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NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
ASHUELOT RIVER DAM (N. (U) CORPS OF ENGINEERS WALTHAM
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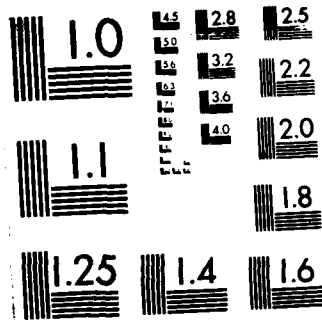
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CONNECTICUT RIVER BASIN
KEENE, NEW HAMPSHIRE

ASHUELOT RIVER DAM
NH 00100
NHWRB 126.01

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) ➤The dam is a gravity structure of split stone masonry. It is about 160 ft. long and 15.6 ft. high. The drainage area for this dam covers 113 square miles of rolling woodland with some minor development and pasture. It is small in size with a significant hazard potential, since appreciable economic loss and possible loss of a few lives could result in the event of a dam failure. Since the risk downstream in the event of a dam failure is on the high side of significant, the ½ PMF has been adopted as the appropriate test flood.		

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 424 TRAPELO ROAD
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REPLY TO
 ATTENTION OF:
 NEDED

APR 06 1981

Honorable Hugh J. Gallen
 Governor of the State of New Hampshire
 State House
 Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Ashuelot River Dam (NH-00100) 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 Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, City of Keene, Keene, New Hampshire 03431.

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 Water Resources Board for your cooperation in carrying out this program.

Sincerely,

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

Incl
 As stated

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NATIONAL DAM INSPECTION

PHASE I INSPECTION REPORT

Identification No.:	100100
NHWRB No.:	126.01
Name of Dam:	Ashuelot River Dam
Town:	Keene
County and State:	Cheshire, New Hampshire
Stream:	Ashuelot River
Date of Inspection:	October 17, 1980

BRIEF ASSESSMENT

The Ashuelot River Dam is located on the Ashuelot River, approximately 5 miles downstream of Surry Mountain Dam. Approximately 500 feet downstream of the dam, the Ashuelot River passes under West Street which intersects State Route 12 in Keene, New Hampshire.

The dam is a gravity structure of split stone masonry. It is approximately 160 feet long and 15.6 feet high. The overflow type spillway has a crest length of 134 feet and is 10.7 feet above the streambed. There is a gate structure at the left abutment which is also constructed of stone masonry. This wasteway structure consists of a forebay leading to three sluiceways, each of which is individually controlled by a vertical stem slide gate. The sluiceways are approximately 6.5 feet high by 5 feet wide with inverts 3.4 feet above the streambed. The middle gate has been blocked with a steel plate. The remaining two timber gates appear to be inoperable.

The dam was built prior to 1919 to provide power to a textiles manufacturing plant. It is presently owned by the City of Keene, New Hampshire, and serves only recreational purposes.

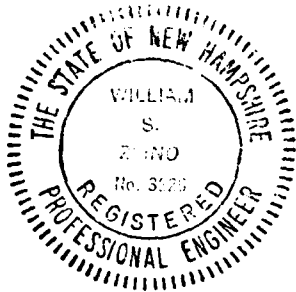
The drainage area for this dam covers 113 square miles of rolling woodland with some minor development and pasture. Approximately, 100 square miles of this watershed is controlled by the Surry Mountain Dam which lies approximately 5 miles upstream.

The Ashuelot River Dam is SMALL in size and its hazard potential classification is SIGNIFICANT since appreciable economic loss and possible loss of a few lives could result in the event of a dam failure. The appropriate test flood for a

dam classified small in size with a significant hazard classification would be between the 100-year flood and one half of the Probable Maximum Flood (1/2 PMF).

Since the risk downstream in the event of a dam failure is on the high side of significant, the 1/2 PMF has been adopted as the appropriate test flood. The peak test flood outflow of 2,860 cfs was developed as the standard project flood outflow from Surry Mountain Dam plus the residual flow from the intervening 13 square mile local area to Ashuelot River Dam. This includes the effects of attenuation in the Ashuelot River Dam pool, which would be negligible for a basin this large. For this outflow, the water surface would be at 475.4 feet (NGVD), which is 1.2 feet below the right abutment (top of the dam). The spillway capacity is 146 percent of the test flood discharge.

The dam is in FAIR condition at the present time. It is recommended that the owner retain the services of a qualified registered professional engineer to evaluate the seepage through the left end wall, and make recommendations for the rehabilitation of the wasteway and cutoff wall. Remedial measures to be undertaken by the owner include repair of the mortar, clearing of vegetation from the gate structure and dike, implementing annual maintenance and inspection programs, and developing a formal written system for warning downstream residents and officials in the event of an emergency. These engineering studies and remedial measures should be implemented by the owner within one year of receipt of this Phase I Inspection Report.



William S. Zoimo

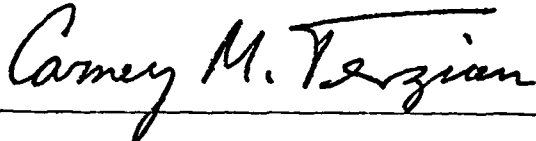
William S. Zoimo
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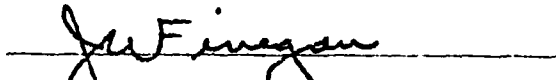
Nicholas A. Campagna, Jr.


Nicholas A. Campagna, Jr.
California Registration No. 21006

This Phase I Inspection Report on Ashuelot River Dam (NH-00100) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

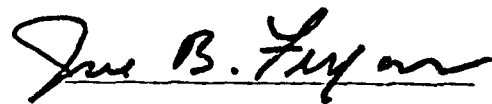


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APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

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

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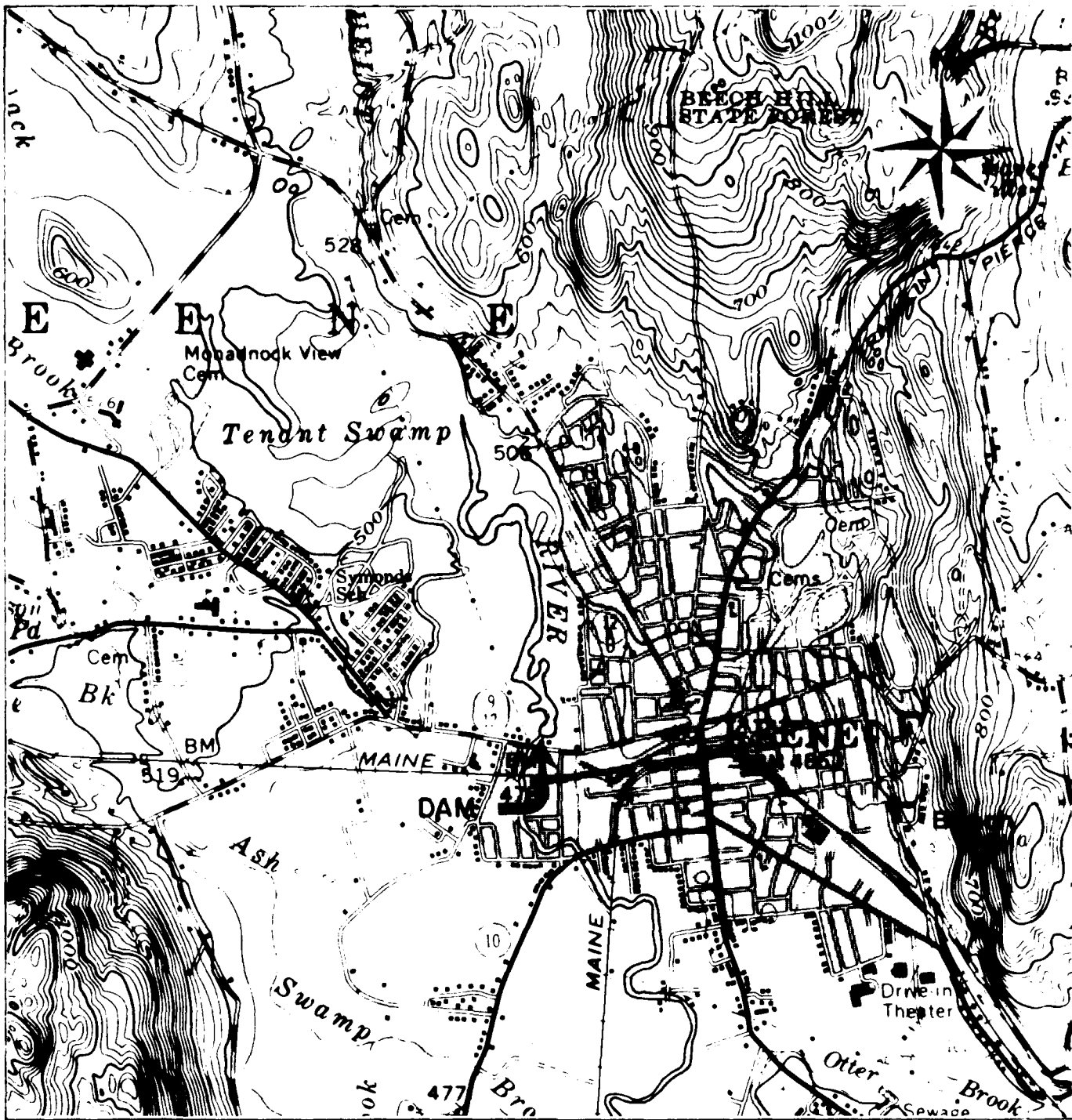
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Overview of Dam



- SCALE -
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FROM USGS KEENE -NH -VT
 QUADRANGLE MAP

GOLDBERG ZOINO & ASSOCIATES, INC
 GEOTECHNICAL - GEOHYDROLOGICAL CONSULTANTS
 NEWTON UPPER FALLS, MASSACHUSETTS

US ARMY ENGINEER DIV NEW ENGLAND
 CORPS OF ENGINEERS
 WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCATION PLAN

FILE No 2605

ASHUELOT RIVER DAM

KEENE, NEW HAMPSHIRE

SCALE AS SHOWN

DATE OCT 1980

National Dam Inspection Program

Phase I Inspection Report

Ashuelot River Dam

Section I: 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. Goldberg-Zoino & Associates, Inc. (GZA) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZA under a letter of September 23, 1980 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract NO. DACW 33-80-C-0055 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 non-federal interests.
- 2) Encourage and prepare 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 Dam

(a) Location

The Ashuelot River Dam (also known as the Faulkner and Colony Dam) is located on the Ashuelot River approximately 5 miles downstream of the Surry Mountain Dam in Keene, New Hampshire. It can be reached from West Street which intersects State Route 12 in Keene, New Hampshire. The dam is shown on USGS Keene NH quadrangle at approximately coordinates N4256.0, W7217.4 (see location map on Page vi). Page B-2 of Appendix B is a site plan for this dam.

(b) Description of Dam and Appurtenances

The Ashuelot River Dam is a masonry dam of cut stone and mortar. It is a total of 160 feet long and 15.6 feet high. There is a wasteway at the left abutment with 3 bays. There is an earth dike

associated with this dam which extends approximately 1,700 feet upstream from the right abutment. The various components of the dam are described in the following paragraphs.

1) Wasteway (See pages B-2, and B-25)

The wasteway is divided into three rectangular sluiceways, each of which is controlled by a separate vertical slide gate. These openings are each 6.5 feet high and the inverts are at approximate elevation 467.5 (NGVD). The right sluiceway is 5.5 feet wide. The other two are each 4.8 feet wide. There is a training wall across the upstream side of the wasteways. This structure is constructed of split stone masonry set in mortar, and has a tunnel opening below water level.

2) Principal Spillway (See pages B-2, and B-25)

The principal spillway is a broad crested weir approximately 134 feet long and 4.5 feet wide at the top with a crest elevation of approximately 471.7 feet (NGVD). This section is constructed of cut granite laid in mortar. There are no flashboards available for this dam. There are holes in the crest of the dam which were used for flashboard stanchions in the past.

3) Earth Dike (See Page B-2)

There is an earth dike associated with this dam. The dike extends approximately 1,700 feet upstream from the right abutment along the right bank of the river. The cross section of this dike is highly variable but in general, it is approximately 4 to 9 feet high with a crest width of 6 to 10 feet. The side slopes vary from nearly vertical to approximately 4 to 1 with an average slope of approximately 1.5 to 1. The crest of the dike is at approximate elevation 476.6 feet (NGVD).

(c) Size Classification

The dam's maximum impoundment of 280 acre feet and height of 15.6 feet place it in the SMALL size category according to the Corps of Engineer's Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is SIGNIFICANT because of the appreciable economic losses and potential for loss of a few lives downstream in the event of dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam is presently owned by the City of Keene, New Hampshire. It is controlled by the Department of Public Works, Keene, New Hampshire, 03431.

(f) Operator

The operation of the dam is controlled by the Department of Public Works. They can be reached by telephone at (603) 352-6550.

(g) Purpose of the Dam

The purpose of the dam is to impound water for recreational purposes. At one time, the dam was used for hydropower for a textile mill.

(h) Design and Construction History

The original design and date of construction are unknown. The records of the New Hampshire Water Resources Board indicate that the dam was constructed prior to 1919 with a split stone, masonry spillway constructed on earth.

(i) Normal Operating Procedure

No formal operating procedures exist for this dam. The outlet gates appear to be inoperable and there is no means available to lower the impoundment.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 113 square miles. It is made up of rolling woodland and pasture. Approximately 100 square miles of the drainage area is controlled by the Corps of Engineer's Surry Mountain Dam.

(b) Discharge at Dam Site

1) Outlet Works

The outlet works at this dam consist of 3 sluiceways at the left abutment. These are inoperable at the present time.

2) Maximum Known Flood

Records indicate that during the flooding of September 1938, the flood stage at this dam reached elevation 477.8 feet (NGVD). This was prior to the construction of the upstream flood control dam (Surry Mountain Dam).

3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillway with the reservoir at top of dam elevation (476.6 feet NGVD) is 4,170 cfs.

4) Ungated Spillway Capacity at Test Flood

The capacity of the spillway at the test flood elevation (475.4 feet NGVD) is 2,860 cfs.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways.

6) Gated Spillway Capacity at Test Flood

There are no gated spillways.

7) Total Spillway Capacity at Test Flood

The capacity of the spillway at Test Flood elevation (475.4 feet NGVD) is 2,860 cfs.

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam elevation (476.6 feet NGVD) is 4,170 cfs.

9) Total Project Discharge at Test Flood Elevation

The total project discharge at Test Flood elevation (475.4 feet NGVD) is 2,860 cfs.

(c) Elevation (feet above NGVD)

- 1) Streambed at toe of dam: approximately 461.0
- 2) Bottom of cutoff: Unknown
- 3) Maximum tailwater: Unknown
- 4) Recreation Pool: Approximately 472.0
- 5) Full flood control pool: Not applicable
- 6) Spillway crest: Approximately 471.7
- 7) Design surcharge: Unknown
- 8) Top of dam: 476.6
- 9) Test flood surcharge: 475.4

(d) Reservoir (length in feet)

This is a run of the river dam with a reservoir length of approximately 15,000 feet.

(e) Storage (acre-feet)

- 1) Normal Pool: 120
- 2) Flood Control Pool: Not applicable
- 3) Spillway Crest Pool: 120
- 4) Top of Dam Pool: 280
- 5) Test Flood Pool: 247

(f) Reservoir Surface (acres)

This is a run of the river dam with a surface area of approximately 34.4 acres.

(g) Dam

- 1) Type: Gravity, overflow, split stone masonry
- 2) Length: Approximately 160 feet
- 3) Height: Approximately 15.6 feet
- 4) Top width: Approximately 4.5 feet, variable
- 5) Side slopes: Not applicable
- 6) Zoning: Not applicable.
- 7) Impervious Core: Not applicable
- 8) Cutoff: Unknown
- 9) Grout curtain: Unknown

(h) Dike

- 1) Type: Earth
- 2) Length: 1,700 feet
- 3) Height: 9 feet
- 4) Top Width: 6 to 10 feet
- 5) Side Slopes: Variable, average 1.5:1

- 6) Zoning: Homogeneous
- 7) Impervious Core: Homogeneous
- 8) Cutoff: Unknown
- 9) Grout Curtain: Unknown

(i) Diversion and Regulating Tunnel

Not applicable

(j) Spillway

- 1) Type: Masonry, broad crested weir
- 2) Length of weir: 134 feet
- 3) Crest elevation: 471.7 feet (NGVD)
- 4) Gates: Spillways not equipped with gates
- 5) Upstream channel: Ashuelot River
- 6) Downstream channel: Ashuelot River

(k) Regulating Outlets

The outlets consist of three sluiceways near the left abutment. These are equipped with vertical stem gates which, at present, are inoperable. The invert elevation of these gates is 467.5 feet (NGVD). Two gates are 4.8 feet wide. The right gate is 5.5 feet wide. All three gates are 6.5 feet high.

Section 2: Engineering Data

2.1 Design Data

None of the original design drawings or calculations are available for this dam. Lacking is data concerning the length and depth of any cutoff and the foundation conditions, and the cross section of the spillway and the dike.

2.2 Construction Records

No construction records are available for this dam.

2.3 Operational Records

No operational records are available for this dam.

2.4 Evaluation of Data

a) Availability

There is no detailed design or construction data available for evaluation.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment of the dam is based primarily on the visual inspection, past performance, and sound engineering judgement.

(c) Validity

Since the observations of the inspection team generally confirm the information contained in the records of the New Hampshire Water Resources Board, a satisfactory evaluation for validity is indicated.

2.5 Other

Two reports by the U.S. Army, Corps of Engineers include information pertinent to this dam. They are the "Flood Plain Information" report, dated December 1972, and the "Flood Plain Management Study", dated December 1978.

Section 3: Visual Inspection

3.1 Findings

(a) General

The Ashuelot River Dam is in FAIR condition at the present time.

(b) Dam

(1) Right End Wall (See Photos 2 and 4)

It was observed that this structure was constructed with squared cemented stone masonry. With the exception of eroded mortared joints on the lower half of this structure, it is in good condition.

A downstream return wall approximately 20 feet long, is constructed with a combination of dry squared stone masonry, and dry random stone masonry. The squared stone masonry abuts the end wall. The stones have ravelled over approximately 20% of the face of the return wall.

A cemented, random stone masonry wall with a squared stone cap returns into the upstream right bank, and is approximately 12 feet long. This wall is in good condition.

(2) Principal Spillway (See Photo 2 and overview)

This structure is constructed with cemented squared stone masonry, and a stone apron. The apron is approximately 6 feet wide. The visual observations revealed that the mortared joints are completely eroded. There is no evidence of distress in this structure.

(3) Left End Wall (See Photos 2, 3, and 5)

This structure is constructed with cemented, squared stone, masonry. Observations of the downstream portion of this structure revealed that there are voids in the masonry up to one square foot in cross section. There is a considerable degree of eroded joints.

(4) Wasteway (See Photos 5, 6, and 7)

This structure consists of a cemented squared stone masonry forebay entrance which houses three foot sluice gates which are each approximately 5 feet by 6.5 feet. Vegetative growth is flourishing on the face of the wall. A triangular section of stone approximately one square foot in surface area has spalled from the face of the wall. Mortared joints have also spalled.

The left and right sluice gate stems have rotted at the waterline, and do not appear to be operable. The operating mechanism consists of a bar operated ratchet gear which actuates a rack gear fastened to the timber stem. The stem for the center gate is missing and the opening is sealed with a steel plate.

Observations of the tunnel outlets reveal that they are constructed with cemented stone masonry. There is a high degree of joint erosion on the right wall of the right tunnel. The other tunnel walls are in good condition. The left tunnel has a 6 inch reinforced concrete overlay over the stone floor. The outlet end of this overlay has eroded, exposing the reinforcing steel. The mortar joints of the stone apron outlet are completely eroded. A concrete cut-off wall is located in front of the stone apron. This wall has been severely damaged, and no longer serves as a cutoff wall.

The left gate is not completely sealed, and seepage at the rate of approximately 100 gpm is flowing through, and around the frame of the gate. Seepage at the rate of approximately 50 gpm is flowing around the steel plate in the center tunnel. Observations of the right tunnel revealed that seepage at the rate of approximately 100 gpm is flowing through the upper right corner of the gate. Considerable seepage is flowing through the open joints of the right wall of this tunnel and the combined discharge is in excess of 200 gpm.

(5) Dike (See Photo 8)

The dike appears to be in fair condition with extensive vegetation in the form of trees and brush on both slopes. There are a few erosion gullies on the upstream slope. This slope is variable from 4 horizontal to 1 vertical up to 1 horizontal to 2 vertical.

(c) Reservoir Area (See Photo 1 and overview)

The shore of the reservoir area is generally shallow to medium sloping woodland. It appears to be stable and in good condition.

(d) Downstream Channel (See Photo 9)

The downstream channel is the Ashuelot River channel. In general, it is stable, and in good condition. There is one area approximately 200 feet downstream on the right bank where some erosion has taken place. This does not appear to be significant.

Downstream of the dike are some small industrial structures and a railroad spur. These appear to be higher than the level of the Ashuelot River at the time the inspection was made.

3.2 Evaluation

The dam and its appurtenant structures are generally in fair condition. The problem areas noted during the visual inspection are listed as follows:

- a) Erosion of mortared joints in right and left end walls, principal spillway and wasteway structures.
- b) Seepage through left end wall into wasteway tunnel.
- c) Inoperable waste gates.
- d) Seepage around three waste gates.
- e) Erosion gullies on upstream slope of dike.
- f) Heavy tree and brush growth on dike.
- g) Vegetation on wasteway structure.

Section 4: Operational and Maintenance Procedures

4.1 Operational Procedures

(a) General

No written operational procedures exist for this dam. The dam is normally self regulating. There are no operating outlet works for this dam.

(b) Description of any Warning System in Effect

There is no warning system in effect at this dam.

4.2 Maintenance Procedures

(a) General

No formal maintenance program exists for the dam, and maintenance is performed infrequently.

(b) Operating Facilities

No formal maintenance program exists, and maintenance is performed infrequently.

4.3 Evaluation

Emphasis on routine maintenance will assist the owner in assuring the long-term safety of the dam and operating facilities. A formal, written, downstream emergency warning system should be developed for this dam.

Section 5: Evaluation of Hydraulic/Hydrologic Features

5.1 General

Ashuelot River Dam is a granite masonry run of the river structure on the Ashuelot River in Keene, New Hampshire. The dam is located about 500 feet upstream of the West Street bridge across the Ashuelot River. It is also known as the Faulkner and Colony Dam.

The spillway is a granite masonry weir which is 134 feet long. There are 3 gates at the left abutment with invert elevations of 464.6 feet (NGVD). The right gate is 5.5 feet by 6.5 feet. The remaining two gates are each 4.8 feet by 6.5 feet. All three gates appear to be inoperable. There is also a 1,700 foot long dike along the west bank of the Ashuelot River, about 4.9 feet above the spillway elevation. The reservoir behind the dam has a surface area of about 34.4 acres, and stores about 120 acre-feet at the dam crest. The spillway crest is about 10.7 feet above the channel invert downstream of the dam, with an elevation of 471.7 feet (NGVD) The right abutment of natural ground is 4.9 feet above the spillway crest. A dike runs along the bank of the Ashuelot River for 1,700 feet with its crest also 4.9 feet above the spillway, at 476.6 feet (NGVD). The left abutment is the concrete gate structure 6.1 feet above the spillway crest.

Downstream of the Ashuelot River Dam, the Ashuelot River is a wide meandering stream with a very flat, bottom slope. It flows through the city of Keene, New Hampshire, five hundred feet downstream of the dam, West Street crosses the river with its bottom chord 12.5 feet above the channel. Just downstream of West Street, there are 4 houses on the west bank of the river

Six hundred feet downstream of the West Street Bridge, the Cheshire Railroad crosses the Ashuelot River with the low chord 13.5 feet above the stream. Downstream of the Cheshire Railroad Bridge, the Ashuelot River runs 1,950 feet to the Island Street Bridge. For the first 1,000 feet of this reach, there is little development near the river, but there are more than 10 houses about 15 feet above the stream in the next 950 feet down to the bridge. Downstream of Island Street, the Ashuelot River continues as a wide, flat stream with 10 to 15 foot banks, extensive flood plains, and frequent development in the flood plain area.

The Ashuelot River Dam would pass the Test Flood discharge with the water surface 1.2 feet below the level of the right abutment, and the 1,700 foot dike.

5.2 Design Data

The basic data on the Ashuelot River Dam is given in the U.S Geological Surveys June 10, 1919 "Report on Developed Water Power"; the New Hampshire Water Resources Board's 1925 "Inventory of Dams and Water Power Developments", and the New Hampshire Water Control Commission December 27, 1938; "Data on Dams

in New Hampshire", and "Data on Reservoirs and Ponds in New Hampshire". Also available are an October 18, 1937 sketch of the dam and inspection reports from June 13, 1930; June 6, 1936; May 27, 1944; October 7, 1954; and October 1, 1976.

More recent data is provided by the Keene, New Hampshire Flood Insurance Study conducted in 1977 and 1978. Original hydrologic and hydraulic calculations are not available for this dam.

5.3 Experience Data

The flood of record in Keene, New Hampshire occurred in 1938. According to an October 19, 1938 letter from the dam's owner at that time, Faulker & Colony Manufacturing Company, the water reached 5 feet above the spillway crest, and did not damage the dam. The dike associated with the dam failed in 1936, and was repaired.

Since the large floods in 1936 and 1938, Surry Mountain Dam has been built upstream of the dam to control discharge from 100 square miles of the 113 square mile drainage area.

5.4 Test Flood Analysis

The hydrologic conditions of interest in this Phase I Inspection are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires use of the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. None of the original hydraulic and hydrologic design analysis was available for this dam.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1,000 acre-feet and the height of less than 40 feet classify this dam as a SMALL structure.

The appropriate hazard classification for this dam is SIGNIFICANT because of the significant economic losses and potential for loss of a few lives downstream in the event of failure of the dam. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure would cause property damage at West Street, the four houses just downstream of West Street, Cheshire Railroad crossing, and the factory near the Cheshire Railroad.

As shown in Table 3 of the "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with a SIGNIFICANT hazard potential would be between the 100-year flood and one-half the probable maximum flood (PMF). Since the risk downstream in the event of dam failure is on the high side of SIGNIFICANT, one-half of the Probable Maximum Flood will be used as the appropriate Test Flood.

The 1/2 PMF flow for this location was established from the flood insurance study of the Ashuelot River. In this study, a Standard Project Flood (SPF) flow of 2,860 cfs (equivalent to 1/2 PMF) was developed as the sum of the SPF outflow from Surry Mountain Dam plus the residual flow from intervening 13 square mile area above the Ashuelot River Dam. A 1/2 PMF flow of 2,860 cfs would create a stage of 475.4 feet (NGVD) which is 3.7 feet above the spillway crest and 1.2 feet below the right abutment. The spillway capacity of 4,170 cfs is 146% of the peak test flood outflow of 2,860 cfs.

5.5 Dam Failure Analysis

The peak downstream flows that would result from the failure of Ashuelot River Dam are estimated using the procedure suggested in "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." The failure is assumed to occur with the water surface elevation at the top of the right abutment, 476.6 feet (NGVD). The outflow prior to dam failure would be 4,170 cfs, creating a tailwater of about 13.9 feet in the channel downstream. This tailwater would be 3.2 feet higher than the spillway crest.

There are two potential failure modes for the Ashuelot River Dam. The main dam could fail or the 1,700 foot dike along the west bank of the Ashuelot River, upstream of the dam could fail. Due to the high degree of submergence, it is estimated that the incremental dam failure flow resulting from failure of the main dam would be 1,130 cfs. Failure of the dike, on the other hand, would result in an incremental flow of 5,260 cfs, or a total failure flow of 9,430 cfs.

The flow from the dike failure would rejoin the Ashuelot River mainstream within 200 feet, upstream of the West Street bridge. The flow of 9,430 cfs would increase the stage from 13.9 feet to 16.7 feet in this reach. The West Street bridge invert is 12.5 feet above the channel bottom, so the bridge might be damaged by pre-failure flows. The increment of 2.8 feet cause by dam failure could cause further damage to the structure. Upstream of West Street Bridge the factories and stores along the river are out of reach of the dam failure floodwave.

Downstream of West Street in this dam reach, there are about 4 houses on the west bank of the Ashuelot River about 15 feet above the channel bottom. The failure of Ashuelot River Dam would cause flooding of 2 to 3 feet at these houses. Due to the relatively shallow flooding and low flow rates, there would be little chance of loss of life at these houses.

The flow would attenuate a great deal in this short reach from West Street bridge to the Cheshire R.R. bridge, due to the small storage released by dam failure and the extensive flood plain for the Ashuelot River. At the downstream end of the reach, the attenuated peak flow would be 7,400 cfs, creating a stage of 15.4 feet. The Cheshire Railroad bridge, which crosses the Ashuelot River at this point, is about 13.5 feet above the channel, so the pre-failure stage of 13.9 would cause little damage. The 1.5 foot increase might cause some damage to the structure.

Just downstream of this bridge is a large warehouse 10 to 12 feet above the stream channel. The pre-failure flow of 4,170 cfs would cause a stage of 13.6 feet in this reach, and 2 to 4 feet of flooding at the warehouse. The dam failure flow of 6,400 cfs would increase the stage by 1.0 feet to 14.6 feet, increasing flooding at the warehouse. Due to the pre-existing flooding and the

small increment to flooding, the threat to life at this location would be small.

Downstream of the Cheshire R.R. Bridge, the Ashuelot River runs 1,950 feet to the Island Street Bridge. For the first 1,000 feet of this reach, there is little development near the river. In the next 950 feet down to the bridge, there are more than 10 houses about 15 feet above the stream. Due to small amount storage released by the failure of Ashuelot River Dam, and the extensive flood plain of the Ashuelot River in this area, dam failure flow would be largely attenuated in the undeveloped first 1,000 feet of this reach. The pre-failure flow would cause significant flooding downstream, but dam failure would add only a small additional increment to flooding.

Since the pre-failure flow would result in significant overbank flooding downstream, another failure mode bears consideration. This is the case of the dam failure under normal flow conditions. If the dam were to fail with only about 0.3 feet of flow over the spillway (about 100 cfs), the peak failure flow would be 3,700 cfs. From prior engineering studies of this river, it is known that the channel capacity about which overbank flooding begins to occur is about 1,300 cfs. Thus, failure at normal flow rates would result in some shallow overbank flooding, but not to depths that would result in structural damage as described above under the dike failure analysis.

The table on the next page summarizes the downstream effects of the failure of the Ashuelot River Dam.

Location	Number Location (see map)	Distance D/S from Dam (ft)	# of Structures	Level Above Stream (ft.)	Flow & Stage Before Failure	After Failure	Comments
Just D/S of Dam	-	-	-	-	4170 cfs 13.9 ft.	9430 cfs 16.7 ft.	-
West Street	-	500	bridge 4 houses	12.5	4170 cfs 13.9 ft.	9430 cfs 16.7 ft.	possible damage to West St. Bridge; 2-3 ft. of flooding at houses.
Cheshire R.R.	1	1100	bridge	13.5	4170 cfs 13.9 ft.	6400 cfs 15.4 ft.	Possible damage to bridge.
D/S of Cheshire R.R.	1	1100	factor	10-12	4170 cfs 13.6 ft.	6400 cfs 14.6 ft.	Increase to flooding.
D/S	-	-	-	-	-	-	Ashuelot River's extensive flood plain would rapidly attenuate flood flows. Next development on river 1000 ft. D/S.

Section 6: Structural Stability

6.1 Evaluation of Structural Stability

(a) Visual Observations

1) General

The Ashuelot River dam is in FAIR condition at the present time.

2) Right End Wall

Mortar has eroded from the joints of this wall. The downstream return wall is partially ravelled. The upstream return wall is in good condition.

3) Principal Spillway

With the exception of eroded mortar joints, this structure is in good condition.

4) Left End Wall

This structure has been subjected to a high degree of joint erosion which is the cause of the high degree of seepage flowing into the right sluiceway. There are voids in this wall.

5) Wasteway

The center sluiceway opening has been permanently sealed with a steel plate. The stems of the other two gates are rotted at the waterline. There is considerable seepage flowing around the gates. The outlet cutoff wall is completely destroyed.

6) Dike

The dike has numerous trees growing on both slopes and a few erosion gullies in the upstream slope.

(b) Design and Construction Records

No plans or calculations of value to a stability assessment are available for this dam.

6.2 Design and Construction Data

No records of structural stability analyses are available for this dam.

6.3 Post Construction Changes

Some filling of the reservoir area has been accomplished along the upstream left side effectively, eliminating an old dike and sluiceway which once brought water to a mill downstream. The middle wasteway has been sealed.

6.4 Seismic Stability

The dam is located in seismic zone No. 2, and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

Section 7: Assessment, Recommendations and Remedial Measures

7.1 Dam Assessment

(a) Condition

The Ashuelot River Dam is in FAIR condition at the present time. There is a high degree of seepage through the left end wall and around the wasteway openings. Eroded masonry joints are prevalent throughout the structure.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgement.

(c) Urgency

The Engineering studies and improvement described herein should be implemented by the owner within one year of receipt of this Phase 1 Inspection Report.

7.2 Recommendations

It is recommended that the services of a qualified registered professional engineer be retained to evaluate:

- a) Investigate the source of seepage through the left end wall.
- b) Review the need and prepare plans for rehabilitation of the wasteway structure.
- c) Prepare plans for reconstruction of the concrete cutoff wall at the wasteway outlet.
- d) Mortar all open stone masonry joints and repair ravelled wall.
- e) Develop a method to remove all trees and brush from the dike, including the roots, and backfill the resulting voids with suitable compacted material.
- f) Prepare plans to regrade and design slope protection for the upstream slope of the dike.

The owner should implement the findings of the above engineering studies.

7.3 Remedial Measures

It is recommended that the following remedial measures be undertaken by the owner:

- (a) Remove all vegetation from the downstream face of the wasteway structure.
- (b) Implement a program of annual technical inspection of the dam and its appurtenances including operation of all outlet works.
- (c) Develop a plan for surveillance of the dam during and immediately after periods of heavy rainfall and a formal downstream emergency warning system for warning downstream residents and officials in the event of an emergency.
- (d) Implement and intensify a program of diligent and periodic maintenance.

7.4 Alternatives

There are no meaningful alternatives to the above recommendations.

APPENDIX A
VISUAL CHECKLIST WITH COMMENTS

Inspection Team Organization

DATE: October 17, 1980

PROJECT: NH00100
Ashuelot River Dam
Keene, New Hampshire
NHWRB 126.01

WEATHER: Clear, warm

INSPECTION TEAM:

Nicholas A. Campagna	Goldberg-Zoino & Assoc.	Team Captain
William S. Zoino	GZA	Soils
Jeffrey M. Hardin	GZA	Soils
Andrew Christo	Andrew Christo Engineers	Structures
Paul Razgha	ACE	Structures
Carl Razgha	ACE	Structures

NHWRB Representative Present - Gary Kerr

NOTE: Tom Gooch and Richard Laramie of Resource Analysis Inc., performed the hydrologic inspection of this dam on October 3, 1980.

CHECKLIST FOR VISUAL INSPECTION

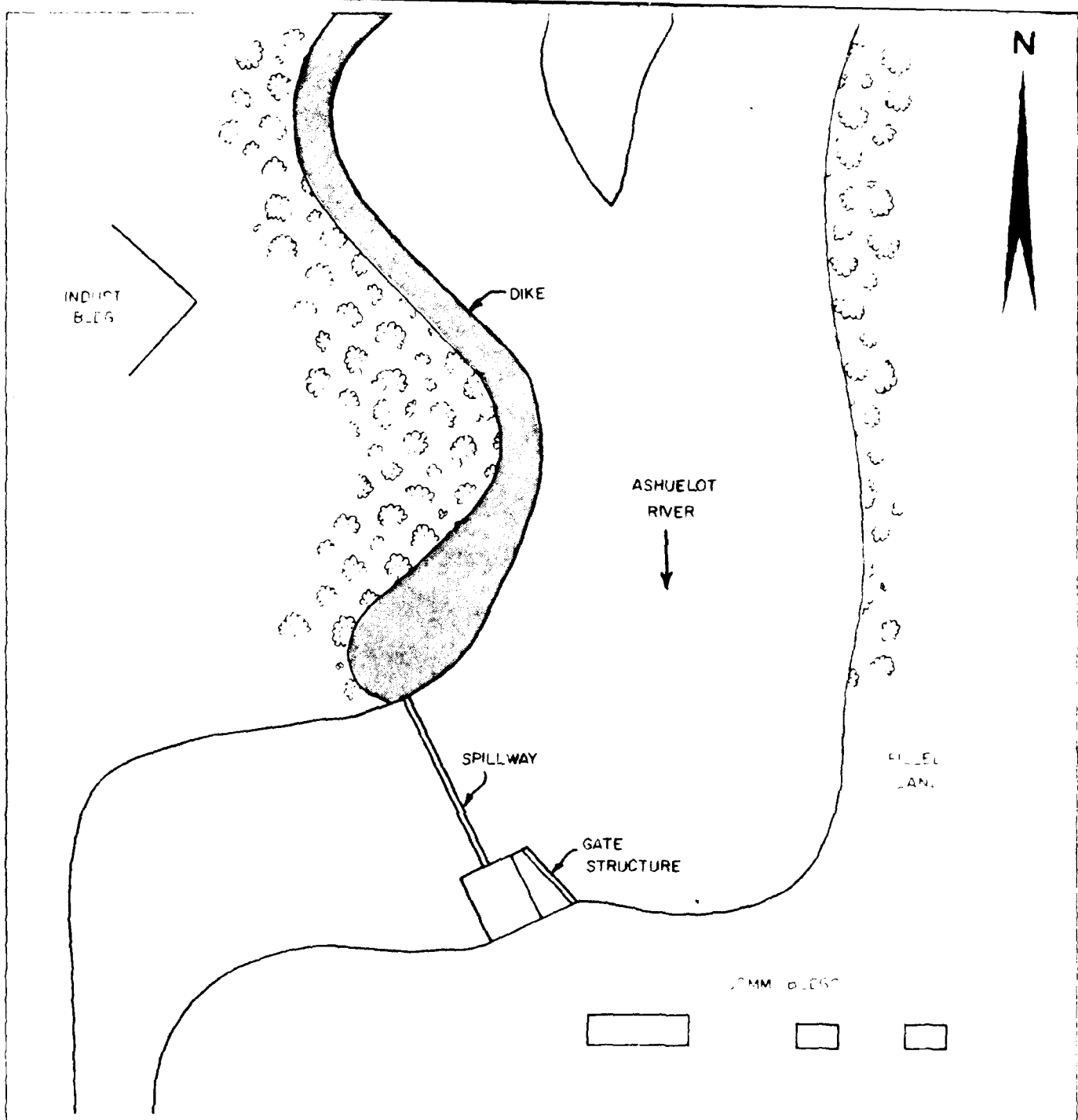
AREA EVALUATED	BY	CONDITIONS AND REMARKS
<u>GENERAL</u>	PR	
Crest Elevation		477.0
Current Pool Elevation		472.0
Maximum Impoundment to Date		Unknown
<u>Right End Wall</u>		Mortar eroded from joints. Downstream wall partially dislodged.
<u>Principal Spillway</u>		Mortar eroded from joints.
<u>Left End Wall</u>		Mortar eroded from joints. Voids up to 1 square foot in masonry. Seepage into tunnel in excess of 200 gpm.
<u>Wasteway</u> Sluice gates		Center gate permanently sealed with steel plate. Stems of adjacent gates Rotted at waterline. Seepage flowing through gate openings 100 gpm at left gate, 50 gpm at right gate.
Forebay Walls		Vegetation flourishing in stone joints. Joints eroded.
Tunnels	PR	Joints eroded on right wall of right tunnel (left end wall) Joints in stone apron eroded. Outlet end of concrete floor of left tunnel eroded exposing reinforcing steel. Concrete cut-off wall destroyed.

CHECKLIST FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITIONS AND REMARKS
<p><u>Dike</u></p> <p>Surface Cracks</p> <p>Pavement Condition</p> <p>Movement or Settlement of Crest</p> <p>Lateral Alignment</p> <p>Vertical Alignment</p> <p>Horizontal Movement</p> <p>Condition at Abutments</p> <p>Indications of Movement of Structural Items on Slopes</p> <p>Vegetation on Slopes</p> <p>Erosion of Slopes</p> <p>Rock Slope Protection</p> <p>Unusual Movement or Cracking at or Near Toes</p> <p>Unusual Embankment or Downstream Seepage</p> <p>Piping or Boils</p>	<p>FR</p> <p>FR</p>	<p>None noted</p> <p>Not applicable</p> <p>None noted</p> <p>Good</p> <p>Good</p> <p>None noted</p> <p>Good</p> <p>None</p> <p>Trees and brush are extensive on both slopes.</p> <p>Few erosion gullies up to 1 foot wide and 1 foot deep along dike on upstream slope.</p> <p>None noted</p> <p>None noted</p> <p>None noted</p> <p>None noted</p>

CHECKLIST FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITIONS AND REMARKS
Foundation Drainage Features	PR	None noted
Toe Drains	PR	None noted
Instrumentation	PR	None noted.

APPENDIX B
ENGINEERING DATA



GOLDBERG ZIINO & ASSOCIATES INC
 GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
 NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGL. ANCE
 CORPS OF ENGINEERS
 WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

FILE NO 2605

SITE PLAN

ASHUELOT RIVER DAM

KEENE, NEW HAMPSHIRE

SCALE SCHEMATIC

DATE OCT 1980

126.01

3/79

DAM IS OWNED BY FEENE HOUSING AUTHORITY,
WHICH HAS ONE OR TWO HOUSING PROJECTS FOR
THE ELDERLY NEARBY. LAND FOR A CITY PARK IS
NEAR DAM, TOO. OLD MILL APPARENTLY BELONGS TO
BARKER REALTY. POND AT DAM IS RUN OF RIVER, HAS
NO NAME.

DAM

JUN 29 1977

June 24, 1977

Mr. Allen I. Lewis, P.E.
Fish & Game Engineer
State of New Hampshire
Fish & Game Department
Box 2003
34 Bridge Street
Concord, New Hampshire 03301

Dear Mr. Lewis:

By your letter of January 26, 1976, you asked for a lease of the dam and water rights on Long Pond in Lempster, on the assumption that these rights are owned by the City of Keene.

In a series of complicated transactions related to the construction of elderly housing, the City of Keene did acquire some rights on the Ashuelot River. I have had a title search done recently to determine precisely what interests we still have, and I find that on September 30, 1971, the Town of Lempster took the water rights at Long Pond from the Keene Housing Authority for non-payment of taxes in the amount of \$5.41. This occurred before the City of Keene acquired any of these properties, so that it would appear that we never did have any rights at Long Pond.

For your information, the rights on the Ashuelot Pond were conveyed by the Keene Housing Authority to an unknown buyer, which I believe to be the Ashuelot Pond or Lake Association. The water rights at Millen Lake were sold by the Keene Housing Authority to the Millen Lake Association. The water rights at Sand Pond were sold by the City of Keene to the Sand Pond Association. The rights at the old Faulkner and Colony Dam just off West Street in Keene are owned by the City of Keene. (HOUSING AUTHORITY)

It would appear that any lease of the Long Pond water rights would have to be negotiated with the Town of Lempster.

I apologize for not answering your letter sooner, but I have been somewhat confused as to who owned what until we had the title search and got the matter straightened out.

Very truly yours,

Charles H. Morang
Charles H. Morang, City Attorney

CHM/bah

cc: Peter Cheney, City Manager

*City Attorney
City Hall
Keene, N.H.*

SEE 136.01 FILE FOR OTHER
LETTERS RELATED TO THIS ONE
B-4

100% RECYCLED PAPER

~~It is understood and agreed that the Lessor shall be responsible on~~

State of New Hampshire

WATER RESOURCES BOARD

37 Pleasant St.
CONCORD 03301

October 6, 1976

Mayor George M. Rossiter
City Hall
Keene, N. H. 03431

Gentlemen:

Under the provisions of RSA-Chapter 482, Sections 8 through 15, the New Hampshire Water Resources Board is authorized to inspect all dams in the state which by reason of their physical condition, height, and location may be a menace to the public safety.

The dam structure (Dam # 126.01) located on your property in Ashuelot River-Keene, N.H. was inspected on October 1, 1976

and as a result of this inspection no discrepancies were found at the time of the inspection which would require any corrective measures.

This letter is provided for your information only. If you have any questions, please feel free to call or write.

Sincerely,



George M. McGee, Sr.
Chairman

GMM/SCB:L

cc: ~~XXXXXXXXXXXXXXXXXX~~

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: Keene Dam Number: 126.01
Name of Dam, Stream and/or Water Body: Ashuelot R
Owner: City Telephone Number: _____
Mailing Address: _____
Max. Height of Dam: 12' Pond Area: 15 A Length of Dam: 150

FOUNDATION:

OUTLET WORKS:

Overflow spillway 134'
5' Freeboard
3 waste gates appear inoperative

ABUTMENTS:

granite, stone cut good shape

EMBANKMENT:

Note: Give Sizing, Condition and detailed description for each item, if applicable.

SPILLWAY: Length: 134 Freeboard: 5

SEEPAGE: Location, estimated quantity, etc.
None

Changes Since Construction or Last Inspection:

Tail Water Conditions:

Overall Condition of Dam: Good

Contact With Owner:

Date of Inspection: 1 Oct 76 Suggested Reinspection Date 1980

Class of Dam: Masonry B

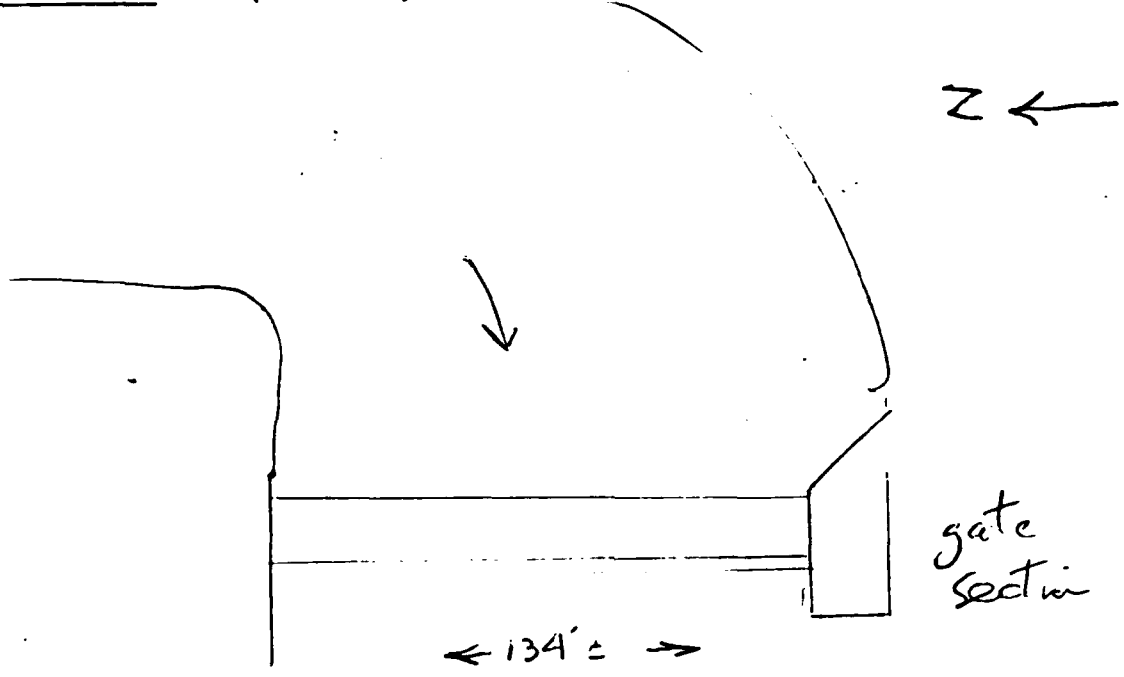
Signature S. Burnett

Date _____

Note: Give Sizing, Condition and detailed description for each item, if applicable.

SKETCH OF DAM

(Show Plan, Elevation & Cross Sections)



WAST SK (FILE 12)

October 8, 1954

Mr. Sheldon L. Barker
Barker Realty Company, Inc.
48 Central Square
Keene, New Hampshire

Dear Mr. Barker:

As a result of your letter of October 4, I was able to inspect your dam in Keene yesterday.

I contacted the caretaker of the plant and went out to the dam with him.

I have very little criticism to make of the structure. One thing that deserves some attention is the condition of the gate stems. These probably are good for another several years but show signs of rotting at the water level and if the dam was not going to be used immediately and funds were available, it might be an appropriate time to replace the gate stems. There is one leak between the right gate and spillway apron but I was not able to determine the nature of the leak. This leak may not be existent when the gates are closed. It would take a little opening and closing of the gate to determine the nature and source of this leak.

I hope this information will be of some use to you.

Very truly yours,

Leonard R. Frost
Water Resources Engineer

lr:c



Office 1571



Residence
Sullivan 8007-11

BARKER REALTY COMPANY, INC.

48 CENTRAL SQUARE ^{Realtors} KEENE, NEW HAMPSHIRE

October 4, 1954.

Mr. Walter White,
Water Resources Board,
Concord, New Hampshire.

Dear Mr. White:

This is to inform you that we are planning to open the gates at the Faulkner & Colony mill property on Wednesday morning, October 6th. It would seem to me that by Thursday it would be possible for your men to inspect the dam. We will continue to operate without the flash boards on at the present time.

Very truly yours,

Sheldon L. Barker

Sheldon L. Barker

SLB/L

B-10

*Oct 7 '54
Elliott's men are not in the good condition
to do the work but more would
be needed to repair them.
Don't know the right
time to do the work - maybe
later in the week - and
be sure to get
the work done.*

REPORT ON FAULKNER AND COLONY'S DAM, KEENE, N. H.

On 27 May 1944, the writer inspected the dam owned and operated by the Faulkner and Colony Manufacturing Company of Keene, New Hampshire. An independent inspection of this dam was made at the same time by an engineer of Charles T. Main, Incorporated of Boston, for the owners.

As the owners had arranged ^{for} drawing the water from the ponded area it was possible to inspect both up and downstream faces of the dam. Near the upstream face and about mid-way of the spillway there was a depression in the material forming the bottom of the pond indicating that at sometime there had been some loss of fine material due to leakage under the dam. The extent of this leakage appeared to be small and not sufficient to cause concern. A thorough examination of the downstream face of the dam failed to disclose the outlet of this leakage. The owners propose to check this condition further by use of colored pigments so that the course of the leakage may be determined, if it still exists, prior to placing a seal over the depression.

Considerable erosion has taken place at the toe of the existing stone spillway. This action apparently has been slow and there is no evidence that it has or will endanger the dam. There is evidence of a sheet timber pile cutoff extending along the toe of the spillway. For a considerable distance the top portion of the piling has been broken off. The remaining portion of the piling should prevent any serious undermining of the spillway.

At the southerly end of the dam there are three gates which were in very good working condition and when closed showed very little leakage. The sluiceway for the gates is divided into three parts by stone masonry walls which support stone slabs covered with earth. The bottom of the sluiceway is paved with heavy stone slabs similar to the spillway. It is the intention of the owners to point up and grout the

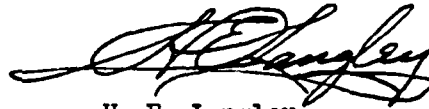
REPORT ON FAULKER AND COLONY'S DAM, KEENE, N. H.

Page -2.- (Continued)

joints between the stones where necessary to prevent wedging action from ice during freezing weather.

In general the dam is in excellent condition. It is evident that it has been carefully maintained. Because of this maintenance and also of the type of material, heavy well laid cement stone masonry, used in the construction of the dam there is no question as to the stability and safety of it.

Submitted, by,



H. E. Langley
Bridge Engineer.

May 26, 1944

Mr. Harold Langley
State Highway Department
Concord, New Hampshire

Dear Mr. Langley:

Confirming our telephone conversation of May 24, I am enclosing our folder on the Faulkner & Colony Manufacturing Company's dam at Keene, New Hampshire, for your information.

I have notified Mr. John Faulkner, Jr., President, that you would be in Keene tomorrow morning, Saturday, to inspect this dam. Thank you for your cooperation.

Very truly yours

Walter G. White
Acting Chairman

wgwin
enc: folder

JOHN C. FAULKNER, JR., President
WINTHROP FAULKNER, Treasurer



42 318
SALES AGENTS
C. H. SCHMIDT & COMPANY
1450 BROADWAY, NEW YORK CITY
Tel. CHickering 4-1072

FAULKNER & COLONY MANUFACTURING CO.
WOOLEN MANUFACTURERS — KEENE, N. H.

Tel. 1886-1887

May 22, 1944.

Richard S. Holmgren, Chief Engineer
Water Control Commission
Concord, New Hampshire

Dear Sir:

Re: Dam Inspection, referring to our
letter of May 20th.

Our plans are as follows: inspect the up stream
side of the dam Saturday morning, May 27th between 8 A. M.
and 11 A. M.

We expect to close all the gates by 11 o'clock
to noon on Saturday, and therefore plan to inspect the
down stream side of the dam shortly after closing the gates
as we believe we have made sufficient arrangements for
the back water to be very low as soon as the gates close.

If anything, such as heavy rains, interferes with
this program, we shall let you know.

Please advise us if you care to come over and
make a state inspection.

Very truly yours,

FAULKNER & COLONY MFG. CO.

By

J. Faulkner Jr.
President

JCFJR:MF

B-14
9:00 AM 4/16/44

JOHN C. FAULKNER, JR., President
WINTHROP FAULKNER, Treasurer



SALES AGENTS
C. H. SCHMIDT & COMPANY
1450 BROADWAY, NEW YORK CITY
Tel. CHickering 4-1072

FAULKNER & COLONY MANUFACTURING CO.
WOOLEN MANUFACTURERS — KEENE, N. H.

Tel. 1886-1887

May 20, 1944.

Richard S. Holmgren, Chief Engineer
Water Control Commission
Concord, New Hampshire

Dear Sir:

We plan to have the mill pond drained so that the upper part of the dam can be inspected Saturday morning, May 27th between 9 and 11 o'clock.

We then propose to let the water into the mill pond, thereby dropping the back water level so that the lower part of the dam can be inspected Sunday morning, May 28th. *or possibly Sat. p.m.*

If anything, such as heavy rains, interferes with this program, we shall let you know.

Please advise us if you care to come over and make a state inspection.

Very truly yours,

FAULKNER & COLONY MFG. CO.

By

A handwritten signature in dark ink, appearing to read 'John C. Faulkner, Jr.', written in a cursive style.

President

JCF JR:MF

August 7, 1941

Faulkner & Colony Mfg. Company
Keene
New Hampshire

Attention: Mr. J. C. Faulkner, Jr.

Gentlemen:

This letter will be in confirmation of a conversation on the telephone this morning.

It is our practice to inspect dams every five years. Since the last inspection of your dam occurred in November 1937, inspection will be due next summer.

In that event, there will be no inspection at this time unless you so request.

Very truly yours,

Roland S. Burlingame
Assistant Engineer

RCB:GME



CLASS OF SERVICE DESIRED	
DOMESTIC	CABLE
TELEGRAM	<input checked="" type="checkbox"/> FULL RATE
DAY LETTER	DEFERRED
NIGHT MESSAGE	NIGHT LETTER
NIGHT LETTER	SHIP RADIOGRAM

Patrons should check class of service desired; otherwise message will be transmitted as a full-rate communication.

WESTERN UNION

R. B. WHITE
PRESIDENT

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

CHECK
ACCT'G INFMN.
TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

CONFIRMATION

Keene, N. H.

Aug. 6, 1941

Richard S. Holmgren, Chief Engineer
Water Control Commission
Concord, New Hampshire

HAVE DRAWN DOWN RIVER UNTIL NEXT SUNDAY. ADVISE IF YOU WISH TO
INSPECT DAM

(Signed) Faulkner & Colony Mfg. Co.
Per J. C. Faulkner, Jr.

Given overphone by KHA 3 P.M. - 8/6/41
1888

RECEIVED

AUG 7 1941

WESTERN UNION GIFT ORDERS SOLVE THE PERPLEXING QUESTION OF WHAT TO GIVE

NEW HAMPSHIRE
WATER RESOURCES BOARD

THE FOLLOWING TERMS OF SERVICE apply to all telegrams and cables unless otherwise indicated.

TERMS OF SERVICE

is a full-rate telegram or Cable unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

1201

SYMBOLS	
DL	Day Letter
NT	Overnight Telegram
LC	Deferred Cable
NLT	Cable Night Letter
Ship Radiogram	

R. B. WHITE
PRESIDENT

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

(33)

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

BL78 14=KEENE NHAMP 6 205P

1941 AUG 6 PM 2 38

RICHARD S HOLLGREN,

CHIEF ENGINEER=

WATER CONTROL COMMISSION CR=

HAVE DRAWN DOWN RIVER UNTIL NEXT SUNDAY ADVISE IF YOU WISH TO INSPECT DAM=

FAULKNER AND COLONY MFG CO.

RECEIVED

AUG 6 1941

NEW HAMPSHIRE
WATER RESOURCES BOARD

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

**NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE**

LOCATION STATE NO. 126.01
 Town Keene : County Cheshire
 Stream Ashuelot River
 Basin-Primary Conn R. : Secondary Ashuelot
 Local Name
 Coordinates—Lat. 42° 55' + 6,000 : Long. 72° 15' - 10,500

GENERAL DATA
 Drainage area: Controlled.....Sq. Mi.: Uncontrolled Sq. Mi.: Total 113.....Sq. Mi.
 Overall length of dam 160 ft.: Date of Construction
 Height: Stream bed to highest elev. 17 ft.: Max. Structure 12 ft.
 Cost—Dam : Reservoir

DESCRIPTION Masonry Spillway with Earth Dike
Waste Gates - Granite blocks, Concrete, Stone & Earth
 Type
 Number 3 : Size 6 ft. high x 6 ft. wide
 Elevation Invert 7.5 : Total Areasq. ft.
 Hoist

Waste Gates Conduit
 Number : Materials
 Size ft.: Length.....ft.: Area sq. ft.

Embankment
 Type
 Height—Max. ft.: Min. ft.
 Top—Width : Elev. ft.
 Slopes—Upstream on..... : Downstream on
 Length—Right of Spillway : Left of Spillway

Spillway
 Materials of Construction Masonry
 Length—Total ft.: Net 134 ft.
 Height of permanent section—Max. 12 ft.: Min. ft.
 Flashboards—Type : Height 2.0 ft.
 Elevation—Permanent Crest 472 : Top of Flashboard
 Flood Capacity 2245 cfs. : 80 cfs/sq. mi.

Abutments
 Materials:
 Freeboard: Max. 5.0 ft.: Min. ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Faulkner & Co Mfg Co

REMARKS Water for processing and boilers

**NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE**

LOCATION AT DAM NO.126.01...
 Town Keene: County Cheshire
 Stream Ashuelot
 Basin—Primary Conn. R.: Secondary Ashuelot R.
 Local Name

DRAINAGE AREA

Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 113 Sq. Mi.

ELEVATION vs. WATER SURFACE AREA vs. VOLUME

Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1) Max. Flood Height
(2) Top of Flashboards
(3) Permanent Crest
(4) Normal Drawdown <u>15</u>
(5) Max. Drawdown
(6) Original Pond

Base Used: Coef. to change to U.S.G.S. Base

RESERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdownft.ft.
Volumeac. ft. ac. ft.
Acre ft. per sq. mi.
Inches per sq. mi.

USE OF WATER Water for processing and boilers

OWNER Faulkner & Co., Mfg Co

REMARKS

Tabulation By A. A. N. & R. L. T. Date December 27, 1938

JOHN C. FAULKNER, JR., President
MENSWEAR SALES AGENTS
FAULKNER & COLONY CO. OF NEW YORK, INC.
51 MADISON AVE., NEW YORK CITY



WINTHROP FAULKNER, Treasurer
WOMENSWEAR SALES AGENTS
C. H. SCHMIDT & COMPANY
1450 BROADWAY, NEW YORK CITY

126.01
FAULKNER & COLONY MANUFACTURING CO.
WOOLEN MANUFACTURERS
KEENE, N. H.

October 19, 1938

New Hampshire Water Control Commission
Concord, New Hampshire

Atten: Mr. Richard S. Holmgren, Chief Engineer

Gentlemen:-

Because you did not send us duplicate copies to fill out on our various dams, I will try to answer them all by this letter.

A. The dams in question being: our dam here at the mill, dam at Ashuelot Pond in Washington, dam at Sand Pond in Washington, dam at Long Pond in Leominster and the dam at Millen Pond in Washington.

1. None of these dams were injured.

3. The only dam that had flashboards off were in Keene and these boards were all pulled before the flood got too high.

4. The maximum height of water over the permanent crest of spillway was as follows:-

Dam at the Mill	- 5'
" " Ashuelot Pond	- 4' to 5'
" " Sand Pond	- 3'
" " Long Pond	- About even with the spillway.
" " Millen Pond	- 2 1/3'

Rec'd 10/20/38

Jacobson	
Holmgren	✓
Talbot	✓

October 19, 1938

5. The day and the hour that the maximum flood reached the dam was as follows:-

At the Mill Pond - approx. 12:30 A. M. on September 22nd.

At the other ponds, probably sometime during September 21st.

6. There is plenty of other interesting information but I will confine my remarks to stating that the covered bridge building over the dam at Keene was blown down stream in two parts by the hurricane.

For the past two weekends we have made very minor repairs to the dam in Keene, such as pointing up the cracks, etc.

The dam at Long Pond appears to be in safe condition because of its stone backing but the front is made of a wooden apron of heavy planks and these have leaked for the past few years so that the front does not ordinarily hold the water back to the spillway level.

If there is any other information that you require, please do not hesitate to call upon us.

Very truly yours,

FAULKNER & COLONY MFG. CO.

By: 
President

JCFJR:H

TOWN NO. 1 TOWN Keene, N. H. NO. 18 PAGE NO. 1
 NAME OF COMPANY Faulkner and Colony Manufacturing Co.
 HOME ADDRESS Keene, N. H.
 DRAINAGE AREA 152 SQ. MI. HEAD 11 FT.
 RIVER Ashuelot RATE SEC. FT. PER SQ. MI. 90% TIME .22

RESOURCES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS	
WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME	WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME
		150	33.44

USES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS	
K. V. A. CAPACITY	ANNUAL KW. H. OUTPUT	K. V. A. CAPACITY	ANNUAL KW. H. PROD. AND CONS ELECT. AND CONS MECH.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 1 126.01 SHBAE
 RIVER ASHMUNSET MILES FROM MOUTH 28.15 D.A.SQ.MI. 152 PSC
 TOWN KEENE OWNER Faulkner & Galway Mfg. Co.
 LOCAL NAME OF DAM _____
 BUILT _____ DESCRIPTION Split Stone (Masonry AE)
 _____ Granite River

POND AREA-ACRES 15+ DRAWDOWN FT. _____ POND CAPACITY-ACRE FT. _____
 HEIGHT-TOP TO BED OF STREAM-FT. 8 MAX. MIN. _____
 OVERALL LENGTH OF DAM-FT. 150 MAX. FLOOD HEIGHT ABOVE CREST-FT. _____
 PERMANENT CREST ELEV. U.S.G.S. 472.0 LOCAL GAGE _____
 TAILWATER ELEV. U.S.G.S. 462.7 LOCAL GAGE _____
 SPILLWAY LENGTHS-FT. 125 134 FREEBOARD-FT. 5.0'
 FLASHBOARDS-TYPE, HEIGHT ABOVE CREST 2.0
 WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST
3 6 6 7.5

REMARKS Condition Good Top of dam El. 463.
25 into Connecticut R. Max High Water 474.78
Dam submerged 1936 flood

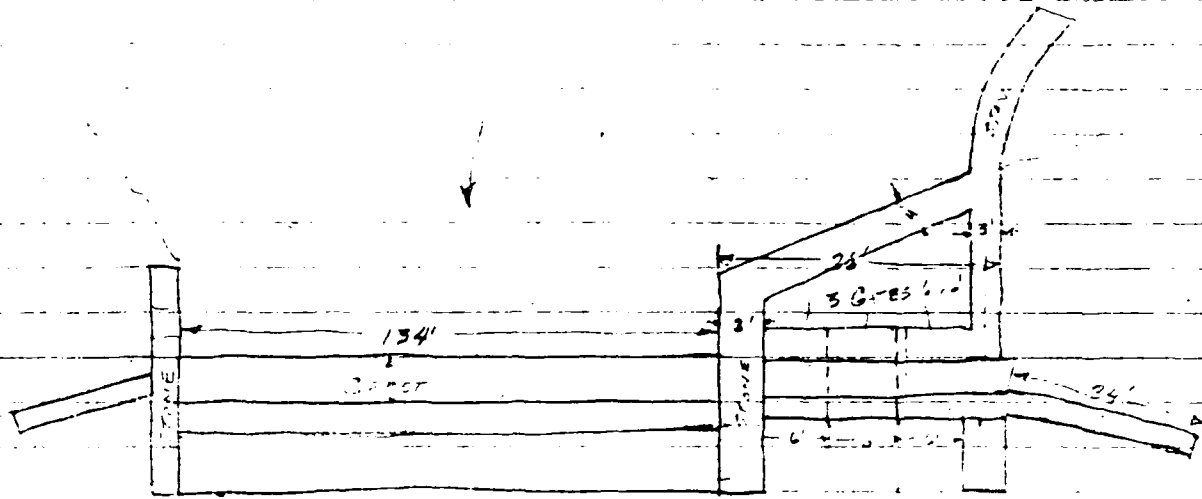
POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
		<u>100</u>	<u>11</u>	<u>PSC</u>		
		<u>50 Est</u>	<u>11.3</u>	<u>AE</u>		

USE Power Woolen Mill Water for processing & power. & hydraulic machinery takeout

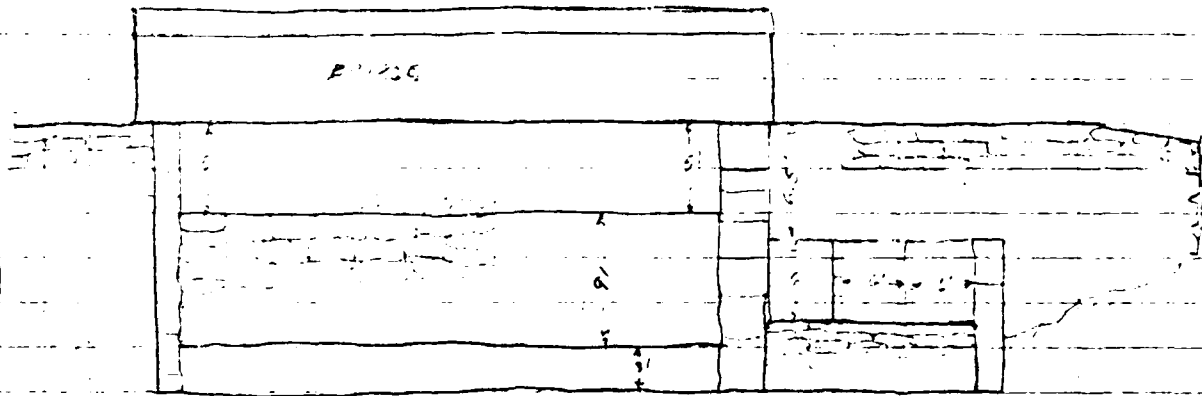
REMARKS Primary 1075 ft. of time 33.4
Tailrace 1700 ft across head in river See map E. Faulkner's
provisions for maintenance Flow ditch for 1800 ft with
sewer all including with St Frack and 5 ft. head to
water other, can be done.

DATE 1975 PSC 1931 AE
10/20/75 J.P. + S.H.S. B-24

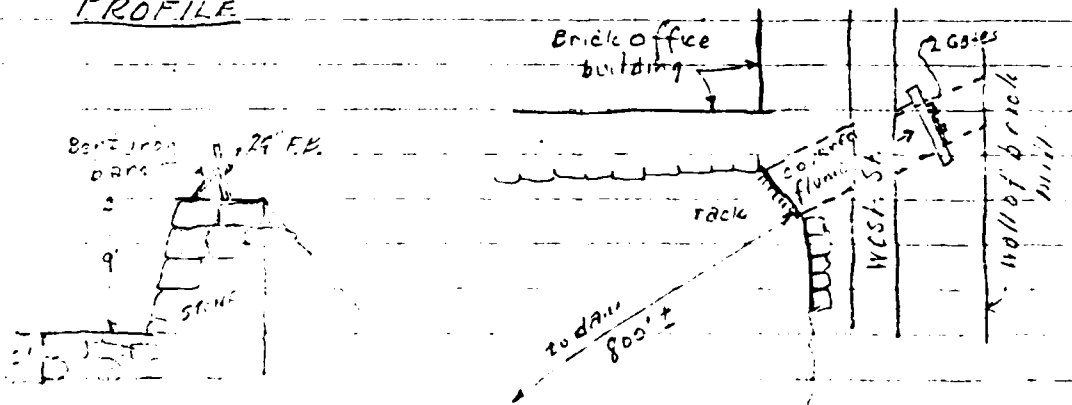


PLAN

2. Dike breached in 1936 flood where river lands repaired by wood piling 15000 by alternate layers soil & concrete



PROFILE



X-SECTION

Plan of intake to mill. Water now used for processing only. wheels removed

Assigned	File
✓ Secty.	
✓ Smith	
✓ Kelly	
Swain	
15	

126.01

RECEIVED
 JUN 22 1936
 N. H. Public Service Commission

MEMORANDUM

1E

In conformity to a letter written by Treasurer Winthrop Faulkner, of Faulkner & Colony Manufacturing Company, their dam at Keene was inspected on the morning of June 6, 1936. The dam had been completely dewatered. The spillway abutments and gates of this dam are of cut granite, laid in cement, and no damage whatever was done to this structure. Small amounts of the cement along the joints had worn away during the past years, and the Company's inspection was made to determine the amount of cement gun work that could be done to improve its condition. There are very long dikes connected with this development. During the flood this was cut through. The dike has been replaced, the sides sodded and small trees planted to deter washing in case of any future floods.

D. W. W.

DWW/a

6/16/36

Recommendation?

C O P Y

126.01

April 28, 1936

J. C. Faulkner, Jr. President
Faulkner & Colony Company
Keene, New Hampshire

Dear Sir:

Replying to your letter of April 21, 1936.

Answering your first comment; "Damage to dams of industrial concerns as reported to the State Planning and Development Commission, and by them reported to the Public Service Commission April 10, 1936". The information we received as stated in our letter was as follows, "Keene, Faulkner & Colony Mfg. Co., Dikes washed out."

Answering your second comment:

Construction and reconstruction (which includes repairs) having to do with dams, dikes, penstock and flume intakes, sluice gates, sluice ways, gates spillways, and flashboards, is subject to approval by the Public Service Commission, and covers all parts of structures holding back and controlling water under a head, for this reason the Q-3 was enclosed. The questions as to flowage, etc., are of importance in connection with new projects, and in existing dams if it is intended to raise the height of the dam permanently or by flashboards. Repairs to the dikes having been made before you received our letter, I can see no reason why you should now file the Questionnaire-Statement.

We would however appreciate being advised when you propose lowering the water to make inspection.

Thanking you, we are,

Very truly yours,

N. H. PUBLIC SERVICE COMMISSION

SJL/hc

R-27

Samuel J. Lord
Hyd. Eng.

126.01

W. C. FAULKNER JR., President
ARTHUR FAULKNER, Treasurer

SALES AGENTS
FAULKNER & COLONY CO. OF N. Y., INC.
51 MADISON AVE., NEW YORK CITY



RECEIVED

Lead	Assigned	File
✓	Secty.	
✓	Smith	
✓	FAULKNER	
	Swain	
Docket No.		

FAULKNER & COLONY MANUFACTURING CO. 1900
WOOLEN MANUFACTURERS
KEENE, N. H.

April 21, 1936

New Hampshire Public Service Commission
Concord, New Hampshire

Att: Samuel J. Lord
Hyd. Eng.

Gentlemen:-

Replying to your letter of April 17th.

In the first place, we do not know what report you refer to dated April 10th as follows - "Dikes washed out".

In the second place, you enclose a Questionnaire-Statement regarding repairs to dams and flowage.

We had a wash out in our dike during the recent flood which was repaired within a few days after the flood was over. As to the dam, we own the whole dam and all the land. We contemplate no particular repairs, but will undoubtedly drop the water somewhat lower later on and will give it an inspection, altho' we doubt if the few extra inches of this flood, over some of our previous floods, were enough to do any harm. The construction of the dam is such that we fail to see how there could have been any ice damage.

If you wish this questionnaire filled out we will be glad to do so, but would ask you to send us another set of blanks so that we may make a duplicate for our files.

Very truly yours,
FAULKNER & COLONY MFG. CO.

By: *J. Faulkner Jr.*
President

JCFJR:A

C O P Y

126.01

April 17, 1936

Faulkner & Colony Mfg. Co.
Keene, New Hampshire

Dear Sirs:

We have at hand a report dated April 10, 1936, as follows:

" Dikes washed out. "

Assuming that you plan to reconstruct, we are calling your attention to Chapter 218 of the Public Laws, Sections 13 to 20 inclusive (copy enclosed). We are also enclosing a Questionnaire-Statement. Please fill out and return the Statement to the Commission before beginning reconstruction.

Very truly yours,

N. H. PUBLIC SERVICE COMMISSION

Samuel J. Lord
Hyd. Eng.

SJL:a

enc.

1
1
Keene (Cheshire County)
Page 18 #1

Inspected June 13, 1930.

Faulkner and Colony

Stone dam. Spillway runs the full length. The gates were working O. K. The dam is in good condition. Considerable repairs have been made since 1925. All masonry pointed up. New concrete base where the mechanical gates open. Dikes all in good condition. Ten foot head and about forty horse power development. Very small seepage reported when dam is not overflowing. Four and one-half inch overflow on day of inspection.

DIVI-7
DIVI-8

File No. Washington 18
Field N. H. 1109.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

REPORT ON DEVELOPED WATER POWER

- 1. Name of stream on which power is located Ashuelot River
- 2. Location of plant: 1/4 Sec. , Tl. , R.
Town or City Keene, County Cheshire, State N. H.
- 3. Location of point of diversion Keene, N. H.

- 4. Name and address of owner or operator Faulkner & Colony Mfg. Co.
Keene, N. H.

- 5. Operating head, fore bay to tailrace 11 feet, including 2' flashboards

6. Water wheels:

No.	Kind	Make	Size	Rated capacity, horsepower (total)
<u>1</u>	<u> </u>	<u>Boiney Hunt</u>	<u>39"</u>	<u> </u>
<u>1</u>	<u> </u>	<u>do</u>	<u>42"</u>	<u> </u>
<u>Total about</u>				<u>150</u>

- 7. How many and what wheels are operated during the low-water season? Varies

- 8. What is the ordinary length of such low-water season? Varies

- 9. Generators: No. None Total rated capacity (KVA)

- 10. Use of power Manufacture textile goods.

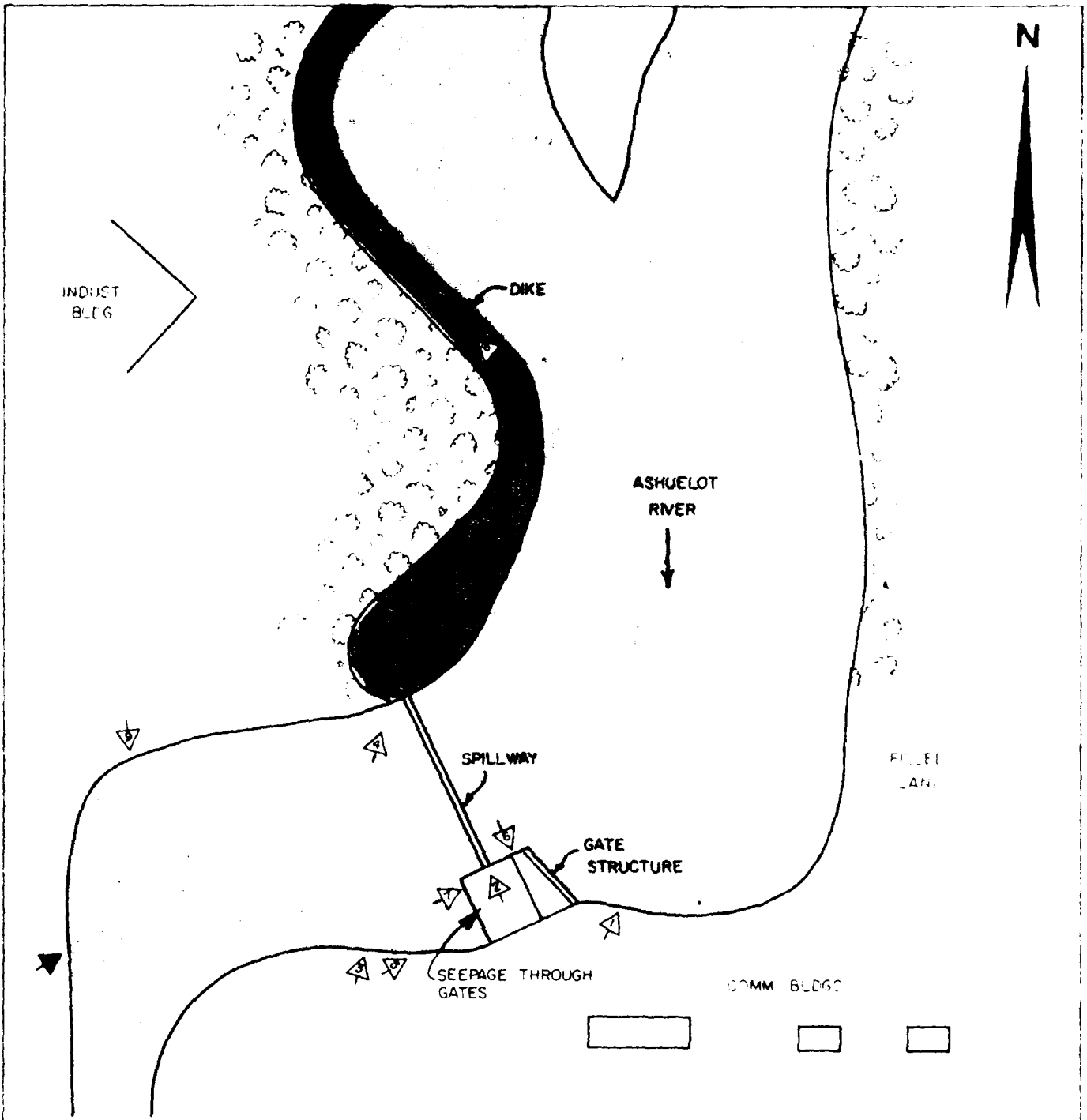
- 11. Average number of hours per day plant runs 8

- 12. Auxiliary power 325 H. P. steam

- 13. Storage reservoir or reservoir or storage at dam
Number 5 Total capacity Unknown

- 14. Date June 10, 1919. Prepared by M. R. Stackpole

APPENDIX C
PHOTOGRAPHS



GOLDBERG ZOINO & ASSOCIATES, INC.
 GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
 NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
 CORPS OF ENGINEERS
 WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO LOCATION PLAN

ASHUELOT RIVER DAM		KEENE, NEW HAMPSHIRE	
		SCALE	SCHEMATIC
		DATE	OCT 1980

FILE NO 2605



1. Reservoir Area From Left Abutment



2. Spillway Crest From Left Abutment



3. Downstream Left End of Spillway Showing Portion of Gate Structure at Left Abutment



4. Right Abutment and Endwall From Downstream Side



5. Gate Structure From Downstream Side - Note Concrete Slabs Placed on Bank for Slope Protection



6. Gate Control Mechanisms - Note Missing Stem on Middle Gate



7. Interior of Sluiceway Nearest the Spillway - Note Seepage Through Masonry



8. Crest of Dike Along Right Bank of Upstream Channel

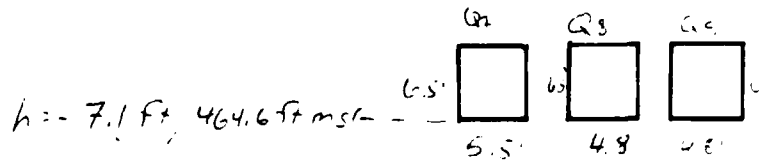
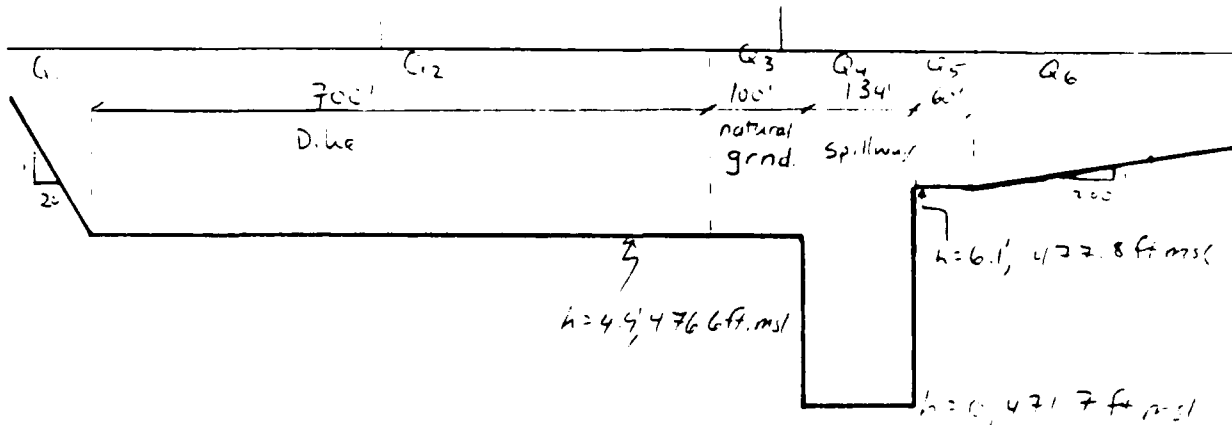


9. Downstream Channel

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Ashuelot River Dam

The elevation of the Ashuelot River Dam given below is based on field notes, FIS data, and USGS Quad Sheet information. The sketch is looking upstream at the dam from below.



Stage-Discharge Curve

For the calculations of the dam's stage-discharge curve the three gates, which appear to be inoperable, will be assumed to be closed.

Thus, $Q_7 = Q_8 = Q_9 = 0$ for all water surface elevations.

for $0 \leq h \leq 4.9$

$$Q_2 = Q_3 = Q_4 = Q_5 = Q_6 = 0$$

$$Q_1 = 3.0 (134) (h)^{3/2}$$

C = 3.0 for a
broad-crested
concrete weir

for $4.9 \leq h \leq 6.1$

$$Q_1 = 2.8 (20) (h-4.9) (.5(h-4.9))^{3/2}$$

$$Q_2 = 2.8 (700) (h-4.9)^{3/2}$$

$$Q_3 = 2.8 (100) (h-4.9)^{3/2}$$

all others unchanged

C = 2.8 for a
broad-crested
concrete weir

for $h \geq 6.1$

$$Q_5 = 2.8 (60) (h-6.1)^{3/2}$$

$$Q_6 = 2.8 (200) (h-6.1) (.5(h-6.1))^{3/2}$$

All others unchanged

Tailwater Submergence

At high flows the tailwater on the Ashuelot River submerges the spillway at Ashuelot River Dam. This tailwater submergence reduces flow over the spillway. The Bureau of Reclamation's Design of Small Dams, figure 254, gives a plot of the reduction factor for an ogee spillway. Reduction for a broad-crested weir is similar. The reduction depends on H_2/H , with H_2 and H defined as in this sketch:

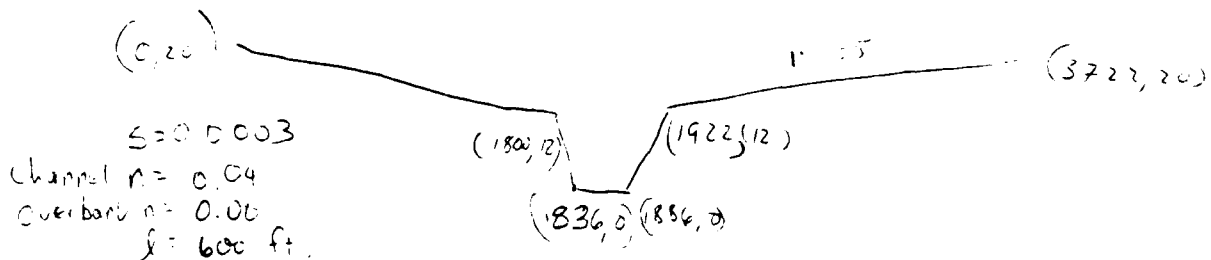


The relationship in Figure 254 for the reduction factor, C_1 , can be approximated as:

$$C_1 = 1.0 \text{ for } H_2/H \geq 0.7$$

$$C_1 = 1.063 - .04096 (H/H_2) \text{ for } 0.15 \leq H_2/H \leq 0.7$$

$H_2 = H - H_1$, where H is determined from linear interpolation from the stage-discharge curve for the Ashuelot River for the first 600 feet downstream of the dam. This section is shown below:



The stage vs. normal flow relationship for this reach is given on the next page. This yields the values for H_1 vs. Flow as shown on Page D-10.

==== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft ²	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	53.0	56.3	0.9	50.9	32.8
2.00	2.0	112.0	62.6	1.8	165.0	106.4
3.00	3.0	177.0	69.0	2.6	331.8	214.1
4.00	4.0	248.0	75.3	3.3	549.0	354.2
5.00	5.0	325.0	81.6	4.0	816.5	526.8
6.00	6.0	408.0	87.9	4.6	1134.9	732.3
7.00	7.0	497.0	94.3	5.3	1505.5	971.4
8.00	8.0	592.0	100.6	5.9	1929.7	1245.1
9.00	9.0	693.0	106.9	6.5	2409.1	1554.4
10.00	10.0	800.0	113.2	7.1	2945.4	1900.4
11.00	11.0	913.0	119.6	7.6	3540.3	2284.3
12.00	12.0	1032.0	125.9	8.2	4195.6	2707.1
13.00	13.0	1379.0	137.9	8.8	4968.2	3322.3
14.00	14.0	1776.0	152.9	9.4	5822.2	4243.1
15.00	15.0	2233.0	170.9	10.0	6825.6	5631.2
16.00	16.0	2767.0	192.9	10.7	8025.6	7619.7
17.00	17.0	3384.0	223.9	11.5	9425.6	10327.3
18.00	18.0	4091.0	262.9	12.5	11025.6	13862.6
19.00	19.0	4908.0	310.9	13.9	12925.6	18327.4
20.00	20.0	5848.0	370.9	15.4	15025.6	23817.8

```

LIST
100 REM - STAGE/DISCHARGE CURVE FOR ASHUELOT RIVER DAM
110 REM - STORED ON TAPE B-1 FILE 16
120 PAGE
130 DIM H9(9),O9(9)
140 REM - H9 VS. O9 = STAGE ABOVE S/W VS. FLOW
150 READ H9,O9
160 DATA 0,0.3,1.3,2.3,3.3,4.3,5.3,6.3,7.3,2169,2284,2707,3322,4243,5631
170 DATA 7620,10327,13863
180 C1=1
190 PRINT USING 200:
200 IMAGE 10T"STAGE VS. DISCHARGE RELATIONSHIP FOR ASHUELOT RIVER DAM"
210 PRINT USING 220:
220 IMAGE / 6T"HEAD C1" 30T"DISCHARGE"
230 PRINT USING 240:
240 IMAGE 1T"(FT. ABOVE S/W)"32T"(CFS)"
250 PRINT USING 260:
260 IMAGE 24T "TOTAL SPILLWAY DIKE LEFT BANK RIGHT BANK "
270 FOR H=0 TO 6 STEP 0.25
280 O1=0
290 O2=0
300 O3=0
310 O4=0
320 O5=0
330 O6=0
340 O4=3*134*H↑1.5
350 IF H<=4.9 THEN 420
360 O1=2.8*20*(H-4.9)*(0.5*(H-4.9))↑1.5
370 O2=2.8*700*(H-4.9)↑1.5
380 O3=2.8*100*(H-4.9)↑1.5
390 IF H<=6.1 THEN 420
400 O5=2.8*60*(0.5*(H-6.1))↑1.5
410 O6=2.8*200*(H-6.1)*(0.5*(H-6.1))↑1.5
420 T1=05+06
430 T2=01+02

```

```

440 T3=04+T1+T2+03
450 IF 04<=09(1) THEN 470
460 GOSUB 520
470 PRINT USING 480,H,C1,T3,04,T2,03,T1
480 IMAGE 6D,2D,8D,2D,8D,9D,9D,10D,13D
490 NEXT H
500 END
510 REM - SUBROUTINE TO ACCOUNT FOR SPILLWAY SUBMERGENCE
520 C1=1
530 I1=0
540 REM - 04=SPILLWAY FLOW
550 04=C1*3*134*H↑1.5
560 C2=C1
570 REM - T3=TOTAL FLOW
580 T3=04+T1+T2+03
590 I1=I1+1
600 REM - LINES 600 TO 670 ESTABLISH H1 BY LINEAR INTERPOLATION OR
610 REM - EXTRAPOLATION FROM FLOW VS. D/S STAGE DATA
620 FOR K=2 TO 9
630 IF 09(K)>T3 THEN 670
640 NEXT K
650 H1=H9(9)+(H9(9)-H9(8))*(T3-09(9))/(09(9)-09(8))
660 GO TO 680
670 H1=H9(K-1)+(H9(K)-H9(K-1))*((T3-09(K-1))/(09(K)-09(K-1)))
680 H2=H-H1
690 IF H2/H>0.7 THEN 760
700 REM - C1 IS THE REDUCTION FACTOR
710 C1=1.063-0.04096*H/H2
720 04=04*C1/C2
730 IF I1<=15 THEN 550
740 T3=04+T1+T2+03
750 RETURN
760 C1=1
770 RETURN

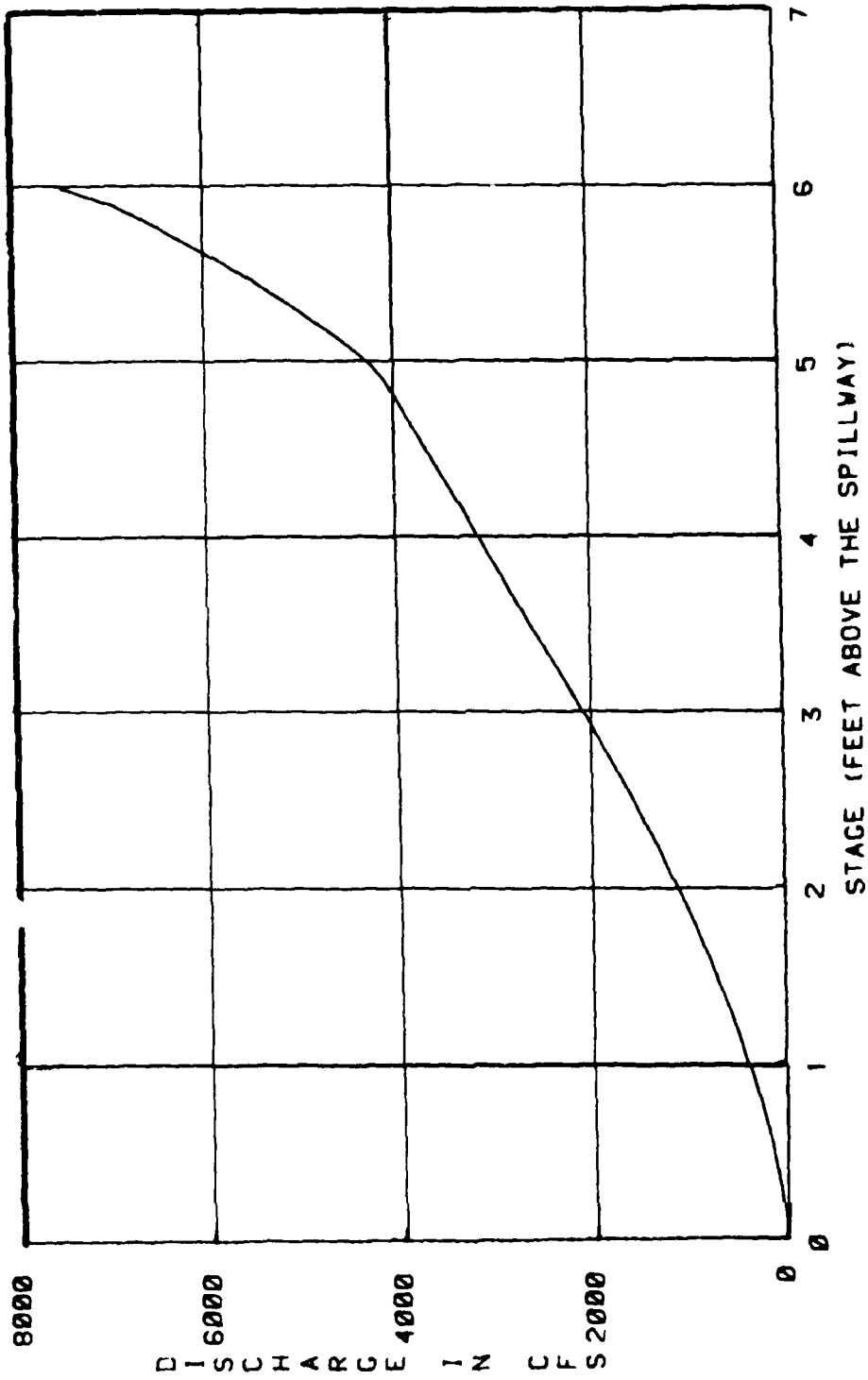
```

STAGE VS. DISCHARGE RELATIONSHIP FOR ASHUELOT RIVER DAM

HEAD (FT. ABOVE S/W)	C1	TOTAL	DISCHARGE (CFS) SPILLWAY	DIKE	LEFT BANK	RIGHT BANK
0.00	1.00	0	0	0	0	0
0.25	1.00	50	50	0	0	0
0.50	1.00	142	142	0	0	0
0.75	1.00	261	261	0	0	0
1.00	1.00	402	402	0	0	0
1.25	1.00	562	562	0	0	0
1.50	1.00	739	739	0	0	0
1.75	1.00	931	931	0	0	0
2.00	1.00	1137	1137	0	0	0
2.25	1.00	1357	1357	0	0	0
2.50	1.00	1589	1589	0	0	0
2.75	1.00	1833	1833	0	0	0
3.00	1.00	2089	2089	0	0	0
3.25	1.00	2355	2355	0	0	0
3.50	1.00	2638	2638	0	0	0
3.75	0.99	2894	2894	0	0	0
4.00	0.98	3152	3152	0	0	0
4.25	0.97	3413	3413	0	0	0
4.50	0.96	3687	3687	0	0	0
4.75	0.95	3962	3962	0	0	0
5.00	0.94	4295	4224	62	9	0
5.25	0.92	4901	4436	407	58	0
5.50	0.88	5602	4555	916	130	0
5.75	0.84	6421	4652	1549	219	0
6.00	0.83	7505	4895	2286	323	0

0

STAGE-DISCHARGE CURVE FOR THE ASHUELOT RIVER DAM



<u>Stage D/S of spillway (ft.)</u>	<u>H₁ (Height above spillway) = Stage-10.7</u>	<u>Flow (cfs)</u>
10	-0.7	1900
10.7	0	2169
11	0.3	2284
12	1.3	2707
13	2.3	3322
14	3.3	4243
15	4.3	5631
16	5.3	7620
17	6.3	10327
18	9.3	13863

If $H_1 \leq 0$, ($Q < 2170$ cfs) there is no reduction (tailwater is below the spillway).

If $H_1 > 0$, the reduction factor applies. A BASIC subroutine to calculate the reduction factor, C_1 , is in the program which calculates the Stage-Discharge relationship for the dam. The stage-discharge relationship in the program would not be valid for flows above 15000 cfs, since at that point the spillway submergence would be so great ($\frac{H_2}{H} \leq 0.15$) that the approximation $C_1 = 1.063 - .04096 \frac{H}{H_2}$ would not be valid.

Stage-Storage Curve

The storage at the spillway crest for the Ashuelot River Dam can be estimated from data available from FIS work, assuming:

$$\text{Storage} = \frac{\text{Depth at spillway}}{2} (\text{length of pool}) (\text{pool width})$$

Depth at spillway = 7 ft. just upstream the dam length of pool = 15,000 ft. until channel bottom is at spillway level. Pool width = 100 ft.

$$\text{Storage} = \left(\frac{7'}{2}\right) (100') \frac{1 \text{ ac-ft.}}{43560 \text{ ft}^3} = 120 \text{ ac. ft.}$$

The surface area of the pond upstream of the dam can be estimated similarly:

$$\begin{aligned} \text{SURFACE AREA} &= (\text{length of pool}) (\text{Width}) = (15000') (100') \frac{1}{43560} \\ &= 34.4 \text{ acres} \end{aligned}$$

Assuming this surface area of 34.4 acres and no spreading as the pond rises:

$$\text{Surcharge storage} = 34.4 \text{ h}$$

$$\text{Total Storage} = 120 + 34.4h$$

For the drainage area of 113 square miles,

$$1" \text{ of runoff} = \frac{113 \left(620 \left(\frac{\text{Ac.}}{\text{sq. mi.}} \right) (1") \right)}{12"/\text{Ft.}} = 6027 \text{ ac-ft.}$$

$$1 \text{ ac-ft.} = \frac{1}{6027} = 0.000166" \text{ of runoff}$$

Surcharge storage to the dam crest = 120 + 169 = 280 ac ft.

The stage-storage curve is given on the next page.

Dam Failure Analysis

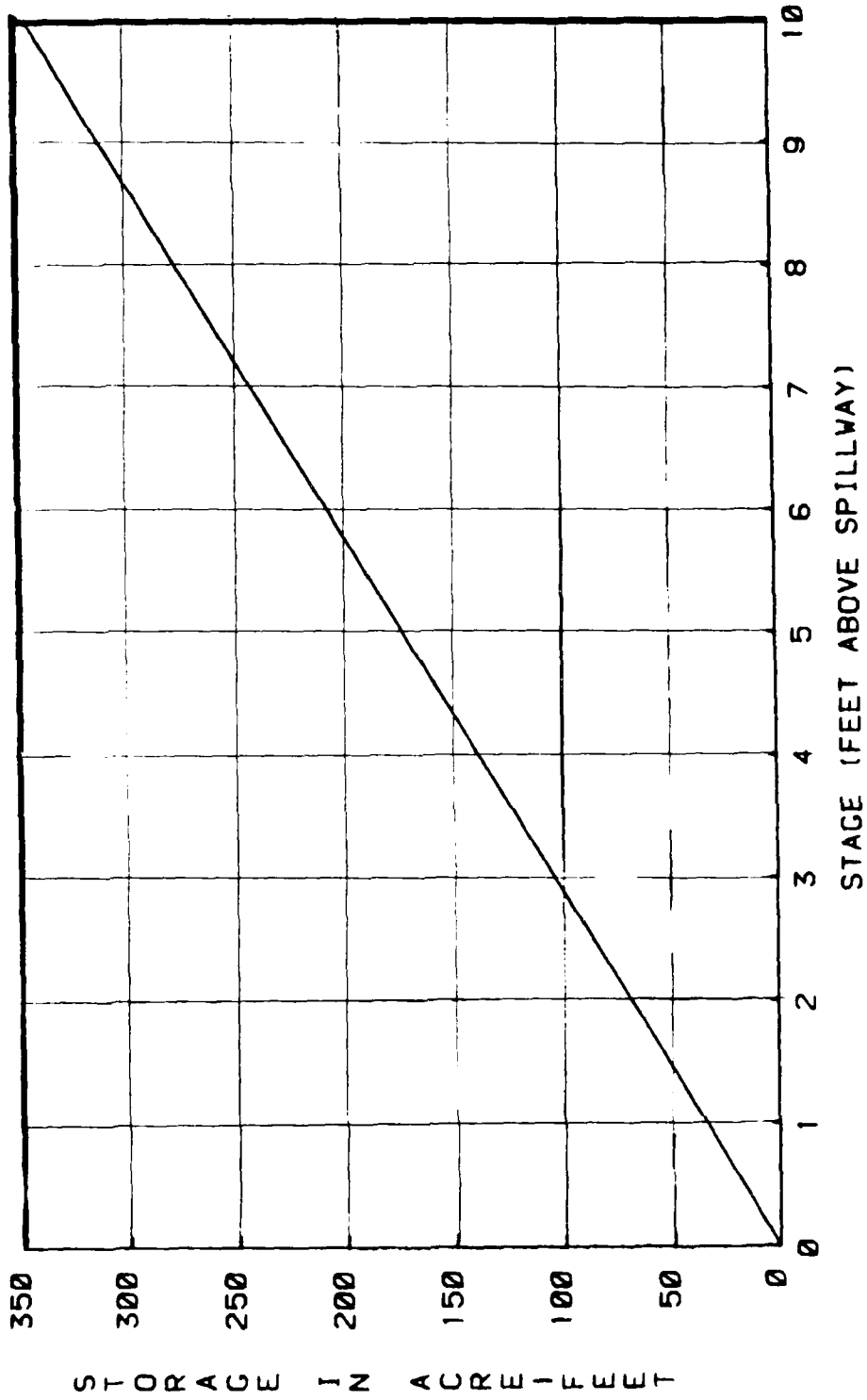
Assume failure when the dam overtops the right abutment and dike,
at $h = 4.9$, 476.6 ft. MSL.

Normal outflow = 4170 cfs

This outflow is significantly greater than the 500 year flow adopted for the Flood Insurance Study, which was 2860 cfs. Based on the FIS results it was determined that 4170 cfs would create considerable flooding downstream, and would cause a tailwater of 13.9 feet at the dam - 3.2 feet above the spillway crest. This would also cause a:

$$\frac{13.9}{10.7 + 4.9} = \frac{13.9}{15.6} = 89.1\%$$

STAGE-SURCHARGE STORAGE CURVE FOR ASHUELOT RIVER DAM



submergence of the dam at failure, which would greatly reduce failure outflow of the main dam. The storage above tailwater at failure would be:

$$(15.6 - 13.9) (34.4 \text{ ac}) = 58.5 \text{ ac-ft.}$$

There are two potential failure modes for Ashuelot River Dam. The main dam might fail, or the 1700 foot dike along the west bank of the Ashuelot River might fail.

Ignoring the reduction in peak flow caused by submergence:

$$\text{Main dam: } Q_{p1} = \frac{8}{27} \sqrt{g} W_b Y_o^{\frac{3}{2}}$$

$$Y_o = \text{Depth above stream invert} = 10.7 + 4.9 = 15.6 \text{ ft.}$$

$$W_b = .4 (\text{width at half height}) = .4(150) = 60 \text{ ft.}$$

$$Q_{p1} = \frac{8}{27} \sqrt{32.2} (60) (15.6)^{\frac{3}{2}} = 6220 \text{ cfs}$$

$$\text{Dike: } Q_{p1} = \frac{8}{27} \sqrt{g} W_b Y_o^{\frac{3}{2}}$$

$$Y_o = 5 \text{ ft.}$$

$$W_b = .4 (700) = 280 \text{ ft.}$$

$$Q_{p1} = \frac{8}{27} \sqrt{32.2} (280) (5)^{\frac{3}{2}} = 5260 \text{ cfs}$$

The failure flow from the main dam would be significantly reduced by tailwater submergence. The tailwater depth at the pre-failure flow of 4170 cfs would be 13.9 ft, 80% of the failure height. In their work on a similar (though not identical) case, Martin & Zovne established a reduction coefficient for peak failure flow of 0.181 (Martin & Zovne, "Finite-Difference Simulation of Bore Propagation," ASCE Journal of Hydraulics Division, July 1971).

Thus, an estimate of peak flow resulting from main dam failure would be $0.181 (6220) = 1130$ cfs. We will take the 5260 cfs flow increment caused by dike failure as the critical case.

$$\text{Peak failure flow} = Q_{pi} + \text{Normal Flow} = 5260 + 4170 = 9430 \text{ cfs}$$

The flow from the dike failure would rejoin the Ashuelot River mainstem within 200 feet, upstream of the West Street bridge. The flow of 9430 cfs would increase the stage from 13.9 feet to 16.7 feet in this reach. (The stage-discharge curve is given on p. D-9). The West Street bridge invert is 12.5 feet above the channel bottom, so the bridge might be damaged by pre-failure flows. The increment of 2.8 feet caused by dam failure could cause further damage to the structure. Upstream of West Street Bridge the factories and stores along the river are out of reach of the dam failure floodwave.

Downstream of West Street in this same reach there are about 4 houses on the west bank of the Ashuelot River about 15 feet above the channel bottom. The failure of Ashuelot River Dam would cause flooding of 2 to 3 feet at these houses. Due to the relatively shallow flooding and low flow rates, there would be little chance of loss of life at these houses.

The stage vs. normal flow relationship for the 600 foot reach from West Street bridge to the Cheshire R.R. bridge are given on Page D-5. The attenuation in this reach is calculated on the next two pages. The flow would attenuate a great deal in this short reach, due to the small storage released by dam failure and the extensive flood plain in the Ashuelot. At the downstream end of the reach the attenuated peak flow would be 6400 cfs creating a stage of 15.4 feet.

The Cheshire Railroad bridge, which crosses the Ashuelot River at this point, is about 13.5 feet above the channel, so the prefailure stage of 13.9 would cause little damage. The 1.5 foot increase might cause some damage to the structure.

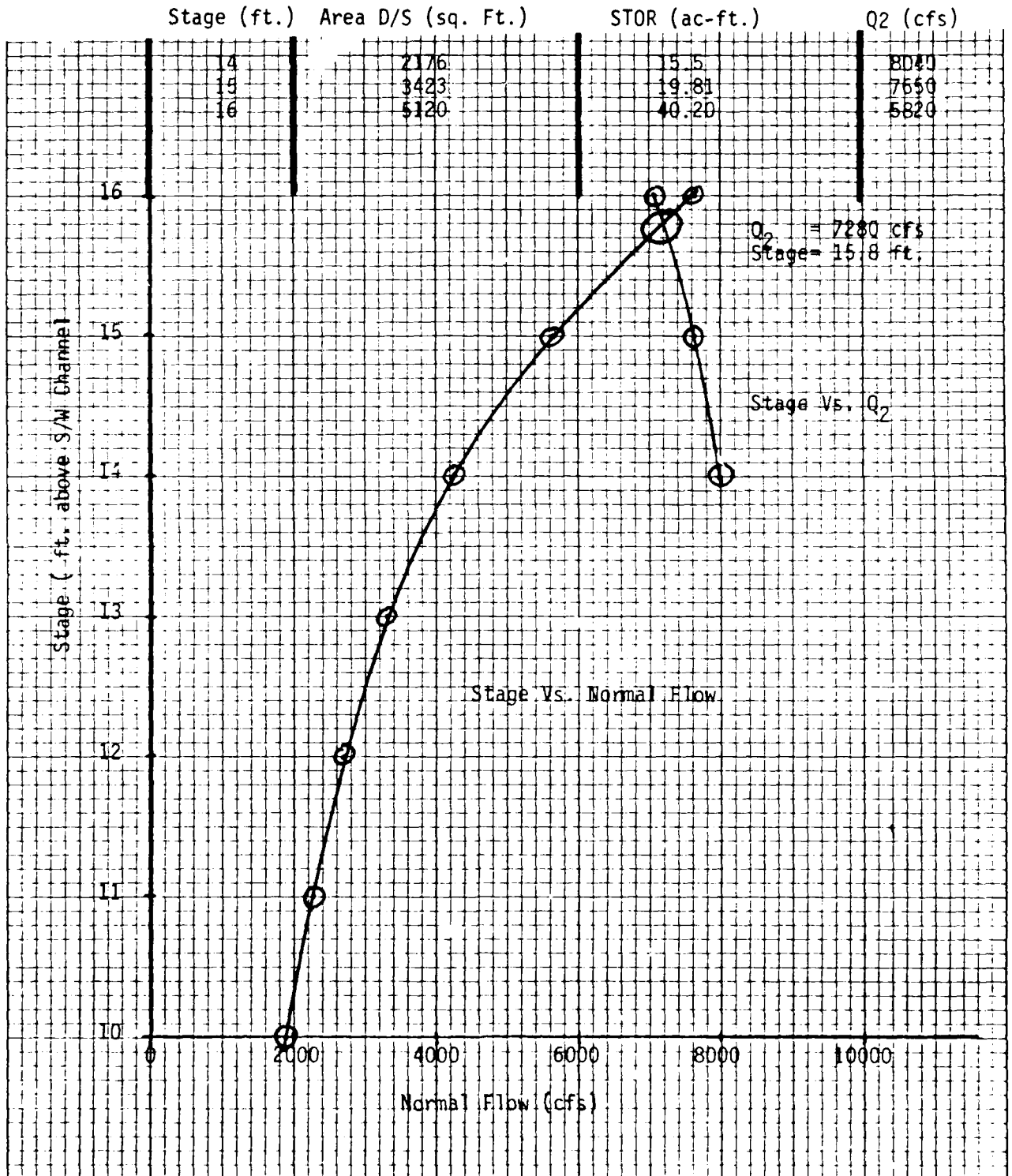
Just downstream of this bridge is a large warehouse 10-12 feet above the stream channel. The channel section in this area is shown on Page D-19.

Attenuated Peak Dam Failure Flow 300' D/S of West Street

$$Q_2 = \text{pre-failure flow} + Q_{p1} \left(\frac{\text{Reach Storage}}{\text{Dam Storage Released by Failure}} \right) = 4170 + 5260$$

$$\left(1 - \frac{\text{STOR}}{58.5} \right) \text{STOR} = \left(\frac{\text{Post Failure area U/S} + \text{area D/S} - \text{pre-failure area}}{2} \right) (\text{length})$$

$$= \left(\frac{6555 + \text{Area D/S}}{2} - 2113 \right) (300) \left(\frac{1}{43500} \right)$$

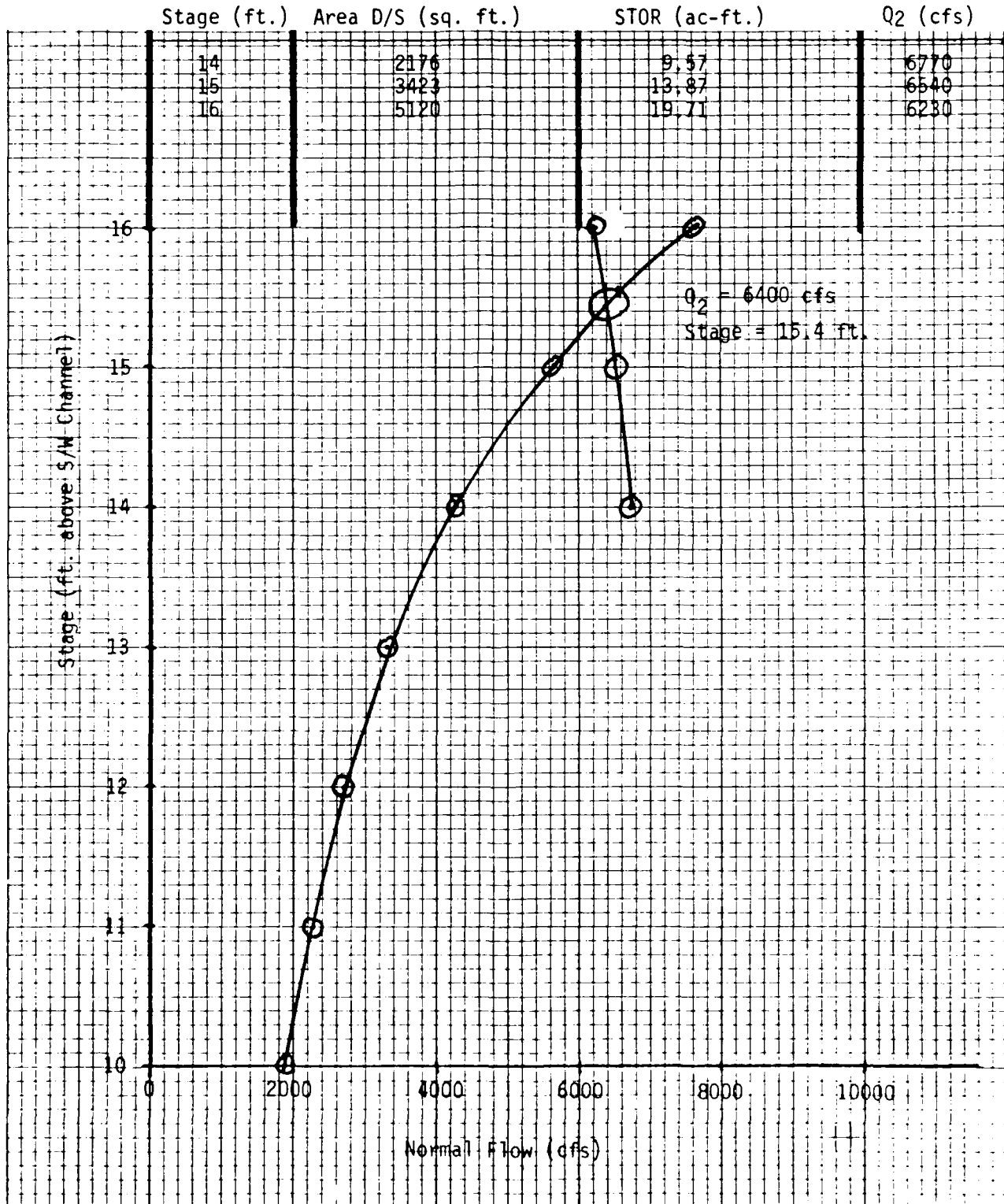


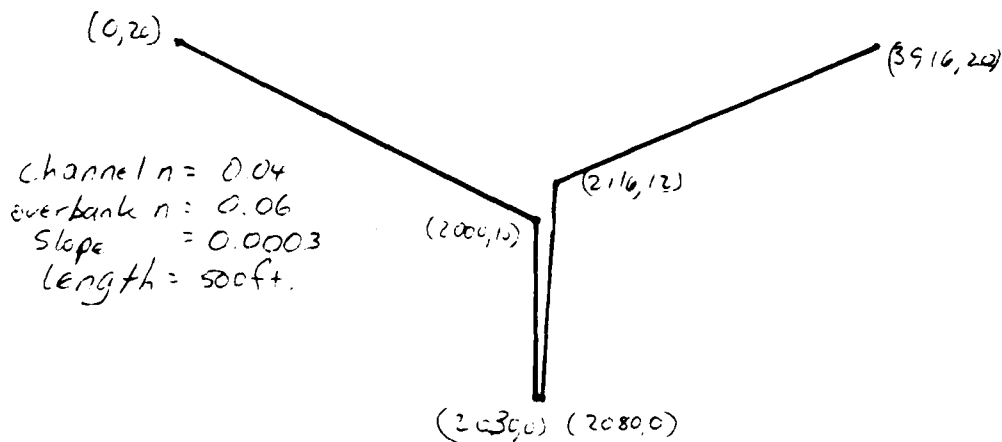
Attenuated Peak Dam Failure Flow at Cheshire R.R. Bridge

$$Q_2 = \text{pre-failure flow} + Q_{pi} \left(1 - \frac{\text{Reach Storage}}{\text{storage released by failure}} \right) = 4170 +$$

$$3110 \left(1 - \frac{\text{STOR}}{53.5} \right) \text{STOR} = \left(\frac{\text{Post failure area U/S} + \text{Area D/S}}{2} - \text{pre-failure area} \right) (\text{length})$$

$$= \left(\frac{3830 + \text{Area D/S}}{2} - 2113 \right)^2 (300) \left(\frac{1}{43500} \right)$$





The stage versus normal flow relationship for this reach is given on the next page. The pre-failure flow of 4170 cfs would cause a stage of 13.6 feet in this reach, and 2-4 feet of flooding at the warehouse. The dam failure flow of 6400 cfs would increase the stage by 1.0 feet to 14.6 feet, increasing flooding at the warehouse. Due to the pre-existing flooding and the small increment to flooding, the threat to life at this location would be small.

Downstream of the Cheshire R.R. Bridge the Ashuelot runs 1950 feet to the Island Street Bridge. For the first 1000 feet of this reach there is little development near the river, with more than 10 houses about 15 feet above the stream in the next 950 feet down to the bridge. Due to the small amount of storage released by the failure of Ashuelot River Dam, and the extensive flood plain of the Ashuelot River in this area, dam failure flows would be largely attenuated in the

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft ²	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	53.0	56.3	0.9	50.9	32.8
2.00	2.0	112.0	62.6	1.8	165.0	106.4
3.00	3.0	177.0	69.0	2.6	331.8	214.1
4.00	4.0	248.0	75.3	3.3	549.0	354.2
5.00	5.0	325.0	81.6	4.0	816.5	526.8
6.00	6.0	408.0	87.9	4.6	1134.9	732.3
7.00	7.0	497.0	94.3	5.3	1505.5	971.4
8.00	8.0	592.0	100.6	5.9	1929.7	1245.1
9.00	9.0	693.0	106.9	6.5	2409.1	1554.4
10.00	10.0	800.0	113.2	7.1	2945.4	1900.4
11.00	11.0	1011.5	116.4	7.7	3546.2	2346.2
12.00	12.0	1426.0	119.6	8.3	4219.3	2846.7
13.00	13.0	2154.5	122.6	8.9	4955.0	3454.8
14.00	14.0	3308.0	125.6	9.4	5755.0	4183.4
15.00	15.0	4886.5	128.6	10.0	6628.4	5066.1
16.00	16.0	6890.0	131.6	10.6	7581.7	6017.6
17.00	17.0	9318.5	134.6	11.2	8624.2	7042.4
18.00	18.0	12172.0	137.6	11.8	9757.7	8137.6
19.00	19.0	15450.5	140.6	12.4	10982.5	9294.7
20.00	20.0	19154.0	143.6	13.0	12307.7	10550.9

STAGE VERSUS NORMAL FLOW - ASHUELOT RIVER @ FACTORY D/S OF WEST STREET

AD-A156 374

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
ASHUELOT RIVER DAM (N..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV DEC 80

3/2

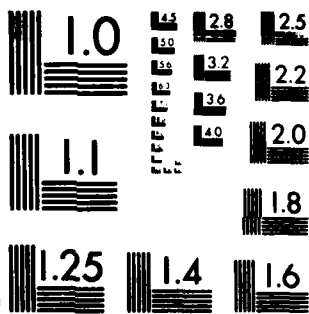
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8 '85



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

undeveloped first 1000 feet of this reach. The pre-failure flow would cause significant flooding downstream, but dam failure would add only a small additional increment to flooding.

The tables on the next page summarizes the downstream effects of the failure of the Ashuelot River Dam.

Test Flood Analysis

Size Classification SMALL (Storage 50-1000 ac-ft.; height less than 40 ft.)

Hazard Classification SIGNIFICANT (based on economic damages and possible loss of a few lives at 4 houses d/s of West Street; West Street Bridge; Cheshire R.R. Bridge; and factory near Cheshire R.R. Bridge.

According to the "Recommended Guidelines," the hazard classification and dam size indicate a test flood between the 100-year and $\frac{1}{2}$ PMF. Since the hazard classification is on the high side of significant, we will use a test flood equal to the $\frac{1}{2}$ PMF flow. The prior Flood Insurance Study for Keene develops a 500 year flood, and this has been taken to approximate the $\frac{1}{2}$ PMF. The Flood Insurance findings indicate a peak flow of 2860 cfs for this event which represents the uncontrolled tributary inflow from the 13 square mile area contributing to the River below the Corps of Engineer's Surry Mountain Dam (D.A. = 101 sq. mi.).

The $\frac{1}{2}$ PMF flood flow of 2860 cfs includes the effects of attenuation in the Ashuelot River Dam pool, which would be negligible for a basin this large. Therefore, the test flood outflow is 2860 cfs, and would create a

peak stage of 475.4 ft. MSL; 3.7 ft. above the spillway crest, 1.2 feet below the dike and right abutment crest, and 2.4 feet below the left abutment crest.

Location	Number Location (see map)	Distance D/S from Dam (ft)	# of Structures	Level Above Stream (ft.)	Flow & Stage Before Failure	After Failure	Comments
Just D/S of Dam	-	-	-	-	4170 cfs 13.9 ft.	9430 cfs 16.7 ft.	-
West Street	-	500	bridge 4 houses	12.5	4170 cfs 13.9 ft.	9430 cfs 16.7 ft.	possible damage to West St. Bridge; 2-3 ft. of flooding at houses.
Cheshire R.R.	1	1100	bridge	13.5	4170 cfs 13.9 ft.	6400 cfs 15.4 ft.	Possible damage to bridge.
D/S of Cheshire R.R.	1	1100	factor	10-12	4170 cfs 13.6 ft.	6400 cfs 14.6 ft.	Increase to flooding.
D/S	-	-	-	-	-	-	Ashuelot River's extensive flood plain would rapidly attenuate flood flows. Next development on river 1000 ft. D/S.



- SCALE -
1:250,000

FROM USGS GLEN FALLS & ALBANY - N.Y.
QUADRANGLE MAPS

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CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

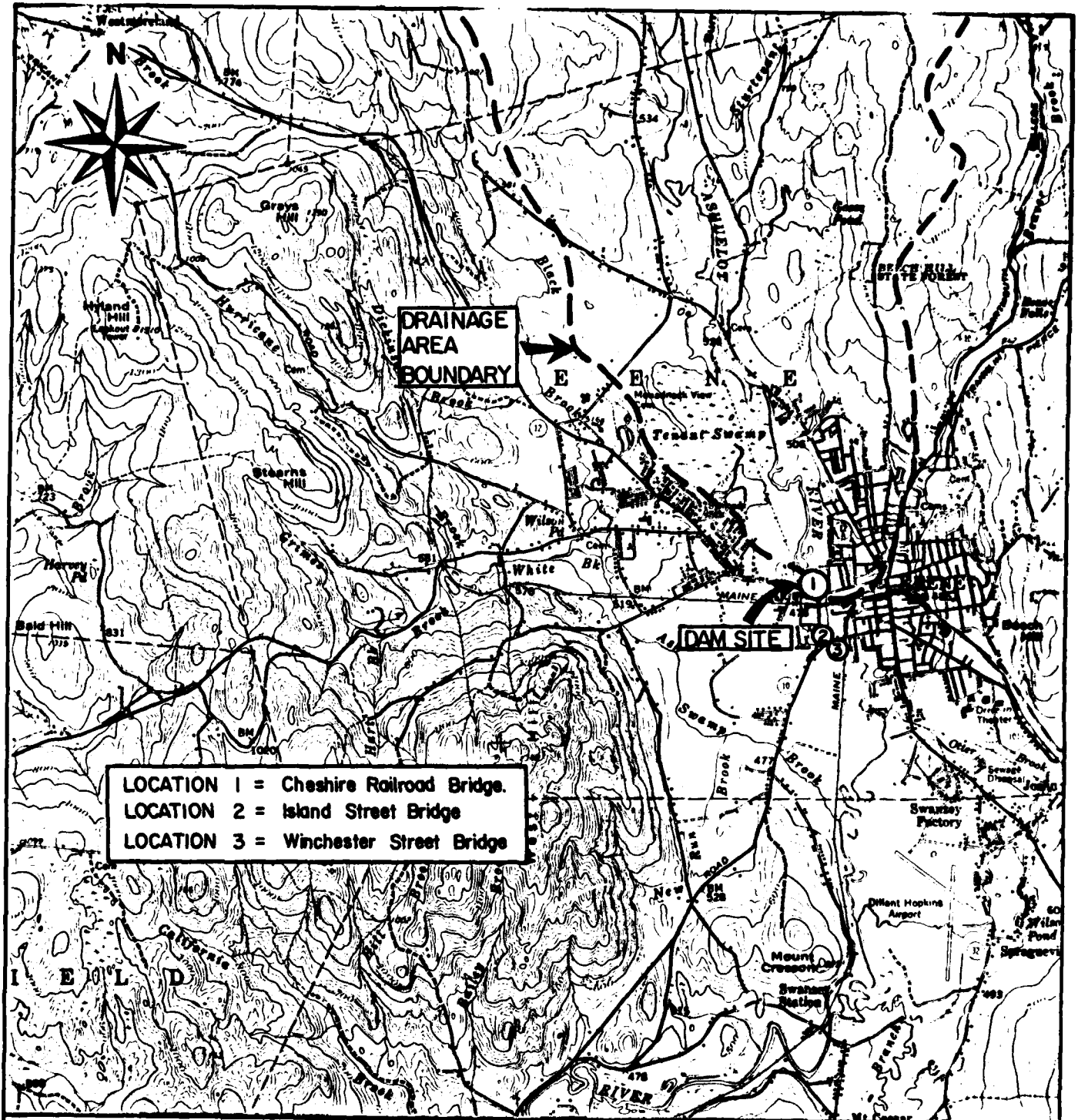
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
LOCATION AND DRAINAGE
AREA MAP

FILE No 2605

ASHUELOT RIVER DAM

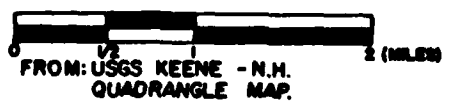
KEENE, NEW HAMPSHIRE

SCALE AS SHOWN
DATE OCT 1980



LOCATION 1 = Cheshire Railroad Bridge.
 LOCATION 2 = Island Street Bridge
 LOCATION 3 = Winchester Street Bridge

- SCALE -



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NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

DOWNSTREAM HAZARD MAP

FILE No. 2803

ASHUELOT RIVER DAM

KEENE, NEW HAMPSHIRE

SCALE AS SHOWN

DATE OCT. 1980

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

IDENTITY NUMBER	DIVISION	STATE	COUNTY	CENSUS DIST.	NAME	LONGITUDE (WEST)	LATITUDE (NORTH)	REPORT DATE
100	05	05	05	05	ASHUELLOT RIVER DAM	72 17 W	25 00 N	10 NOV 60

POPULAR NAME	NAME OF IMPROVEMENT
ASHUELLOT RIVER	ASHUELLOT RIVER
REGION/BASIN	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE
01 A	KEENE
TYPE OF DAM	POPULATION
BGOT	0

YEAR COMPLETED	PURPOSES	HYDRAULIC HEIGHT (FEET)	IMPOUNDING CAPACITIES (ASBESTOS)
1919	R	16	220
		16	120

REMARKS

D/S HAS	SPILLWAY TYPE	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CUYD)	POWER CAPACITY (KW)	INSTALLED	PROPOSED	NAVIGATION LOCKS
2	160	134	2280				

OWNER	ENGINEERING BY
CITY OF KEENE	UNKNOWN
	CONSTRUCTION BY
	UNKNOWN

DESIGN	REGULATORY AGENCY
NH PSC	NH MRB
	OPERATION
	NH MRB
	MAINTENANCE
	NH MRB

INSPECTION BY	INSPECTION DATE
GOLDBERG ZOI NO & ASSOC INC	17 OCT 60
	DAY MO YR
	PL 92-367
	AUTHORITY FOR INSPECTION

REMARKS

DIST OWN FED K PRV/FED SCS A VER/DATE

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