

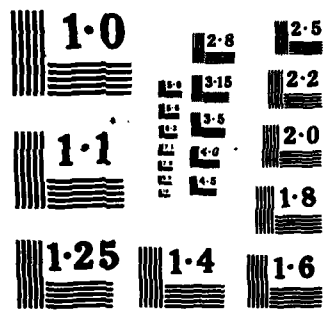
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
LAKE MANSFIELD DAM (V. 1U) CORPS OF ENGINEERS WALTHAM
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**RICHELIEU RIVER BASIN
STOWE, VERMONT**

**LAKE MANSFIELD DAM
VT 00100**

**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**



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

MARCH, 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is an earthfill dam with a cyclopean concrete core wall. The dam is about 500 ft. long and 32 ft. high. The dam is small in size with a significant hazard potential. The dam is judged to be in fair condition primarily because of the numerous trees on the crest, the condition of the upstream riprap and the fact that overtopping has occurred at a low zone near the right abutment. Annual record maintenance and recorded technical inspections should be instituted.		

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

REPLY TO
ATTENTION OF:
NEDED

DEC 06 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 Lake Mansfield Dam 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, Lake Mansfield Trout Club.

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,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

LAKE MANSFIELD DAM

VT00100

STOWE, VERMONT

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No: VT00100
Name of Dam: Lake Mansfield
Town: Stowe
County and State: Lamoille, Vermont
Stream: Miller Brook
Date of Inspection: November 21, 1978

BRIEF ASSESSMENT

Lake Mansfield Dam is an earthfill dam with a cyclopean (very large aggregate) concrete core wall. The upstream and downstream slopes are about 2H:1V and the crest is about 10 feet wide. The crest length is 500 feet and the dam is 32 feet high at the deepest part of the valley. The spillway is 33.5 feet long and was constructed in a separate channel in bedrock on the left side of the dam. Both the left and right spillway abutments appear to be bedrock. A small natural hill has been incorporated as part of the downstream face of the dam near the right side. The dam was constructed in 1909 and substantial repairs were made in 1965.

The dam is classified as small yet has a significant hazard potential in the event of dam failure. The impoundment has a surface area of about 41 acres at normal pool elevation and stores nearly 320 acre-feet. The dam is located near the headwaters of the Miller Brook in Stowe, Vermont. Three houses are located downstream along Miller Brook and would be within the marginal flood limits in the event of dam failure.

Due to the small size classification and significant hazard potential, one-half of the Probable Maximum Flood is used as the test flood. Under this condition, the dam would have a surcharge of 6.7 feet. The dam has a total drainage area of 2.5 square miles of steep-sloped forested land. The spillway has a capacity to carry 20% of the test flood flow of 4615 CFS (1846 CSM).

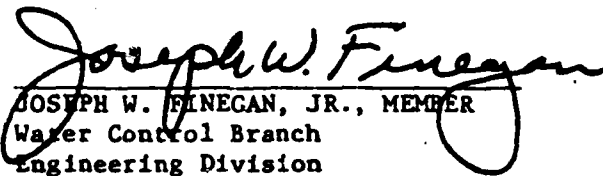
The dam is judged to be in fair condition primarily because of the numerous trees on the crest, the condition of the upstream riprap and the fact that overtopping has occurred at a low zone near the right abutment.

Annual recorded maintenance and recorded technical inspections should be instituted. The following recommendations and suggested remedial measures should be addressed:

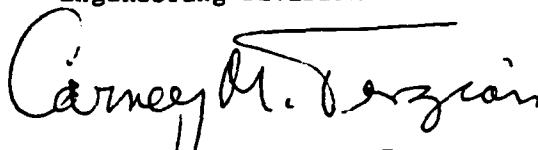
1. The trees on the crest of the dam should be cut and the root structures removed.
2. The crest should be made level over the entire length.
3. Repairs to the riprap on the upstream side of the crest should be implemented.
4. Discharge from drains and seepage should be analyzed and recorded on a monthly basis for flow and suspended solids concentration.
5. Growth on the downstream slope of the dam should be mowed yearly.

In addition, an engineer qualified in the design of dams should be engaged to analyze the spillway size and dam freeboard with respect to flood flows. Consideration should be given to construction of an emergency spillway.

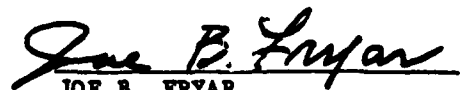
This Phase I Inspection Report on Lake Mansfield Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and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


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


JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division


CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design 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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There were no deposits of silt, sand or clay observed in any of the wet zones downstream from the drains or elsewhere along the toe of the dam. The pools downstream from one drain and from the low-level outlet were rusty-colored, as noted above.

The downstream face of the dam undulates enough to be visually obvious. These undulations are random and form no pattern that was apparent. They may be caused by frost action or by differential settlement of the downstream shell after it was placed in 1965. Also, the slope could have been constructed essentially as it currently exists.

c. Appurtenant Structures

The appurtenant structures associated with Lake Mansfield Dam are generally in good condition. The spillway, low-level outlets, service bridge, stopboard system and spillway discharge channel are described in the following.

The rectangular concrete spillway is 33.5 feet in length. The actual spillway crest is a steel 2" x 2" angle bolted into the upstream edge of the spillway. The downstream spillway edge is nearly vertical for 15 feet. Angular stone (40-60 lb.) appear to have been set into the downstream spillway face (see Photo 9). There are concrete abutments on each end of the spillway that interface between the concrete spillway and the natural rock abutments. These abutments have spalled and cracked, exposing large aggregate, characteristic of concrete poured during the early 1900s (see Photo 7).

The stopboard arrangement consists of steel angles set into the concrete as shown in Photo 7. Stopboards 6' 8-1/2" in length and 23 inches high are inserted into the steel supports. It does not appear that these supports are designed for a specific failure height. Therefore, removal of these boards in the event of flood waters would depend upon manual operation.

There are two low-level outlet conduits at Lake Mansfield. A 14 to 16-inch gate valve is set into the spillway about 15 feet below the spillway crest. This gate would allow approximately 35 CFS water to pass with water level at the spillway crest. This valve is reported to be functional, although inspection for leakage was impossible during the site survey.

Another low-level outlet has been built into the old streambed. The conduit has been extended with a 24-inch CMP passing under the 1965 renovation work. The conduit is shown in Photo 14. According to Mr. Lane the inlet gate valve has not functioned since 1930. Efforts to work the valve have shown the valve to be immobile.

The downstream face of the dam as it currently exists was constructed in 1965 using bank-run gravel from a local borrow pit. At that time the low-level outlet conduit was extended to the new downstream toe and four 6-inch diameter CMP drains were installed to carry water from the old downstream face to the downstream face as it presently exists. The CMP drains were installed near zones where seeps had been observed earlier on the old downstream face, according to Mr. Al Lane. The conduit and the drains are located approximately in the plan view in Figure 1.

Photo 12 shows a general view of the CMP drain that is located to the left of the natural hill that lies within the dam. A substantial zone of rusty-colored water has been recorded downstream from the rock covered outlet. A close-up of this outlet is shown in Photo 13. The rocks have been removed and the top of the CMP pipe is visible. The level rod, which is calibrated in tenths of a foot, is coated with a rusty-colored film. Water was flowing from the drain at a rate visually estimated at about 1 to 3 GPM.

Photo 14 shows the downstream end of the low-level outlet conduit and two of the downstream toe drains that exit just above the conduit. There was no water observed in the drain shown on the left in the photograph. In the drain shown at the right, the water was not flowing but was frozen and filled most of the pipe. Water was exiting from the conduit considerably more rapidly than from the downstream drain in Photo 12, perhaps at a rate of 3 to 6 GPM. The flowing water was clear, but a large area downstream was ponded, rusty-colored water. The outline of this zone, which reached beyond the edges of the pool visible on the date of inspection, is shown in Figure 1.

Photo 11 shows the downstream end of the 6-inch CMP drain at the right abutment contact with the natural ground. No flow was observed at the time of inspection, although icicles from previous flow remained on the invert. The ice was clear.

In Figure 1, it can be seen that wet zones are prevalent downstream from the toe of the dam, chiefly in locations where the downstream toe drains had been installed. The two wet zones on the right side could be caused by seepage through the dam, but may also be due to the natural stream that was flowing down the slope of the natural ground on the right side and downstream from the dam. A wet zone shown in Figure 1 to the left of the low-level outlet conduit is at a higher elevation than the water in the conduit. This wet zone is likely to be caused by seepage through the dam that is not collected in the downstream drains.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

This dam is in fair condition. Birch trees, 4 to 12 inches in diameter, line the upstream dam crest. A filter between the impervious crest material and the riprap face has not been provided. There are random undulations in the downstream face of the dam. In addition, there is a low section at the extreme right of the dam. This section will overtop prior to the rest of the dam and there has not been any intentional protection provided to guard against wash during such an overtopping.

b. Dam

The crest of this dam is not at a uniform elevation. There is a low zone near the right abutment which is about 8 to 10 inches lower than the remainder of the crest (see Figure 1). According to Mr. Al Lane, water has passed over this zone in the past, when other portions of the crest were not overtopped. This portion of the crest is shown in Photos 2 and 3. The dip in the crest is not visually discernible; however, it is plotted in profile in Figure 1, Appendix B. Scour and other effects of such past overtopping are not evident now. The dates when overtopping occurred, whether pre-1965 or post-1965, are not known.

Birch trees, 4 to 12 inches in diameter, are growing along the upstream crest line of the dam, as shown in Photographs 1 and 4. There are a few birch trees along the downstream crest line near the left abutment, as can be seen in Photographs 4, 5 and 10. However, these trees are growing out of, or near, the natural bedrock that forms the left abutment of the earthfill. The small natural hill near the right side of the dam, which is sketched in plan view in Figure 1, is forested, but the adjacent earthfills are covered with brush and shrubs only.

The riprap along the upstream face consists of stone ranging in size from about 100 to 1000 pounds. It appears to have been placed directly against the embankment soils without provision of a filter zone. Near the center of the dam a 10 to 15-foot long portion of the riprap lies on a nearly vertical face over a height of about 5 feet below the crest. It appears that this portion of the crest may have been eroded to a vertical face and then covered with a wall of stones to reduce further erosion.

This inspection report is based primarily on observations made during the visual inspection and in part upon the drawings, verbal history and other records of the 1965 maintenance work.

c. Validity

The data available for the 1965 maintenance work appear to be consistent with the visual observations made at the site.

SECTION 2 - ENGINEERING DATA

2.1 Design

There are no documents available that describe the original (1909) design of the dam. However, detailed construction drawings and specifications were prepared for the substantial dam renovation performed in 1965. Copies of this information are contained in Appendix B.

2.2 Construction

There are no documents available that describe the original construction of the dam. The firm of B.E. Lord & Sons, Inc. of East Barre, Vermont, was the contractor on the 1965 dam renovation project. As-built drawings, following the renovations were not prepared. However, according to Al Lane, P.E., member of the Lake Mansfield Trout Club, the finished product differs from the design drawings only in the fact that a "low section was left near the right abutment."

2.3 Operation

Operational procedures have been assigned to a caretaker residing less than a mile from the dam. The present caretaker, Mr. Donald Arnold (telephone 802-253-4029), has been with the Trout Club for several years serving in this capacity. Although most of his time is taken up with the care and maintenance of Club buildings, he controls flashboard placement and other maintenance of the dam. Every 3 to 5 years, the dam is lowered to about 15 feet below the spillway crest for dam inspection and impoundment cleaning. Mr. Arnold has been instructed in emergency measures during high water periods. Since he lives at the dam site, he would be available to deal with most situations.

2.4 Evaluation

a. Availability

The drawings describing the construction project performed in 1965 to improve the stability of the downstream slope and to control seepage are available from the Lake Mansfield Trout Club in Stowe, Vermont.

b. Adequacy

There are no records of the original design and construction. The records of the 1965 maintenance work are adequate to judge the extent of the work performed, but not to establish the character of the earth materials used for this work.

(7) Impervious Core

A cyclopean core wall at an approximate elevation to 1152 presumably constructed to serve as an impervious core. Thickness about 2 feet at the top and 4 feet at the bottom, see Figure 2, Appendix B. Based on the method of construction of such walls and on seepage observed downstream, it is judged that this core wall is not impervious.

(8) Cutoff

None known. Core wall is probably founded on bedrock.

(9) Grout Curtain

None known.

(10) Other

Not applicable.

h. Diversion and Regulating Tunnel

Not applicable.

i. Spillway

Lake Mansfield has a concrete overflow spillway 33.5 feet in length, designed for continuous overtopping. The crest is situated about 5 feet below the crest of the dam and can accommodate 23-inch flashboard placement during normal flow periods. The downstream channel slopes at about 2.5 percent in the flow direction.

In addition to this spillway, there is a low zone near the right dam abutment. Overtopping would begin in this zone, where the crest is at elevation 1154.

j. Regulating Structures

The water level can be affected by opening or closing at 14-inch (or 16-inch) gate valve 15 feet directly under the spillway (invert elevation 1135.1). Otherwise, the impoundment level remains constant at or above the spillway crest, elevation 1150, or at the stopboard elevation of 1151.9.

(5) Test Flood Pool

579 acre-feet.

f. Reservoir Surface Area

(1) Recreation Pool

41 acres.

(2) Flood Control Pool

50 acres.

(3) Spillway Crest

41 acres.

(4) Test Flood Pool

60 acres.

(5) Top of Dam

50 acres.

g. Dam

(1) Type

Earth embankment. A cyclopean core wall with top at about elevation 1152 is shown in Figure 2, Appendix B.

(2) Length

Approximately 400 feet.

(3) Height

Maximum height approximately 31 feet.

(4) Top Width

Variable 10 feet.

(5) Side Slopes

Upstream face 2H:1V, assumed from lake contour map.
Downstream face: 2H:1V.

(6) Zoning

None.

(4) Recreation Pool (Normal)

1150.1 feet MSL.

(5) Full Flood Control Pool (Maximum Pool)

1155.0 feet MSL.

(6) Spillway Crest (Gated)

1150.1 feet MSL.

(7) Design Surcharge (Original Design)

Unknown.

(8) Top of Dam (Maximum)

1155.0 feet MSL.

(9) Test Flood Design Surcharge

1156.8 feet MSL.

d. Reservoir Data

(1) Length of Maximum Pool

2700 feet.

(2) Length of Recreation Pool

2700 feet.

(3) Length of Flood Control Pool

2700 feet.

e. Storage Data

(1) Recreation Pool

320 acre-feet.

(2) Flood Control Pool

515 acre-feet.

(3) Spillway Crest Pool

320 acre-feet.

(4) Top of Dam

514 acre-feet.

Mansfield. In addition, there have been two other structures designed into the dam to act as low-level discharge conduits. One outlet, no longer functional, consists of a 24" ACCGMP running the width of the dam in the pre-dam brook bed. A closed gate valve at the inlet to the conduit is no longer functional according to the operator. Another outlet, located in the spillway wall, consists of a 14" or 16" diameter gate valve. This outlet allows the level to be lowered about 15 feet below the spillway crest (base of stopboards).

(2) Maximum Known Flood at Dam Site

There are no records of any flood flows for the Lake Mansfield Dam.

(3) Ungated Spillway Capacity at Top of Dam

926 CFS at 1155 feet above MSL (top of dam).

(4) Ungated Spillway Capacity at Test Flood Elevation

1950 CFS at 1156.8 feet above MSL.

(5) Gated Spillway Capacity at Normal Pool Elevation

Not applicable.

(6) Gated Spillway Capacity at Test Flood Elevation

Not applicable.

(7) Total Spillway Capacity at Test Flood Elevation

1950 CFS at 1156.8 feet above MSL.

(8) Total Project Discharge at Test Flood Elevation

4615 CFS at 1156.8 feet above MSL.

c. Elevation Data

(1) Streambed at Centerline of Dam

1124 feet MSL.

(2) Maximum Tailwater

Not applicable.

(3) Overflow Structure Upstream Invert

1150.1 feet MSL.

e. Ownership

Lake Mansfield is owned by the Lake Mansfield Trout Club, a private entity.

f. Operator

The individual responsible for the daily operation is the caretaker, Mr. Donald Arnold, RFD #1, Stowe, Vermont 05672. Telephone 802-253-4029.

g. Purpose of Dam

The dam's sole purpose is to impound water to provide a recreational reservoir known as Lake Mansfield to serve as prime habitat for trout, as well as an area for boating and swimming by club members.

h. Design and Construction History

Lake Mansfield Dam reportedly was constructed in 1909. No data are available concerning its original design or construction. Subsequently, the dam was raised about two feet from its original elevation. Plans for the raising were drawn in 1965 and are contained in Appendix B.

i. Normal Operating Procedures

Normal operating procedures consist of mowing the grass on the crest of the dam and regulation of the lake level by stopboard installation. In addition, the Lake is lowered about 15 feet every 3 to 5 years for cleaning.

1.3 Pertinent Data

a. Drainage Area

The total drainage area which supplies Lake Mansfield consists of 2.5 square miles of steep-sloped forested land. A number of small streams drain this basin and enter the lake at three locations. The soils in this mountainous region are thin and of relatively low porosity.

Natural rock formations in this area are principally a foliated green schist with pegmatite intrusions present in the vicinity.

b. Discharge at Dam Site

(1) Outlet Works

The spillway, 33.5 feet long, is designed for continuous overtopping and thus provides the major outlet at Lake

b. Description of Dam and Appurtenances

The dam is an earth embankment structure with a cyclopean core wall. The upstream face has riprap exposed above the Lake level with a variable slope of about 2H:1V. The downstream face is sloped at 2H:1V. The crest of the dam, with the exception of the right dam abutment is at a constant elevation of approximately 1155 feet MSL as assumed by interpolation from a USGS topographic map. The right abutment has been left about one foot lower in order to act as an "emergency spillway."

The dam has been raised about 2 feet from its initial crest elevation of 1153 feet above MSL in 1965. This renovation involved placement of an impermeable material on the crest itself and placement of sufficient pervious material to create a downstream face of 2H:1V. Additionally, as part of that project, toe drains were installed between the old downstream face and the additional material.

The normal outlet is a vertical concrete wall overflow spillway located at the extreme left dam abutment. A discharge channel has been excavated in the natural rock at the left abutment area. This channel rejoins the pre-dam streambed (which was located through the center of the dam) beyond the toe of the dam.

A low-level discharge conduit has been incorporated into the spillway structure about 15 feet below the spillway crest. This outlet is controlled by a 14" to 16" gate valve operated every 3 to 5 years when the impoundment is cleaned. Otherwise the lake level is affected only by the placement of 23" stopboards along the spillway.

Another low-level discharge conduit was built under the dam in the old streambed. This conduit was extended under the fill placed in 1965. However, the gate valve controlling its use was described by the operator as being no longer operable.

c. Size Classification

Lake Mansfield Dam has a size classification of small. The dam has a maximum height of 31 feet and impounds about 320 acre-feet at a normal water surface of 1154.9 feet MSL. A dam with a maximum storage volume of less than 1000 acre-feet or a height less than 40 feet is classified as small. In this case, both criteria apply.

d. Hazard Classification

The hazard classification would place Lake Mansfield in the significant category. Three homes are downstream within the marginal flood limits should the dam fail.

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

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. Dufresne-Henry Engineering Corporation 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 Dufresne-Henry Engineering Corporation under a letter of November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0010 has been assigned by the Corps of Engineers for this work.

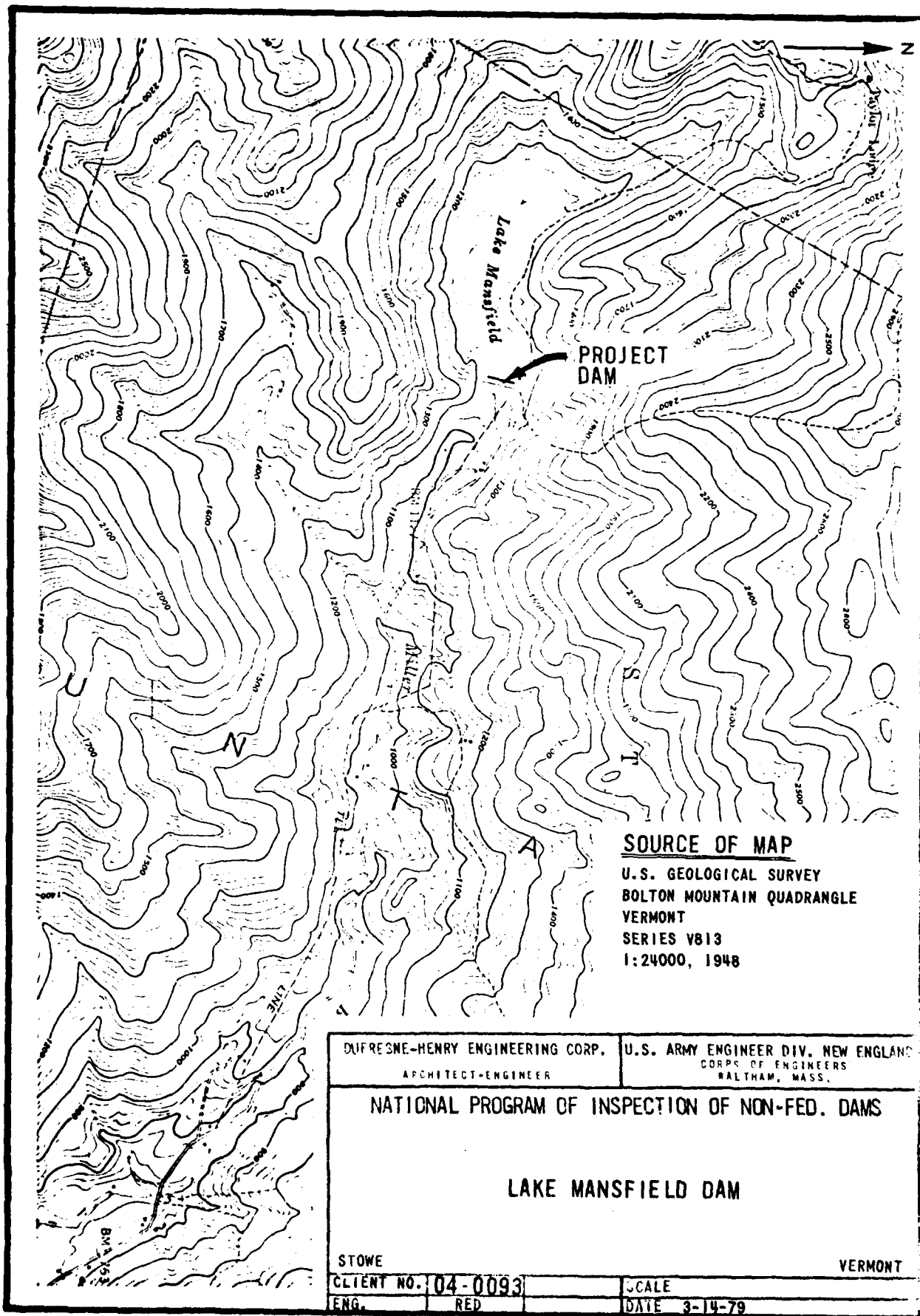
b. Purpose

- (1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by nonfederal interests.
- (2) Encourage and prepare the states to initiate quickly effective dam safety programs for nonfederal dams.
- (3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Lake Mansfield Dam is located in the Town of Stowe, Lamoille County, Vermont. The site is located at the headwaters of the Miller Brook, a tributary of the Little River above the Waterbury Reservoir. The Little River drains into the Winooski River which feeds Lake Champlain. Lake Mansfield Dam is located approximately one-half mile upstream of the confluence of Miller Brook and the Little River.



Will be available
after spring thaw

OVERVIEW OF
LAKE MANSFIELD DAM
STOWE, VERMONT

The service bridge, shown in Photo 6, is located directly over the spillway crest. There is 43 inches of clear area between the crest and the bottom of the 6-inch steel I-beam stringers. The bridge supports are in good condition; however, the 2-inch by 6-inch decking needs replacing.

d. Reservoir Area

The reservoir area consists of approximately 41 acres at normal pool level (with flashboards). Siltation appears not to be a problem nor is any prolific aquatic growth.

e. Downstream Channel

The spillway discharge channel has been cut into the left side of the dam between two natural rock areas (see Figure 1). The channel is relatively free of debris and loose rocks as shown in Photo 9.

3.2 Evaluation

a. Freeboard and Low Zone on Crest

According to the verbal history of this dam, water has flowed over the low zone on the right side of the crest some time in the past. Such overtopping could erode and may even cause dam failure of this earth embankment dam. The cyclopean concrete wall that is within the dam could slow down such a failure, and may in some cases prevent complete failure. However, it cannot be relied upon to be stable if the overtopping water erodes the soils downstream from the wall and removes its support. To avoid this potential situation, the spillway capacity and the crest height should be so selected that overtopping will not occur during the design storm. Alternatively, if overtopping will be allowed to occur, then the crest and the downstream face should be protected against the erosive effects of the water. Therefore, the low zone on the right side of the crest should either be eliminated so that premature overtopping does not occur, or the downstream face protected against erosion.

b. Vegetation on Dam

A row of birch trees lines the upstream crest of the dam. If these trees are allowed to stay, high winds could uproot them and lead to washout of the dam. Furthermore, continued root growth and the continual movement of the roots due to winds could create openings through the dam that could lead to an erosion failure. For these reasons, the trees on the crest and on all surfaces of the earth embankment should be cut.

After the trees are cut, it is reasonable to expect that the roots remaining in the ground will rot slowly, each year increasing the likelihood that a channel will be formed through which water can flow more easily and thus lead to an erosion failure of this dam. Therefore, the roots of the trees should be removed as part of the continuing maintenance program for the dam. This work should be done in such a manner as not to endanger the integrity of the dam.

The shrubs growing on the downstream face and elsewhere on the dam have been allowed to grow to a height of 3 to 5 feet. This shrubbery should be cut at least once per year so that the surfaces of the dam will be directly observable and to prevent the growth of any significant root system.

c. Seepage Through Dam

The observations made on the day of inspection did not indicate that the seepage was in any way unusual. However, it appeared that water flowed at greater rates in the past. For example, the outline of the rusty-colored zones downstream from the dam extended beyond the edges of the existing pools. Also, frozen water was present in two of the drains, which indicates that water was flowing previously.

The seeps that are present should be observed monthly throughout the year and during significant storms. Both the quantity and total suspended solids of the water should be recorded. In addition, the location of any seeps that are not related to flow through the toe drains should be recorded and the flow monitored. Any changes that are observed will be signals for concern about the dam.

d. Undulations on Downstream Slope

The undulations observed on the downstream slope show no definite pattern. They may be caused by:

1. Differential settlement of the material in the downstream shell.
2. By frost action.
3. They may have been built into the downstream face.

It does not appear that these undulations are any cause for concern about the stability of this dam.

e. Service Bridge

The decking on the service bridge should be replaced as soon as possible as emergency stopboard control would be impossible without such a safe access.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The major operational procedure at Lake Mansfield is the installation and removal of the stopboards on a semiannual basis. Other procedures involve the removal of floatable debris collecting on the log boom and dam crest. In addition to these activities, the dam is casually observed on a daily basis.

4.2 Maintenance of Dam

Apart from the major renovation project done in 1965, the following activities are performed.

1. Grassed areas are mowed along the crest of the dam during the summer months.
2. Brush has been cut on the downstream side of the dam about 3-4 years ago. Such brush removal should be performed again within the next year.

4.3 Maintenance of Operating Facilities

The service bridge is painted and stained on a biannual basis.

The gate valve, incorporated into the spillway is operated every 3-5 years.

4.4 Description of Any Warning System in Effect

There is no warning system in effect.

4.5 Evaluation

The mowing of the grass on the dam crest is proper maintenance, however, this procedure should be extended to include the cutting of brush on the downstream face of the dam to insure that large trees will not "appear."

SECTION 5 - HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Evaluation of Features

a. General

The Lake Mansfield Dam is an earth embankment dam with a cyclopean concrete core, built solely as a recreational project. It is a low surcharge storage-high spillage type dam.

b. Design Data

No data is available on the original design or construction in 1909. However, in 1965 the dam crest was raised two feet. Construction drawings for this improvement are included in Appendix B.

c. Experience Data

The only historical information available was that from Mr. Al Lane, P.E., a Lake Mansfield Trout Club member. He stated that water had passed over the low region near the right abutment. The dates when overtopping had occurred were not known.

d. Visual Observations

The dam crest adjacent to the right abutment was found to be approximately one foot lower than normal crest elevation. Built to act as an emergency spillway, this low section will overtop prematurely during high water periods, giving way to erosion. With increasing water levels, the velocities over the low zone would also increase, compounding the erosive action. Continued erosion could lead to dam failure.

e. Test Flood Analysis

The test flood (1/2 the Probable Maximum Flood - PMF) was developed using the computer program HEC-1 from the U.S. Army Corps of Engineers. The results showed the 1/2 PMF to be 4615 CFS (1846 CSM). During this test flood, the Lake Mansfield Dam would be overtopped by 1.8 feet of water. The low zone near the right abutment would have 2.6 feet of water flowing over it. This is assuming that the earth embankment would not erode during overtopping.

f. Dam Failure Analysis

If the Lake Mansfield Dam failed with the water level at the top of the earth embankment, a wave of water approximately 20 feet high would be released. This wave would not dissipate that quickly because of the steep slopes downstream. Therefore, several of the houses downstream within marginal flood limits would be endangered.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The visual observations did not reveal any scarps, cracks, indications of movement, or seepage from points high on the downstream face which would lead to concern about the structural stability of the dam.

It was stated by Mr. Al Lane that overtopping had occurred over the right end of the crest some time in the past. Such overtopping, if it were to occur again, could lead to an erosion failure of the dam. Thus the spillway capacity and crest elevation must be checked to prevent overtopping during the design storm. Alternatively, the downstream face of the dam could be protected to prevent such a washout during overtopping. There is a natural hill incorporated within the downstream face of the dam near the right side.

b. Design and Construction Data

The original design and construction data are not available. It appears that the dam was constructed of earth fill that was placed both upstream and downstream from a cyclopean concrete wall. This information is not sufficient to judge the stability of the dam.

c. Operating Records

Although there are no formal operating records at Lake Mansfield, the owners of the dam do employ a full-time operator/caretaker. His duties involve lake level regulation via stopboards and a low-level outlet conduit. Floatable debris collecting on the log boom and dam crest is also removed at yearly intervals.

d. Post-Construction Changes

In 1965 the dam was repaired by adding a downstream shell composed of local bank-run gravel. The downstream slope was flattened to 2H:1V, as it exists today. The upstream slope is approximately 2H:1V, based on the lake-bottom depth contours. These dimensions are not unusual for a dam of this height. However, since there is no information available on the strength characteristics of the materials in the dam, one cannot judge its stability.

The soil that was used to create the downstream shell was described verbally as a pervious bank-run gravel. Visual inspection indicates there were no seeps or evidence of past seeps observed on the downstream face. This confirms the likelihood that the downstream shell is pervious compared with the material in the original structure. As such, this condition indicates the downstream slope is drained adequately to preclude buildup of significant internal water pressures. Regular observation of the downstream face is important so that precautions can be taken if seeps do, at some later date, begin to exit from the downstream face.

e. Seismic Stability

This dam is in Seismic Zone 2 and, in accordance with recommended guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

This dam is judged to be in fair condition. Numerous trees have been allowed to grow on the upstream side of the crest. These trees should be cut and their roots properly removed. The riprap on the upstream face is in need of repair in some locations.

b. Adequacy of Information

This Phase I evaluation was based primarily on the visual inspection, in part on the plans drawn up for repair of the dam in 1965, and, in part, on verbal history as provided by Mr. Al Lane.

c. Urgency

The recommendations given below should be carried out within one year after receipt of the Phase I Inspection Report.

d. Need for Additional Investigation

The recommendations listed in Section 7.2 should be carried out.

7.2 Recommendations

Several remedial measures should be carried out by the owners as soon as practicable.

1. The trees on the crest of the dam should be cut. The roots of the trees should be handled as discussed in Section 7.3.
2. The crest of the dam should be made level so that no portion will be significantly lower than any other portion.
3. The upstream slope should be made uniform and the riprap should be repaired, using a proper filter beneath it, to reduce the potential for erosion of the crest.

In addition, an engineer qualified in the design of dams should be engaged to analyze the spillway size and dam freeboard in order to preclude overtopping during the design storm, or the downstream face should be protected against potential erosion due to overtopping.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

The quantity and suspended solids concentration of seepage exiting from the downstream drain and from the low-level outlet conduit should be recorded monthly. In addition, such monitoring shall be done during and immediately after any rainstorm that is expected to exceed 2 inches of rainfall. Any significant changes in quantity or solids should be evaluated by an experienced engineer as soon as practicable.

When the seepage in a. above is monitored, the entire downstream face should be observed to determine whether any other seeps are present. Such seeps should also be monitored. If changes occur, the meaning of such changes should be evaluated by an experienced engineer as soon as practicable.

To avoid possible deleterious effects of rotting roots in the dam, the roots of the trees in the crest should be removed and the crest repaired with properly selected compacted soil. The roots need not be removed all in one year. Rather, the removal can be done sequentially over a period of about 5 years as part of routine maintenance. The procedure for removal and reconstruction should be carefully planned to ensure that the integrity of the dam is not impaired.

The growth on all surfaces of the embankment should be mowed at least once per year to preclude any substantial root growth and to enable one to observe the downstream face easily. Any trees and brush in the spillway discharge channel should be removed annually.

A qualified engineer should be engaged to inspect the dam and appurtenant structures annually to identify significant features requiring maintenance, repair or alteration.

7.4 Alternatives

Not applicable.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Lake Mansfield Dam
Stowe, VT

DATE Nov, 21, 1978

TIME 0800-1100

WEATHER Partly Sunny 14⁰F.

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

PARTY:

- | | |
|--|-------------------------------------|
| 1. <u>James Maynes, D&H</u> | 6. <u>Al Lane, Trout Club</u> |
| 2. <u>Morris Root, D&H</u> | 7. <u>Thomas Arnold, Trout Club</u> |
| 3. <u>Robert Dufresne, Jr. D&H</u> | 8. _____ |
| 4. <u>Steve Poulos, GEI</u> | 9. _____ |
| 5. _____ | 10. _____ |

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

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
1. Crest Elevation	1154.9 feet MSL.
2. Current Pool Elevation	1150 feet MSL.
3. Maximum Impoundment to Date	41 acres at current pool elevation.
4. Surface Cracks	None observed.
5. Pavement Condition	No pavement exists.
6. Movement or Settlement of Crest	None observable. Too irregular to judge. Zone of footpath on crest is depressed a few inches below the upstream and downstream crestlines due to use.
7. Lateral Movement	See Items 11 and 13.
8. Vertical Alignment	Too irregular to judge. Slight depression evident within about 20 ft from right abutment.
9. Horizontal Alignment	Crest is arched slightly downstream at left and right abutments. Appears to have been constructed with that shape to meet abutting bedrock.
10. Condition at Abutment and at Concrete Structures	Right abutment-good condition. A 6-in. drain exits at downstream end of abutment contact line. Water frozen, none flowing. See Fig. 1. Left abutment-good condition. No seepage at abutment contact line. See Fig. 1.
11. Indications of Movement of Structural Items on Slopes	No structural items on slopes.
12. Traspassing on Slopes	Free access but very limited use. Path exists near left abutment contact line.
13. Sloughing or Erosion of Slopes or Abutments	+ 6-in. undulations on downstream slope. Could be frost action or erosion of granular shell prior to growth of cover.
14. Rock Slope Protection - Riprap Failures	100 to 1000+ lb. stone visible from crest to water level and at least 2 ft below. No filter evident under stone. Zone near center of dam has vertical upstream face above water. Seems to have been eroded, then covered with riprap.
15. Unusual Movement or Cracking at or Near Toe	None observed.
	A-2

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S. J. Poulos

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
16. Unusual Embankment or Downstream Seepage	Seepage in a few locations as in Fig. 1.
17. Piping or Boils	None observed.
18. Foundation Drainage Features	None present.
19. Toe Drains	See plans in App. B. One 6-in. toe drain at downstream end of right abutment contact line. Two 6-in. toe drains on top of 24-in. low level discharge conduit. One 6-in. toe drain 8 to 10 ft left of natural hill that forms part of downstream slope. See Fig. 1.
20. Instrumentation System	None.
21. Vegetation	Numerous 4- to 12-in. dia. birch trees on upstream and downstream crestlines. Spaced average of 4 ft o.c. upstream side. Shrubbery on downstream slope.

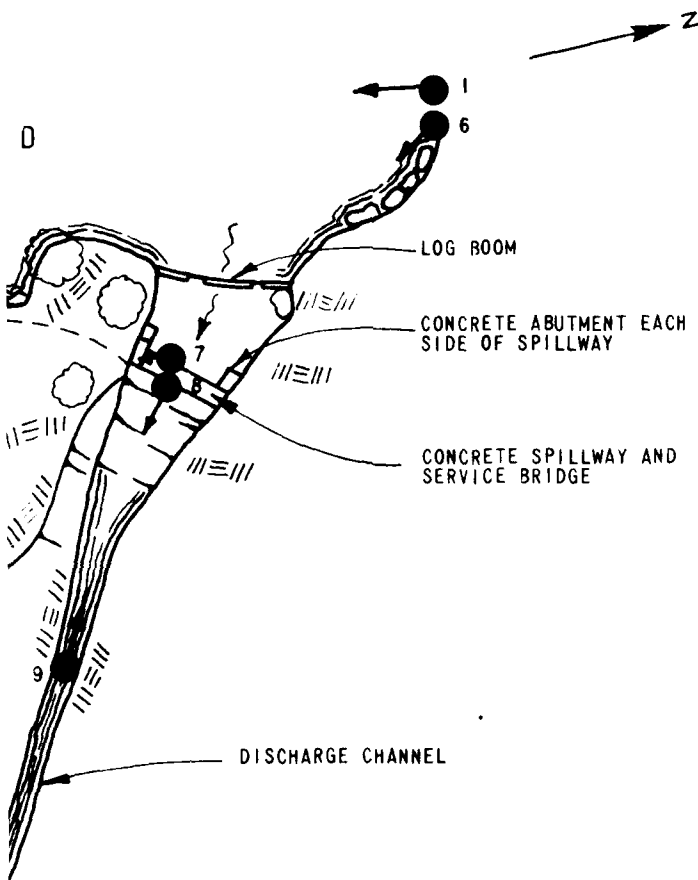
PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT. DATE Nov. 21, 1978
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE Geotechnical NAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>DIKE EMBANKMENT</u> 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 Vegetation	No dike.

NOTES

- 1 ICICLE ON DS INVERT IS CLEAR. NO FLOW.
- 2 1-3 GPM VERY RUSTY WATER. WAS COVERED WITH STONES WHICH WERE MOVED TO OBSERVE WATER.
- 3 NO WATER EVIDENT
- 4 FILLED WITH WATER. FROZEN. NO FLOW.
- 5 3-6 GPM FLOW. CLEAR BUT RUSTY STAINED ZONE DOWNSTREAM AS SHOWN.
- 6 WET ZONE. NO FLOW OBSERVED.
- 7 SMALL STREAM EMERGING FROM NATURAL HILL. PROBABLY A CONTINUATION OF STREAM BELOW RIGHT ABUTMENT.
- 8 SMALL SEEP << 1 G.P.M.



LEGEND

- ROCK
- WET AREA
- RIPRAP
- A.C.C.G.M.P.
- STREAM
- SMALL SEEP << 1 G.P.M.
- DECIDUOUS TREE

FIGURE 1

DUFRESNE-HENRY ENGINEERING CORP.		U.S. ARMY ENGINEER DIV. NEW ENGLAND	
ARCHITECT-ENGINEER		CORPS OF ENGINEERS WALTHAM, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE MANSFIELD DAM			
PHOTO LOCATION KEY MAP			
CLIENT NO. 04-0093	SCALE NOT TO SCALE		
ENGR.	RED	2-21-79	DATE 3-1-79

LAKE MANSFIELD

RIGHT ABUTMENT

FOOT PATH

NATURAL HILL

STREAM
(≈ 10 GPM)

WOODED
AREA

CREST

6" ϕ TOE DRAIN

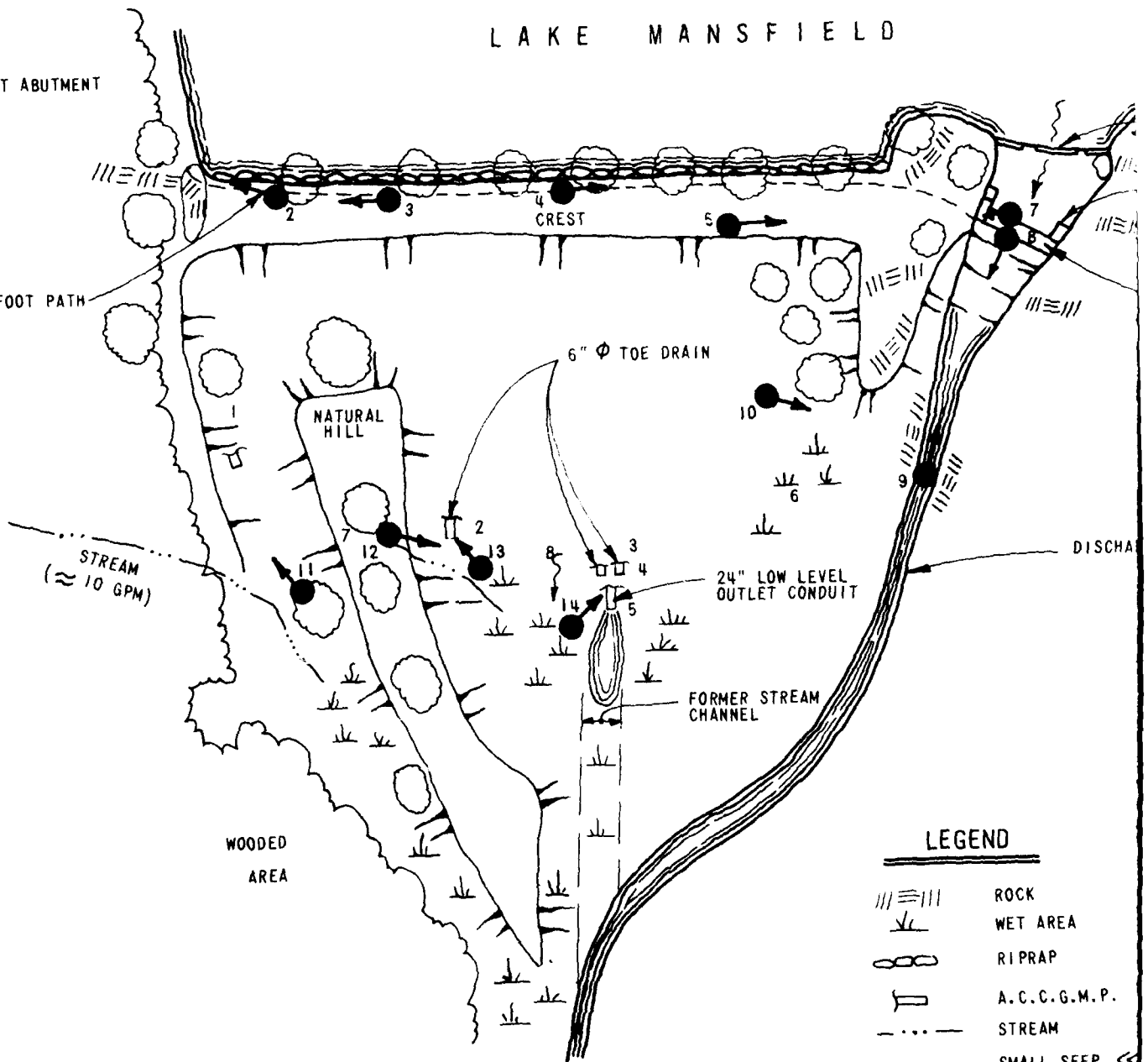
24" LOW LEVEL
OUTLET CONDUIT

FORMER STREAM
CHANNEL

DISCHARGE

LEGEND

- ///=/// ROCK
- /// WET AREA
- RIPRAP
- A.C.C.G.M.P.
- STREAM
- SMALL SEEP
- DECIDUOUS TREE



APPENDIX C

PHOTOGRAPHS

1. Upstream Crest of Dam Showing Riprap and Birch Trees.
2. Looking Along Crest Toward Right Abutment and Showing Upstream Face.
3. Looking Along Crest Toward Right Abutment and Showing Downstream Area.
4. Birch Trees Along Crest, Looking Toward Left Abutment.
5. Upstream Portion of Left Abutment From Middle of Dam.
6. Upstream Side of Spillway Showing Log Boom and Service Bridge.
7. Spillway Crest, Right Abutment and Stopboard Frame.
8. Spillway Discharge Channel, Looking Downstream From Spillway.
9. Downstream Spillway Channel.
10. Downstream Portion of Left Abutment From Middle of Dam.
11. 6-Inch Diameter CMP at Downstream Side of Right Abutment Contact Line.
12. Rusty Water Exiting From 6-Inch Diameter CMP Toe Drain Near Center of Dam.
13. Close-up of Water Seep in Photo 12.
14. 24-Inch Diameter CMP Low-Level Outlet and Two 6-Inch Diameter Toe Drains Above. One toe drain was dry; one was full of ice.

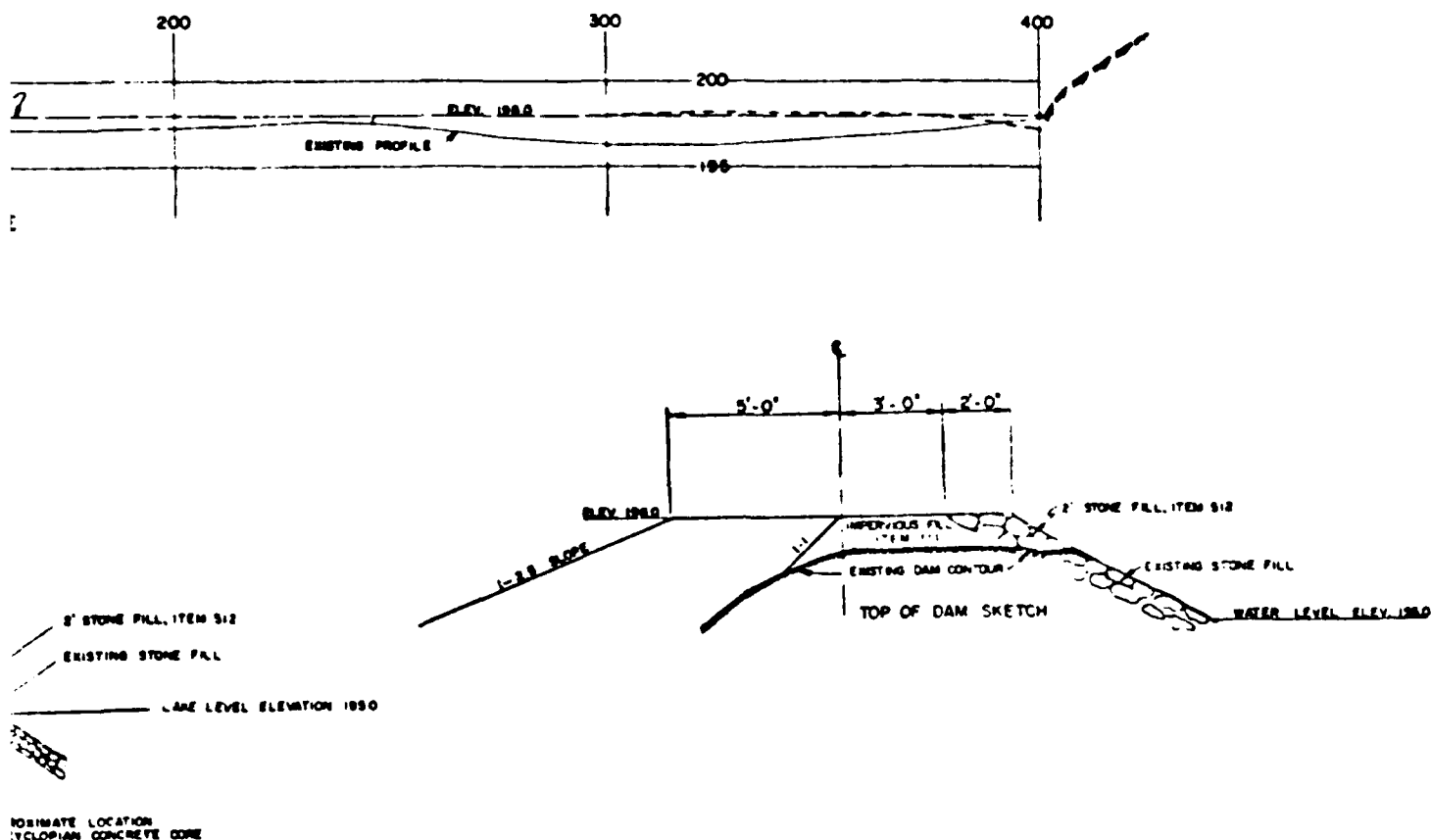
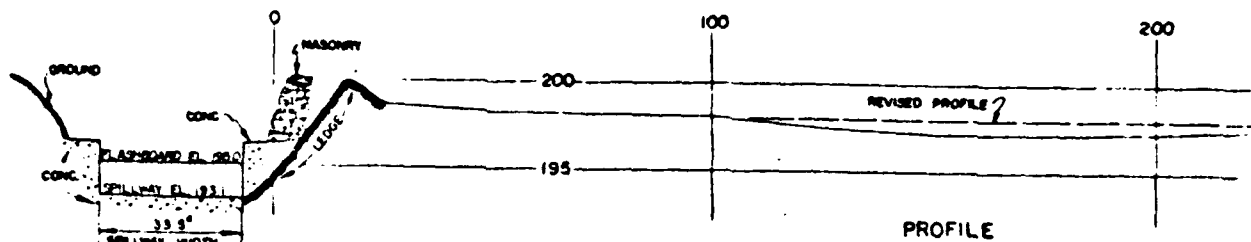


FIGURE 2

SOURCE OF MAP

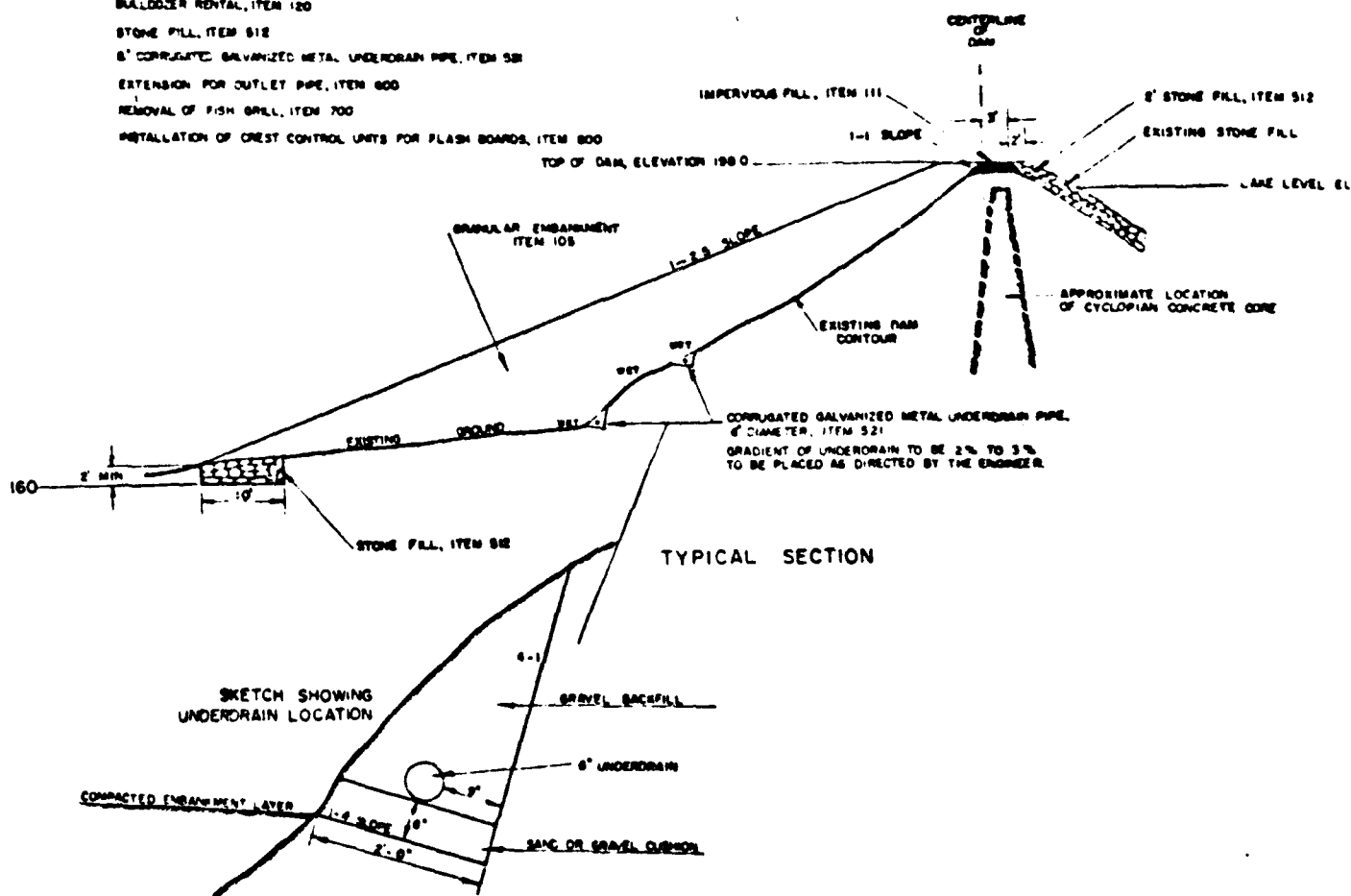
MR. A. LANE, PE
MEMBER, LAKE MANSFIELD TROUT CLUB

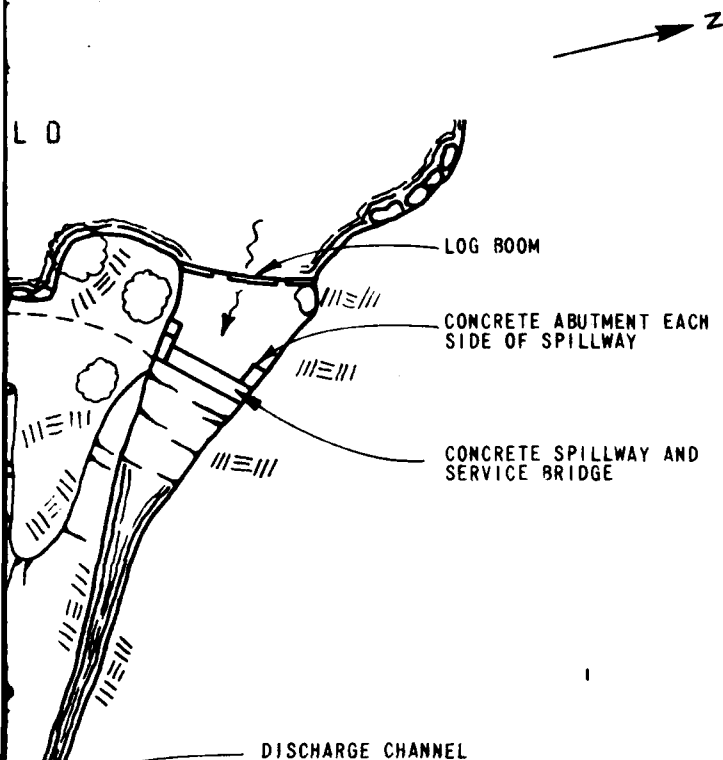
DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEERS		U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS BALTIMORE, MARY	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE MANSFIELD DAM MAJOR RENOVATION PROJECT			
CLIENT NO. 04-0093	SCALE NOT TO SCALE		
ENGR. RED	2-28-79	DATE MARCH 1, 1979	



CONSTRUCTION ITEMS

CLEARING AND GRUBBING, ITEM 101
 GRANULAR EMBANKMENT, ITEM 105
 IMPERVIOUS FILL, ITEM 111
 BULLDOZER RENTAL, ITEM 120
 STONE FILL, ITEM 512
 8" CORRUGATED GALVANIZED METAL UNDERDRAIN PIPE, ITEM 521
 EXTENSION FOR OUTLET PIPE, ITEM 500
 REMOVAL OF FISH GRILL, ITEM 700
 INSTALLATION OF GREST CONTROL UNITS FOR FLASH BOARDS, ITEM 800





LEGEND

- ROCK
- WET AREA
- RIPRAP
- A.C.C.G.M.P.
- STREAM
- SMALL SEEP < 1 G.P.M.
- DECIDUOUS TREE

NOTES

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- 6 WET ZONE, NO FLOW OBSERVED
- 7 SMALL STREAM EMERGING FROM NATURAL HILL, PROBABLY A CONTINUATION OF STREAM BELOW RIGHT ABUTMENT
- 8 SMALL SEEP 1 GPM

FIGURE 1

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 LAKE MANSFIELD DAM SKETCH PLAN			
CLIENT NO.	04-0023	SCALE	NOT TO SCALE
DATE	RED	2-21-79	DATE MARCH 1, 1979

LAKE MANSFIELD

RIGHT ABUTMENT

CREST

FOOT PATH

6" ϕ TOE DRAIN

NATURAL HILL

STREAM
(≈ 10 GPM)

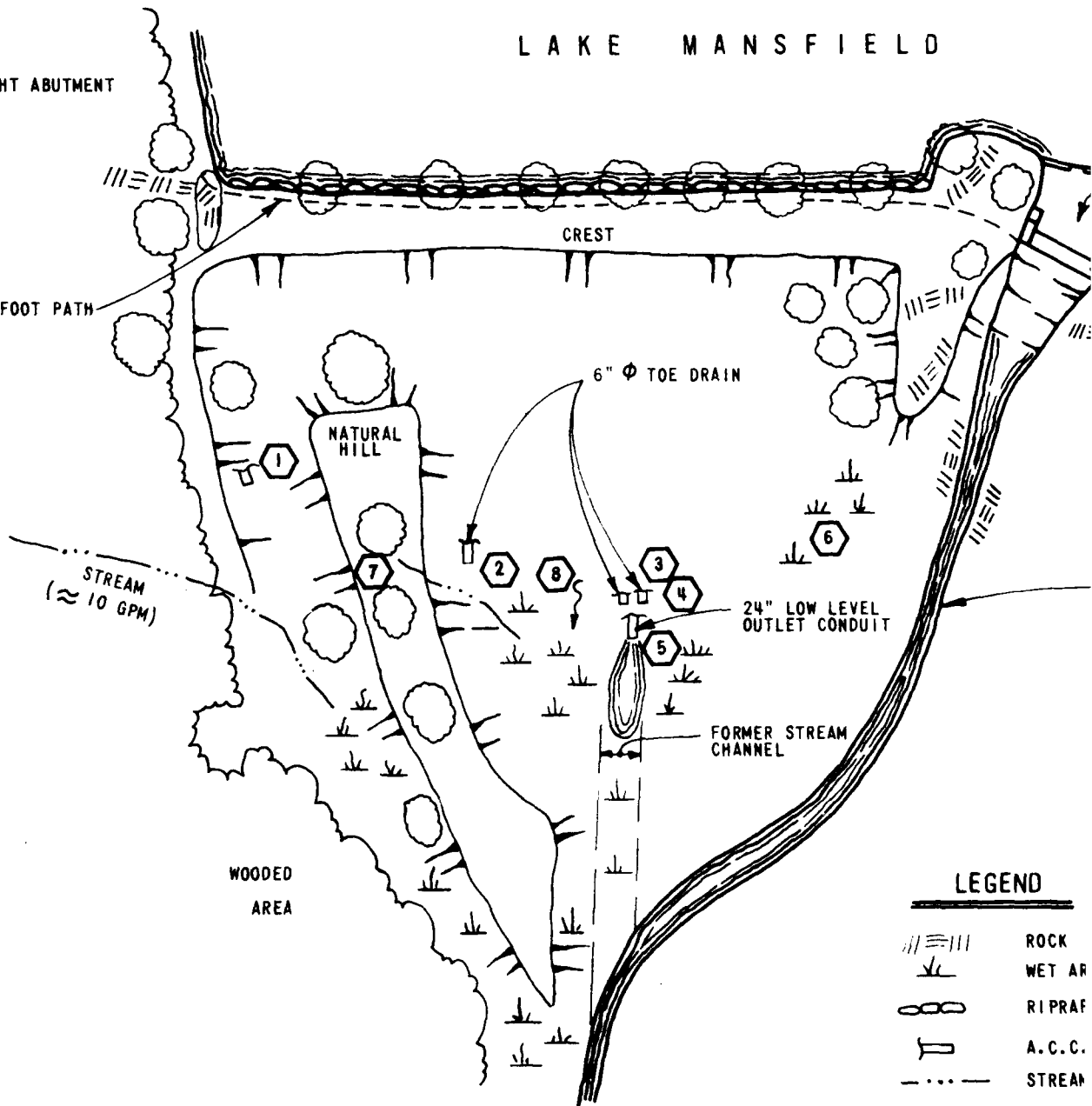
24" LOW LEVEL
OUTLET CONDUIT

FORMER STREAM
CHANNEL

WOODED
AREA

LEGEND

	ROCK
	WET AR
	RIPRAF
	A.C.C.
	STREAM
	SMALL
	DECIDI



APPENDIX B
PROJECT RECORDS AND PLANS

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam DATE Nov. 21, 1978
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE Geotechnical NAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	No geotechnical aspects.
Bearings	N/A
Anchor Bolts	N/A
Bridge Seat	Adequate on each abutment, appears solid.
Longitudinal Members	6" Steel I-Beams, well maintained and in good condition
Underside of Deck	Deck of 2 x 6 - need replacing.
Secondary Bracing	4" x 4" beams in good shape.
Deck	Some 2" x 6" members need replacing.
Drainage System	N/A
Railings	Appear solid.
Expansion Joints	N/A
Paint	Steel members in fine condition. Wood has been adequately stained.
b. Abutment & Piers	
General Condition of Concrete	Old, some spalling but in fair condition.
Alignment of Abutment	To irregular to judge.
Approach to Bridge	Foot path.
Condition of Seat & Backwall	N/A

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE Geotechnical NAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	Satisfactory . Log boom is in place .
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees line adjacent ups. crestline and shoreline. Chiefly birch trees.
Floor of Approach Channel	Not visible. Underwater. Probably natural bedrock
b. Weir and Training Walls	
General Condition of Concrete	Good shape.
Rust or Staining	Staining visible on the concrete spillway.
Spalling	Visible on the upper part of the abutments on each side of the weir.
Any Visible Reinforcing	No.
Any Seepage or Efflorescence	None visible.
Drain Holes	None
c. Discharge Channel	
General Condition	Good. Natural bedrock opening.
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Forested slopes adjacent to channel
Floor of Channel	Natural bedrock
Other Obstructions	Channel is only about 10 ft. wide by 15 ft. deep, i.e. quite narrow.

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	LOW LEVEL OUTLET CONDUIT IS COVERED BELOW, NOT THE GATE IN SPILLWAY.
General Condition of Concrete	No concrete
Rust or Staining	There is a rusty zone downstream of the low level outlet conduit, probably due to corrosion of CMP outlet.
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	Not applicable
Channel	
Loose Rock or Trees Overhanging Channel	No loose rock. See below
Condition of Discharge Channel	Natural ground. Forested.

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978
PROJECT FEATURE _____ NAME _____
DISCIPLINE Geotechnical NAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u> General Condition of Concrete Rust or Staining on Concrete Spalling Erosion or Cavitation Cracking Alignment of Monoliths Alignment of Joints Numbering of Monoliths	 There is no transition.

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansified Dam, Stowe, VT.DATE Nov. 21, 1978

PROJECT FEATURE _____

NAME _____

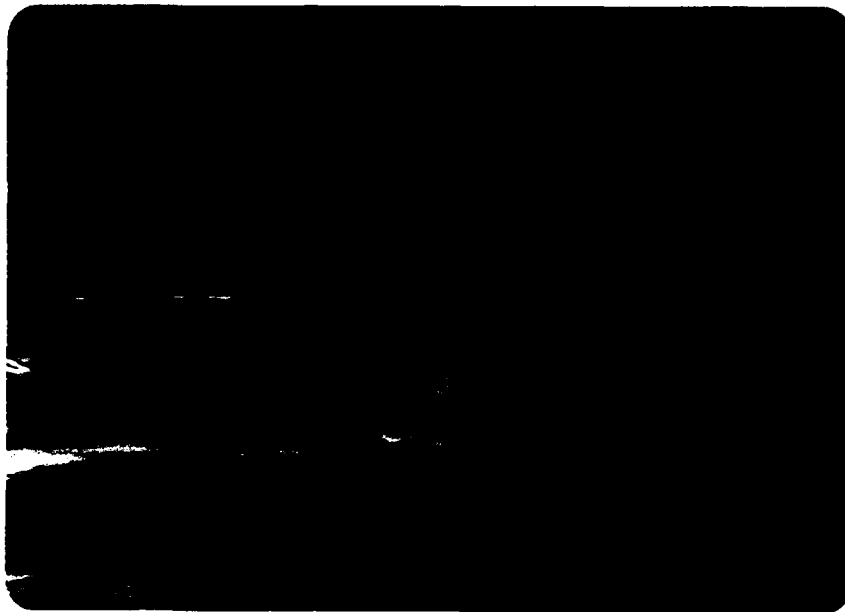
DISCIPLINE GeotechnicalNAME S.J. Poulos

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u> 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 Emergency Gates Lightning Protection System Emergency Power System Wiring and Lighting System	No control tower at Lake Mansfield. N/A A-6

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Mansfield Dam, Stowe, VT DATE Nov. 21, 1978
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE Geotechnical NAME S.J. Poulos

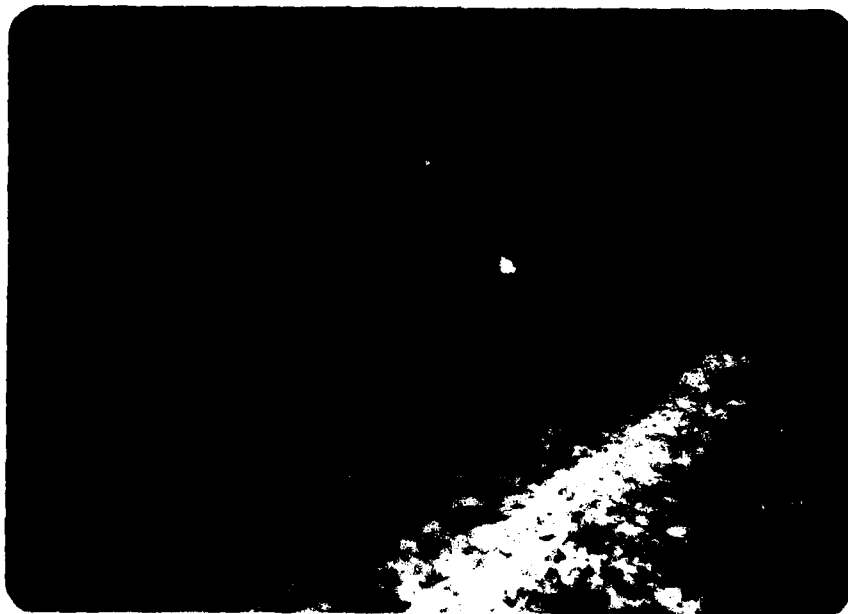
AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u> a. Approach Channel Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of Concrete Lining Drains or Weep Holes b. Intake Structure Condition of Concrete Stop Logs and Slots	 1. There is a low level outlet conduit passing through the bottom of the dam in the deepest part of the streambed. The intake channel is submerged in the lake. There is no intake structure. 2. There is a gate within the spillway structure. The intake channel is the same as for the spillway and is covered on page 9.



#1. UPSTREAM CREST OF DAM SHOWING RIPRAP
AND BIRCH TREES



#2. LOOKING ALONG CREST TOWARD RIGHT ABUTMENT
AND SHOWING UPSTREAM FACE



#3. LOOKING ALONG CREST TOWARD RIGHT ABUTMENT
AND SHOWING DOWNSTREAM AREA



#4. BIRCH TREES ALONG CREST, LOOKING TOWARD
LEFT ABUTMENT



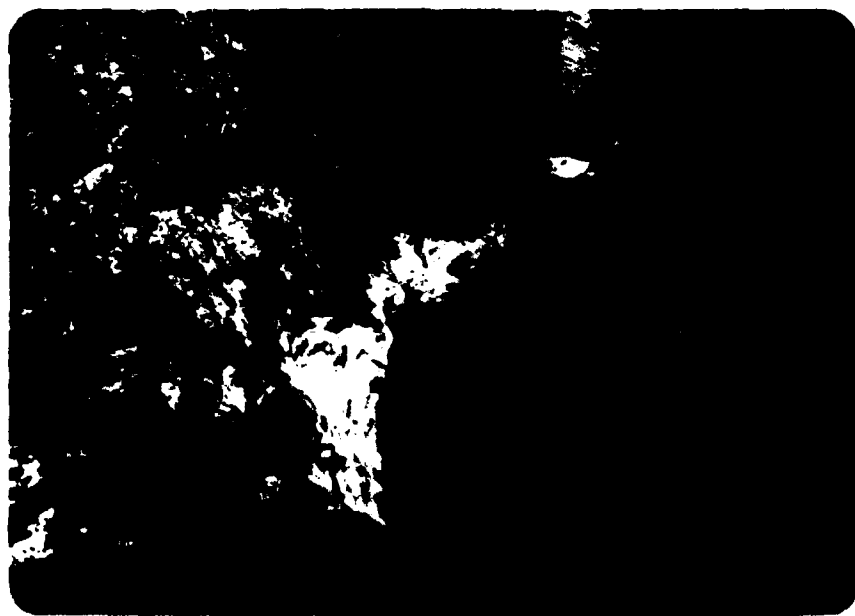
#5. UPSTREAM PORTION OF LEFT ABUTMENT FROM MIDDLE
OF DAM



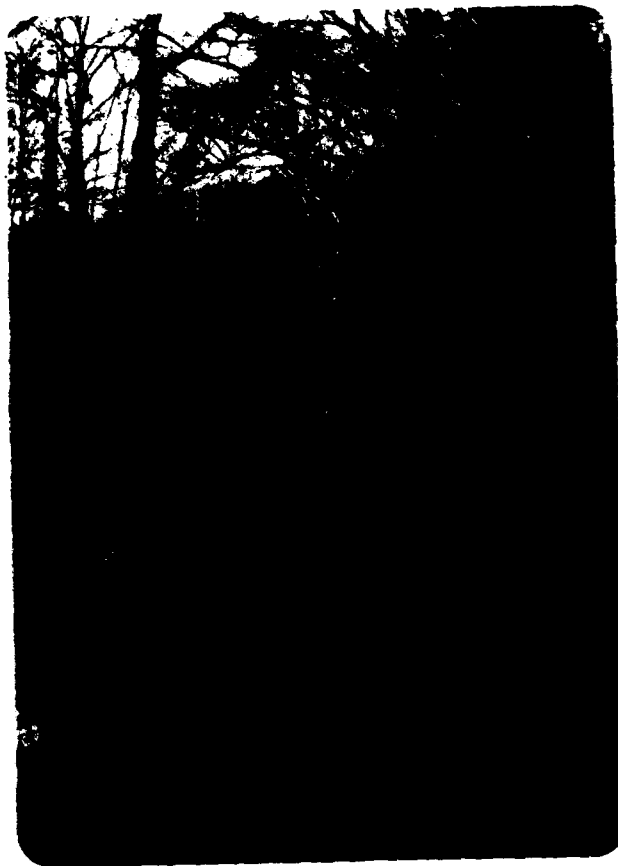
#6. UPSTREAM SIDE OF SPILLWAY SHOWING LOG BOOM
AND SERVICE BRIDGE



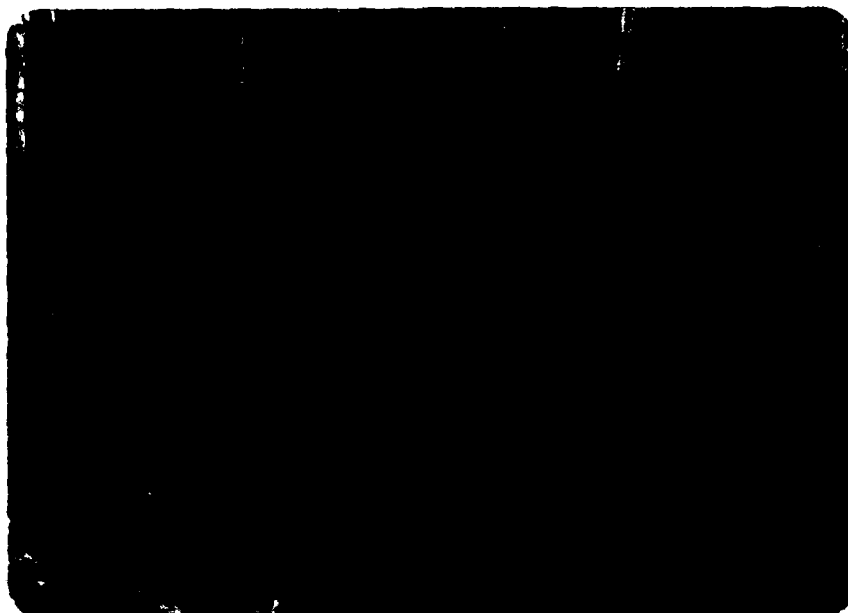
#7. SPILLWAY CREST,
RIGHT ABUTMENT
AND STOPBOARD
FRAME



#8. SPILLWAY DISCHARGE CHANNEL, LOOKING DOWN-
STREAM FROM SPILLWAY



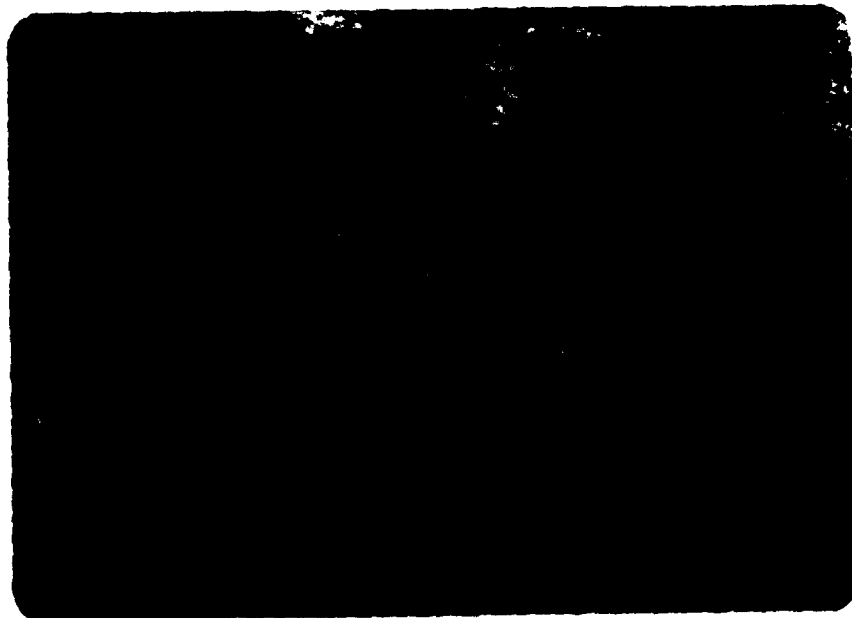
#9. DOWNSTREAM SPILL-
WAY CHANNEL



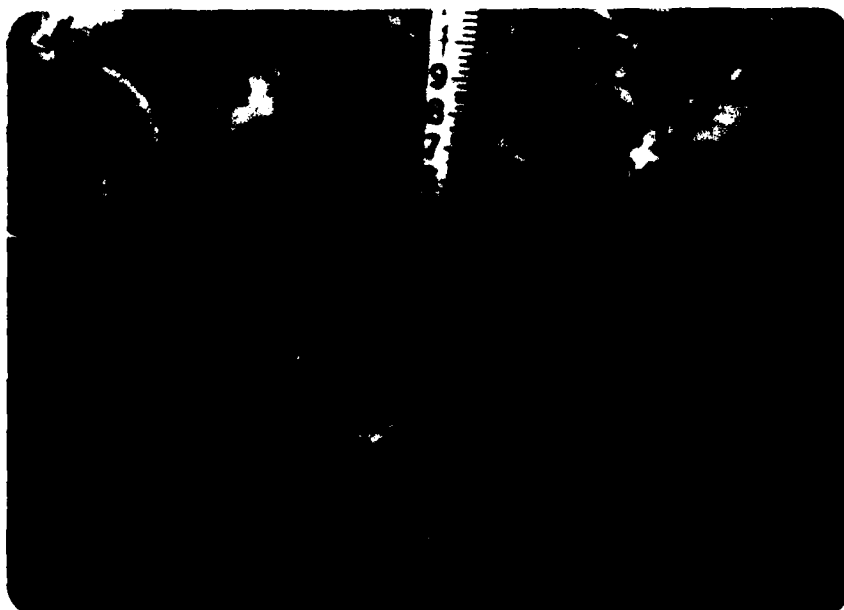
#10. DOWNSTREAM PORTION OF LEFT ABUTMENT FROM
MIDDLE OF DAM



#11. 6-INCH DIAMETER
CMP AT DOWNSTREAM
SIDE OF RIGHT
ABUTMENT CONTACT
LINE



#12. RUSTY WATER EXITING FROM 6-INCH DIAMETER
CMP TOE DRAIN NEAR CENTER OF DAM



#13. CLOSE-UP OF WATER SEEP IN PHOTO #12.



#14. 24-INCH DIAMETER CMP LOW-LEVEL OUTLET AND TWO 6-INCH DIAMETER TOE DRAINS ABOVE. ONE TOE DRAIN WAS DRY; ONE WAS FULL OF ICE.

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

DUFRESNE-HENRY ENGINEERING CORPORATION

DATE _____ SUBJECT _____ SHEET NO. _____ OF _____
JOB NO. _____

APPENDIX D

HYDROLOGIC / HYDRAULIC COMPUTATIONS

TEST FLOOD	D-1
STORAGE ROUTING	D-1
RATING CURVES	D-2, D-3
DISCHARGE & STORAGE COMPS.	D-4 - D-6
FAILURE ANALYSIS	D-7
HEC-1	D-8 ON

DUFRESNE-HENRY ENGINEERING CORPORATION

W.A. LEONARD
DATE 2/7/79

SUBJECT LAKE MANSFIELD
DRAINAGE AREA
& CLASSIFICATION

SHEET NO. D-1 OF
JOB NO. 04-0093

PLANIMETER READING 17.39

SCALE 1:24,000

FACTOR TO SQ MI .14348

$17.39(.14348) = \underline{\underline{2.495 \text{ SQ MI}}}$

DAM CLASSIFICATION

SIZE:

HEIGHT 15'
FLOOD AREA 41 ACRES

SIZE CLASSIFICATION

SMALL

HAZARD:

(3)
A FEW HOUSES WITHIN
MARGINAL FLOOD LIMITS

SIGNIFICANT

TEST FLOOD

⇒ 100yr- 1/2 P.M.F

FROM HEC-1

PEAK FLOW

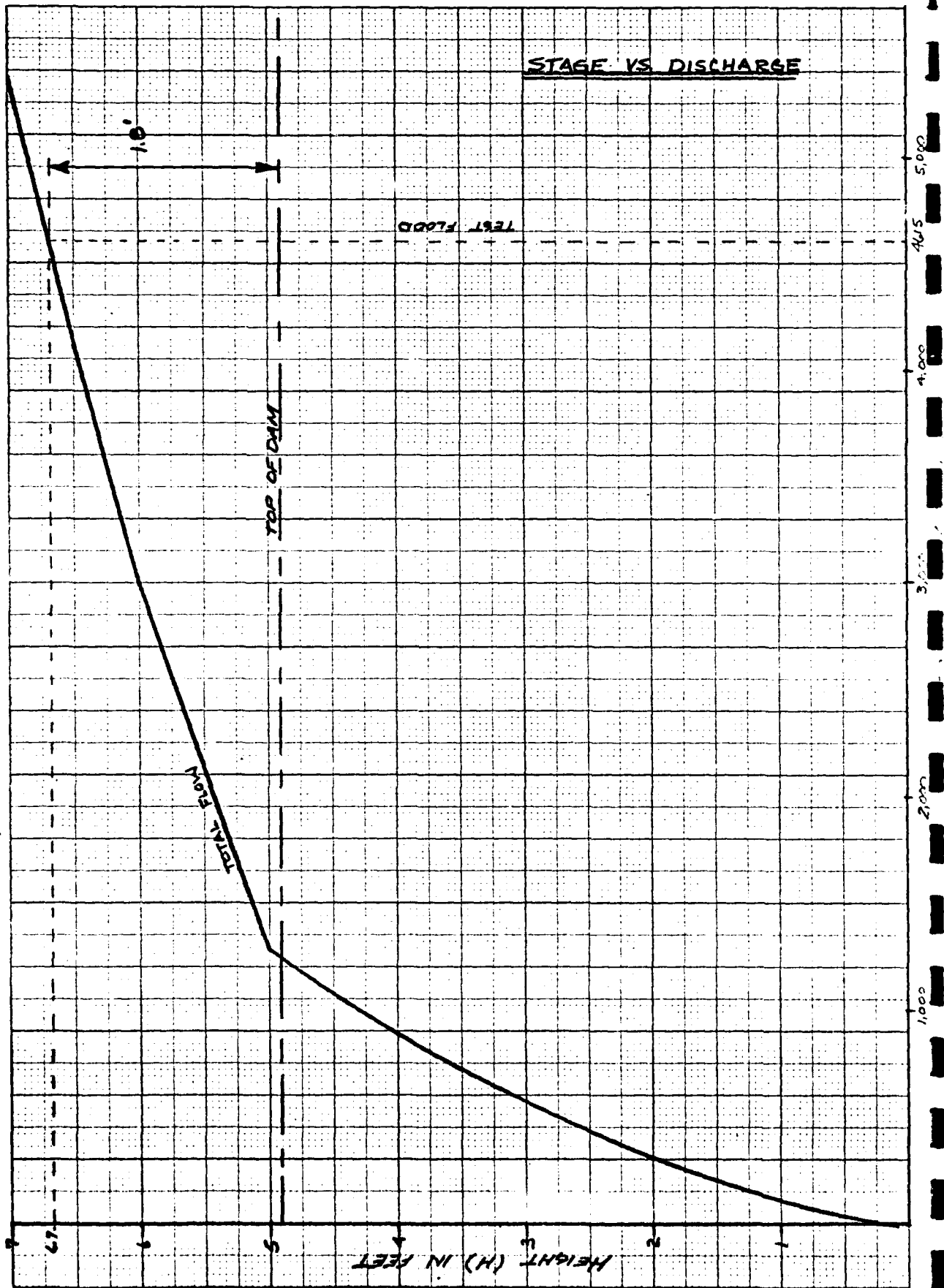
9818 cfs

ROUTING

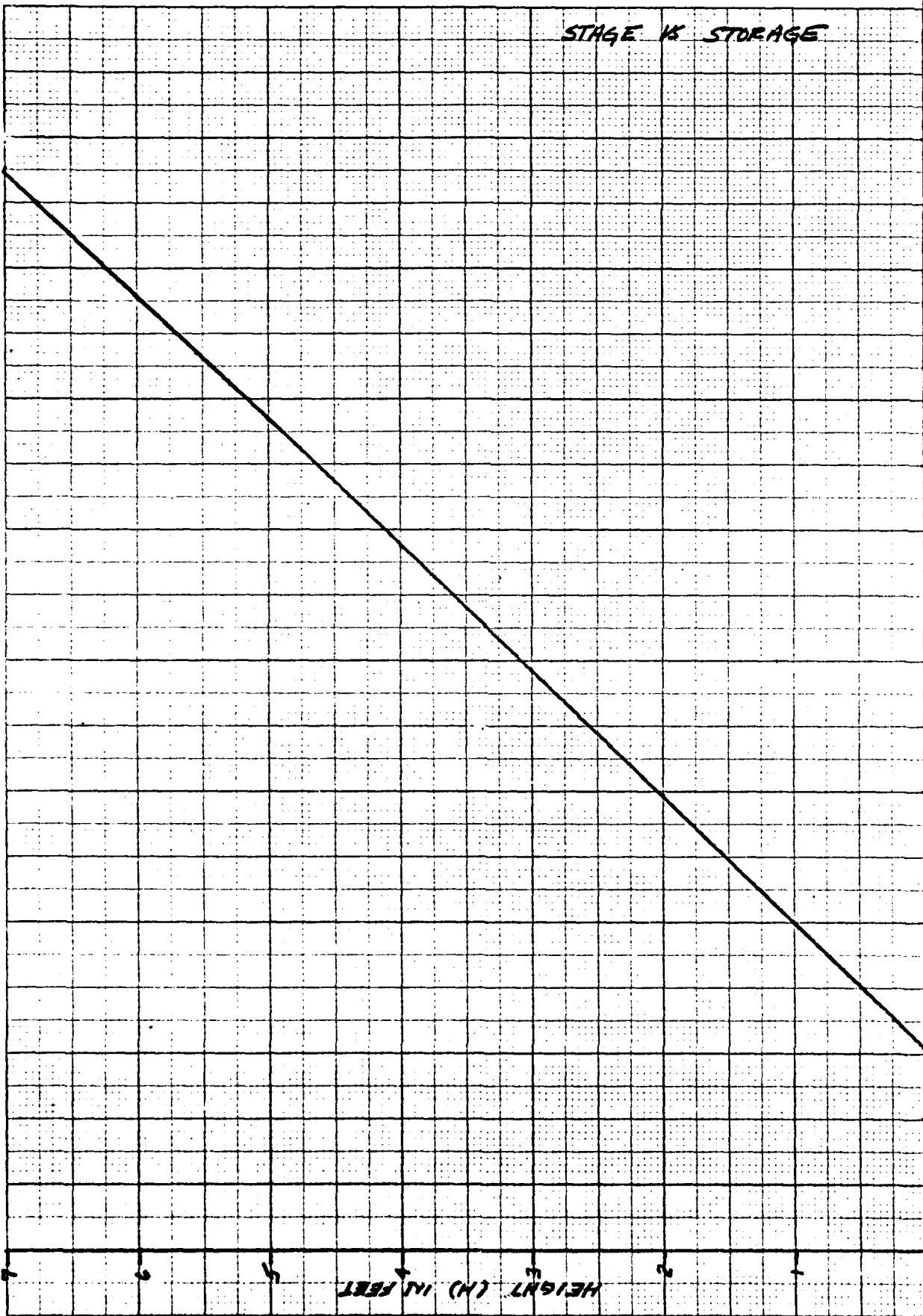
FROM HEC-1

ROUTED FLOW

4615 cfs



STAGE 15 STORAGE



DUFRESNE-HENRY ENGINEERING CORPORATION

BY W. A. LEONARD
DATE 2/9/79

SUBJECT LAKE MAINSFIELD
TEST FLOOD SELECTION
± CAMPS

SHEET NO. D-4 OF
JOB NO. DA-0093

FOR SMALL DAM WITH SIGNIFICANT HAZARD

TEST FLOOD 100% TO 1/2 PMF

$$\frac{1}{2} \text{ PMF} = 2460(2.5)(.5) = \underline{\underline{3075 \text{ cfs}}}$$

FROM COE R. D. T.

DISCHARGE VALUES FOR SPILLWAY
SPILLWAY ELEV 193.1
ASSUMING DAM TO WITHSTAND OVERTOPPING

$$Q = CLH^{3/2} \quad L = 33.5'$$

ASSUME C = 3.33 FOR SHARP
CRESTED WEIR.

$$h = 0 \quad Q = 0$$

$$h = 1 \quad Q = 3.33(33.5)(1)^{3/2} = \underline{112 \text{ cfs}}$$

$$h = 2 \quad Q = 3.33(33.5)(2)^{3/2} = \underline{316 \text{ cfs}}$$

$$h = 3.2 \quad Q = 3.33(33.5)(3.2)^{3/2} = \underline{639 \text{ cfs}}$$

$$h = 4 \quad Q = 3.33(33.5)(4)^{3/2} = \underline{892 \text{ cfs}}$$

$$h = 5 \quad Q = 3.33(33.5)(5)^{3/2} = 1247 \text{ cfs}$$

$$+ 2.5(1/2 \times .9 \times 30)(.9)^{1/2} = 32$$

TOTAL 1279 cfs

FOR LENGTH ENHANCEMENT
 $Q = CLH^{1/2}$
ASSUME C = 2.5

$$h = 6 \quad Q = 3.33(33.5)(6)^{3/2} = 1640$$

$$+ 2.5[1/2(.9)(30) + 380(1)](1.9)^{1/2} = 1356$$

TOTAL 2996 cfs

$$h = 7 \quad Q = 3.33(33.5)(7)^{3/2} = 2046$$

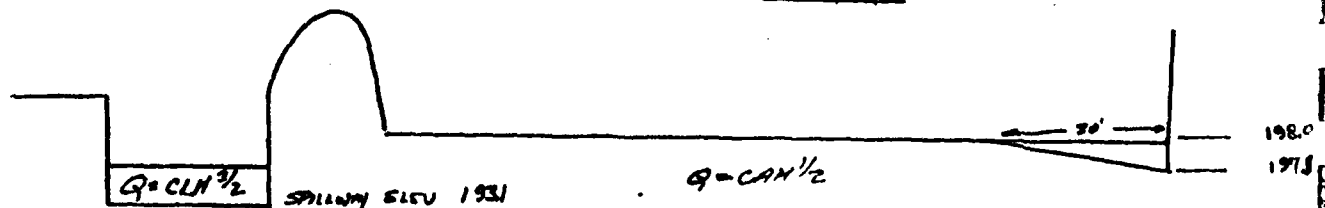
$$+ 2.5[1/2(.9)(30) + 380(2)](2.9)^{1/2} = 3293$$

TOTAL 5339 cfs

$$h = 6.5 \quad Q = 3.33(33.5)(6.5)^{3/2} = 1849$$

$$+ 2.5[1/2(.9)(30) + 380(1.5)](2.4)^{1/2} = 2260$$

TOTAL 4109 cfs



DUFRESNE-HENRY ENGINEERING CORPORATION

W. A. LEONARD

SUBJECT LAKE MANSFIELD

SHEET NO. D-5 OF

DATE 9/12/79

STORAGE COMPS

JOB NO. 04-0093

CONTIGUOUS	AREA (FT ²)	AVERAGE AREA	DEPTH	VOLUME (ACRE-FT)
5	— 0 —			
B	$.6 \times 6400 = 3,840$	1,920	2'	.09
P	$6.97 \times 6400 = 44,608$	22,224	3'	1.67
S	$34.2 \times 6400 = 218,880$	131,744	5'	15.12
D	SUB AREA 1 53.58 SUB AREA 2 24.61 TOTAL $78.19 \times 6400 = 500,416$	359,648	5'	41.28
	SUB AREA 1 78.08 SUB AREA 2 35.91 SUB AREA 3 56.19 TOTAL $170.18 \times 6400 = 1,089,152$	794,784	4'	72.98
C	SUB AREA 1 98.26 SUB AREA 2 44.37 SUB AREA 3 58.78 SUB AREA 4 40.57 MINUS -.23 TOTAL $261.64 \times 6400 = 1,674,496$	1,381,824	6'	190.33
TOTAL				321.47 A-FT

TOP CONTOUR ASSUMED AT SPILLWAY ELEV $\Rightarrow$ 193.1

DUFRESNE-HENRY ENGINEERING CORPORATION

BY W.A. LEONARD

SUBJECT LAKE MANSFIELD

SHEET NO. D-6 OF

DATE 2/12/79

STORAGE COMPS

JOB NO. 04-0095

TOTAL AREA FOR 193.1 CONTOUR $1,674,496 / 43,560 = 38.44 \text{ ACRES}$

ASSUME SAME SURFACE AREA FOR INCREASING ELEVATIONS, & THAT DAM WOULD WITHSTAND OVERTOPPING

<u>h</u>	<u>WSEL</u>	<u>STORAGE</u>
0	193.1	321.47
1	194.1	359.91
2	195.1	398.35
3	196.1	436.79
4	197.1	475.23
5	198.1	513.67
6	199.1	552.11
7	200.1	590.55

AT TEST FLOOD $h = 6.7'$
OF 4615 cfs

$$\text{STORAGE} = 6.7 (38.44) + 321.47 = 579.02 \text{ ACRE-FT}$$

DUFRESNE-HENRY ENGINEERING CORPORATION

WAL
DATE 3-1-79

SUBJECT LAKE MANSFIELD
DAM FAILURE ANALYSIS

SHEET NO. D-7 OF
JOB NO. 04-0093

USING DAM WIDTH (250') AT MID-HEIGHT (ELEV 182.5)
IF 40% OF WIDTH FAILED

$$Q = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2}$$

$$Q = \frac{8}{27} \cdot 4(250) \sqrt{32.2} (31)^{3/2} = 29,020 \text{ cfs}$$

IF DAM FAILED - FLOW WOULD EQUAL 29,020 cfs
(WITH WSEL = 198.0)

DUFRESNE-HENRY ENGINEERING CORPORATION

BY W.A.L.
DATE 3-1-79

SUBJECT LAKE MANSFIELD
SOIL CLASSIFICATION

SHEET NO. D-8 OF
JOB NO. 04-0093

PREDOMINANT SOILS FOR LAKE MANSFIELD DRAINAGE
AREA FROM SOIL CONSERVATION SERVICE ARE:

LYMAN-MARLOW — CLASS C
PERU — CLASS C

LAND USE — WOODED

SLOPES — STEEP

RUNOFF CURVE NUMBER FROM SCS IS 73

FOR CN 73 USING A WET CONDITION
RAINFALL LOSSES = . 30 INCHES

UNIFORM RAINFALL LOSS FOR CLASS C
SOIL = .12 IN/H2

DUFRESNE-HENRY ENGINEERING CORPORATION

W.A. LEONARD
 DATE 2-28-79
 SUBJECT LAKE MANSFIELD - STONE
 COMPUTER DATA
 SHEET NO. D-9 OF
 JOB NO. 04-0093

518 - AREA 1 DRAINAGE AREA

$$5.48(.14348) = .79 \text{ SQ MI}$$

AVERAGE SLOPE

2.9" LENGTH

10% @ .29"
 85% @ 2.47"

$$\frac{2520 - 1160}{2.18(24,000)/12(5,280)} = 1647' / \text{MILE}$$

$$T_p = 2.2 \left(\frac{L - L_c}{L_s} \right)^{.37} \Rightarrow 2.2 \left(\frac{\frac{2.9(24,000)}{12(5,280)} (.6) \frac{2.9(24,000)}{12(5,280)}}{\sqrt{1647}} \right)^{.37} = .50$$

523 - AREA 2 DRAINAGE AREA

$$5.97(.14348) = .78 \text{ SQ MI}$$

AVERAGE SLOPE

4.2" LENGTH

10% @ .42"
 85% @ 3.57"

$$\frac{2120 - 1160}{3.15(24,000)/12(5,280)} = 805' / \text{MILE}$$

$$T_p = 2.2 \left(\frac{L - L_c}{L_s} \right)^{.37} \Rightarrow 2.2 \left(\frac{\frac{4.2(24,000)}{12(5,280)} (.6) \frac{4.2(24,000)}{12(5,280)}}{\sqrt{805}} \right)^{.37} = .74$$

DUFRESNE-HENRY ENGINEERING CORPORATION

BY W.A. LEONARD SUBJECT LAKE MAUSFIELD - STOWE SHEET NO. D-10 OF
 DATE 2-28-79 COMPUTER DATA JOB NO. 04-0093

SUB-AREA 3 DRAINAGE AREA

$$2.5 - .79 - .78 = .93 \text{ SQ MI}$$

AVERAGE SLOPE

LENGTH 3.05" @ 10% .3"
 @ 85% 2.5"

$$\frac{2420 - 1190}{3.05(24,000)/12(5,280)} = 1065' / \text{MILE}$$

$$T_p = 2.2 \left(\frac{L L_c}{15} \right)^{.37} \Rightarrow 2.2 \left(\frac{\frac{3.05(24,000)}{12(5,280)} (.6) \frac{3.05(24,000)}{12(5,280)}}{\sqrt{1065'}} \right)^{.37} = .56$$

DUFRESNE-HENRY ENGINEERING CORPORATION

E W.A. LEONARD
DATE 3-8-72

SUBJECT LAKE MANSFIELD
1/2 PMF TEST FLOOD

SHEET NO. D-11 OF
JOB NO. 04-0023

FROM HEC 1 COMPUTER PROGRAM TO DETERMINE $1/2$ PMF.

$$\underline{\underline{1/2 PMF = 4615 \text{ cfs.}}}$$

FROM STAGE-DISCHARGE GRAPH $h = 6.7$

$$WSEL = 6.7 + 193.1 = 199.8$$

TOP DAM 198

$\therefore$ 1.8' OF WATER FLOWING OVER TOP OF
DAM IF DAM WOULD SURVIVE
OVERTOPPING.

$$\text{AT LOW ZONE } 199.8 - 197.2 = 2.6' \text{ OVER TOP}$$

$$\begin{array}{l} \text{AT } h = 6.7' \\ \text{TEST FLOOD } 4615 \text{ cfs} \end{array} \quad \text{STORAGE} = 321.47 + 6.7(38.4) = \underline{\underline{579.4}}$$

$$\begin{array}{r} 197.2 \\ - 193.1 \\ \hline 4.1 \end{array}$$

A. $h = 4.1$ WSEL WOULD BE LEVEL WITH LOW ZONE ON RIGHT
ABUTMENT

$$Q = 333 (33.9) (4.1)^{3/2} = \underline{\underline{926 \text{ cfs}}}$$

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

LAKE MANSFIELD
 STONE VERMONT
 RESERVOIR STORAGE-OUTFLOW

JOB SPECIFICATION
 HQ NHR NHIN IDAY IWR IMIN METAC IPLT IPRT INSTAN
 100 0 10 1 0 0 0 2 0 0
 JOPER 0 NMT
 3 0

SUB-AREA RUNOFF COMPUTATION

WATERSHED RUNOFF SUB-AREA 1
 ISTAG ICOMP IECOM IFAPE JPLT JPRT INAME
 1 0 0 0 0 0 1

HYDROGRAPH DATA
 INTDGC IUNG TAREA SNAP TRSDA TRSPC RATIO ISHOW ISAME LOCAL
 1 1 0.75 0.0 0.0 1.00 0.500 0 0 0

PRECIP DATA
 SPPE PMS R6 R12 R24 R48 R72 R96
 0.0 16.00 111.00 123.00 133.00 0.0 0.0 0.0

LOSS DATA
 STRKE DLTZR ATOL ERAIN STRKS ATIOK STRTL CNSTL ALSMX RTIMP
 0.0 0.0 1.00 0.0 0.0 1.00 0.30 0.12 0.0 0.0

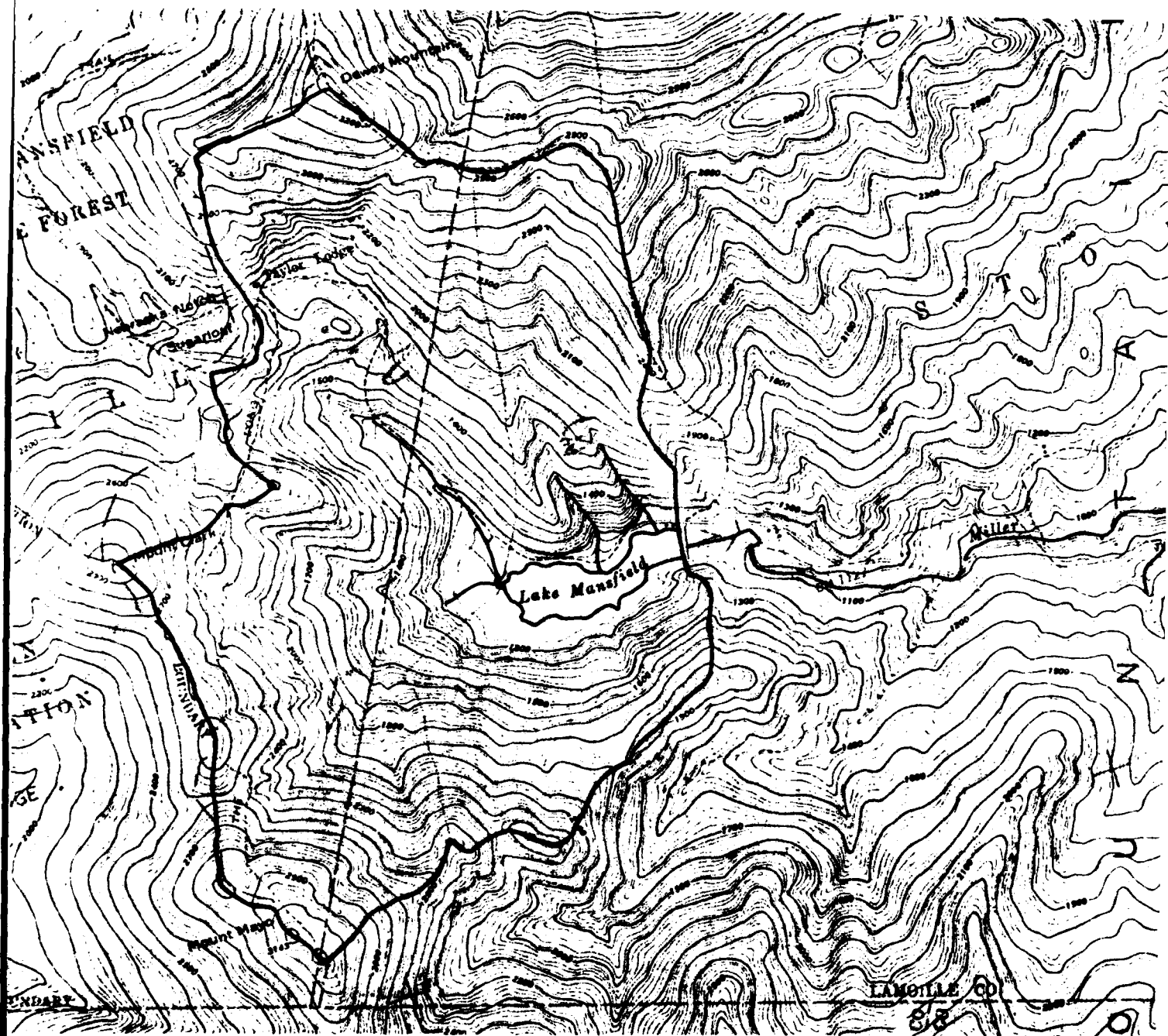
UNIT HYDROGRAPH DATA
 TFS 0.50 CP80.75 NTAG 0

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TCM 4.00 AND R6 1.53 INTERVALS
 STATGS 1.50 QRC5NA -0.10 RTIDAP 1.50

UNIT HYDROGRAPH 11 END-OF-PERIOD ORIGINATES, LAGS 0.50 HOURS, CP8 0.75 VOL8 1.00
 129. 430. 696. 736. 520. 266. 136. 69. 35. 18.

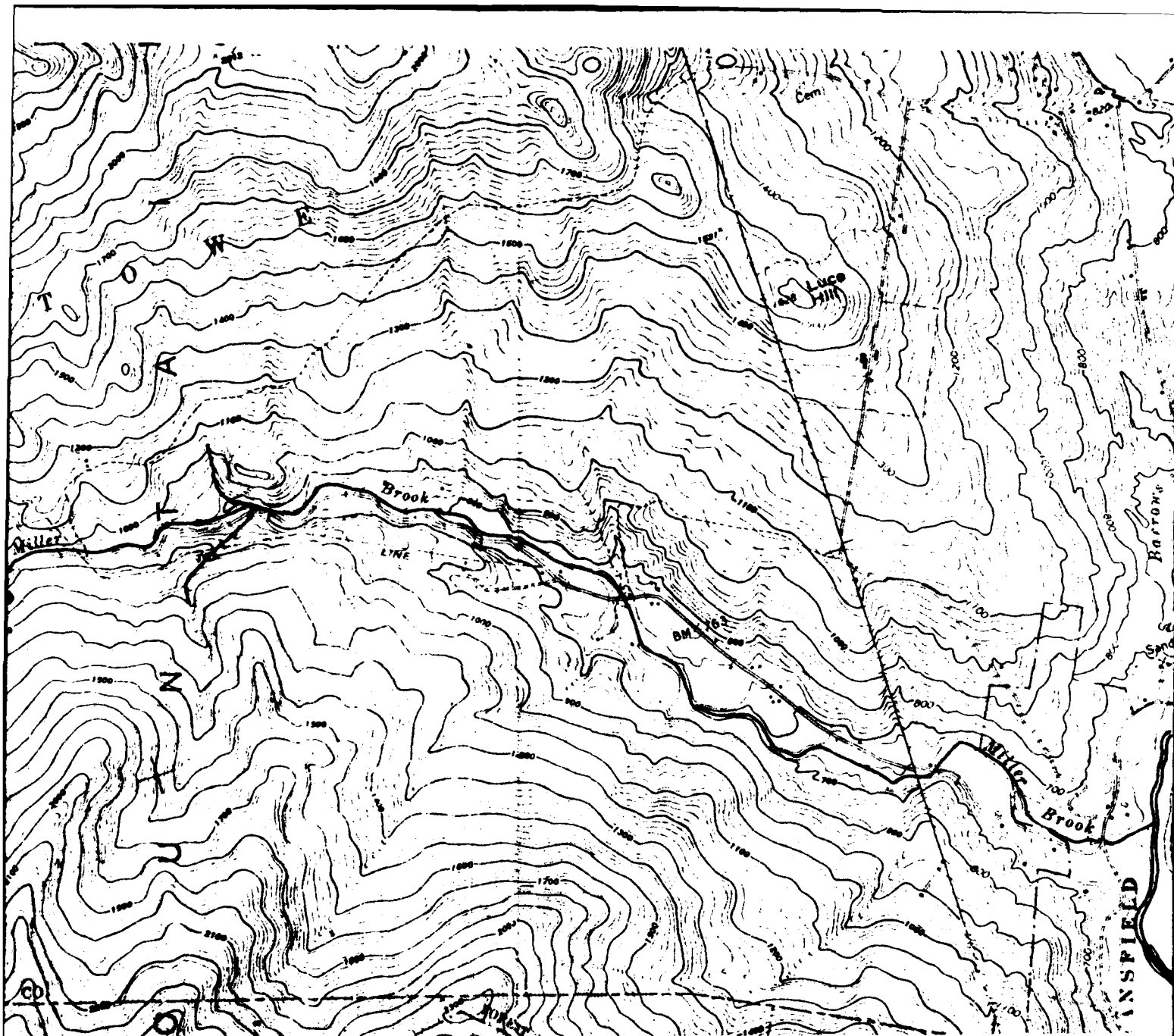
RUNOFF SUMMARY, AVERAGE FLOW

HYDROGRAPH AT	1	2	3	0	1	4615.	2049.	633.	665.	2.50	4.93	4.78	AREA
HYDROGRAPH AT	1593.	1417.	1825.	4010.	4615.	2049.	633.	665.	2.50	4.93	4.78	212.	203.
ROUTED TO	706.	686.	826.	2215.	2049.	633.	665.	2.50	4.93	4.78	212.	203.	4.78



SOURCE 01

U.S. GEOLOGICAL SURVEY
BOLTON MOUNTAIN
VERMONT
SERIES V813
1:24000, 1984



SOURCE OF MAP

U.S. GEOLOGICAL SURVEY
 BOLTON MOUNTAIN QUADRANGLE
 VERMONT
 SERIES V813
 1:24000, 1948



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 LAKE MANSFIELD DAM

DRAINAGE AREA AND DOWNSTREAM CONDITIONS

STONE

CLIENT NO. 04-0093

SCALE 1:24000

VERMONT

DATE 1-28-50

DATE 1-28-50

APPENDIX E

Information as Contained in the National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

STATE	SPILLWAY	DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE	REPORT DATE
VT	100	100	100	100	100	12 APR 79

POPULAR NAME	NAME OF IMPOUNDMENT
LAKE HANSFIELD	LAKE HANSFIELD

RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	POPULATION
MILLER RIVER	STOW	0

TYPE OF DAM	YEAR COMPLETED	PURPOSES	IMPOUNDING CAPACITY (ACR-FEET)	POPULATION
100	100	100	100	100

REMARKS
100

SPILLWAY	DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
100	100	100	100	100

OWNER	ENGINEERING BY	CONSTRUCTION BY
LAKE HANSFIELD TRUST CLN	UNKNOWN	R.E. LORO + SON, BARRE

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
100	100	100	100

INSPECTION BY	INSPECTION DATE	INSPECTION REPORT
HUGHES MERRY BROS. CORP.	21 NOV 78	P.L. 92-167

REMARKS
100

100 UNM FED R PHY/PED SCS A VEN/DATE

REVISION IN 1965

DATE
FILMED
-8