

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
MAIN STREET DAM (MA 0.) (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAY 79

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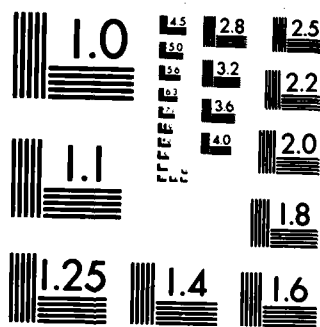
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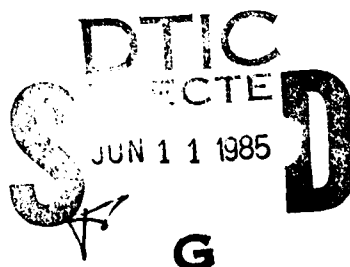
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MERRIMACK RIVER BASIN
HUDSON, MASSACHUSETTS

MAIN STREET DAM
MA 00448

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

MAY 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Merrimack River Basin Hudson, Massachusetts Danforth Brook		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam consists of earth embankments with a stone masonry downstream face and a stone masonry spillway. The left embankment is approximately 200 Ft. long, the right embankment is about 120 ft. long, and the spillway is about 21 ft. long. The left and right embankments are about 18 ft. high while the spillway is about 15 ft. high. The spillway is in good condition with no noticable defeiciencies. The dam has a classification of small and a hazard potential of high. --		

NEDED-E

Honorable Edward J. King

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

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. This report has also been furnished to the owner of the project, Larkin Lumber Co., Hudson, Massachusetts.

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

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

Sincerely,

Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

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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

OCT 15 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts

Dear Governor King:

Inclosed is a copy of the Main Street 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 Main Street Dam would likely be exceeded by floods greater than 24 percent of one half the Probable Maximum Flood (1/2 PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

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

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

MAIN STREET DAM
MA 00448

MERRIMACK RIVER BASIN
HUDSON, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.: MA 00448
Name of Dam: MAIN STREET DAM
Town: HUDSON
County and State: MIDDLESEX, MASSACHUSETTS
Stream: DANFORTH BROOK
Date of Inspection: 8 NOVEMBER 1978

BRIEF ASSESSMENT

Main Street Dam consists of earth embankments with a stone masonry downstream face and a stone masonry spillway. The left embankment is approximately 200 feet long, the right embankment is approximately 120 feet long, and the spillway is approximately 21 feet long, including the center pier. The left and right embankments are approximately 18 feet high while the spillway is approximately 15 feet high. The dam impounds the waters of Danforth Brook in the Town of Hudson, Massachusetts. The dam was originally constructed to supply water to an adjacent mill. There is no known operational outlet works.

The spillway is in good condition with no noticeable deficiencies. There is seepage present at the base of the north and west stone walls of the discharge channel beneath the building on the right side of the spillway. Because the source of this flow is unknown as well as the limited spillway capacity and need for maintenance, the dam is considered to be in only fair condition.

Based on the size classification, small, and hazard potential classification, high, in accordance with Corps of Engineers Guidelines, the adopted spillway test flood is the 1/2 PMF (Probable Maximum Flood). Hydraulic analysis indicates that the spillway capacity at top of dam is approximately 460 cfs which is about 24 percent of the total test flood of 1900 cfs. The estimated test flood stage is about 3.3 feet above the top of dam.

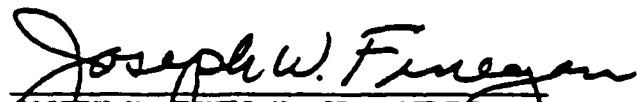
Investigations are recommended to verify the source of the seepage, to determine necessary modifications to increase the spillway capacity and to determine a method of lowering the reservoir water surface in times of emergency. Remedial measures include clearing brush and trees from the embankments, providing slope protection on the upstream faces of the embankments, and repairing the joints in the stone masonry walls. The Owner should develop a formal maintenance program, operational procedure, and emergency procedures plan and should institute a program of annual technical inspections. The remedial measures and recommendations should be performed within one year of receipt of this report by the Owner.

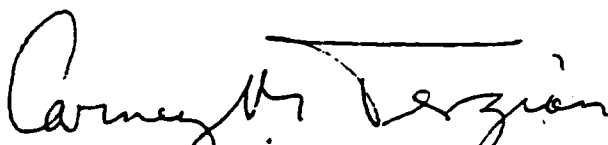
Camp Dresser & McKee Inc.

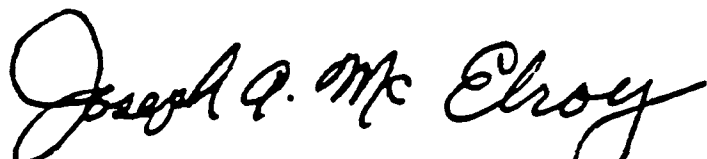
Roger H. Wood
Roger H. Wood
Vice President



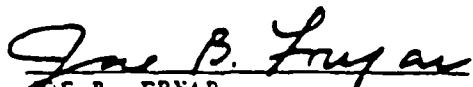
This Phase I Inspection Report on Main Street Dam, has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice,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


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


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials 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 Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction 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 aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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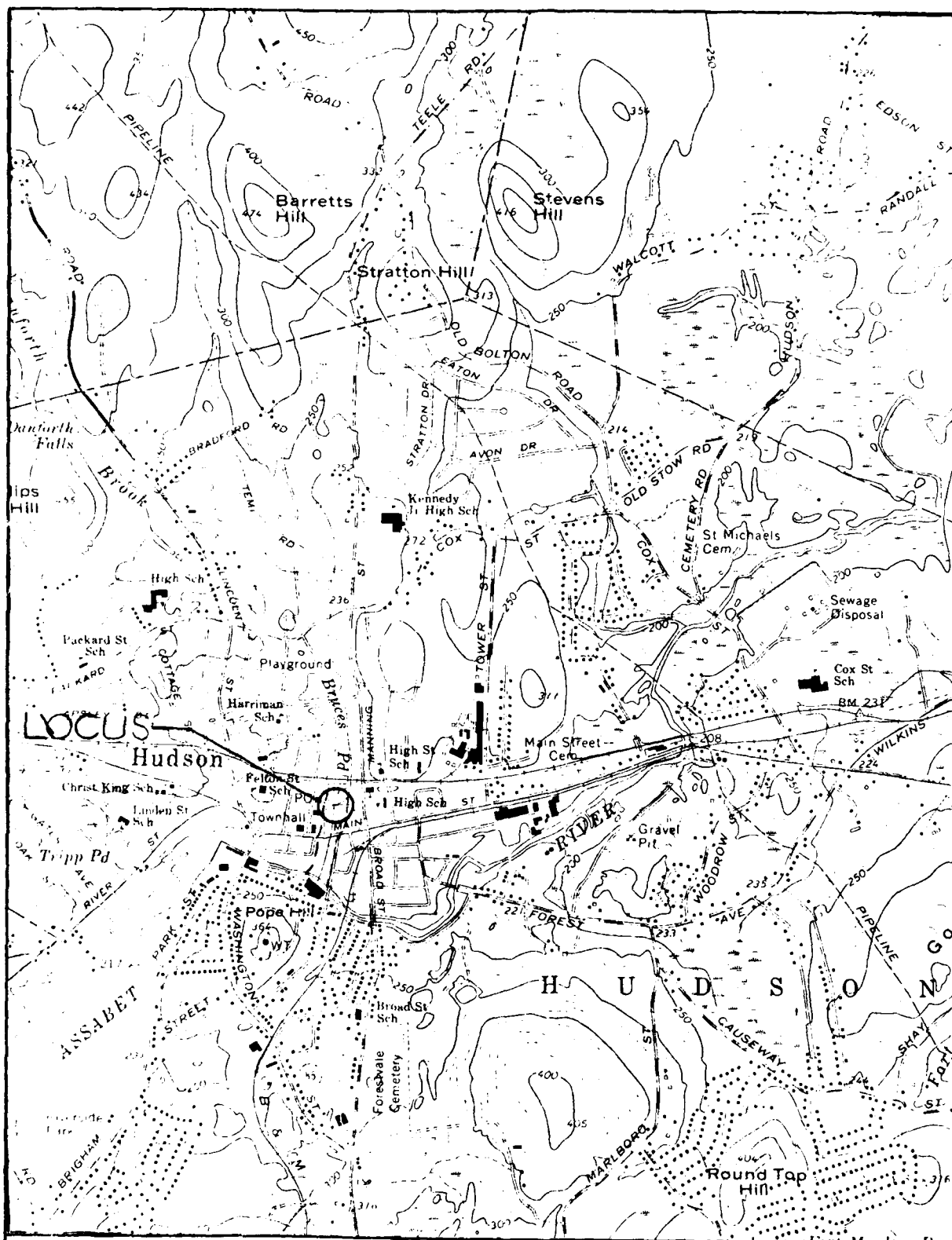
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A. Overview of spillway and left embankment from right embankment.



B. Overview of upstream face of dam and spillway.



DAM MAIN STREET

IDENTIFICATION NO. 00448



LOCATION MAP
USGS QUADRANGLE
HUDSON, MASSACHUSETTS

APPROX. SCALE: 1" = 2000'

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
MAIN STREET DAM
MA 00448

SECTION 1: PROJECT INFORMATION

1.1 General

- a. Authority - Public Law 92-367, 8 August 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.

Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under letters of 12 July 1978 and 23 October 1978, from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-78-C-0354 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for the soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:
- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - The Main Street Dam is located on Danforth Brook at the outlet of Bruces Pond in the downtown section of the Town of Hudson, Massachusetts. The dam is approximately 1/4 mile above the confluence of Danforth Brook with the Assabet River. Access to the dam is through private property owned by Larkin Lumber Company, 136 Main Street, Hudson, Mass.

- b. Description of Dam and Appurtenances - The Main Street Dam consists of earth embankments with a stone masonry downstream face and a stone masonry spillway. The remains of an outlet works which discharged under the adjacent building are present at the spillway right abutment. The left embankment is approximately 200 feet long, the right embankment is approximately 120 feet long, and the spillway is approximately 20 feet long excluding a 1 foot wide center pier. While the embankment crest widths are somewhat uniform for the major portion of the dam, they do widen appreciably at the abutments. The crest elevations of both embankments vary from elevation 217.7 to 218.5

The left embankment is approximately 18 feet high with an irregular upstream face and a vertical stone masonry downstream face. A two-story building is located at the downstream edge of the dam crest, with the second story projecting above the dam. The downstream face of the dam serves as the first floor wall of the building. The embankment crest is approximately 18 feet wide with an average crest elevation of 218.0. The building is a wood and brick structure extending approximately 180 feet from the edge of the spillway.

The right embankment is approximately 18 feet high and 20 feet wide with an irregular upstream face and a vertical stone masonry downstream face. The average crest elevation is 218.0. Like the left embankment, the right embankment has a two-story wood and brick structure constructed up against the downstream face of the dam. The upper story of the building projects above the top of the dam. The building extends approximately 110 feet from the right abutment, except for a 10-foot open spot approximately 82 feet from the right abutment.

The crest of the stone masonry spillway is approximately 3.0 feet below the top of the dam. The spillway is a cascade with a broad crested weir. Height of the spillway is approximately 15 feet. The walls of the spillway are concrete and stone masonry.

- c. Size Classification - The height of the dam is approximately 18.0 feet and the estimated total storage capacity at the top of the dam is 72.9 acre-feet. According to guidelines established by the Corps of Engineers, the dam is classified in the small category.
- d. Hazard Classification - Due to the close proximity of structures immediately downstream, excessive economic loss and the loss of more than a few lives would probably occur if the dam should suddenly fail. The dam failure analysis indicates that should a portion of the dam suddenly fail, a large amount of water would suddenly inundate the buildings immediately downstream of the dam. Additionally, large volumes of water, primarily in the form of sheetflow, would flood the large commercial area along

Main Street. Depth of flow would range generally about 2 - 3 feet, but would cover a wide area as the flow continued on its way to the Assabet River. Consequently, the Main Street Dam is classified in the high category.

- e. Ownership - The Main Street Dam is presently owned by Larkin Lumber Company, 136 Main Street, Hudson, Massachusetts, 01749.
- f. Operator - Mr. Alan Parker of Larkin Lumber Company, 136 Main Street, Hudson, Massachusetts, 01749 (Phone: 562-3217) is the operator of the Main Street Dam.
- g. Purpose of the Dam - The Main Street Dam originally diverted water to a small mill located on the right embankment. The mill no longer uses the water for power generation and the dam presently has only aesthetic value.
- h. Design and Construction History - No records of the design or construction of the dam were located and none are believed to exist.
- i. Normal Operational Procedures - There are no formal operational procedures currently in effect for this structure. There is no known operational gate.

1.3 Pertinent Data

There are no known elevations previously established at the dam site. Consequently, the water surface elevation of 215 shown on the USGS Quadrangle, Hudson, Mass., 1966, was adopted as being the spillway crest elevation. All other elevations given in this report pertaining to the dam site were estimated from the assumed spillway crest elevation on National Geodetic Vertical Datum (NGVD).

- a. Drainage Area - The dam impounds waters of Danforth Brook to create Bruces Pond, in the Town of Hudson, Massachusetts. The watershed above the dam is approximately 7 square miles. The watershed is very flat and is primarily wooded with extensive swamps and marsh areas. There is very little development throughout the drainage area.
- b. Discharge at Dam Site - Accurate records of peak discharges at the dam site were not located. On numerous occasions, the parking area immediately downstream of the spillway has been inundated. Comments by local residents indicate that up to two feet of water has flooded this area.

- (1) Outlet works-----No known operable outlet
- (2) Maximum known flood at damsite-----Unknown
- (3) Ungated spillway capacity at top of dam
460 cfs @ 218.0 elev.
- (4) Ungated spillway capacity at test flood elevation
1100 cfs @ 221.3 elev.
- (5) Gated spillway capacity at normal pool elevation-----N/A
- (6) Gated spillway capacity at test flood elevation-----N/A
- (7) Total spillway capacity at test flood elevation
1100 cfs @ 221.3 elev.
- (8) Total project discharge at test flood elevation
1900 cfs @ 221.3 elev.

c. Elevation (NGVD)

- (1) Streambed at centerline of dam-----200 (Est.)
- (2) Test flood tailwater-----207.7 (Est.)
- (3) Upstream portal invert diversion tunnel-----N/A
- (4) Normal pool.....215.0
- (5) Full flood control pool-----N/A
- (6) Spillway crest-----215.0
- (7) Design surcharge (Original Design)-----Unknown
- (8) Top of dam-----Varies, avg. is 218.0
- (9) Test flood surcharge-----221.3

d. Reservoir

- (1) Length of test flood pool----- 4200 ft (Est.)
- (2) Length of normal pool-----2500 ft
- (3) Length of flood control-----N/A

e. Storage (acre-feet)

- (1) Normal pool-----18.4 (Est.)
- (2) Flood control pool-----N/A
- (3) Spillway crest pool-----18.4 (Est.)
- (4) Top of dam-----73 (Est.)
- (5) Test flood pool-----160 (Est.)

f. Reservoir Surface (acres)

- (1) Normal pool-----11 (Est.)
- (2) Flood-control pool-----N/A
- (3) Spillway crest-----11 (Est.)
- (4) Test flood pool-----38 (Est.)
- (5) Top of dam-----22 (Est.)

g. Embankments

Right Embankment

Left Embankment

- | | | |
|---------------------|--|--|
| (1) Type | Earth with stone masonry downstream face | Earth with stone masonry downstream face |
| (2) Length | Approx. 120 ft | Approx. 200 ft |
| (3) Height | 18 ft approx. | 18 ft approx. |
| (4) Top width | 20 ft min. | 18 ft min. |
| (5) Side slopes | Irregular U/S
Vertical D/S | Irregular U/S
Vertical D/S |
| (6) Zoning | Unknown | Unknown |
| (7) Impervious Core | Unknown | Unknown |
| (8) Cutoff | Unknown | Unknown |
| (9) Grout Curtain | Probably none | Probably none |

h. Diversion and Regulating Tunnel-----None

i. Spillway

- (1) Type-----Broad-crested stone masonry weir with cascade
- (2) Length of weir-----2 @ 10 ft
- (3) Crest elevation-----215.0
- (4) Gates-----None
- (5) U/S Channel-----Bruces Pond
- (6) D/S Channel-----15 ft wide by 5 ft channel

j. Regulating Outlets

An outlet structure is located at the spillway right abutment. While references have been made to the existence of a gate within the structure, the access to the gate is sealed and no actual discharge outlet for the facility was located. Observations and comments during the site examination indicate the outlet structure is no longer operational.

SECTION 2: ENGINEERING DATA

- 2.1 Design Records - There are no known design records for the dam.
- 2.2 Construction Records - No records of the original construction were located.
- 2.3 Operation Records - No operational records other than State inspection reports are available for the dam.
- 2.4 Evaluation - Since no engineering records are available, the evaluation of the dam must be based primarily on the results of the visual examination which is detailed in Section 3.

SECTION 3: VISUAL INSPECTION

3.1 Findings

- a. General - The Phase I Visual Examination of the Main Street Dam was conducted on 8 November 1978.

In general, the dam was observed to be in fair condition based on the condition of the embankments and the absence of an operable reservoir drain. The reservoir level at the time of the site examination was 3 inches above the weir crest.

Visual inspection checklists for the site visit are included in Appendix A and selected photographs are given in Appendix C.

- b. Dam - The downstream face of the spillway is a stepped cascade constructed of cut stone masonry which is in good condition. The upstream training walls, center pier and right spillway wall are constructed of concrete and are also in good condition. There is some efflorescence and minor cracking on the right spillway wall (common wall of abandoned raceway). There is a flow of water coming from the low end of the abandoned raceway through a drain hole in the downstream end of the right wall as shown in Photo 3. There are no flashboards present at the weir crest but five 1-inch diameter steel pins embedded in the crest were observed. The pins are spaced at 16-inch centers and may cause a build up of debris.

The fieldstone walls of the stilling basin and downstream channel are generally in good condition. Some smaller stones are missing and voids are developing in the joints.

The earth embankments located to the right and left of the spillway are generally in fair condition. There is no visual evidence of significant settlement, lateral movement, or major erosion or seepage, but there are some deficiencies as listed below.

- (1) Except for a section of recently-placed gravelly sand along the right embankment, the upstream faces of the embankments have a random growth of trees, brush and weeds, as shown in Photos A and B. At several locations along the left embankment, there is rubble and trash along the shoreline.
- (2) The irregular upstream faces of the embankments have little or no systematic erosion protection; the irregularity may reflect local undercutting by wave action, although none was evident at the time of the inspection.

- (3) The crest of the left embankment has a partial cover of grass and weeds, as shown in Photos 5 & 6. It is locally uneven and rutted. The larger surface area of the right embankment has been recently graded with gravelly sand fill.
 - (4) There were indications of very slight seepage near the bottom of the downstream stone masonry wall of the left embankment. Two locations were noted within the building and one immediately to the east.
 - (5) There was slight seepage from the base of the north and west stone masonry walls of the discharge channel beneath the building on the right side of the spillway. According to a representative of the Larkin Lumber Company, this flow does not come from the dam; rather it enters the building crawl space at the west end, from the direction of the right abutment slope. Wet areas and seepage, with drainage into the building crawl space, were evident at the base of the stone masonry wall that parallels the right abutment slope.
- c. Appurtenant Structures - The concrete of the former outlet works (common wall of the spillway) is in good condition with some efflorescence and minor cracking observed. The new concrete structure built over the raceway is in excellent condition. The flow of water through the drain hole near the end of the raceway indicates the gate within the raceway is probably not completely sealed.
- d. Reservoir Area - Bruces Pond is formed by the impoundment of the waters of Danforth Brook by the Main Street Dam. Development is very sparse immediately upstream of the dam. Relatively minor flooding would occur upstream of the dam due to the increase of water surface elevation during the test flood. No structures would be affected by the flooding.
- No significant potential was observed for landslides into the general pool area of the dam which could create waves that might overtop the dam. No conditions were noted that would result in a sudden increase of sediment load into the upstream pool.
- e. Downstream Channel - Discharges from the Main Street Dam are conveyed approximately 1/4 mile to the confluence of Danforth Brook with the Assabet River. At the toe of the spillway, flow is directed 50 degrees to the right and enters a channel approximately 5 feet deep and 8 feet wide. This channel goes under a portion of the structure located on the right embankment,

where it makes another 90 degree bend to the left. The discharge channel then passes under a small bridge and then under another building with an opening of 5 feet by 15 feet. The average slope of the channel is approximately .005 as it crosses Main Street and flows to the Assabet River. Downstream of Larkin Lumber, development is very congested with many commercial establishments along Main Street.

3.2 Evaluation

The Main Street Dam embankments appear to be performing satisfactorily at the present time. The slight seepage through the dam masonry is apparently under control, although much of the downstream face of the right embankment is not accessible for examination. The overgrown and generally unprotected upstream faces of the embankments offer some potential for future problems, particularly where the crest width is only 18 to 20 ft. However, the pond is relatively sheltered and the dam is not exposed to heavy wave action.

The spillway and appurtenant structures appear to be in good structural condition but there is no operable reservoir drain. While the minor items noted above should be given attention, there appears to be no significant potential for failure of the spillway at this time.

SECTION 4: OPERATIONAL PROCEDURES

- 4.1 Procedures - In general, there is no established routine for the operation of the dam.
- 4.2 Maintenance of the Dam - Except for the recently-placed gravelly sand that is exposed on part of the crest and slope to the right of the spillway, there is no evidence that the embankments or spillway have received maintenance in the recent past. There is no established formal procedure for the maintenance of the dam.
- 4.3 Maintenance of Operating Facilities - There are no formal operational procedures. There are no known operational gates at the dam.
- 4.4 Description of any Warning System in Effect - There is no established warning system or emergency preparedness plan in effect for this structure.
- 4.5 Evaluation - Formal operational procedures, maintenance programs, warning systems and emergency preparedness plans should be established for the dam. Periodic inspections should be made of the dam and tree and brush growth at the dam should be brought under control. Maintenance of the structure should be performed at regular intervals. The Owner should institute a program of annual technical inspections.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - The Main Street Dam is located on Danforth Brook at the outlet of Bruces Pond, 1/4 mile above the confluence of Danforth Brook with the Assabet River. The dam is an earth and stone masonry type with a broad crested stone masonry spillway approximately 20 feet long. The spillway discharge channel passes under two structures and three small bridges before joining the Assabet River. The dam, at one time, provided a source of water power for a mill located on the right bank. The mill no longer generates it's own power. The dam creates an impoundment of approximately 11 acres and an estimated total storage capacity of 18.4 acre-feet at its spillway crest of elev. 215. The pool at top of dam (elev. 218) comprises 20.9 acres and has a total storage capacity of approximately 72.9 acre-feet.
- b. Design Data - There were no plans or records located concerning the design details or manner of construction of this dam. All hydraulic/hydrologic criteria used in this report were developed utilizing the USGS Quadrangle maps and information gathered during the inspection.
- c. Experience Data - Flood records for the Main Street Dam were not located. Extensive flooding downstream of the dam has occurred on numerous occasions. According to local residents, up to 2 feet of water has inundated the parking area and buildings downstream of the dam, resulting in flooding along Main Street.
- d. Visual Observation - At the time of the inspection on 8 November 1978, there was approximately 3 inches of flow over the spillway crest, an estimated discharge of less than 10 cfs. The stone masonry spillway appeared to be in good hydraulic condition with the exception of accumulated debris. Iron pins are provided on the spillway crest, possibly for flashboards. Flow passes over the broad-crested spillway and falls approximately 15 feet over a series of steps to an open channel at the base of the spillway. This open channel turns right at the toe of the spillway, passes under a structure, turns left, and flows beneath two bridges and a second structure as it continues onto Main Street via a 5 feet deep by 15 feet wide channel. Average slope of this channel is approximately .005.
- e. Test Flood Analysis - Based upon Corps of Engineers Guidelines, the recommended test flood for the size (small) and hazard potential (high) is within the range of 1/2 PMF to a full PMF (Probable Maximum Flood). Because the dam is quite small, the

1/2 PMF was adopted as the test flood. The PMF was determined using the guideline curves presented by the New England Division of the Corps in "Estimating Maximum Probable Discharges" for the Phase I, Dam Safety Investigations. The watershed terrain was determined to be very flat, with extensive swampy areas. The peak inflow rate was determined to be 560 cfs per square mile for the PMF or 280 cfs/sq mi for the 1/2 PMF. Peak inflow used for this analysis was 1960 cfs.

Routing of the 1/2 PMF inflow rate through Bruces Pond resulted in a test flood outflow of approximately 1,900 cfs. Due to the configuration of the buildings along the downstream edge of the dam crest and the spillway characteristics, the water level during the test flood would rise to Elevation 221.3. This results in a water surface stage 3.3 feet above the top of dam. The spillway cannot pass the test flood. Serious downstream flooding will result, especially in the parking area and lumberyard buildings along the toe of the dam. Sheet flow flooding would also occur in the commercial areas on Main Street.

- f. Dam Failure Analysis - Based on Corps of Engineers Guidelines for Estimating Dam Failure hydrographs and assuming that a failure would occur along a section 80 feet wide with the water level at the top of the dam (elev. 218.0), the failure would result in a peak outflow rate of 10,600 cfs. The estimated downstream capacity of the open channel is approximately 820 cfs. The sudden release of water in the event of a dam failure would cause severe flooding immediately downstream of the dam and in the commercial area along Main Street. After the flow passed through the structures located immediately against the dam, the flooding would occur in the form of sheetflow, inundating the areas along Main Street to a depth of approximately 2 - 3 feet.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observation - There was no visible evidence of dam embankment or spillway instability during the site examination on 8 November 1978. The observed locations of slight seepage through the downstream walls showed no evidence of soil movement, and are not considered to pose an immediate hazard to the stability of the downstream faces of the embankments. There was no evidence of movement of structural items.
- b. Design and Construction Data - There are neither design drawings nor construction data which would show the embankment cross sections, the physical properties of the materials in the embankments, nor structural details of the spillway. Thus, theoretical analyses of the structural stability of the dam embankments and spillway are not possible.

The above-water embankment geometry, as determined by limited measurements at the site, is typical of this type of old New England dam, and the dam has had a long period of service. As long as there are not seepage or erosion problems, the embankments and spillway would be expected to be adequately stable under static loading conditions.

- c. Operating Records - No operating records are known to exist for the project.
- d. Post-Construction Changes - Without design or "as-built" drawings, the extent of post-construction changes to the project is not known. The concrete walls at the spillway and the gate structure appear to be of more recent construction than the original stone masonry.
- e. Seismic Stability - The dam is located in Seismic Zone 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - The visual examination of the Main Street Dam did not reveal any evidence of failure or conditions which would warrant urgent remedial treatment. However, because of the limited spillway capacity, the absence of an operable reservoir drain and the need for maintenance and additional investigations that are outlined hereinafter, the project is considered to be in only fair condition.
- b. Adequacy of Information - All of the information for the Phase I Investigation had to be obtained from visual examination and limited measurements at the site. This information has been sufficient for the purpose of this investigation, but it does not permit detailed evaluation of stability or seepage.
- c. Urgency - The recommended additional investigations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken within one year of receipt of the report by the Owner.
- d. Need for Additional Investigations - Additional investigations should be performed by the Owner as outlined in the following section.

7.2 Recommendations

The Owner should engage a qualified registered professional engineer to perform the following investigations:

1. An investigation to verify the source of the water flow that is entering the discharge channel through the north and west stone masonry walls beneath the building to the right of the spillway. This can apparently be accomplished from the crawl space under the building. If all or part of this flow originates at the downstream stone masonry wall of the right embankment the source should be examined for evidence of piping or soil erosion, and the flow should be regularly monitored to determine if conditions are changing with time. If soil movement or changing conditions become evident, corrective action should be taken.
2. A detailed hydrologic-hydraulic investigation to determine the adequacy of the spillway and to determine any modifications to increase its capacity as necessary including modifications to the crest of the dam. If the results of the investigation indicate that flashboards should not be used, the five one-inch

diameter steel pins should be removed from the spillway crest to prevent the buildup of debris.

3. An investigation to determine the required repairs, modifications or new construction to provide a method of lowering the reservoir water surface in times of emergency.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures - It is recommended that the following remedial work be undertaken by the Owner, in addition to the investigations outlined in Section 7.2, to correct deficiencies noted during the visual examination:
 - (1) Clear brush and trees from the dam embankments where the crests are less than 25 ft wide, including stump removal and backfilling, and cut grass and weeds on the embankments at least once a year.
 - (2) Where the embankment crests are less than 25 ft wide provide riprap or cobble slope protection on the upstream faces; restore and reshape local eroded areas.
 - (3) The joints in the stone masonry walls should be rechinked or mortared.
 - (4) Develop a formal maintenance procedure, operational procedure and emergency procedures plan and warning system in cooperation with downstream officials.
 - (5) Due to the limited capacity of the spillway, the dam should be kept under surveillance during periods of high precipitation and high reservoir levels.
 - (6) Initiate a program of annual technical inspections.

7.4 Alternatives - Not applicable.

APPENDIX A

INSPECTION TEAM ORGANIZATION AND CHECK LIST

Page No.

VISUAL INSPECTION PARTY ORGANIZATION

A-1

VISUAL INSPECTION CHECK LIST

Embankment - Right of Spillway

A-2

Embankment - Left of Spillway

A-3

Spillway

A-4

Spillway

A-5

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

DAM: Main Street Dam

DATE: November 8, 1978

TIME: 10:00 a.m.

WEATHER: 50° F - Overcast - Drizzle ...

WATER SURFACE ELEVATION UPSTREAM: 2" over spillway crest

STREAM FLOW: 5.0 cfs

INSPECTION PARTY:

1. Robert P. Howard - CDM - Structural/Operations
2. Francis E. Luttazi - CDM - Structural/Operations (Ass't)
3. Charles E. Fuller - CDM - Hydraulic/Hydrology
4. Joseph E. Downing - CDM - Hydraulic/Hydrology (Ass't)
5. Peter L. LeCount - Haley & Aldrich - Soils
6. _____

PRESENT DURING INSPECTION:

1. _____
2. _____
3. _____
4. _____

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Main Street

DATE: 8 November 1978

EMBANKMENT: Right of Spillway

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows 2. Crest a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Movement or Settlement 3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains 4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	1. a. Brush, scattered trees to 8" dia. several cut trees on bank. b. Irregular slope, recently-placed gravelly sand near spillway sloughing down over bank. c. No protection evident d. None observed 2. a. Partly grass & weeds b. None observed c. None observed d. Not evident, area of recent fill near spillway may have been low. 3. a. None-masonry wall in bldg. b. N/A c. N/A d. N/A e. None observed f. Slight seepage from base of wall into waterway alongside apillway; more seepage (est. 2 gpm) from below bldg. into side of waterway, but all or part of this originates from wall that is at base of slope downstream from rt. abutment. g. None observed - h., i. Apparently none 4. - a., b., c. No significant movement or irregularity evident. d. Appears satisfactory e. None evident f. Part of functioning lumber yard g. None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Main Street

DATE: 8 November 1978

EMBANKMENT: Left of Spillway

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows 2. Crest a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Movement or Settlement 3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains 4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	1. a. Brush, scattered trees to 18" dia., weeds, local rubble & trash. b. Irregular slope, possibly locally undercut near top. c. Occasional rock in slope, dumped concrete rubble at one location. d. None observed 2. a. Partly grass & weeds b. Not significant c. None observed d. Local areas up to 6 in. low. 3. a. None-masonry wall in bldg. b. N/A c. N/A d. N/A e. None observed f. Local v. sl. seepage near base of wall in bldg. g. None observed h. Small concr. box @ base of wall near abutment. i. Apparently none 4. a. None evident b. Crest locally low, apparent local, slight settlement. c. No irregularity evident in face of wall. d. Appears satisfactory e. Slight cracking of brick building foundation wall above spillway wall. f. Part of functioning lumber yard. g. None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Main Street Dam (Larkin Lumber Co.)

DATE: November 8, 1978

SPILLWAY: _____

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc.	1. a. Good b. None-Channel divided by 12" concrete pier. c. None
2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids or Erosion i. Visible Reinforcement j. General Struct. Condition	2. a. None present-Five 1" diameter steel pins 16 inches high present in crest. b. See Raceway Facility c. None d. None observed e. None observed f. None observed g. Good h. N/A i. N/A j. Good
3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition	3. a. Good condition-stone block paving b. Good condition c. Ledge d. None e. None observed f. Pipe column in the center of discharge channel entrance. g. Good
4. Walls a. Wall Location - Left (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	4. a. (1) None (2) None (3) None (4) Concrete wall at approach channel is in good condition. Spillway wall is grouted stone with brick foundation wall of building on top. No cracks observed. (5) Joints in grouted stone could be repointed. Joints in brick wall good. (6) Upstream edge of brick wall has broken off. (7) N/A (8) Good

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Main Street Dam (Larkin Lumber Co.) DATE: November 8, 1978

SPILLWAY: _____

CHECK LIST	CONDITION
b. Wall Location - Right (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition c. Wall Location-Stilling Basin (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition 5. Raceway Facility	b. (1) None (2) Efflorescence at several locations on concrete wall. Large flow from weep hole at downstream end. (3) Minor stains observed (4) Few minor cracks (5) Good (6) Very minor erosion (7) None observed (8) Good c. (1) None (2) None (3) None (4) None (5)(6) Open jt. fieldstone masonry in good condition. Some smaller stones missing and some voids developing in the joints. (7) N/A (8) Good 5. Raceway Facility has been abandoned, a new concrete structure built over it. The remaining portion covered by boards. Seepage evident at bottom of facility and exiting through weep hole.

DESCRIPTION OF DAM
DISTRICT 4

Submitted by C. John V. Murphy

Date 12/9/74

Dam No. 4-9-1/1-2

City/Town Hudson

Name of Dam MINIST. DAM

1. Location: Topo Sheet No. 15B
Provide 8 1/2" x 11" in clear copy of topo map with location of dam clearly indicated.

2. Year build: Unknown Year/s of subsequent repairs Unknown

3. Purpose of dam: Water Supply Recreational
Irrigation Other None

4. Drainage Area: 1+ Sq. mi. 640 Acres.

5. Normal Ponding Area: 15+ acres Ave. Depth 5+
Impoundment: 25 M gals. 75 acre ft

6. No. and type of dwellings located adjacent to pond or reservoir
i.e., summer homes etc Larkin-Lombard Company

7. Dimensions of Dam: Length 250+ Max. Height 19+
Slopes: Upstream face 2:1
Downstream face Vert
Width across top 18+

8. Classifications of Dam by Materials:
Earth X Conc. Masonry ✓ Stone Masonry ✓
Timber Rockfill Other

9. A. Description of present land usage downstream of dam: 80% rural
20% Urban

B. Is there a storage area of flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure
no ✓ yes

APPENDIX B-1

DAM NO. 4-9-141-2

10. Risk to life and property in event of complete failure.

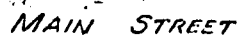
No. of people
No. of homes
No. of businesses
No. of industries
No. of utilities
Railroads
Other dams
Other

Center of town probably would flood

Type
Type

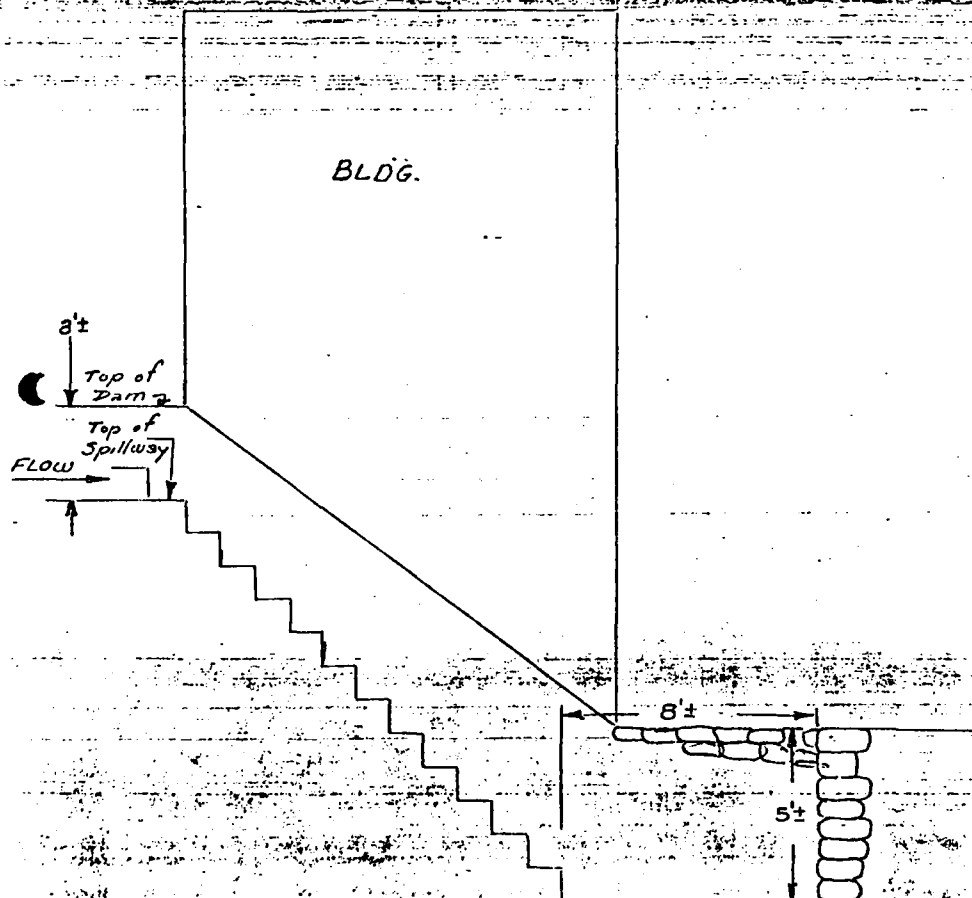
11. Attach sketch of dam to this form showing section and plan 8 1/2" x 11" sheet

APPENDIX B-2



APPENDIX B-3

Dam No. 4-9-141-2



SECTION A-A
(NOT TO SCALE)

APPENDIX B-4

INSPECTION REPORT - DAMS AND RESERVOIRS

(1.) Location: City/Town Hudson

Dam No. 4-97-141-2

Name of Dam Phoebe St. Dam

Inspected by Tracy V. Hargis

Date of Inspection 12/4/74

(2) Owner: per: Assessors Prev. Inspection

Reg. of Deeds Pers. Contact

1. Larkin Lumber Co. 126 Main St. Hudson Mass 01749
Name St. & No. City/Town State Tel. No.

2.
Name St. & No. City/Town State Tel. No.

3.
Name St. & No. City/Town State Tel. No.

(3) Caretaker: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Same
Name St. & No. City/Town State Tel. No.

(4) No. of Pictures taken 2

(5) Degree of Damage: (if dam should fail completely)*

1. Minor 2. Moderate
3. Severe 4. Disastrous

*This rating may change as land use changes (future development)

(6) Gate Control: Automatic Manual

Operative per: No.

Contract closed at time of inspection for 6 months

(7) Reason for Rating

1. Good 2. Minor Repairs
3. Major Repairs 4. Urgent Repairs

(8) Downstream Face of Dam: Condition: 1. Good ☒ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Rep _____

Comments: _____

(9) Emergency Spillway: Condition: 1. Good _____ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: None

(10) Water Level @ time of inspection 0.5 ft. above ☒ below _____
top of dam _____ Principal Spillway ☒
Other _____

(11) Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment

Animal Burrows and Washouts

Damage to slopes or top of dam

Cracked or damaged Masonry

Evidence of Seepage

Evidence of Piping

Erosion

Leaks

Trash and/or debris impeding flow

Clogged or blocked spillway

Other _____

(12) Remarks & Recommendations: (Fully Explain)

The mill and office buildings would be in danger if dam gave way and Main Street probably would flood. In the past Hudson Center has been flooded from water over this dam.

(13) Overall Condition:

1. Safe ☒
2. Minor repairs needed ☐
3. Conditionally safe - major repairs needed ☐
4. Unsafe ☐
5. Reservoir impoundment no longer exists (explain) ☐
6. Recommend removal from inspection list ☐

APPENDIX C

SELECTED PHOTOGRAPHS OF PROJECT

PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Page No.</u>
.	Overview of Spillway and Left Embankment from Right Embankment	iv
B.	Overview of Upstream Face of Dam and Spillway	iv
1.	Overview of Spillway	C-1
.	View of Left Side of Spillway from Parking Lot	C-2
5.	View of Spillway and Parking Lot Downstream	C-2
4.	View of Downstream Channel and Culvert Under Building	C-3
.	View of Embankment from Left Abutment. Note Upper Stories of Buildings Constructed at Downstream Edge of Crest	C-3
.	Upper Story of Building Constructed at Downstream Edge of Dam Crest	C-4

LOCATION PLAN

	<u>Page No.</u>
Location of Photographs	C-5



1. Overview of spillway from downstream parking lot.



2. View of left side of spillway from parking lot.



3. View of spillway and parking lot downstream.



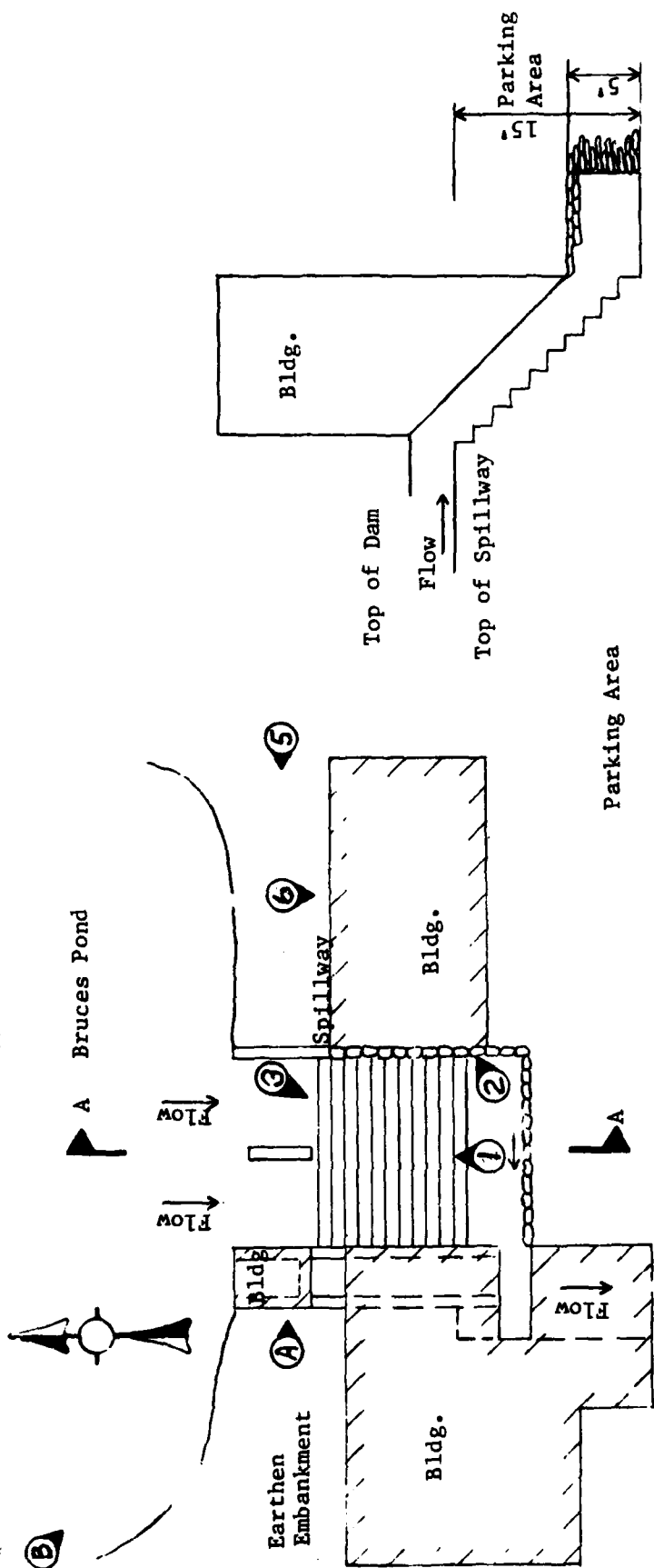
4. View of downstream channel and culvert under building.



5. View of embankment from left abutment. Note upper stories of buildings constructed at downstream edge of crest.

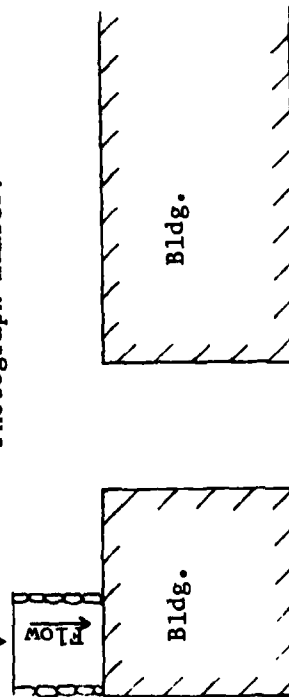


6. Upper story of building constructed at downstream edge of dam crest.



② Denotes direction of view and Photograph number.

Section A-A
(Not to Scale)



Plan of Main Street Dam
(Not to Scale)

MAIN STREET

National Program of Inspection
of Non-Federal Dams
Location of Photographs
Main Street Dam
Hudson, Massachusetts

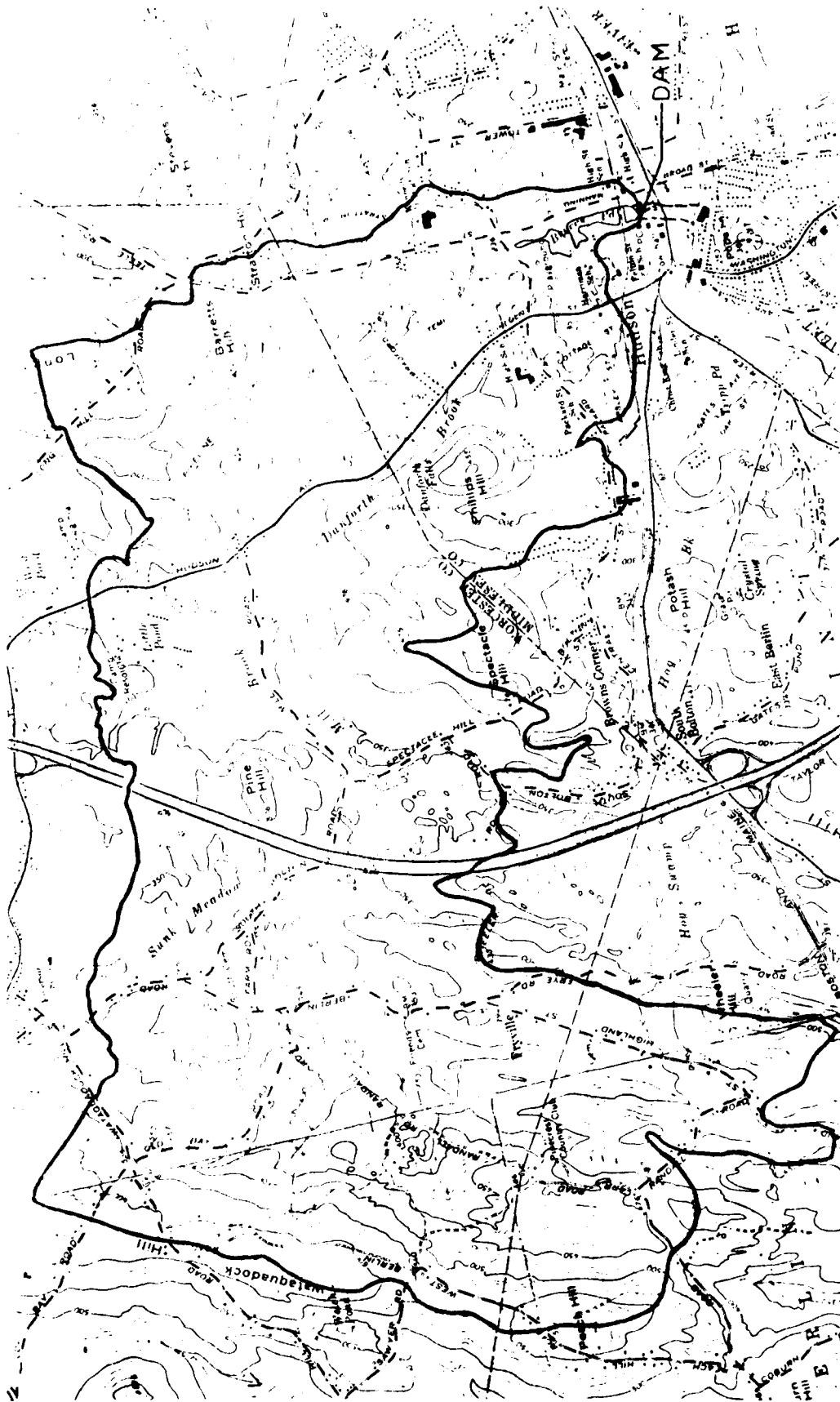
APPENDIX D

OUTLINE OF DRAINAGE AREA AND
HYDRAULIC COMPUTATIONS

COMPUTATIONS

Page No.

Drainage Area Map	D-1
Drainage Area	D-2
Elevations and Storage Determination	D-3
Size Classification, Hazard Potential and Test Flood Determination	D-4
Flood Routing, PMF	D-6
Dam Failure Analysis	D-10
Tailwater Analysis	D-12



MAIN STREET DAM
DRAINAGE AREA AND
IMPACT AREA
SCALE: 1" = 2000'



CAMP DRESSER & McKEE Inc.
Consulting Engineers
Boston, Mass.

APPENDIX D-1

CAMP DRESSE & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT Corps of Engineers
PROJECT Main St Dam
DETAIL Drainage Areas

JOB NO. 380-5-18
DATE CHECKED 4/11/79
CHECKED BY WAK

PAGE 1/1
DATE 3/7/79
COMPUTED BY PAE

MAIN ST. DAM

DRAINAGE AREA

HUDSON QUAD

EAST OF RTE 495: 1. 25.86
2. 25.90 > 25.88 in²

WEST OF RTE 495: 1. 12.26
2. 12.22 > 12.24 in²

CLINTON QUAD

1. 10.87
2. 10.67 > 10.77 in²

TOTAL = 28.89 in² = 4489.4 Acres = 7.01 mi²

WATER SURFACE AREAS

EL. 215

1. 0.12
2. 0.12 > 0.12 in² = 11.02 Acres = .0172 mi²

EL. 220

1. 0.31
2. 0.36
3. 0.33 > 0.32 in² = 29.38 A = .0459 mi²

EL. 230

1. 1.03
2. 1.00 > 1.01 in² = 93.20 A = .1456 mi²

APPENDIX D-2

CLIENT COF
 PROJECT Mt. St. Dam
 DETAIL Crest Dimensions

 JOB NO 380-5-18
 DATE CHECKED 4/11/79
 CHECKED BY JED

 PAGE 1/10
 DATE 3/22/77
 COMPUTED BY WAK
Central Elevations

There is no published crest elevations available.

USGS Quad HUDSON, MASS, 1966 shows the pond elevation to be at Elev 215 msl. Assume the crest elevation to be 215.0 msl.

Crest Elev = 215.0

Top left abutment = 218.5'

Top right abutment = 218.5'

Top left embankment = 217.7 (low spot)

Top right embankment = 217.8 (low spot)

Toe of spillway = 200.0

Surface Areas

Pond at El 215 = 11.02 ac.

El 220 = 29.38 ac.

El. 230 = 93.20 ac.

El. 217.7 = $[(29.38 - 11.02)/5] 2.7 + 11.02 = 20.93$ ac.

Storage Capacities

At Crest elev 215 = $11.02 \times 5' \times 3 = 16.53$ ac-ft.

At elev 220 = $16.53 + \left(\frac{11.02 + 29.38}{2}\right) 5 = 119.37$ ac-ft

elev 230 = $119.37 + \left(\frac{93.20 + 29.38}{2}\right) 10 = 732.27$ ac-ft

elev 217.7 = $\frac{119.37 - 16.53}{5} \times 2.7 + 16.53 = 72.91$ ac-ft

elev 218.5 = $\frac{119.37 - 16.53}{5} \times 3.5 + 16.53 = 89.07$ ac-ft

CLIENT C of E
PROJECT Main St. Dam
DETAIL ClassificationJOB NO 380-S-18
DATE CHECKED 4/18/79
CHECKED BY LEDPAGE 2110
DATE 3/22/79
COMPUTED BY WAKSize Classification

Hydraulic Height Toe Spillway to top of spillway
Wingwalls = $218.5 - 200.0 = 18.5'$

Storage Capacities

at Top Dam = 72.91 ac-ft

at Top Abutment = 89.07 ac-ft

∴ Size classification is SMALL

Hazard Potential

Should the dam fail, it is readily evident that excessive economic loss would occur. Extensive commercial development is immediately on the downstream face of the dam. In many instances, the actual downstream face of the dam forms the foundation wall of several buildings. Loss of life could be extensive. Should the dam fail without warning, many lives could be lost by the sudden flow of water. For these reasons, the dam is rated in the HIGH category.

CLIENT CofE
PROJECT Main St. Dam
DETAIL HydrologyJOB NO 380-5-1B

DATE CHECKED _____

CHECKED BY _____

PAGE 3/10DATE 3/22/79COMPUTED BY WAKTEST FLOODHazard - High & Size Small $\rightarrow$ $1/2$ PMF to PMF

Since the dam is very small, and the hazard is medium high hazard, use the $1/2$ PMF.

Drainage AreaFrom USGS Quad = 7.01 mi²

Terrain is flat & swampy

Flows

From PMF Curves

$$Q = 560 \text{ cfs/mi}^2 = 3926 \text{ cfs}$$

$$1/2 \text{ PMF} = \underline{1963 \text{ cfs}}$$

Ratina Curve

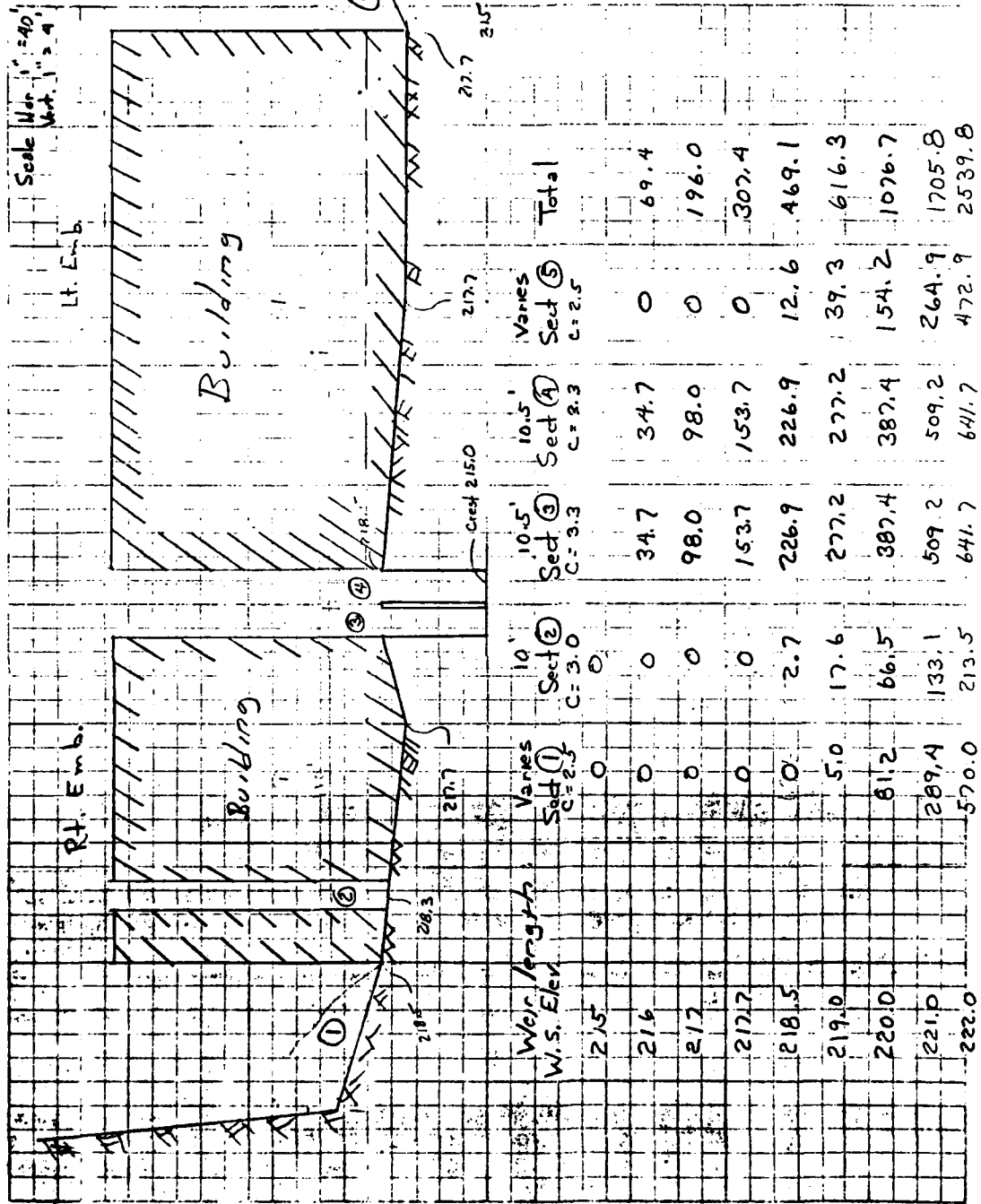
Main street dam is unique in the fact that there is a series of buildings located on the dam itself. These buildings will act as a barrier to any flow overtopping the earth embankments, resulting in a higher rise in water surface elevation. Due to the many openings in the buildings, serious damage to the interiors of the buildings will occur. For the purposes of this analysis, assume that the buildings will hold back most of the water and therefore act effectively as a dam.

CAMP DRESSER & MOORE INC.

CLIENT Cole
 PROJECT Main St Dam
 DETAIL Weir Analysis

JOB NO 380-5-18
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APPENDIX D-6

CAMP DRESSER & MAKEE INC.

CLIENT C of E
 PROJECT Main St Dam
 DETAIL Elev - Storage - Surf Area

JOB NO 380-5-18

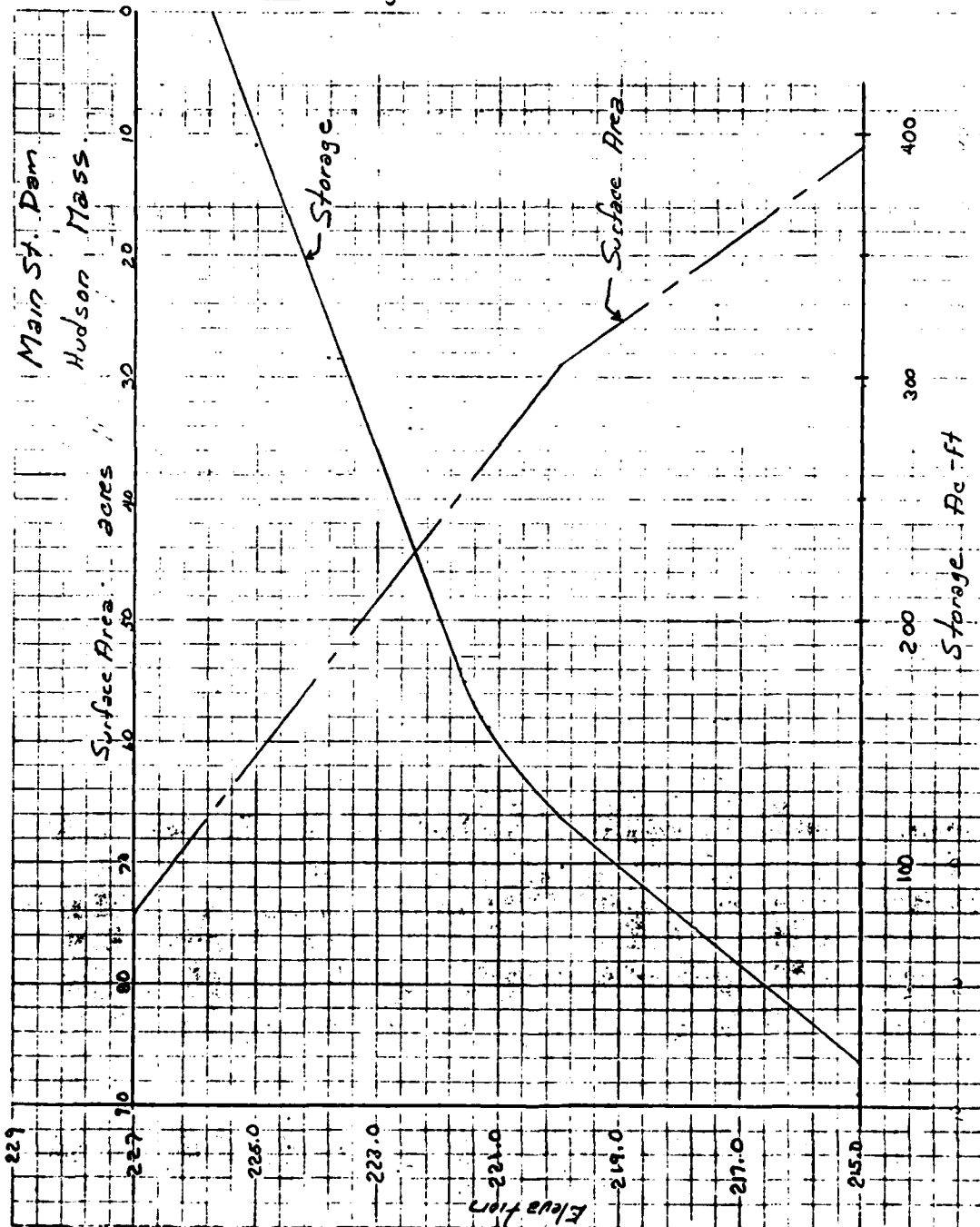
DATE CHECKED 4/11/79

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DATE 3/23/79

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APPENDIX D-7

CLIENT C of E
 PROJECT Main St Dam
 DETAIL Test Flood

 JOB NO 380-5-18
 DATE CHECKED 4/14/79
 CHECKED BY SD

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 DATE 3/23/79
 COMPUTED BY WBR
Surcharge-Storage Routing
 $Q_{p1} = 1960 \text{ cfs} = \text{test flood inflow}$

surcharge height = 221.4' msl (see rating curve, next page)

From Storage Curve

 $\text{Stor @ el 221.4} = 165 \text{ ac-ft} - 18.4 = 146.6 \text{ ac-ft}$
 $\text{STOR}_1 = \frac{146.6}{(53.3 \times 7.01)} = .39''$
 $Q_{p2} = 1960 \times \left(1 - \frac{.39}{9.5}\right)$
 $= 1880 \text{ cfs}$

surch. ht = 221.25' msl

 $\text{Stor @ el 221.25} = 155 \text{ ac-ft}$
 $\text{Avg. Stor} = \frac{165 + 155}{2} = 160 \text{ ac-ft}$

Surch. El. @ Stor 160 ac-ft = 221.3

 $Q \text{ at el 221.3} = 1900 \text{ cfs}$

Inflow = 1960 cfs

Outflow = 1900 cfs

Test Flood $Q = 1900 \text{ cfs @ Elev. 221.3 msl}$

Spillway is inadequate to handle the test flood. Overtopping of the dam will occur at approx. 460 cfs. Spillway capacity is approx. 24% of the Test Flood.

CAMP DREBBER & MOORE INC.

CLIENT C of E
PROJECT Main St Dam
DETAIL Elev-Disch Curve

JOB NO 380-5-18

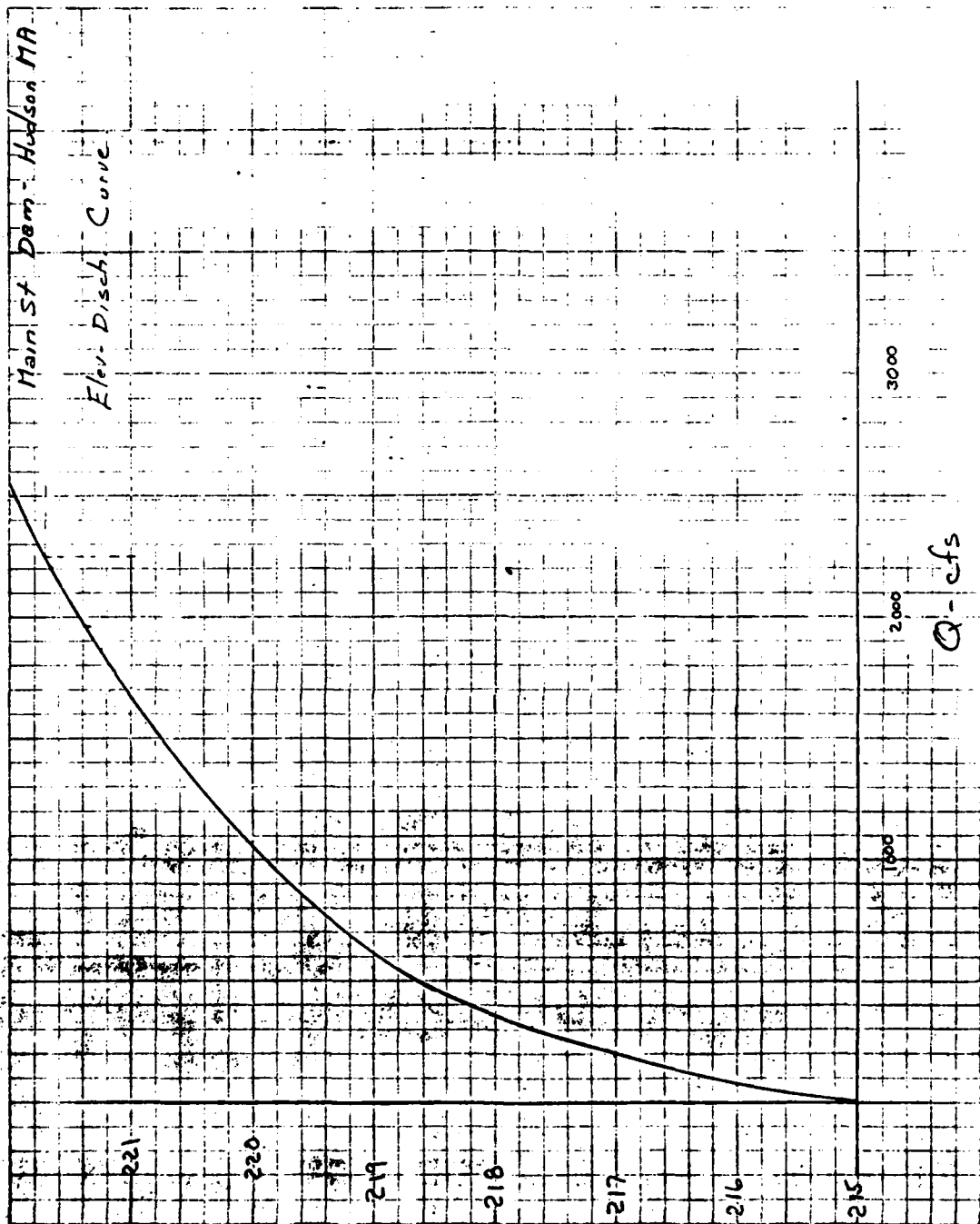
DATE CHECKED 4/11/79

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APPENDIX D-9

CLIENT C of E
 PROJECT Main St Dam
 DETAIL Dam Failure Analysis

JOB NO 380-S-18DATE CHECKED 4/11/79CHECKED BY EDPAGE 8/10DATE 3/23/79COMPUTED BY WAKDam Failure Analysis

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

where $W_b = 40\%$ of dam length
 $g = 32.2$

$$Y_o = W_s \text{ elev at top dam} - \text{elev toe dam}$$

for the Main St. dam

$$W_b = .4 (200')$$

Assume that the left
 embankment will be
 the portion of the dam
 that fails.

$$Y_o = \text{Elev } 218.0 - 200.0$$

$$= 18.0'$$

$$Q_p = \frac{8}{27} \times 80' \times \sqrt{32.2} \times 18.0^{3/2}$$

$$= 10,272 \text{ cfs} \quad \text{plus } 310 \text{ cfs going over spillway at time of failure.}$$

$$\text{Total } 10,582 \text{ cfs.}$$

Significant inundation would occur downstream should a portion of the dam collapse. The downstream channel would be in no way adequate to handle the resultant flows. Most of the flow would probably not even reach the downstream channel. A large percentage of flow would pass through the lumber yard and buildings and on to Main St.

CLIENT C&E
 PROJECT Main St Dam
 DETAIL Downstr. Capacities

JOB NO 380-5-18
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Downstream capacities
 Long Culvert between Main St & Spillway
 Culvert is approx 5' high x 15' wide.

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

$$n = .02$$

$$A = 75 \text{ ft}^2$$

$$R = A/w_p = 75/25 \text{ (assume just under full)} = 3$$

$$S = .005 \text{ est.}$$

$$= \frac{1.49}{.02} \times 75 \times 3^{2/3} \times .005^{1/2}$$

$$= 74.5 \times 75 \times 2.08 \times .0707$$

$$= 820 \text{ cfs} \quad \text{No way near adequate}$$

This is the max theoretical capacity. Due to several 90° bends, especially at the base of the spillway, the actual capacity of the downstream channel would be somewhat less.

Tailwater Analysis

During the test flood, the flow over the spillway will be approximately 1105 cfs. The capacity of the downstream channel is approximately 820 cfs. The remaining flow, 285 cfs, will have to be weir flow, over the parking lot wall. The resulting watersurface elevation will be approximately 207.7'.

Spillway crest elevation is 215'.

∴ The spillway crest is not submerged.

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

END

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