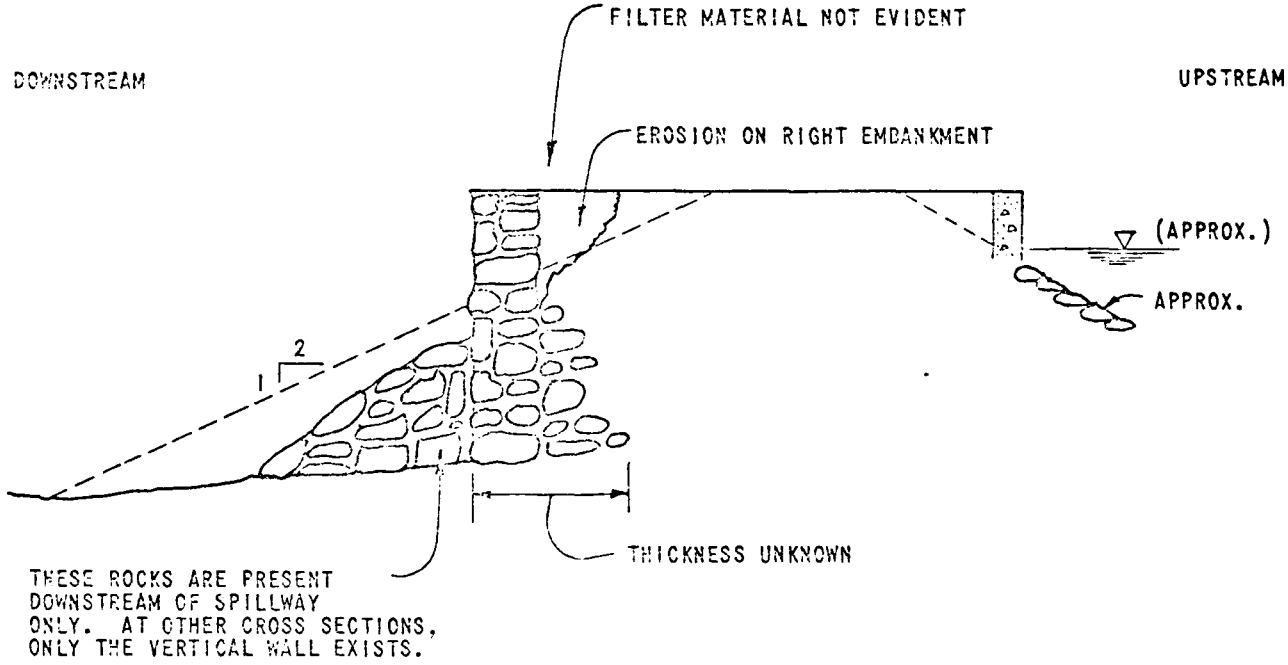
DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEER			U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

STAR LAKE DAM
DETAILS

DRAWN	RB		SCALE 1"=20' HOR. AND VERT.
ENGR.	MRP		DATE JULY 1978

2 of 2



STAR LAKE DAM

N.T.S.

CROSS SECTION ABOUT 10 FT. RIGHT OF SPILLWAY

22-0553

JRS

RB

JULY 1978

STAR LAKE DAM

VERMONT

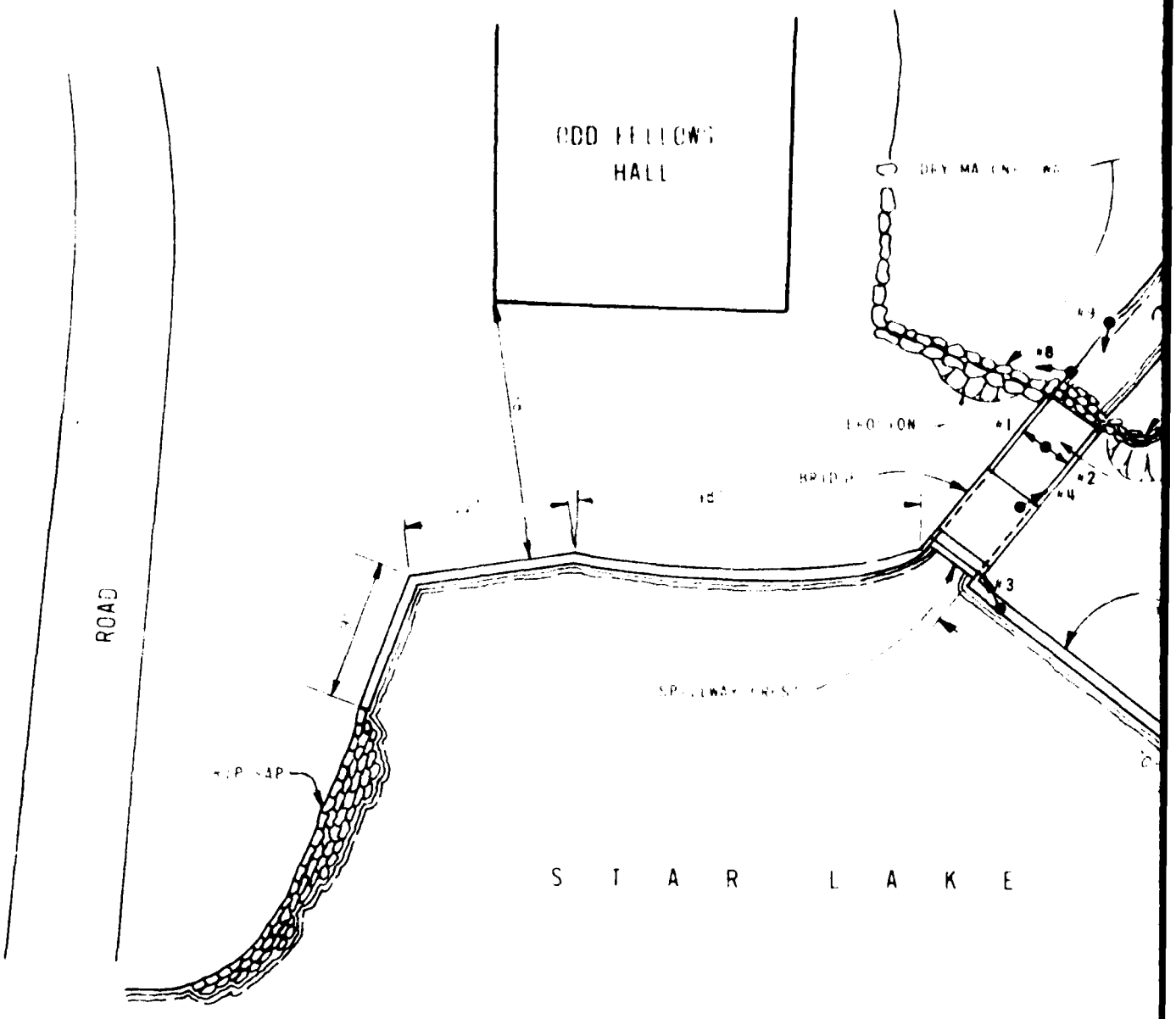
A

FIGURE 3

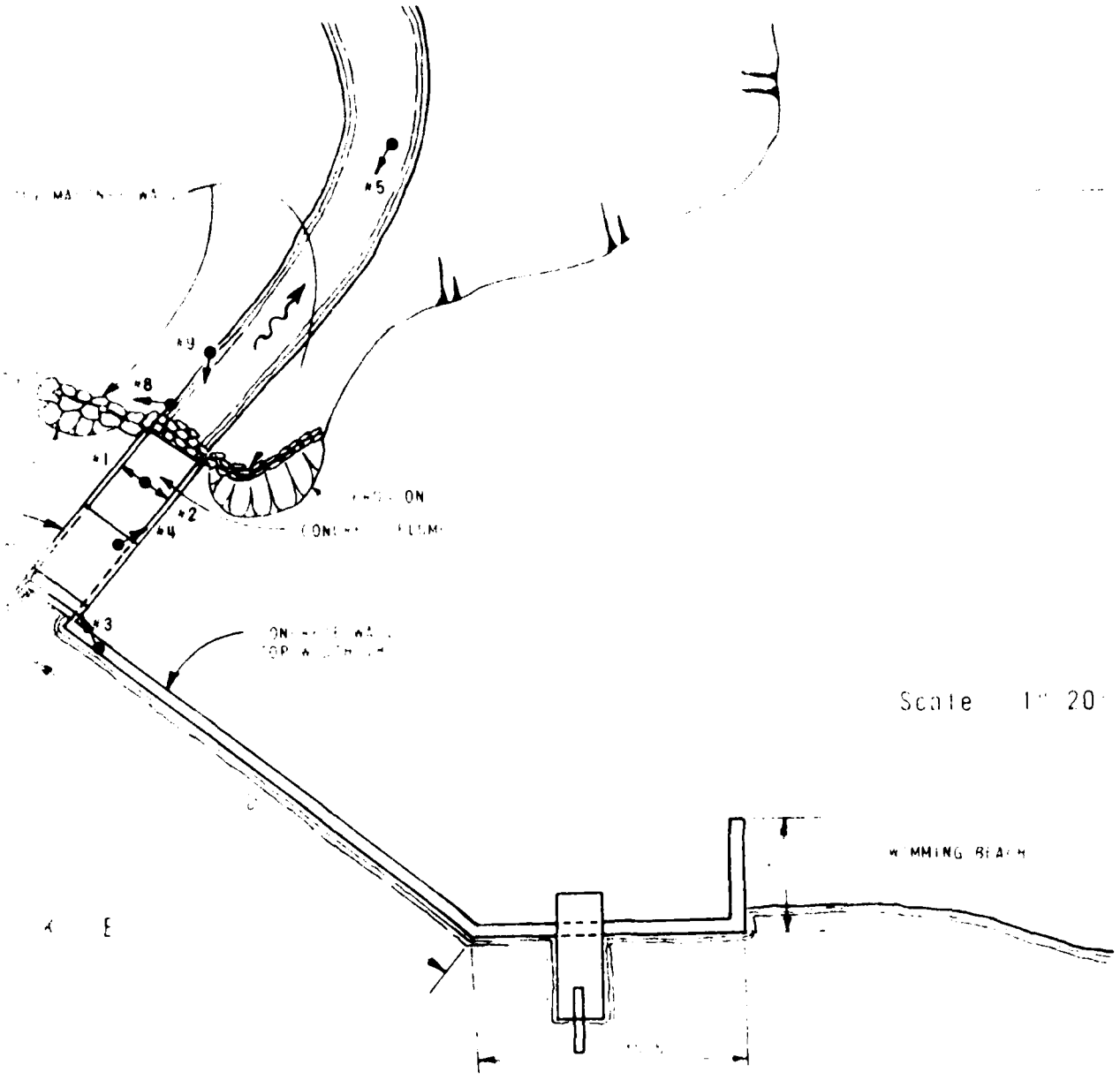
APPENDIX C

Photographs

1. Crack and misalignment in right wall and slab of flume.
2. Crack and separation of flume - note all flow is entering the crack and the material below.
3. Right abutment for footbridge and support for stop board angle.
4. Erosion along left wall of spillway flume.
5. Downstream channel looking upstream towards spillway.
6. Box culvert under road - note constriction.
7. Downstream channel where basement wall of house forms a portion of box culvert.
8. Bow in right vertical dry stone masonry wall which supports the concrete spillway.
9. Rubble and debris at end of spillway - note 2' diameter outlet pipe.



NOTE: PHOTOGRAPHS #6 AND #7 WERE TAKEN DOWNSTREAM (WESTERLY) FROM THIS SKETCH WHERE THE OUTLET STREAM PASSES UNDER THE ROADWAY IN BELMONT VILLAGE. NO. 6 IS AT INLET UNDER ROADWAY AND NO. 7 IS AT THE OUTLET



[illegible] ENGINEERING CORP.	U.S. ARMY ENGINEER DIV. NEW ENGLAND

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCATIONS OF PHOTOGRAPHS TAKEN JUNE 20, 1978

DRAWN	RB		SCALE	AS SHOWN
ENGR.	MRP		DATE	JULY 1978

2 of 2

#1 CRACK AND MISALIGNMENT IN RIGHT WALL AND SLAB OF FLUME

#2

CRACK AND SEPARATION OF FLUME-
NOTE ALL FLOW IS ENTERING THE
CRACK AND THE MATERIAL BELOW

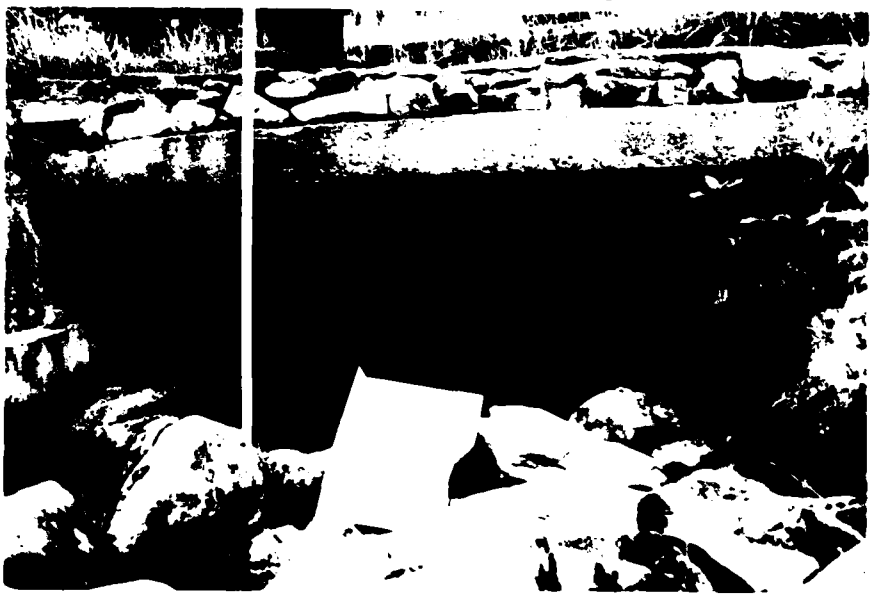
#3

RIGHT ABUTMENT FOR FOOT BRIDGE AND SUPPORT FOR STOP BOARD ANGLES

#4

EROSION ALONG LEFT WALL OF SPILLWAY FLUME

#5 DOWNSTREAM CHANNEL LOOKING UPSTREAM TOWARDS SPILLWAY



#6 BOX CULVERT UNDER ROAD NOTE CONSTRUCTION

#7

DOWNSTREAM CHANNEL WHERE BASEMENT WALL OF HOUSE FORMS A PORTION OF BOX CULVERT. LOOKING UPSTREAM

#8

BOW IN RIGHT VERTICAL DRY STONE MASONRY WALL WHICH SUPPORTS THE CONCRETE SPILLWAY.

#9 RUBBLE AND DEBRIS AT END OF SPILLWAY NOTE 2' DIAMETER OUTLET PIPE

APPENDIX D

HYDRAULIC COMPUTATIONS

DUFRESNE-HENRY ENGINEERING CORPORATION

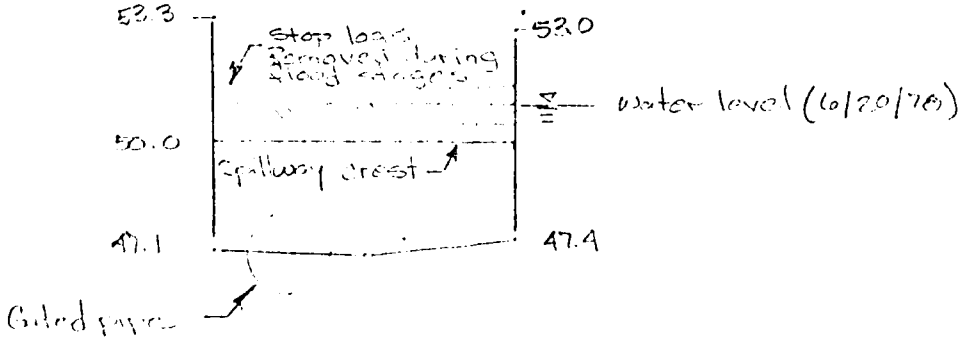
BY JCF SUBJECT STAR LAKE DAM SHEET NO. 1 OF 11
DATE 7/10/78 JOB NO. 22-0553

RATING CURVE COMPUTATIONS

Outlet works consist of a principal concrete flume spillway and a 2 foot diameter gated pipe spillway with an invert 4 feet below the crest of the flume. The flume is about 29 feet long with a vertical drop of 2.7 feet. The 2 foot C.I.P drops 2 feet over its length and is controlled by a gate at the inlet with an upright square timber that functions as a gate stem. Stop logs at the upstream end of the concrete flume serve to increase lake levels during the low-water season. These stop logs are inserted and raised by hand.

Upon inspection, three 0.5' stop logs were in place raising the lake level 1.0 foot (assumed elevation 1851 feet msl.) above the crest of the spillway. Stop logs were easily removed and during flood stage it is assumed they would be removed. The pipe spillway gate was covered over with approximately 1'-2' of silt and debris. In addition, the wooden gate stem was broken off 0.5' above water level. The pipe gate was deemed inoperable.

Compute Flume Spillway Computations



Discharge Equation: $Q = CLh^{3/2}$

$Q = 3.1 * 8 * h^{3/2} = 21.8\ h^{3/2}$

Elevation	h	$h^{3/2}$	Q
50.5	0.5	0.35	9
51.0	1.0	1.00	25
51.5	1.5	1.84	46
52.0	2.0	2.83	70
52.5	2.5	3.95	98
53.0	3.0	5.20	129
53.5	3.5	6.55	162
54.0	4.0	8.00	198
54.5	4.5	9.55	237
55.0	5.0	11.18	277
55.5	5.5	12.90	320
56.0	6.0	14.70	365
56.5	6.5	16.57	411
57.0	7.0	18.52	459
57.5	7.5	20.54	509
58.0	8.0	22.63	561

Velocity head assumed negligible

Overbank Flow Computations

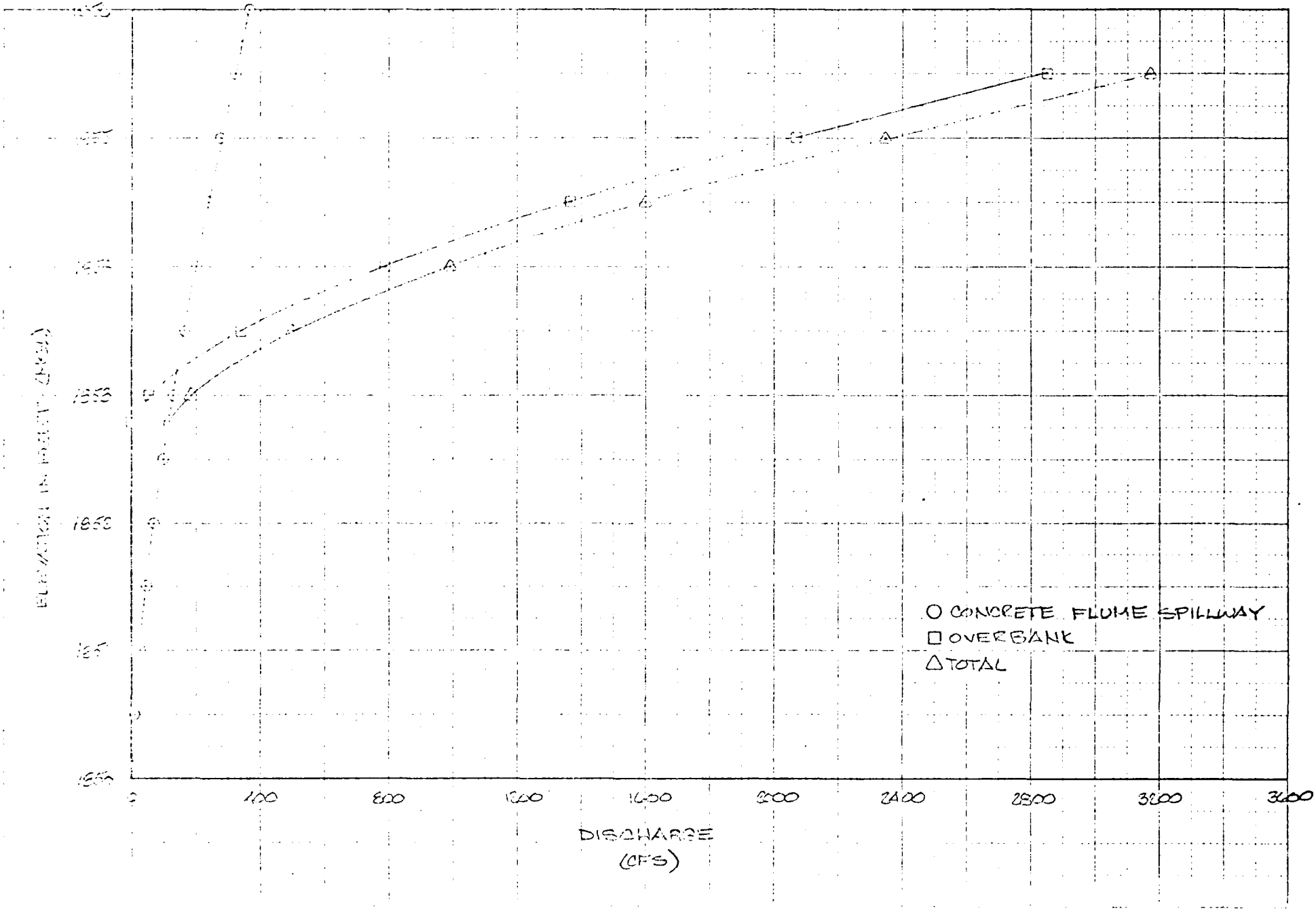
Discharge Equation: $Q = CAh^{1/2}$ [1]

where; A = Flow area over embankment at a given depth h
h = flow depth measured from the low point on the embankment
C = weir flow coefficient

Velocity head in overbank flow areas is assumed to be negligible
Low embankment elevation ≈ 52.8 (average)

Elev.	h	A	C	Q
1853	0.2	49	2.5	55
53.5	0.7	163	↓	341
54	1.2	289		791
54.5	1.7	419		1366
55	2.2	558		2069
55.5	2.7	694		2851
56	3.2	832		3721

[1] Soil Conservation Service, NEH, Section 4, page 14-46


ELEVATION IN FEET (MSL)
1858
1856
1854
1852
1850
0
400
800
1200
1600
2000
2400
2800
3200
3600
DISCHARGE
(CFS)
O CONCRETE FLUME SPILLWAY
□ OVERBANK
△ TOTAL

Storage Computation

From previous inspection reports, the lake normally stores 413 acre-ft of water.[1] From previous correspondence, the lake area at elev. 1846 is 15 acres,[2] at 1850 is 50[3] acres, and from planimetering, is normally 62 acres (at elev 1851)

Elevation (ft. msl.)	Area (acres)	Total Storage (acre-ft)	Storage above Pipe Invert (acre-ft)	Storage above Spillway Crest (acre-ft)
1846	15	227	0	0
1850	50	357	130	0
1851	62	413	186	56
1852	↓	475	248	118
1853		537	310	180
1854		599	372	242
1855		661	434	304
1856		723	496	366

[1] State of Vt. 1952 Dam Inspection Report
[2] Correspondence, J.E. Corrutti to H.J. Kreppein, 20 September 1961
[3] Correspondence, H.J. Kreppein to J.E. Corrutti, 28 September 1961

Spillway Design Flood

Size Classification:	Storage (Ac-Ft)	Height (Ft)
	~525	~15

Size Category is Small

Hazard Potential:
Dam failure would damage isolated homes, secondary highways, and agricultural areas. Loss of life would be limited. The hazard potential would, therefore, be significant

One-half the Probable Maximum Flood (0.5* PMF) is chosen as the Spillway Design Flood (SDF) in accordance with Corps of Engineers recommendations

DUFRESNE-HENRY ENGINEERING CORPORATION

BY DCF SUBJECT STAR LAKE DAM SHEET NO [illegible] OF [illegible]
DATE 7/10/78 JOB NO [illegible]

DETERMINATION OF SNYDER'S SYNTHETIC HYDROGRAPH COEFFICIENTS, C_p & t_p

C_p assumed = 0.68 (average value found by equating Snyder u.h. to SCS UHG)

t_p = lag time from midpoint of unit duration rainfall to peak of unit hydrograph (hours).

SCS curve number method[1]

$$L = \text{lag time (hrs)} = t_p = \frac{\ell^{0.8}(S+1)^{0.7}}{1900\, Y^{0.5}}$$

where L = lag time (hrs) = t_p
ℓ = hydraulic length of watershed (greatest flow length) ft.
$S = (1000/CN) - 10$
Y = average watershed land slope in percent

$\ell = 6340$ ft
$S = (1000/70) - 10 = 4.3$
$Y = 10.2$

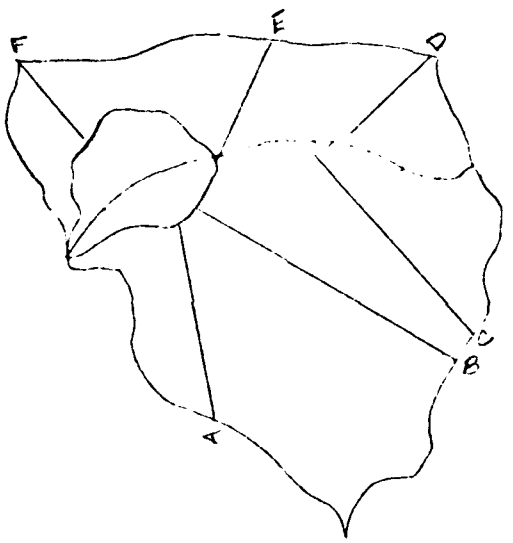
$$L = \frac{6340^{0.8}\,(4.3+1)^{0.7}}{1900\,(10.2)^{0.5}} = \frac{(1100.7)(3.0)}{(1900)(3.2)} = 0.58 \approx 0.6 \text{ hour}$$

[1] Soil Conservation Service, NEH, Section 4, Hydrology, August 1[illegible] pages 15-1 7

SOILS

DRAINAGE AREA SOILS ARE COMPRISED OF THE MARLOW-PERU-LYMAN SLOPING ASSOCIATION AND THE PERU-MARLOW-LYMAN ASSOCIATION. THESE ARE GENERALLY WELL DRAINED LOAMY GLACIAL TILL SOILS, LOW IN LIME CONTENT, WITH A HARDPAN OR BEDROCK WITHIN 3 FEET OF THE SURFACE. BOTH SOIL TYPES ARE IN HYDROLOGIC SOIL GROUP C.

THE DRAINAGE AREA HAS A GOOD FOREST COVER RESULTING IN A CN 70



SLOPE COMPUTATION

SLOPE	DROP (FT)	LENGTH (FT)	SLOPE (%)	% OF WATERSHED	%×SLOPE
A	189	2770	6.8	25	170
B	369	4150	8.8	24	211
C	350	3430	11.1	14	155
D	340	1630	20.9	14	293
E	201	1850	11.3	11	124
F	89	1540	5.8	12	70
				Σ=	1023

Average Slope = 1023/100 = 10.2%

STAR LAKE
DRAINAGE AREA = 1.10 SQ

Probable Maximum Storm

Maximum possible 24-hour precipitation over a 200 square mile area at Star Lake is 17 inches[1]

Duration Hrs	% Index
6	110
12	122
24	132
48	142

Rainfall Loss Data

Initial rainfall loss is 0.35 inches from SCS, NEH-4, (page 10.7) for a curve number (CN) 70 under multiple day storm conditions (Antecedent Moisture Condition III)

Infiltration rates for clay loams and sandy loams typical of glacial till soils vary from 0.05 - 0.15 in/hr. for Hydrologic Group C soils and from 0.15 - 0.30 in/hr for Group B soils[2]. Soils in the Star Lake watersheds are in Group C. Infiltration rate is assumed to be 0.15 inch/hour.

Initial Flow

Quick Return Flow (QRF) from SCS, NEH-4 is 10.44 csm. QRF is related to the Climatic Index, $C_i = 100 P_a / (T_a)^2$ where P_a = average annual precipitation in inches
T_a = " " temperature in degrees F.

$C_i = 100 (48) / 45.3 = 2.34$

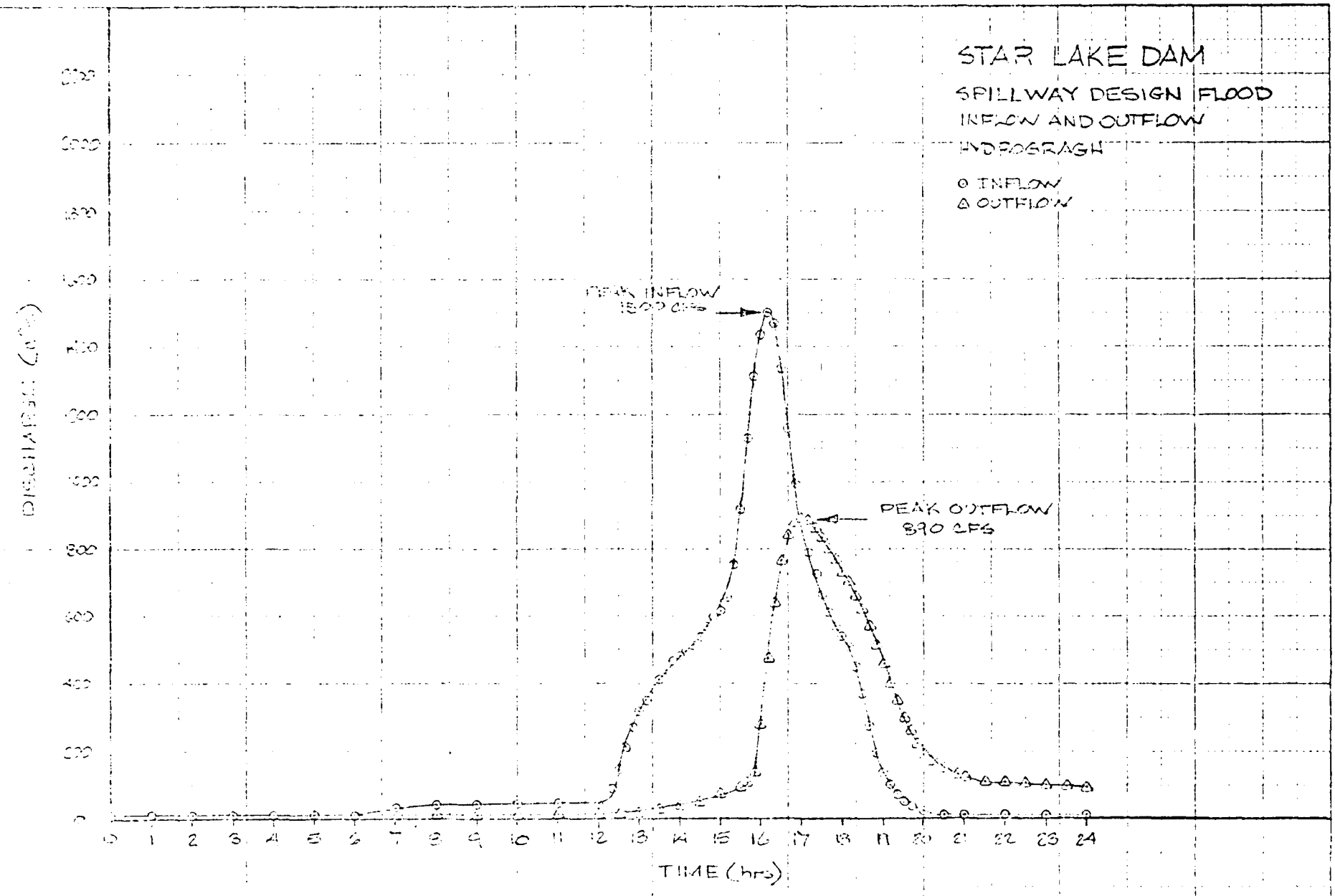
1 Department of the Army, Office of the Chief of Engineers, Civil Engineer Bulletin No. 52-8, Plate No. 1, 26 Mar. 19[illegible]

2 Chow, V.T., Handbook of Applied Hydrology, McGraw-Hill, New York, Page 12-26.

HEC-1 Results

Runoff Computation

	PMF (cfs) INFLOW	0.5 PMF (cfs) INFLOW	0.5 PMF (cfs) OUTFLOW
Peak	3000	1500	890
Peak 6-hr	1420	710	460
Peak 24-hr	400	200	130


STAR LAKE DAM
SPILLWAY DESIGN FLOOD
INFLOW AND OUTFLOW
HYDROGRAGH
⊙ INFLOW
△ OUTFLOW
PEAK INFLOW
1500 CFS
PEAK OUTFLOW
890 CFS
DISCHARGE (CFS)
TIME (hrs)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

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

SPILLWAY DESIGN FLOOD
STAR LAKE DAM
PHASE I DAM SAFETY INVESTIGATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	10	1	0	0	0	2	0	0

JOPER	NWT
3	0

SUB-AREA RUNOFF COMPUTATION

PROBABLE MAXIMUM 24-HOUR PRECIPITATION

ISTAW	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.10	0.0	1.10	0.0	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	17.00	110.00	122.00	132.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.304

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.35	0.25	0.0	0.09

UNIT HYDROGRAPH DATA
TP= 0.60 CP=0.68 NTA= 0

RECESSION DATA
STRTQ= 11.00 QRCSN= 11.00 RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 4.20 AND R= 2.61 INTERVALS

UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES, LAG= 0.60 HOURS, CP= 0.68 VOL= 1.00

104.	365.	649.	790.	697.	500.	349.	243.	170.	118.
83.	58.	40.	28.	20.	14.	10.	7.		

END-OF-PERIOD FLOW

	TIME	RAIN	EXCS	COMP Q
1	0 10	0.01	0.00	11.
1	0 20	0.01	0.00	12.
1	0 30	0.01	0.00	12.
1	0 40	0.01	0.00	13.
1	0 50	0.01	0.00	14.
1	1 00	0.01	0.00	15.
1	1 10	0.01	0.00	15.
1	1 20	0.01	0.00	15.
1	1 30	0.01	0.00	16.
1	1 40	0.01	0.00	16.
1	1 50	0.01	0.00	16.

1	12	60	0.26	0.24	692.
1	13	10	0.26	0.24	700.
1	13	20	0.26	0.24	768.
1	13	30	0.26	0.24	827.
1	13	40	0.26	0.24	883.
1	13	50	0.26	0.24	928.
1	13	60	0.26	0.24	961.
1	14	10	0.33	0.31	990.
1	14	20	0.33	0.31	1030.
1	14	30	0.33	0.31	1083.
1	14	40	0.33	0.31	1143.
1	14	50	0.33	0.31	1194.
1	14	60	0.33	0.31	1231.
1	15	10	0.83	0.81	1308.
1	15	20	0.83	0.81	1510.
1	15	30	0.83	0.81	1849.
1	15	40	0.83	0.81	2256.
1	15	50	0.83	0.81	2614.
1	15	60	0.83	0.81	2870.
1	16	10	0.31	0.28	2994.
1	16	20	0.31	0.28	2926.
1	16	30	0.31	0.28	2671.
1	16	40	0.31	0.28	2316.
1	16	50	0.31	0.28	1991.
1	16	60	0.31	0.28	1758.
1	17	10	0.24	0.22	1588.
1	17	20	0.24	0.22	1450.
1	17	30	0.24	0.22	1327.
1	17	40	0.24	0.22	1220.
1	17	50	0.24	0.22	1135.
1	17	60	0.24	0.22	1076.
1	18	10	0.02	0.00	1009.
1	18	20	0.02	0.00	899.
1	18	30	0.02	0.00	737.
1	18	40	0.02	0.00	550.
1	18	50	0.02	0.00	389.
1	18	60	0.02	0.00	273.
1	19	10	0.02	0.00	195.
1	19	20	0.02	0.00	140.
1	19	30	0.02	0.00	100.
1	19	40	0.02	0.00	74.
1	19	50	0.02	0.00	57.
1	19	60	0.02	0.00	44.
1	20	10	0.02	0.00	35.
1	20	20	0.02	0.00	29.
1	20	30	0.02	0.00	25.
1	20	40	0.02	0.00	22.
1	20	50	0.02	0.00	20.
1	20	60	0.02	0.00	19.
1	21	10	0.02	0.00	19.
1	21	20	0.02	0.00	19.
1	21	30	0.02	0.00	19.
1	21	40	0.02	0.00	19.
1	21	50	0.02	0.00	19.
1	21	60	0.02	0.00	19.
1	22	10	0.02	0.00	19.
1	22	20	0.02	0.00	19.
1	22	30	0.02	0.00	19.
1	22	40	0.02	0.00	19.
1	22	50	0.02	0.00	19.
1	22	60	0.02	0.00	19.
1	23	10	0.02	0.00	19.
1	23	20	0.02	0.00	19.
1	23	30	0.02	0.00	19.
1	23	40	0.02	0.00	19.
1	23	50	0.02	0.00	19.

1	2	10	0.01	0.00	16.
1	2	20	0.01	0.00	16.
1	2	30	0.01	0.00	16.
1	2	40	0.01	0.00	16.
1	2	50	0.01	0.00	16.
1	2	60	0.01	0.00	16.
1	3	10	0.01	0.00	16.
1	3	20	0.01	0.00	16.
1	3	30	0.01	0.00	16.
1	3	40	0.01	0.00	16.
1	3	50	0.01	0.00	16.
1	3	60	0.01	0.00	16.
1	4	10	0.01	0.00	16.
1	4	20	0.01	0.00	16.
1	4	30	0.01	0.00	16.
1	4	40	0.01	0.00	16.
1	4	50	0.01	0.00	16.
1	4	60	0.01	0.00	16.
1	5	10	0.01	0.00	16.
1	5	20	0.01	0.00	16.
1	5	30	0.01	0.00	16.
1	5	40	0.01	0.00	16.
1	5	50	0.01	0.00	16.
1	5	60	0.01	0.00	16.
1	6	10	0.04	0.02	18.
1	6	20	0.04	0.02	24.
1	6	30	0.04	0.02	34.
1	6	40	0.04	0.02	47.
1	6	50	0.04	0.02	58.
1	6	60	0.04	0.02	66.
1	7	10	0.04	0.02	71.
1	7	20	0.04	0.02	75.
1	7	30	0.04	0.02	78.
1	7	40	0.04	0.02	80.
1	7	50	0.04	0.02	81.
1	7	60	0.04	0.02	82.
1	8	10	0.04	0.02	83.
1	8	20	0.04	0.02	83.
1	8	30	0.04	0.02	84.
1	8	40	0.04	0.02	84.
1	8	50	0.04	0.02	84.
1	8	60	0.04	0.02	84.
1	9	10	0.04	0.02	84.
1	9	20	0.04	0.02	84.
1	9	30	0.04	0.02	84.
1	9	40	0.04	0.02	84.
1	9	50	0.04	0.02	84.
1	9	60	0.04	0.02	84.
1	10	10	0.04	0.02	84.
1	10	20	0.04	0.02	84.
1	10	30	0.04	0.02	84.
1	10	40	0.04	0.02	84.
1	10	50	0.04	0.02	84.
1	10	60	0.04	0.02	84.
1	11	10	0.04	0.02	84.
1	11	20	0.04	0.02	84.
1	11	30	0.04	0.02	84.
1	11	40	0.04	0.02	84.
1	11	50	0.04	0.02	84.
1	11	60	0.04	0.02	84.
1	12	10	0.22	0.20	102.
1	12	20	0.22	0.20	169.
1	12	30	0.22	0.20	265.
1	12	40	0.22	0.20	426.
1	12	50	0.22	0.20	551.

SUM 15.66 13.08 57023.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2994.	1416.	396.	396.	57012.
INCHES		11.98	13.39	13.39	13.39
AC-FT		703.	786.	786.	786.

DVR

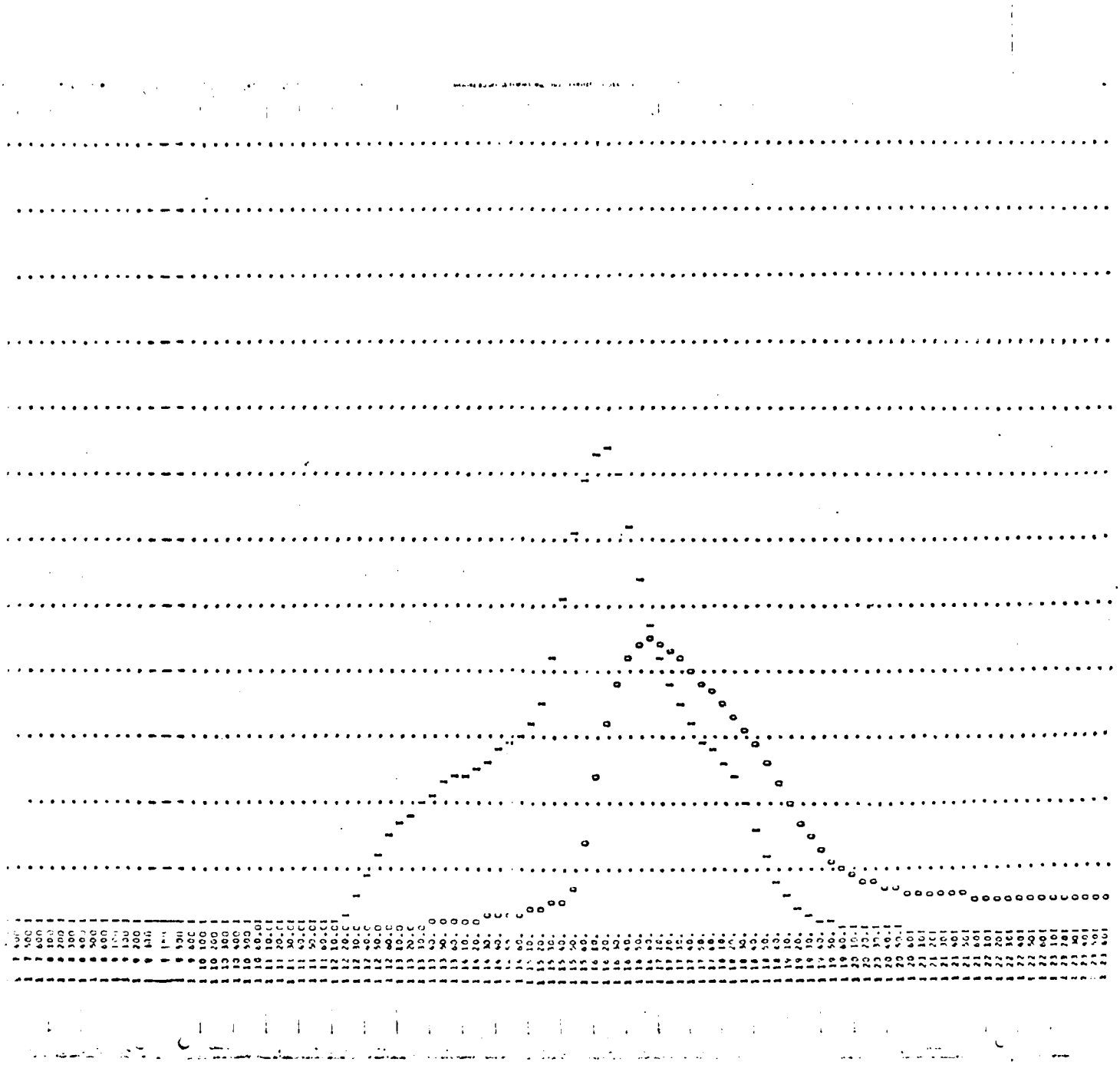
RUNOFF MULTIPLIED BY 0.50

6.	6.	6.	7.	7.	7.	8.	8.	8.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
8.	8.	8.	8.	8.	8.	9.	12.	17.	23.
29.	33.	36.	38.	39.	40.	40.	41.	41.	41.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	51.	84.	142.	213.	276.	321.	354.	384.
413.	441.	464.	480.	495.	515.	542.	572.	597.	615.
654.	755.	925.	1128.	1307.	1435.	1497.	1463.	1336.	1158.
996.	879.	794.	725.	664.	610.	568.	538.	504.	449.
368.	275.	194.	137.	97.	70.	51.	36.	29.	22.
18.	15.	13.	11.	10.	9.	9.	9.	9.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	9.	9.	9.						

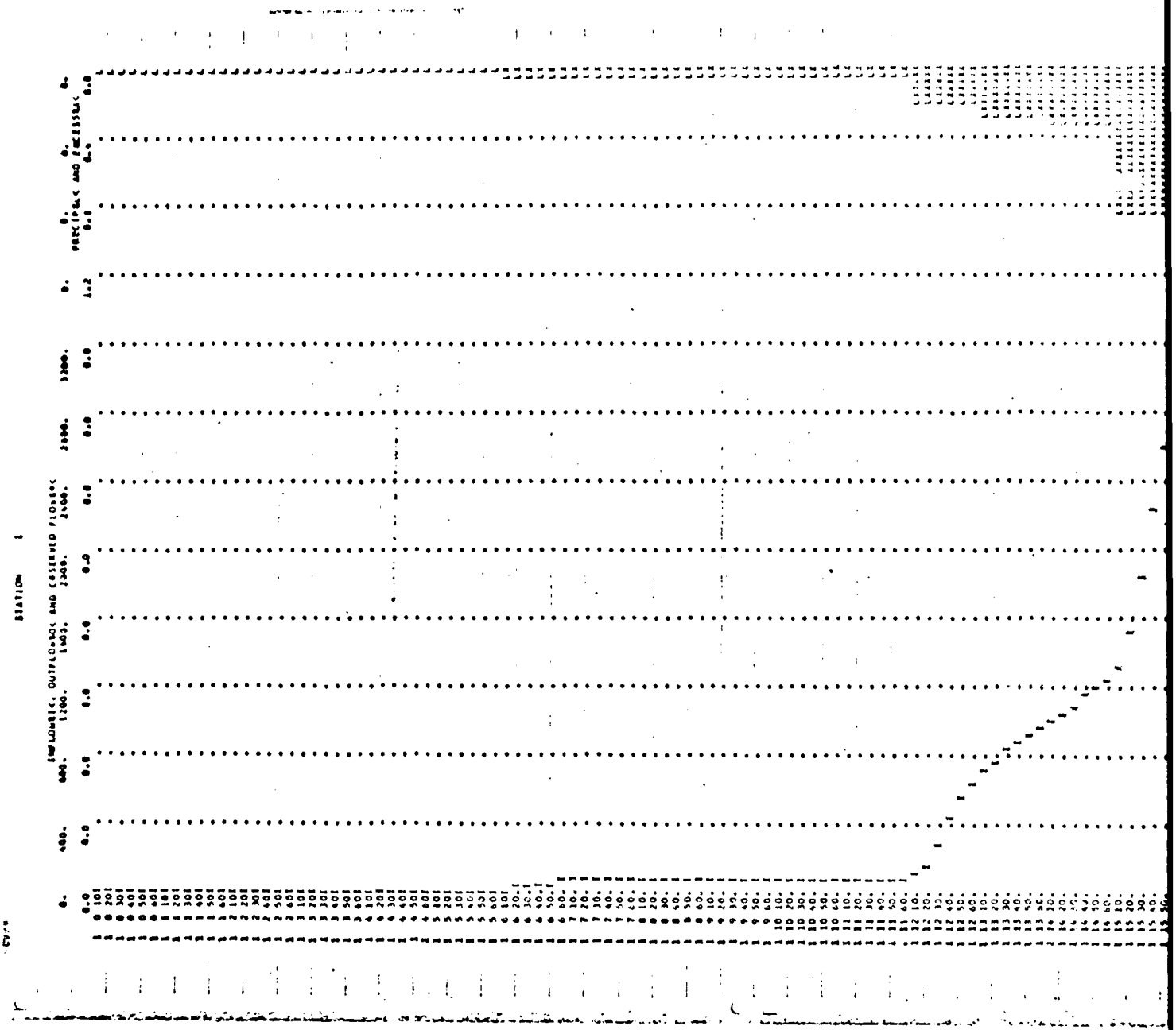
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1497.	708.	196.	198.	28506.
INCHES		5.99	6.70	6.70	6.70
AC-FT		351.	393.	393.	393.

STATION
INFLOWRIC, OUTFLOWRIC AND OBSERVED FLOWRIC
0.
200.
400.
600.
800.
1000.
1200.
1400.
1600.

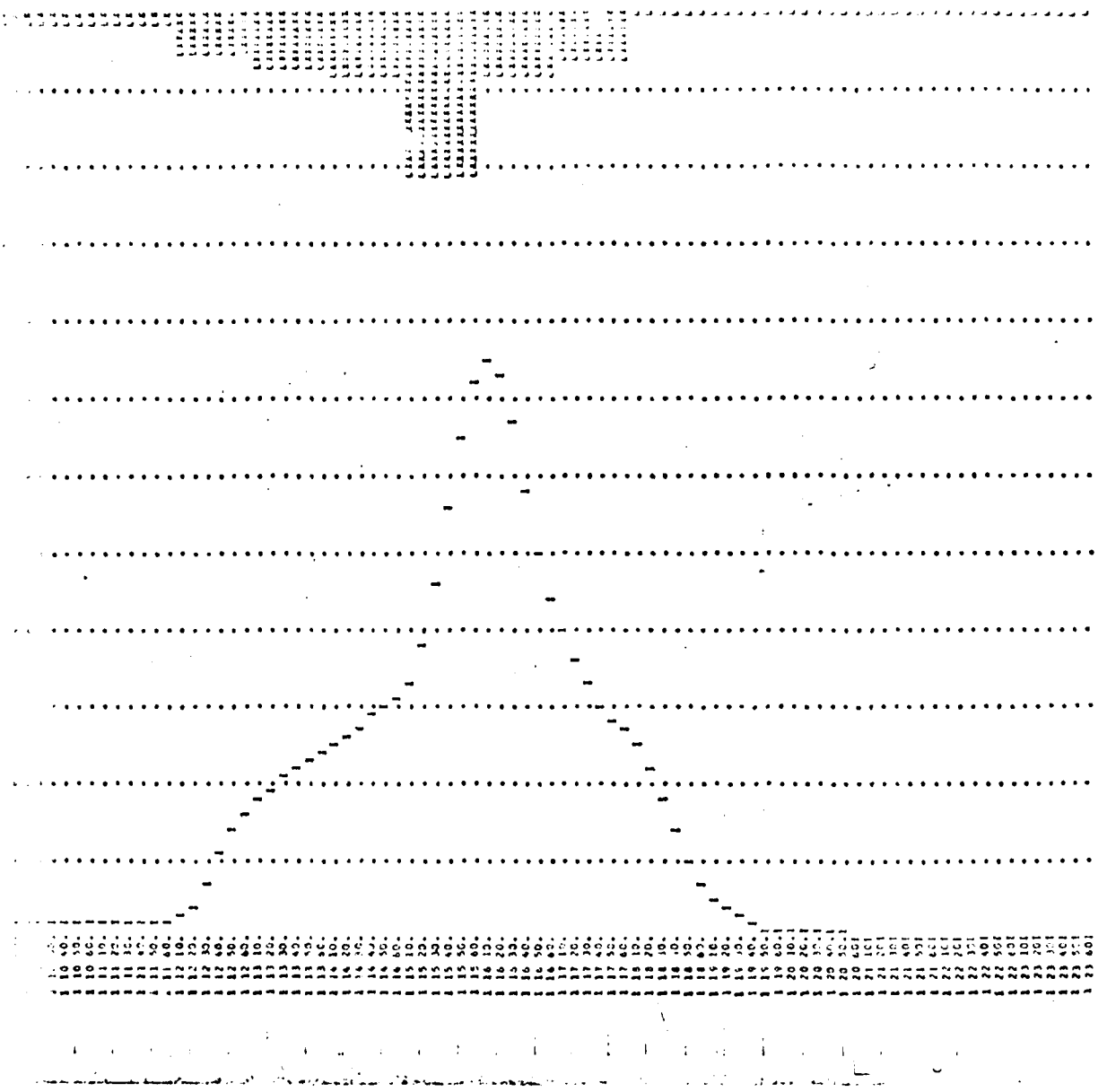
1 of 2



2 of 2



1 of 2



DVN*

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

HYDROGRAPH ROUTING

PULS RESERVOIR ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.0	0.0	0.0	-1.

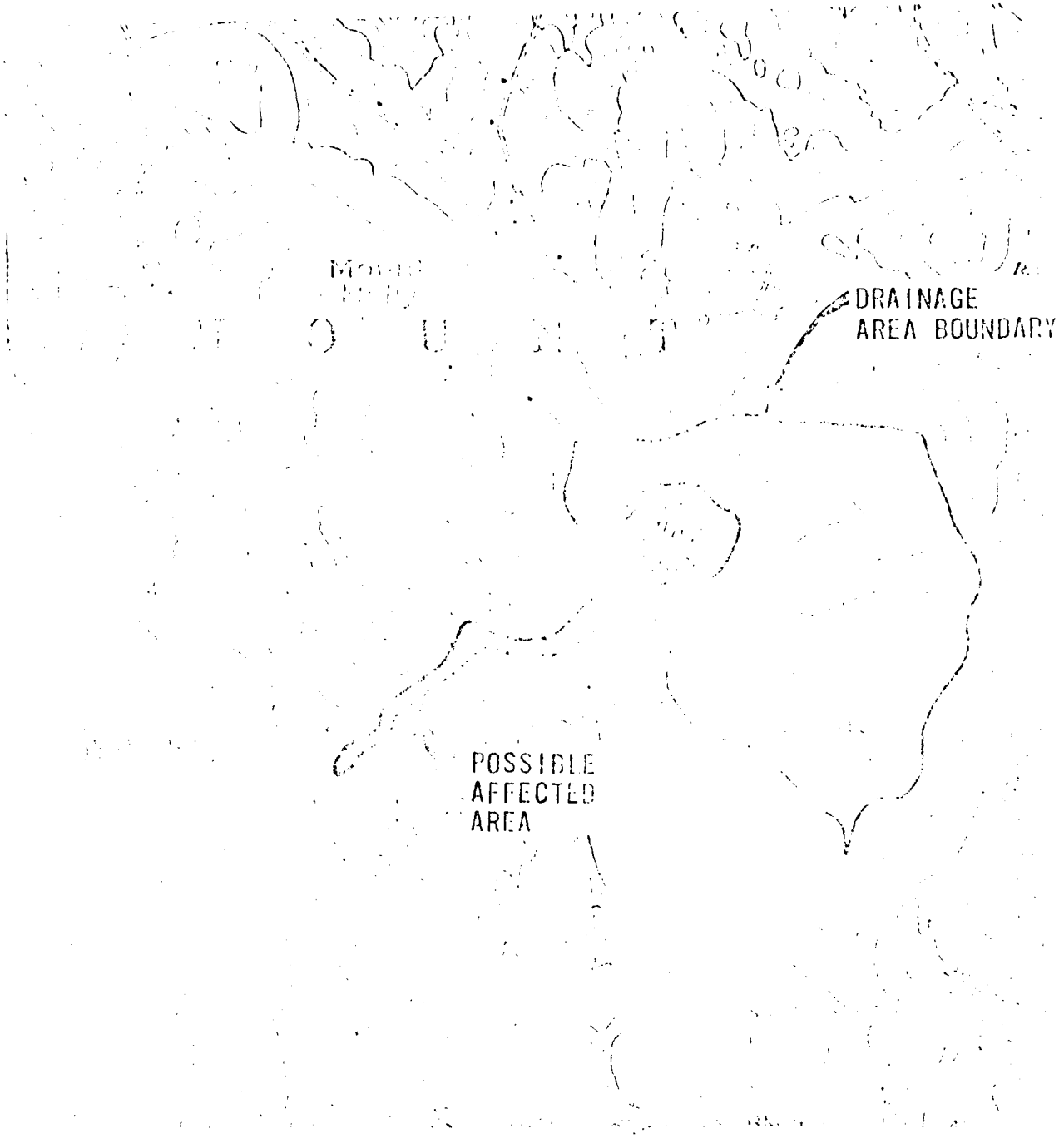
STORAGE	357.	385.	413.	444.	475.	506.	525.	537.	599.	661.
OUTFLOW	0.	9.	25.	46.	70.	98.	116.	164.	990.	2390.

	TIME	EOP STOR	AVG IN	EOP OUT
1	0 10	374.	6.	6.
1	0 20	374.	6.	6.
1	0 30	374.	6.	6.
1	0 40	374.	6.	6.
1	0 50	374.	7.	6.
1	0 60	374.	7.	6.
1	1 10	374.	7.	6.
1	1 20	374.	8.	6.
1	1 30	374.	8.	6.
1	1 40	374.	8.	6.
1	1 50	375.	8.	6.
1	1 60	375.	8.	6.
1	2 10	375.	8.	6.
1	2 20	375.	8.	6.
1	2 30	375.	8.	6.
1	2 40	375.	8.	6.
1	2 50	375.	8.	6.
1	2 60	375.	8.	6.
1	3 10	375.	8.	6.
1	3 20	375.	8.	6.
1	3 30	375.	8.	6.
1	3 40	375.	8.	6.
1	3 50	375.	8.	6.
1	3 60	375.	8.	6.
1	4 10	375.	8.	6.
1	4 20	375.	8.	6.
1	4 30	375.	8.	6.
1	4 40	375.	8.	6.
1	4 50	375.	8.	6.
1	4 60	375.	8.	6.
1	5 10	375.	8.	6.
1	5 20	375.	8.	6.
1	5 30	375.	8.	6.
1	5 40	375.	8.	6.
1	5 50	375.	8.	6.
1	5 60	375.	8.	6.
1	6 10	375.	8.	6.
1	6 20	375.	10.	6.
1	6 30	376.	14.	6.
1	6 40	376.	20.	6.
1	6 50	376.	26.	6.

1	6	60	376.	31.	6.
1	7	10	377.	34.	6.
1	7	20	377.	37.	6.
1	7	30	378.	38.	7.
1	7	40	378.	39.	7.
1	7	50	378.	40.	7.
1	7	60	379.	41.	7.
1	8	10	379.	41.	7.
1	8	20	380.	41.	7.
1	8	30	380.	42.	7.
1	8	40	381.	42.	8.
1	8	50	381.	42.	8.
1	8	60	382.	42.	8.
1	9	10	382.	42.	8.
1	9	20	383.	42.	8.
1	9	30	383.	42.	8.
1	9	40	384.	42.	9.
1	9	50	384.	42.	9.
1	9	60	385.	42.	9.
1	10	10	385.	42.	9.
1	10	20	385.	42.	9.
1	10	30	386.	42.	9.
1	10	40	386.	42.	10.
1	10	50	387.	42.	10.
1	10	60	387.	42.	10.
1	11	10	388.	42.	10.
1	11	20	388.	42.	11.
1	11	30	388.	42.	11.
1	11	40	389.	42.	11.
1	11	50	389.	42.	11.
1	11	60	390.	42.	12.
1	12	10	390.	47.	12.
1	12	20	391.	66.	12.
1	12	30	392.	113.	13.
1	12	40	395.	178.	14.
1	12	50	398.	244.	16.
1	12	60	402.	298.	19.
1	13	10	406.	337.	21.
1	13	20	411.	369.	24.
1	13	30	416.	399.	27.
1	13	40	421.	427.	31.
1	13	50	427.	453.	35.
1	13	60	433.	472.	39.
1	14	10	439.	488.	43.
1	14	20	446.	505.	47.
1	14	30	452.	528.	52.
1	14	40	459.	557.	58.
1	14	50	466.	584.	63.
1	14	60	474.	606.	69.
1	15	10	482.	635.	76.
1	15	20	490.	704.	84.
1	15	30	501.	840.	93.
1	15	40	513.	1026.	105.
1	15	50	528.	1218.	135.
1	15	60	544.	1371.	281.
1	16	10	559.	1466.	416.
1	16	20	572.	1480.	641.
1	16	30	582.	1359.	765.
1	16	40	588.	124?.	845.
1	16	50	591.	1072.	883.
1	16	60	591.	937.	852.
1	17	10	591.	836.	883.
1	17	20	589.	759.	8?2.
1	17	30	587.	694.	835.
1	17	40	585.	637.	802.
1	17	50	582.	589.	767.

1	18	10	576.	521.	697.
1	18	20	574.	477.	661.
1	18	30	571.	409.	620.
1	18	40	567.	322.	571.
1	18	50	562.	235.	515.
1	18	60	558.	165.	458.
1	19	10	554.	117.	402.
1	19	20	550.	84.	350.
1	19	30	546.	61.	302.
1	19	40	543.	44.	260.
1	19	50	540.	33.	223.
1	19	60	537.	25.	190.
1	20	10	535.	20.	174.
1	20	20	533.	16.	162.
1	20	30	531.	14.	151.
1	20	40	529.	12.	141.
1	20	50	528.	11.	131.
1	20	60	526.	10.	122.
1	21	10	524.	9.	116.
1	21	20	523.	9.	114.
1	21	30	522.	9.	113.
1	21	40	520.	9.	111.
1	21	50	519.	9.	110.
1	21	60	517.	9.	109.
1	22	10	516.	9.	108.
1	22	20	515.	9.	106.
1	22	30	513.	9.	105.
1	22	40	512.	9.	104.
1	22	50	511.	9.	103.
1	22	60	510.	9.	101.
1	23	10	508.	9.	100.
1	23	20	507.	9.	99.
1	23	30	506.	9.	98.
1	23	40	505.	9.	97.
1	23	50	503.	9.	96.
1	23	60	502.	9.	95.
		SUM			19264.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	852.	455.	134.	134.	19264.
INCHES		3.85	4.53	4.53	4.53
AC-FT		226.	265.	265.	265.



DRAINAGE AREA = 1.10 SQ. MI.

JOB NO.	22-0553
SCALE	
DRAWN BY	—
DATE	

EDWARD HENRY ENGINEERING CORP.

DRAINAGE AREA MAP

APPENDIX E

Information as contained in the National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
VT	10 NED		VT 021	01				STAR LAKE DAM	4524.9	7249.2	15	AUG	78

POPULAR NAME	NAME OF IMPOUNDMENT
	STAR LAKE

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI)	POPULATION
01 01	TROUT RIVER	BELMONT	0	400

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT)	DIST	JWN	FED H	PRV/FED	SCS A	VER/DATE
RECTANG	1900	R	16	15	525	413	NED	N	N	N	N	07AUG78

REMARKS

DAMS	SPILLWAY LENGTH (FT)	SPILLWAY TYPE	SPILLWAY WIDTH	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PLANNED (MW)	NAVIGATION LOCKS NO.	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
1	217	C	8	116	4500											

OWNER	ENGINEERING BY	CONSTRUCTION BY
BELMONT PLAYGROUND SOC.		

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
DUFRESNE-HENRY ENG CORP	20JUN78	PL 92-367

REMARKS

END

FILMED

9-85

DTIC