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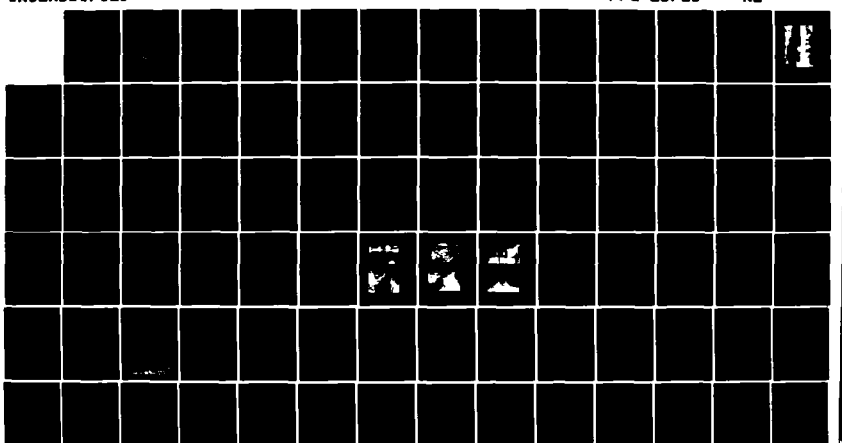

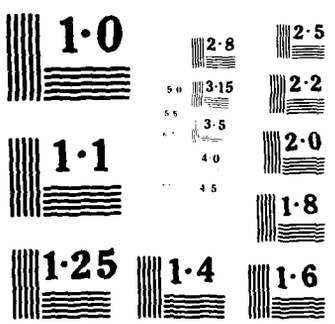

MEGUNTICOOK RIVER BASIN
CAMDEN, MAINE

KNOX MILL DAM
ME-00276

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

AUGUST 1978

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Megunticook River Basin
Camden, Maine
Megunticook River

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

The dam is a stone masonry gravity dam. It has concrete and earth wing walls. It is about 27 ft. high and has an overall length of about 650 ft. The dam is judged to be in good condition. There are areas of concern which must be corrected to improve the long-term safety of the dam. It is small in size with a hazard potential of high.

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

REPLY TO
ATTENTION OF:

NEDED

SEP 10 1973

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

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

A copy of this report has been forwarded to the Department of Agriculture and the Department of Transportation, cooperating agencies for the State of Maine. In addition, a copy of the report has also been furnished the owner, Camden Water & Power Co., 33 Mechanic Street, Camden, Maine 04843.

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, the Department of Agriculture and the Department of Transportation for your cooperation in carrying out this program.

Sincerely,

Max B. Scheiler

MAX B. SCHEILER
Colonel, Corps of Engineers

Incl
As stated

KNOX MILL DAM

ME-00276

MEGUNTICOOK RIVER BASIN

CAMDEN, MAINE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

ME-00276

KNOX MILL DAM

CAMDEN
KNOX COUNTY, MAINE

MEGUNTICOOK RIVER

July 18, 1978

BRIEF ASSESSMENT

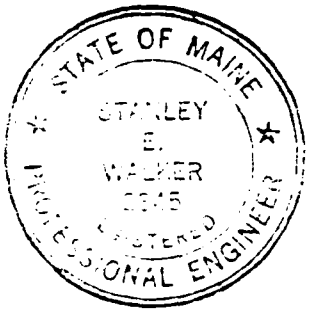
The Knox Mill Dam is a stone masonry, gravity dam. It has concrete and earth wing walls. The dam is about 27 feet high and has an overall length of about 650 feet.

Based on the visual inspection, and reports of past operational performance, the Knox Mill Dam is judged to be in good condition. There are, however, areas of some concern which must be corrected to improve the long-term safety of the dam.

Based on its small size and high hazard classification in accordance with the Corps of Engineers' guidelines, the test flood falls between 1/2 and 1 times the Maximum Probable Flood (MPF). The existing spillway will not pass a flow greater than approximately a 10-year flood without overtopping the dam. The spillway will carry only approximately 3.5 percent of the MPF and therefore the spillway capacity is seriously inadequate.

Maintenance and operational procedures as outlined in Section 7 should be implemented within 12 months. Investigations regarding modifications to the dam should be completed and implemented within 24 months after receipt of this report by the owner. A particular maintenance item is the reworking of the stone supporting the timber section of the north wing wall. Investigation should consider providing the south wing wall with an erosion resistance downstream support and increasing the spillway capacity by utilizing

designed-to-fail flashboards. The structure is reasonably resistant to distress caused by overtopping but it is recommended that a definite plan for around-the-clock surveillance by implemented for periods of unusually heavy rain or anticipated runoff and a formal warning system be developed for use should an emergency develop.



EDWARD C. JORDAN CO., INC.

Stanley E. Walker, P.E.
Project Manager

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

Charles G. Tiersch

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

Fred J. Ravens Jr

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

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

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 "Maximum Probable 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.

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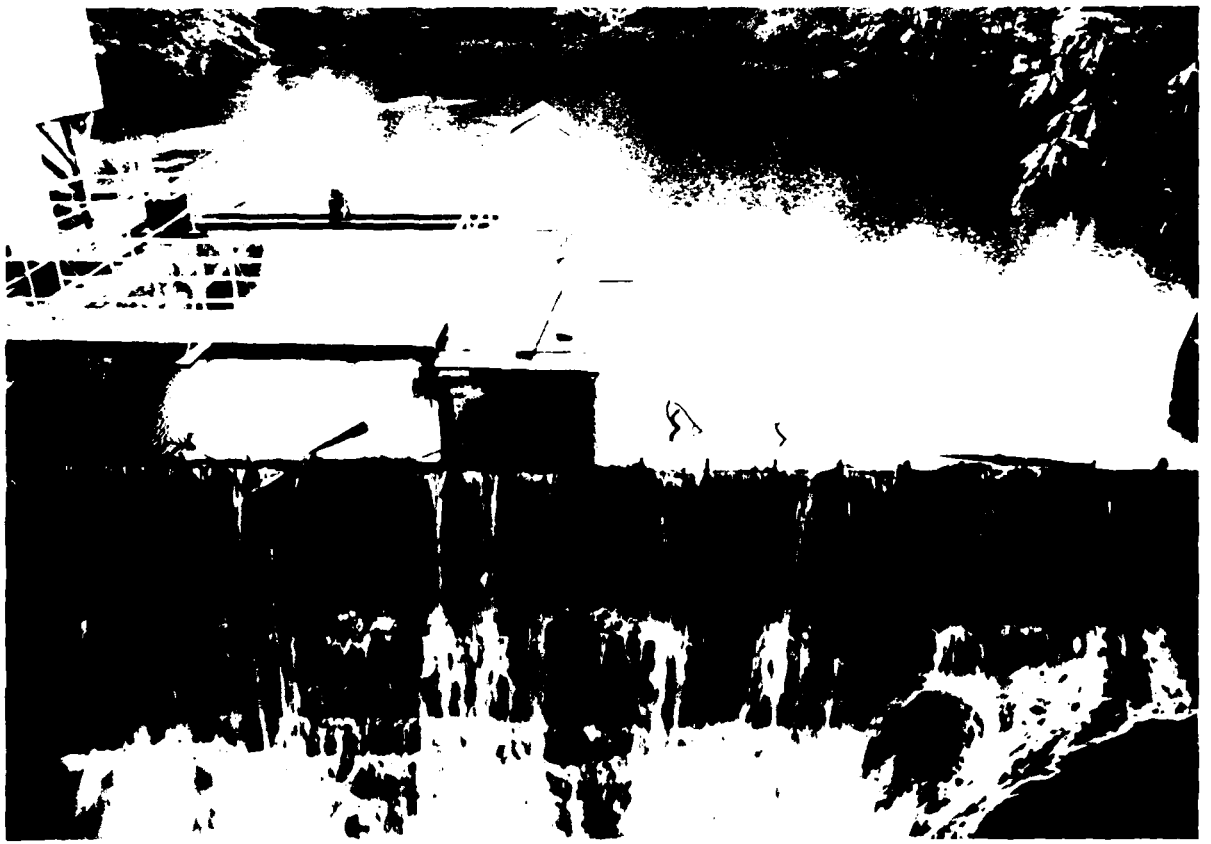
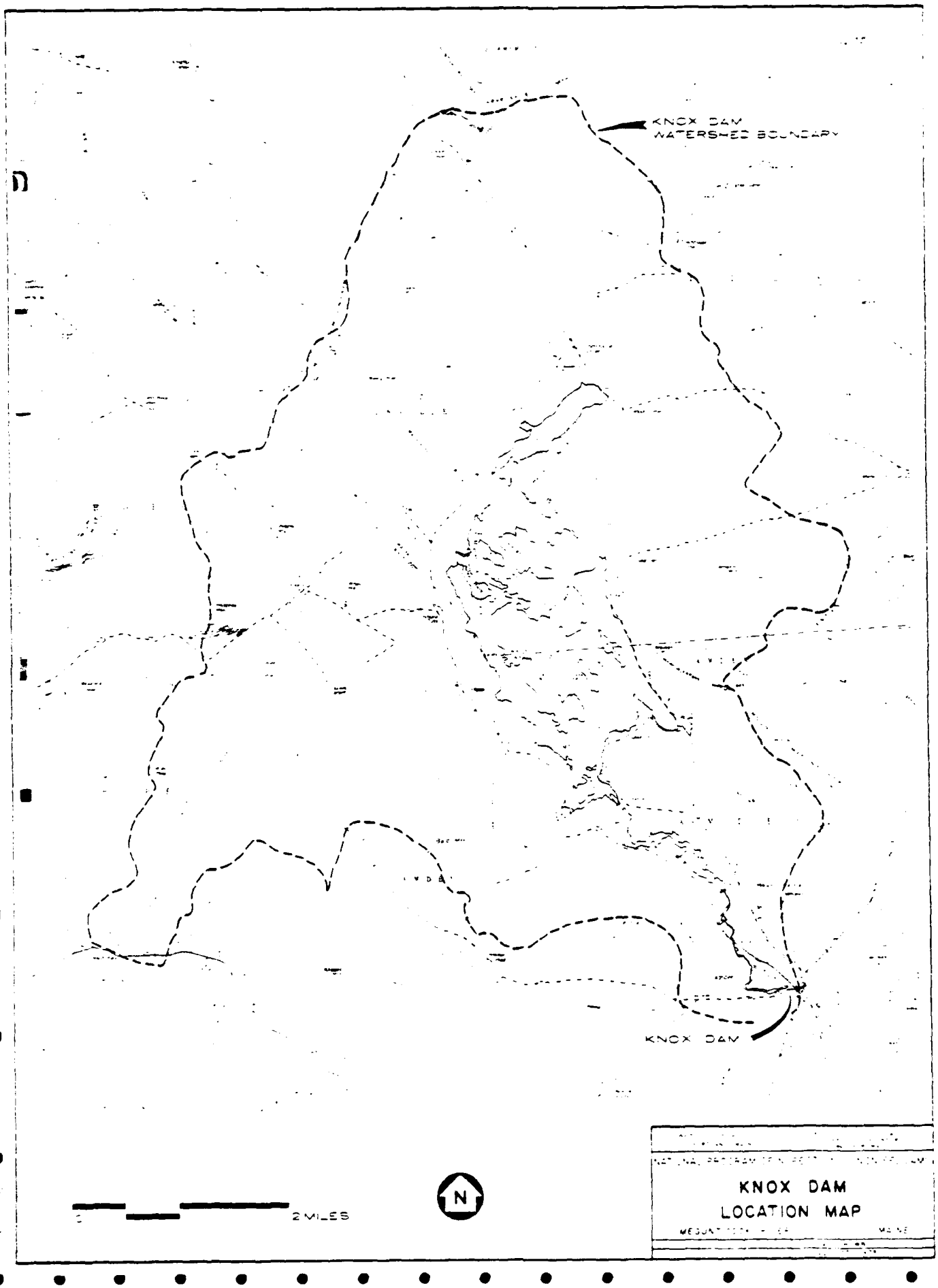




KNOX DAM
LOCATION MAP

PHASE I INSPECTION REPORT

KNOX DAM

SECTION 1

PROJECT INFORMATION

1.1 GENERAL

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Edward C. Jordan Co., Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Edward C. Jordan Co., Inc. under a letter of June 20, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0349 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

a. Location. The Knox Dam is located near the intersection of Washington and Mechanic Streets in the town of Camden, Maine N 44°-12'-30", W 69°-4'

b. Description of Dam and Appurtenances. The Knox Mill Dam is constructed of mortar-laid, cut stone masonry with a timber self loading spillway. The dam is located in a narrow valley in bedrock. A plan, profile, and x-sections are presented in Appendix B. The Knox Woolen Mill buildings occupy the area around both the north and south sides of the dam and over the river below the dam. The dam is about 23 feet high and has an overall length of about 650 feet.

c. Size Classification. Based on storage capacity the Knox Dam is classified as a small sized dam.

d. Hazard Classification. In the event of failure of the Knox Dam, the Knox Mill factory buildings about 20 feet downstream of the dam would be substantially damaged, and there would be a great chance for the loss of many lives in the factory, unless the employees had been evacuated prior to failure. Thus the Knox Dam is classified as having a high hazard potential.

e. Ownership: Camden Water & Power Co.
33 Mechanic Street
Camden, Maine 04843

The Camden Water and Power Company is an affiliate of Knox Woolen Mills Company.

f. Operator: Mr. David Stearns or
Mr. David Hardy
Knox Woolen Mills
33 Mechanic Street
Camden, Maine
Tel. 1-207-236-3368

g. Purpose of Dam. The dam stores and supplies process water to the Knox Woolen Mill and forms the head pond for a hydro-mechanical turbine.

h. Design and Construction History. Construction of the Knox Dam likely predates 1900. It was rebuilt in the late 1920's. There are no records available of its design or construction.

i. Normal Operating Procedures. The outlet gate at the Knox Dam is used only to allow maintenance of the dam and to facilitate passage of heavy runoff. The spillway has 1.5-foot long flashboard rods in its crest but only 12 inches of flashboards are used. The hydro-mechanical turbine draws about 100 cfs for about 8 hours daily, five days a week. Process water is also drawn from the pond daily.

1.3 PERTINENT DATA

a. Drainage Areas. The drainage area above Knox Dam is approximately 34.9 square miles and lies in portions of the Searsmont, Lincolnville, Hope and Camden townships. About 9 percent of the entire drainage area is storage at Seabright Pond, Megunticook Lake and Norton, Levenseller, Moody, Hobbs and Fish Ponds. The watershed has a rolling topography varying in elevation from about 27 feet to about 1100 feet.

b. Discharge at Damsite. No records of high water could be located. Therefore, maximum known flood height at the dam could not be determined.

(1) Outlet works (conduit) - size 32 inches in width by 56 inches in height and upstream invert elevation of about 37 feet and a downstream invert elevation of about 28 feet. The gate was successfully operated during the visual inspection of July 18, 1978.

(2) The maximum discharge at the damsite is unknown.

(3) The ungated spillway capacity at maximum pool elevation (54.6 feet) is 1299 cfs.

(4) Gated spillway capacity at maximum pool elevation - not applicable.

(5) Total capacity at maximum pool elevation is 1579 cfs.

c. Elevations. Survey data collected at the Knox Dam was referenced to a temporary benchmark. The following elevations were later referenced to USGS mean sea level datum by assuming that elevation of 50 feet is equal to the spillway crest elevation (top of flashboards at 51 feet). This appears to be a reasonable estimate of normal pool elevation based on visual observations at the dam.

LOCATION	ELEVATION (feet above MSL)
Top of Dam	54.6
Maximum Pool-Design Discharge	Unknown
Full Flood Control Pool	54.6
Recreation Pool	50.0
Spillway Crest	50.0
Diversion Tunnel Invert	Not Applicable
Streambed at Centerline of Dam	32.0
Maximum Tailwater	Unknown
Test Flood Elevation (MPF)	63.0

d. Reservoir. The length of both the maximum pool (Elevation 54.6) and the recreation or normal pool (Elevation 50.0) was estimated from a USGS map to both be 500 feet, since the inlet of Knox Mill Pond is at Knowlton Dam.

e. Storage. Storage volume for Knox Pond was estimated by planimetering surface areas from a USGS map and multiplying by the depth of the pond. The 10 March 1978 inventory sheet shows the normal impounding capacity to be 120 acre-feet. This capacity would assume an average depth in the pond that is much greater than the height from normal pool to the invert of the river channel at the dam outlet. Therefore, the estimated storage volumes in the following table were used instead of those in the inventory sheet for this study.

ITEM	STORAGE (acre-feet)
Recreational/Normal Pool	15
Design Surcharge	Unknown
Top of Dam	20

f. Reservoir Surface. The following are surface areas for Knox Mill Pond.

ITEM	SURFACE AREA (acres)
Top of Dam	1.1
Emergency Spillway Crest	1.1

g. Dam

Type - Mortar-laid cut stone masonry dam with earth embankment north wing wall and concrete south wing wall.

Length - North embankment approximately 190 feet, mortar-laid cut stone masonry section 51 feet, South wing wall 148 feet. See plan and profile in Appendix B-1.

Height - 22.0 feet from stream bed to spillway crest.

Top Width - Varies, see X-sections in Appendix B-1.

Side Slopes - See X-sections in Appendix B-1.

Zoning, Impervious Core, and Cutoff - See X-sections.

h. Division and Regulating Tunnel. Not applicable.

i. Spillway.

Type - Trapezoidal-shaped X-section. See X-sections in Appendix B-1.

Length - 51.0 feet.

Crest Elevation - Approximately 50.0 feet (51.0 including flashboards).

Gates - None.

j. Regulating Outlets.

Type - Drain from bottom of upstream channel.

Length - Unknown.

Closure - The regulated outlet is closed by a timber gate 40 inches wide and 60 inches high.

Access - From downstream outlet of conduit only.

Regulating Facilities - The gate is operated by a rack and gear.

SECTION 2

ENGINEERING DATA

2.1 DESIGN

None Available

2.2 CONSTRUCTION

None Available

2.3 OPERATION

The outlet gate at the Knox Dam is used only to allow maintenance of the dam and to facilitate passage of heavy runoff. The spillway has 1.5-foot long flashboard rods in its crest but only 12 inches of flashboards are used. The hydro-mechanical turbine draws about 100 cfs for about 8 hours daily, five days a week. Process water is also drawn from the pond daily.

2.4 EVALUATION

a. Availability. No data is available regarding design (including structural, hydrologic, and hydraulics), or construction of the facilities.

b. Adequacy. The lack of indepth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity. Not applicable.

SECTION 3

VISUAL INSPECTION

3.1 FINDINGS

a. General. The Knox Dam is located in a narrow gorge in the bedrock within a broad section of the Megunticook River valley. The dam appears to be founded on bedrock. The dam appears to be in a generally good condition.

b. Dam.

(1) Structural - The Knox Dam is constructed of mortar-laid, cut stone masonry; see plan, profile, and X-sections (Appendix B-1). The wing walls of the dam consist of rubble stone masonry, a timber section, a concrete section and earth embankment. See Appendix A for detail inspection findings.

The visual inspection resulted in the following major findings:

(a) The cut stone masonry portion of the dam is in excellent condition. The mortared joints are sound and no distress of this portion of the structure was observed.

(b) The rubble masonry sections of the dam (training and wing walls) are in generally good repair, however some cracking has occurred. The training wall supporting the south end of the service bridge is cracked and some leakage was observed.

(c) The timber training and wing wall at the north abutment has been replaced within the past few years. The timber is in good condition but the granite stones backing the wall are loose with substantial voids.

(c) The timber spillway is leaking through the planking but the timber is in generally good condition. Very little rot has occurred.

(2) Hydraulics - At the time of the visual inspection the pond level was about 1.1 feet below the top of the flashboards. The only substantial discharge was through the 24-inch diameter penstock to Knox Mill's hydro-mechanical turbine. The turbine draws about 100 cfs for 8 hours per day, 5 days per week. There was leakage through the timber portion of the spillway. During operation of the regulated outlet gate, the Knox Mill Pond water surface elevation was lowered about 2 feet. About 500 feet upstream of the Knox Dam is the Knowlton Dam. The spillway at the Knowlton Dam is about 15 feet longer than the Knox Dam spillway, and the controlled outlet at the Knowlton Dam appears to be much larger than the one at the Knox Dam.

c. Appurtenant Structures. The gate works at the Knox Dam consist of a timber vertical lift gate operated manually by a rack and gear. The gate works are in good mechanical order. There is no provision for locking the gate position but the location of the works within the Knox Mill area discourages vandalism.

d. Reservoir Area. The outlet from Knox Mill Pond is controlled by Knox Dam which is a mortar-laid cut stone masonry dam. The approach channel is formed by the pond and is unrestricted. See photograph K-1.

e. Downstream Channel. As shown in photographs K-2, 4, 5, and 6 the downstream channel is constricted by Knox Mill which is situated over Megunticook River about 20 feet downstream of the dam. Further downstream the channel is restricted several times by street crossings and buildings situated over the river. The river channel is quite rocky, but the gradient between the dam and the ocean is steep (about 3 percent). Several Knox Mill buildings are on the overbanks in the immediate area of the dam. Further downstream the overbanks are comprised of a portion of Camden's business district.

3.2 EVALUATION

Based on the visual inspection, the dam appears to be in good mechanical and structural condition. However, as outlined in Section 7, some maintenance is necessary. Should the dam fail, the Knox Mill factory buildings just downstream of the dam would undergo substantial damage. Since the Knowlton Dam, about 500 feet upstream of Knox Dam, has a longer spillway and a larger controlled outlet than Knox Dam, the Knowlton Dam would appear to have a minimum affect on Knox Dam.

SECTION 4

OPERATING PROCEDURES

4.1 PROCEDURES

The outlet gate at the Knox Dam is used only to allow draining of pond for maintenance of the dam and to facilitate passage of heavy runoff. The spillway has 1.5-foot long flashboard rods in its crest, but only 12 inches of flashboards are used. The hydro-mechanical turbine draws about 100 cfs for about 8 hours daily, five days a week. Process water is also drawn from the pond daily.

4.2 MAINTENANCE OF DAM

No record of maintenance was available for Knox Dam. Major repairs (no details available) were reportedly made to the dam during the 1960's. Maintenance is reportedly made on an as-needed basis.

4.3 MAINTENANCE OF OPERATING FACILITIES

No record of maintenance is available. No recent repairs were reported to have been made, nor was any evidence of any recent repairs observed during the field inspection.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

None in effect.

4.5 EVALUATION

Although the Knox Dam is in fair to good repair, no regular maintenance program is apparently in effect. Repairs have been undertaken in the past on an as-needed basis. No formal warning system for either high water or structural distress is in effect at the dam.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data was not available for the Knox Dam.

b. Experience Data. Published hydrologic data for the Megunticook River Basin appears to be entirely lacking. It is estimated that the 10-year and 100-year flood discharges at Knox Dam are about 1330 cfs and 3960 cfs, respectively. These flows were calculated by performing a log-Pearson Type III statistical analysis of a similar USGS gaged watershed, (Kettle Brook Gage No. 01109500 at Worcester, Mass., drainage area = 31.3 square miles).

A review of lake level data for Megunticook Lake would indicate that the 10-year flood flow was likely equalled or exceeded four times in the last 50 years: in April, 1940; in December, 1969; in December, 1973; and in December, 1977.

c. Visual Inspection. The outlet of Knox Mill Pond is controlled by the Knox Dam, which is a mortar-laid cut stone masonry dam. The spillway and outlet gate are generally in good condition. The downstream channel is restricted by the Knox Mill factory buildings which are situated over Megunticook River just downstream of the dam.

d. Overtopping Potential. The hazard potential was determined by examining downstream areas for possible damage. The failure analysis assumes a breaching of the dam at full spillway capacity. The wave height just downstream of Knox Dam would be approximately 26 feet and the potential flow from failure of the dam would be about 4700 cfs. The wave would travel only about 20 feet downstream at which point it would be restricted by the channel under the Knox Mill factory buildings. At a pool elevation equal to full spillway, the

conduit beneath the Knox Mill factory has a capacity of about 2650 cfs. At a wave height of 28 feet, the water surface elevation would be about at mid-height of the second story of the factory. See photograph K-2. In the event of failure of the Knox Dam, the Knox Mill factory buildings would be substantially damaged, and there would be a great chance for the loss of many lives in the factory, unless the employees had been evacuated prior to failure. Damage downstream of the factory would be likely, though it is thought that destruction of the Knox Mill factory buildings would dissipate much of the energy from the dam failure. Thus, because of the potential for loss of life within the Knox Mill factory, the Knox Dam is classified as having a high hazard potential.

There is a possibility of failure of the south wing wall of the dam. This possibility was examined according to rule of thumb methods as described in an attachment to ETL 1100-2-234. If the south wing wall failed at a Knox Mill Pond elevation equal to full spillway, there would be sheet flooding of about 1 foot in depth in a 500 foot wide flood plain between Knox Mill and the ocean. Some damage to property would occur. Should the north wing wall be breached by flood flows, these flows would be encompassed by the Knox Mill building complex.

Since Knox Dam is classified as having a high hazard potential, the dam was analyzed for passing the maximum probable flood. The maximum probable flood (MPF) has been calculated to be 44,600 cfs, according to the COE "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations." Consideration of the effect of surcharge storage (according to the same COE reference) does not reduce the MPF since the Knox Mill Pond has insignificant storage. The spillway capacity of the dam is about 1579 cfs, which is 3.5 percent of MPF.

The drainage area of the Knox Dam is 34.9 square miles and the reservoir area is about 1 acre. Inflows to Knox Dam are highly dependent on the regulated or spillage outflows from Megunticook Lake, a large upstream reservoir within the watershed. A detailed hydrologic analysis of Knox Mill Pond could not be performed without including the analysis of this other project. The possible effects of Megunticook Lake were not considered in this cursory study of Knox Dam.

At MPF flows the Knox Mill Dam does not hydraulically control. These high flows would move into the flood plain upstream of the dam. At the location of the Knox Mill Dam, the MPF elevation would be controlled by the configuration of the valley. The MPF elevation at the Knox Mill Dam would be about 63 feet, or about 8.5 feet above the dam.

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Based on the visual observations, the dam appears to be in good structural condition. As outlined in Section 7, some maintenance of the dam is necessary. The timber portion of the north wing wall of the dam is of particular concern.

b. Design and Construction Data. No data regarding original design or construction is available for the Knox Dam.

c. Operating Records. None available.

d. Post Construction Changes. No post construction changes are apparent in the dam except for cracks and spalling of the rubble masonry at the south training wall at the service bridge, and replacement of the timber training and wing wall at the north abutment. No settlement or horizontal movement is apparent.

A hydro-mechanical turbine was reportedly installed in 1902. It was maintained in use until the 1940's when a new turbine was reportedly installed which is in use presently. The dam was reportedly rebuilt in the late 1920's. The last major repairs (details unknown) were made in the 1960's.

e. Seismic Stability. The Knox Dam is located in Seismic Zone 1 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition. The visual inspection and compilation of available engineering data indicate that the Knox Dam is in good condition, however the spillway will pass only approximately a 10-year flood. The stability of the dam is assessed to be good under this condition. The 100-year flood is anticipated to cause overtopping of the wing walls of the dam by approximately 1 to 2 feet. Under this condition the spillway section of the dam appears stable, but the wing walls are subjected to distress caused by erosion. The maximum probable flood (MPF) peak flow at the Knox Dam has been calculated to be 44,600 cfs. The spillway capacity of the Knox Dam is only 3.5 percent of the MPF but due to the shape of the valley and the downstream restriction caused by the Knox Mill, the inadequacy of the spillway capacity relative to the MPF is of little significance. Under high flood flows, (in excess of 100-year flood) water will spill over the stream banks well above the dam as well as over the wing walls of the dam. The downstream restriction caused by the Knox Mill is so significant that under extreme flows the mill structure becomes the hydraulic control by submerging the dam. The channel beneath the mill will carry only about 7 percent of the MPF.

b. Adequacy of Information. The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection findings, performance history, and engineering judgment.

c. Urgency. Maintenance of the facilities should be implemented within 12 months. The recommendations regarding redesign and reconstruction of the facilities should be investigated and implemented within 24 months after receipt of this report by the owner.

d. Need for Additional Investigation. The spillway discharge capacity of this and other dams inspected on the Megunticook River are inadequate. Further hydrologic studies are necessary to assess the flood discharge characteristics of the watershed and to establish appropriate parameters for the design of spillway improvements for the several dams on the Megunticook River.

7.2 RECOMMENDATIONS

The following recommendations regarding improvements should be investigated by a qualified engineer and implemented as necessary to assure the long-term safety of the dam:

1. A system to prevent erosion and provide support during overtopping flows downstream of the south masonry wing wall along the section parallel to Mechanic Street.

2. A designed-to-fail flashboard system should be developed and implemented for the spillway of the Knox Dam. If such a system is used, the spillway capacity will be increased by almost 40 percent during flood flows when the flashboards collapse. This increase in spillway capacity would lessen the frequency of overtopping of the wing walls of the dam.

3. Enlargement or alteration of the spillway to improve the discharge capacity at the dam.

7.3 REMEDIAL MEASURES

a. Alternatives. Not applicable

b. Operating and Maintenance Procedures. Although the dam structure is in generally good repair, a program of regular inspection and maintenance should be developed. The following maintenance actions and operating procedures should also be implemented.

1. Repair all spalled and cracked surfaces of the rubble concrete masonry portions of the dam; in particular, the south training wall at the end of the service bridge.

2. The granite stone fill should be reworked behind the timber wing wall at the north abutment to establish firm support for the timber wall.

3. The north embankment wing wall should be cleared of trees, brush, and debris and a grassed surface should be established to provide better erosion resistence.

4. The control bridge and flashboard rods may act as debris collectors during flood flows. Equipment and personnel should be available to keep the spillway clear during flood flows.

5. Because the dam is upstream of populated areas and is subject to overtopping and subsequent distress, around-the-clock surveillance should be provided during periods of high precipitation or anticipated run-off.

6. A formal warning system which could be used in the event of an emergency should be developed and implemented.

7. The dam should be inspected by a qualified engineer at least once every two years.

APPENDIX A

FIELD INSPECTION NOTES

Inspection Date: July 18, 1978

Inspection Team:

Name	Discipline
Frank Nader	Hydrology/Hydraulics
Stephen Cole	Geotechnical
Henry Catley	Structural
Peter Deletetsky	Survey
Ernest Jurick	Photographer

1. CONCRETE AND STONE MASONRY STRUCTURES

a. Concrete Surfaces. None of the structural components of the dam consist of concrete.

Stone Masonry Surfaces. The dam consists of granite blocks which are mortar-laid. The surface shows no indication of deterioration. The south wing wall consists of mortar-laid rubble masonry and is in generally good repair. The north wing wall consists of a timber section and a buried rubble masonry wall section. Several of the upper stones of this masonry wall have been displaced.

b. Structural Cracking. No structural cracking was observed in the masonry dam or wing walls. Some small cracks were observed in the south service bridge pier.

c. Movement. No evidence of horizontal or vertical movement was observed.

d. Junctions. The junctions between the timber spillway and the wing walls appear good. The ends of the wing walls blend into natural ground.

e. Drains. A 12-inch square opening exists in the bottom course of the stone masonry portion of the dam. No flow was observed from this opening, however, it is likely the outlet of an internal drain system.

f. Water Passages. The spillway of the dam is a timber, self-loading, section. It shows no signs of serious wear. The downstream face of the dam consists of granite stone masonry. No evidence of significant erosion or wear was observed. The regulated outlet consists of a stone masonry conduit. No significant erosion or wear was observed.

g. Seepage or Leakage. No seepage or leakage was observed coming from the downstream face of the dam from the masonry. Some seepage was coming from the toe of the south training wall near the end of the service bridge.

h. Monolith Joints. Not applicable.

i. Foundation. The masonry spillway portion of the dam is apparently founded on bedrock. No undermining or distress was observed.

j. Abutments. The abutments of the Knox Dam are the end of the masonry spillway section of the dam on the north and the mill building and wing wall on the south. The north abutment is bedrock which is sound and has no evidence of weathering. The south abutment is likely bedrock but could not be observed due to the existence of mill buildings and soil overburden.

2. EMBANKMENT STRUCTURES

The only embankment related to the Knox Dam is the backfill around the north wing wall.

a. Settlement. None apparent.

b. Slope Stability. The embankment slopes are grassed and no evidence of instability was observed.

c. Seepage. None observed.

d. Drainage Systems. None observed and none are reported to exist.

e. Slope Protection. The upstream face of the embankment area is riprapped throughout most of its length. No erosion is apparent.

3. SPILLWAY STRUCTURES

The spillway consists of a timber self-loading section on top of the masonry portion of the dam. See the X-sections and photographs. Flashboard rods 1.5-feet long exist on the spillway crest and 1-foot of flashboards is in use. The flashboard rods appear to be of a non-failing type.

a. Control Gates. None exist in spillway.

b. Unlined Saddle Spillways. None exist.

c. Approach and Outlet Channels. The approach channel downstream of the Knowlton Street Bridge is unobstructed. The outlet channel is restricted by the Knox Mill factory buildings which are situated over Megunticook River just downstream (about 20 feet) of the dam.

d. Stilling Basin. The stilling basin consists of the bedrock channel downstream of the dam. No signs of significant erosion were noted.

4. OUTLET WORKS

The regulated outlet consists of a vertical lift timber gate 40 inches in width by 60 inches in height.

a. Intake Structure. Pond water level prohibited visual inspection of the intake structure, however, operation of the gate indicated that no obstructions exist.

b. Operating and Emergency Control Gates. The regulated outlet gate is a timber vertical lift gate operated manually by a rack and gear. The operating equipment appeared to be in good condition. See photograph K-3.

c. Conduits, Sluices, Water Passages. The outlet sluice consists of a stone masonry conduit. No erosion of the surfaces of the conduit was observed. Some leakage was occurring through the gate and also through the roof of the conduit.

d. Stilling Basin. See 3-d above.

e. Approach and Outlet Channel. In the area of the outlet works there appears to be no build-up of silt.

f. Drawdown Facilities. The regulated outlet is used for necessary drawdown of the pond. Operation of the outlet was observed and pond water levels dropped during the operation. It was reported that the outlet could drain the pond during normal flow conditions.

5. SAFETY AND PERFORMANCE INSTRUMENTATION

None at dam.

6. RESERVOIR

a. Shore Line. No major active or inactive landslide areas on Knox Mill Pond were observed.

b. Sedimentation. The watershed (34.9 square miles) has remained essentially rural in nature over the past years. There are no new developments or new sources of sediment loads on the pond.

c. Potential Upstream Hazard Areas. The Knox Mill Pond is partially surrounded by Knox Mill buildings, which would be affected by MPF elevations, but not by maximum water storage pool elevation.

d. Watershed Runoff Potential. The watershed has remained essentially rural with very few changes in development over the past 50 years.

7. DOWNSTREAM CHANNEL

The channel downstream of the dam is restricted by the Knox Mill factory buildings which are situated over the Megunticook River just downstream of the dam. In the event of failure of the dam, the Knox Mill buildings would probably be substantially damaged, thereby threatening the lives of many workers in the factory. Thus the Knox Dam is classified as having a high hazard potential.

5. OPERATION AND MAINTENANCE FEATURES

a. Reservoir Regulation Plan. No formal plan on file. The reservoir is, however, reportedly maintained with a water level above the flashboards of the dam to provide sufficient head for the power turbine. The regulated outlet is used to pass high flows and for draining the pond for maintenance.

b. Maintenance. The owner's representative indicated that they have no regular maintenance program, but maintenance is apparently performed on an as-needed basis.

APPENDIX B

ENGINEERING DATA

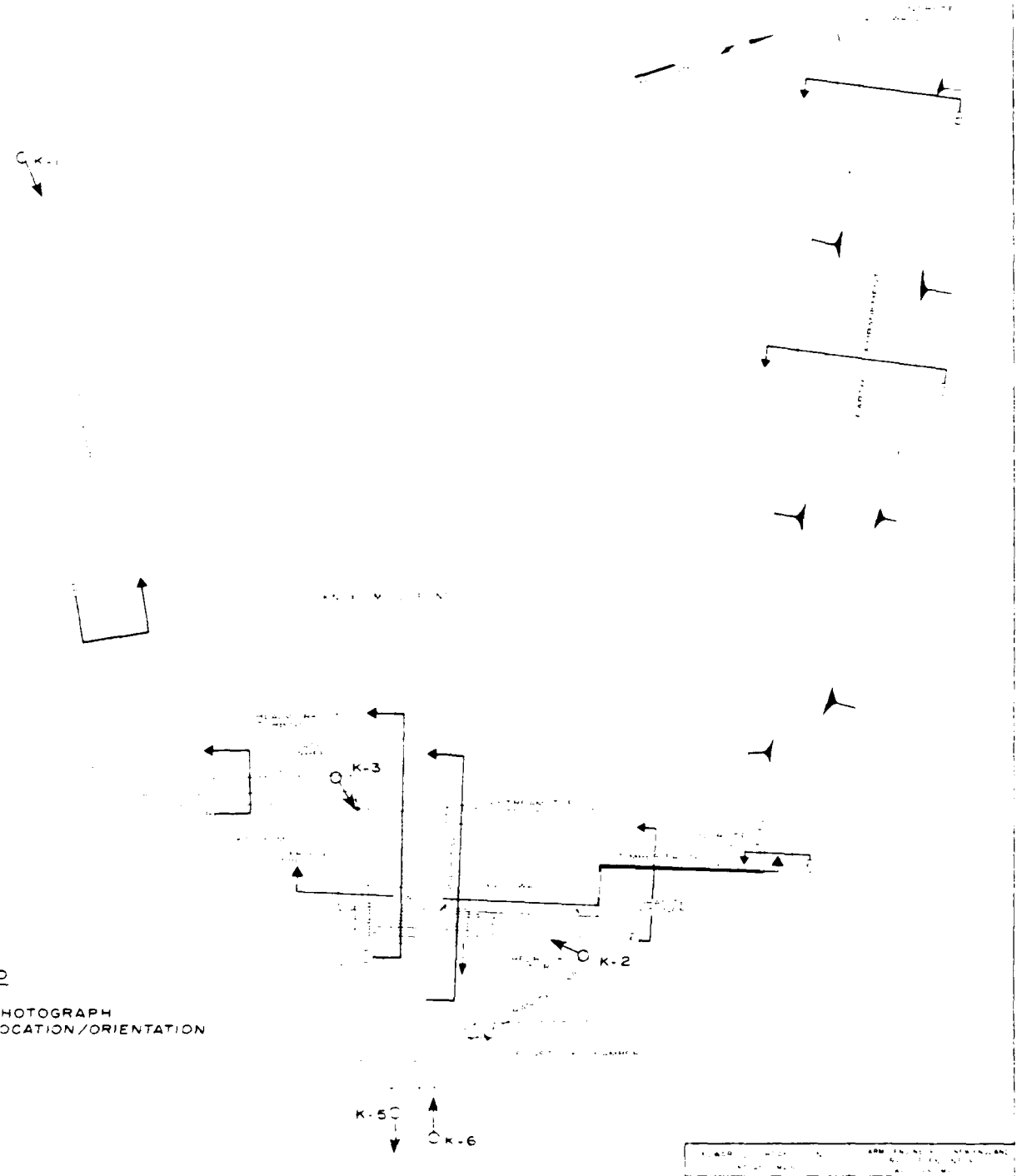
This appendix lists the engineering data collected either from project records and other sources or data developed as a result of the visual inspection. The contents of this appendix are listed below.

Appendix	Description
B-1	General Project Data

APPENDIX B-1

GENERAL PROJECT DATA

As built drawings showing plans, elevations and sections of the Knox Dam were unavailable. Plans, elevations and sections, with limited amount of detail developed as a part of the visual inspection of the dam, are attached to this section.

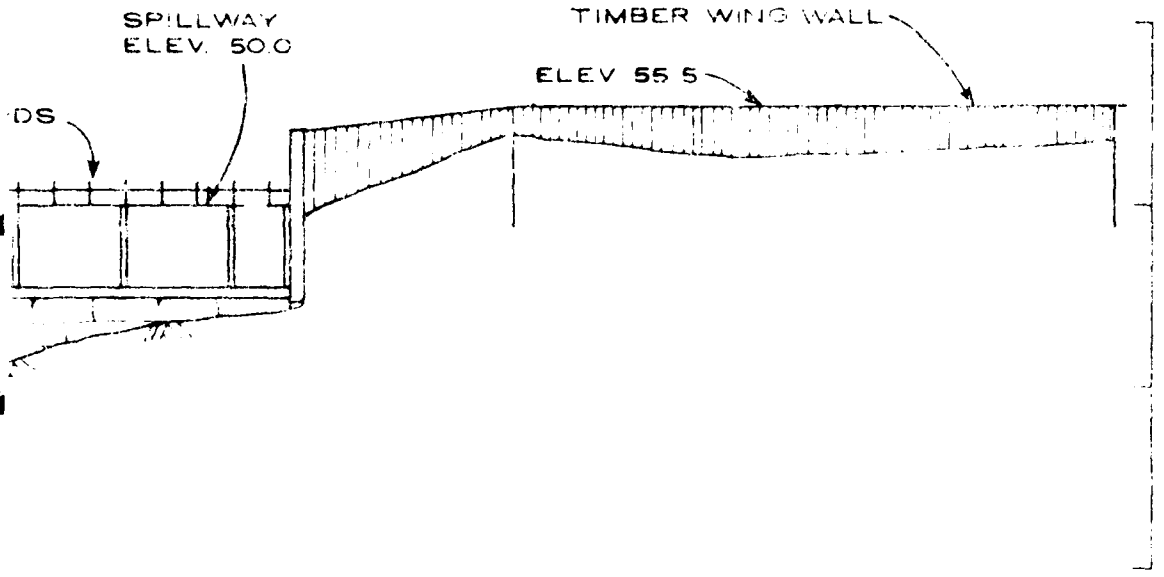


LEGEND

PHOTOGRAPH LOCATION/ORIENTATION

KNOX DAM
PLAN VIEW

E-1.3

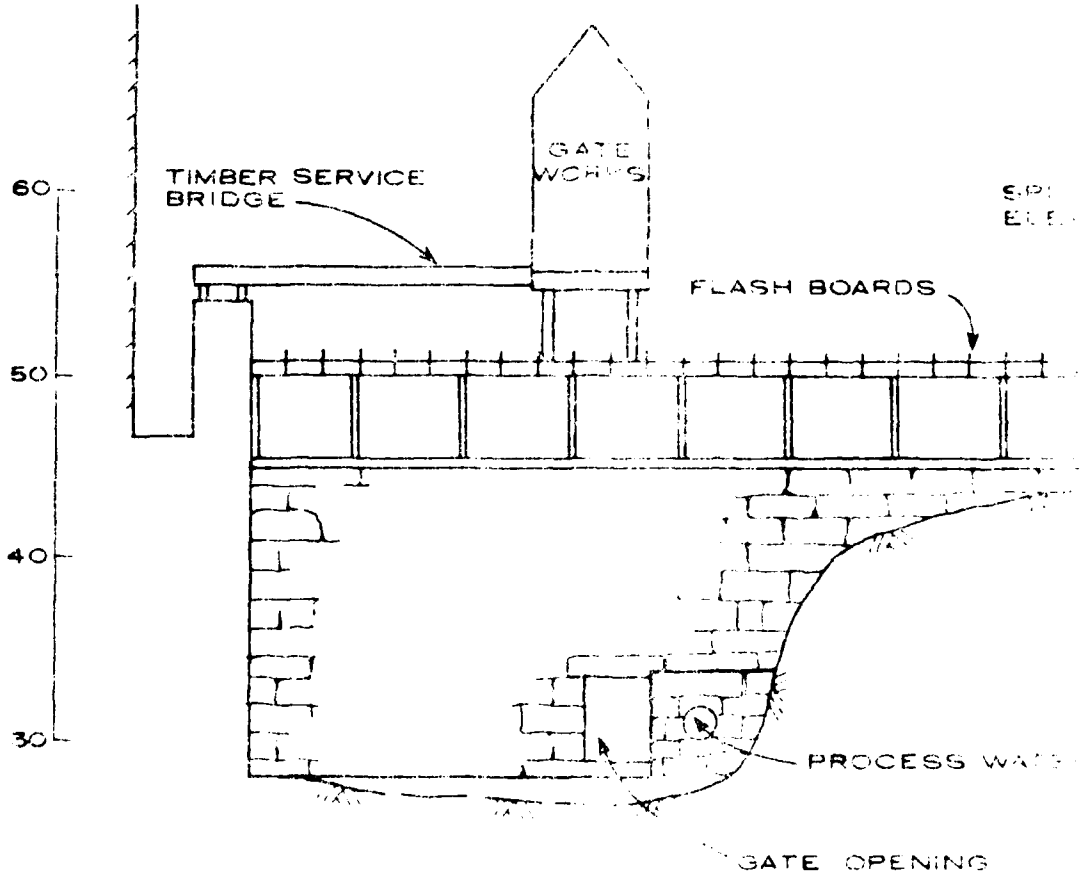


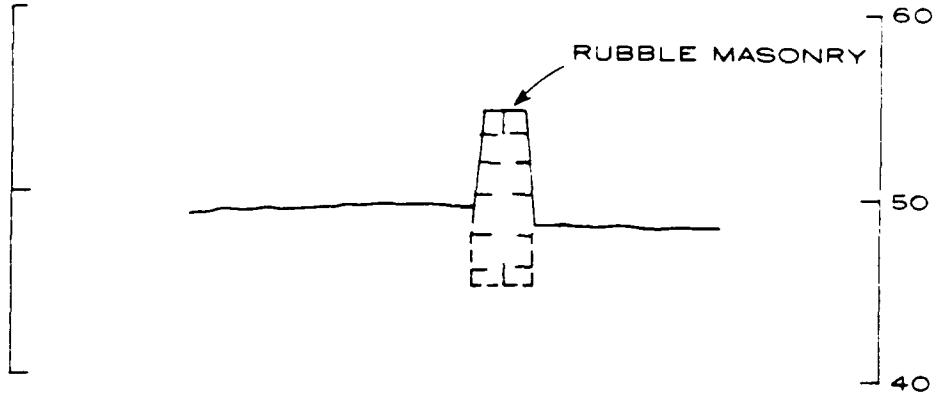
LESS WATER PENSTOCK

ENING

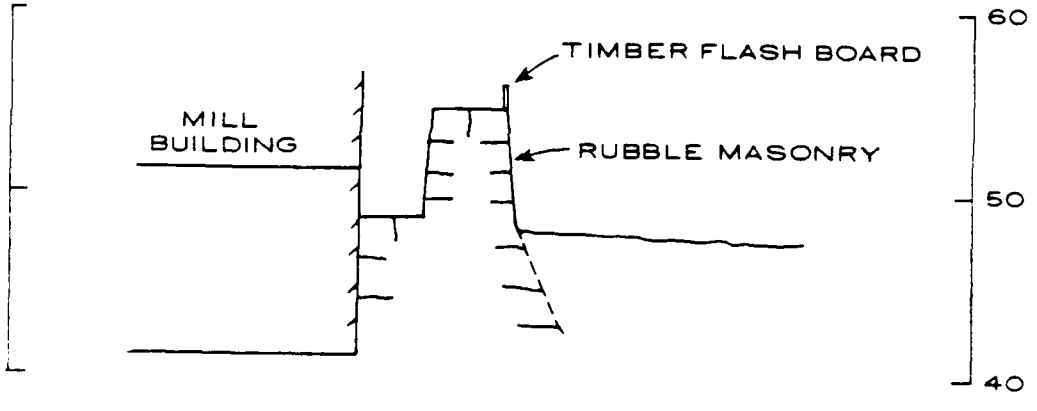
KNOX DAM
PROFILE

NEWFOUNDICOOK RIVER


60
50
40
30
TIMBER SERVICE BRIDGE
GATE
FLASH BOARDS
PROCESS
GATE OPENING



SECTION A



SECTION B

0 5 10 15 FEET

EDWARD C. JORDAN CO., INC.

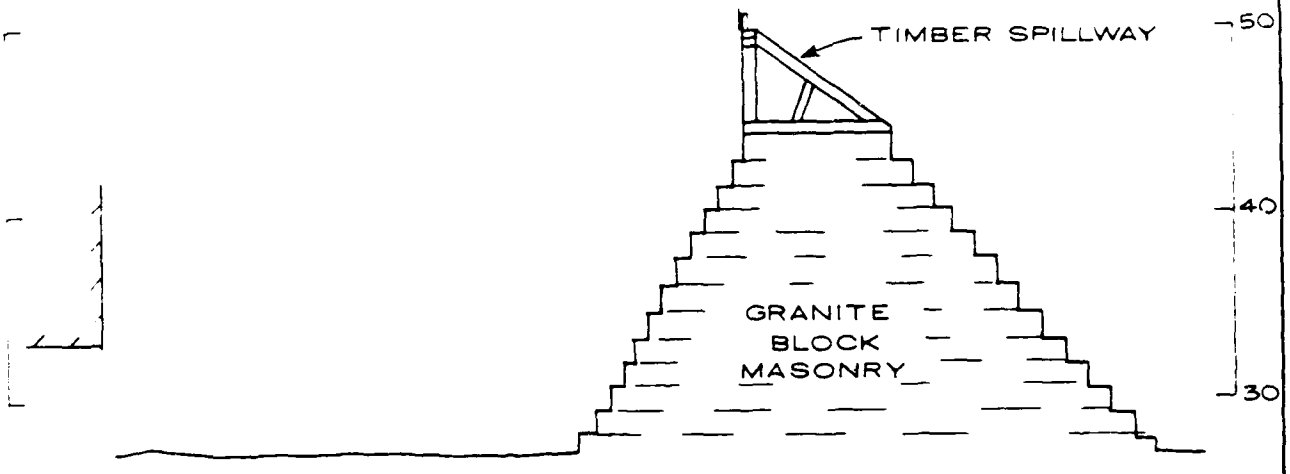
U.S. ARMY ENGINEER DIV. N.E.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

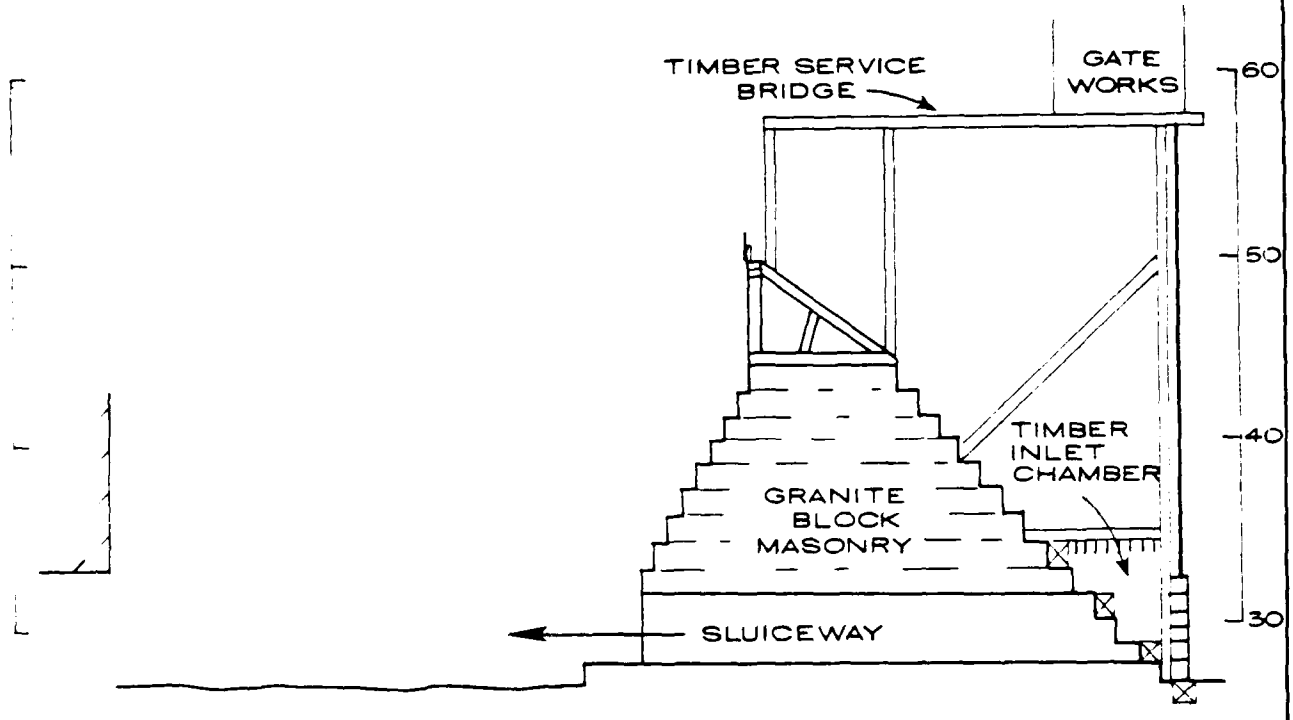
KNOX DAM
X-SECTIONS

MEGUNTICOOK RIVER MAINE

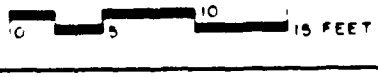
DATE AUGUST 1978



SECTION C



SECTION D



EDWARD C. JORDAN CO. INC.

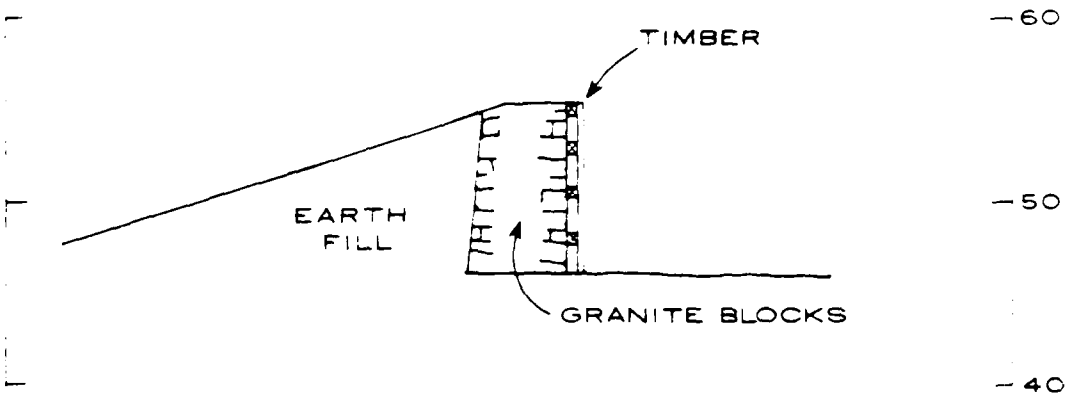
U.S. ARMY ENGINEER DIV. NE & ENGR. AREA

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

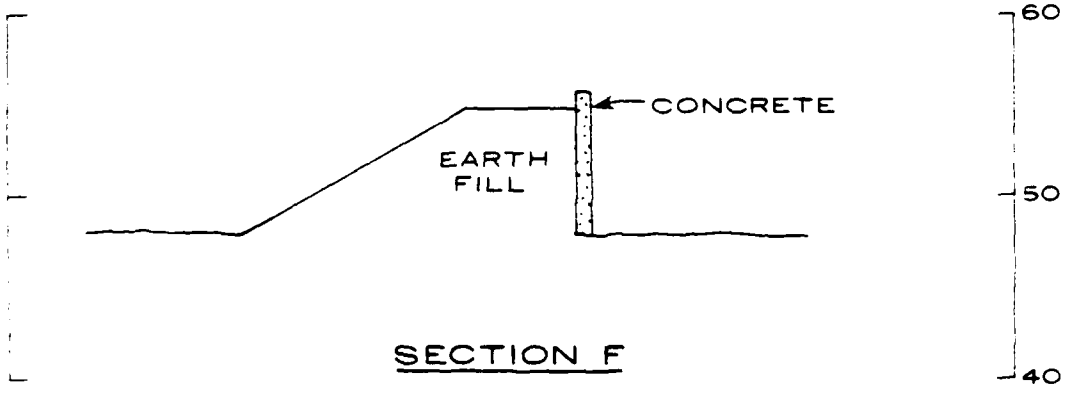
KNOX DAM
X-SECTIONS

MEGUNTICOOK RIVER MAINE

DATE AUGUST 1978



SECTION E



SECTION F

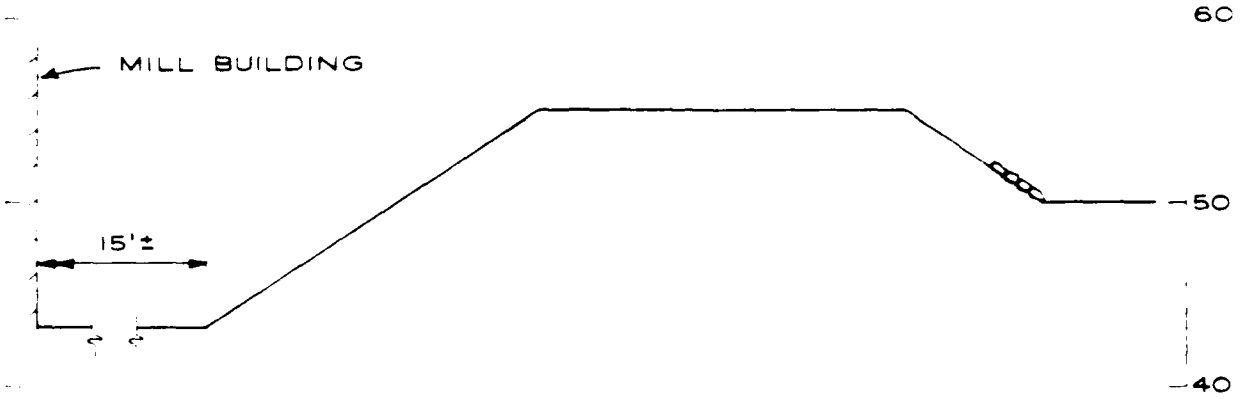
10 5 0 10 15 FEET

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

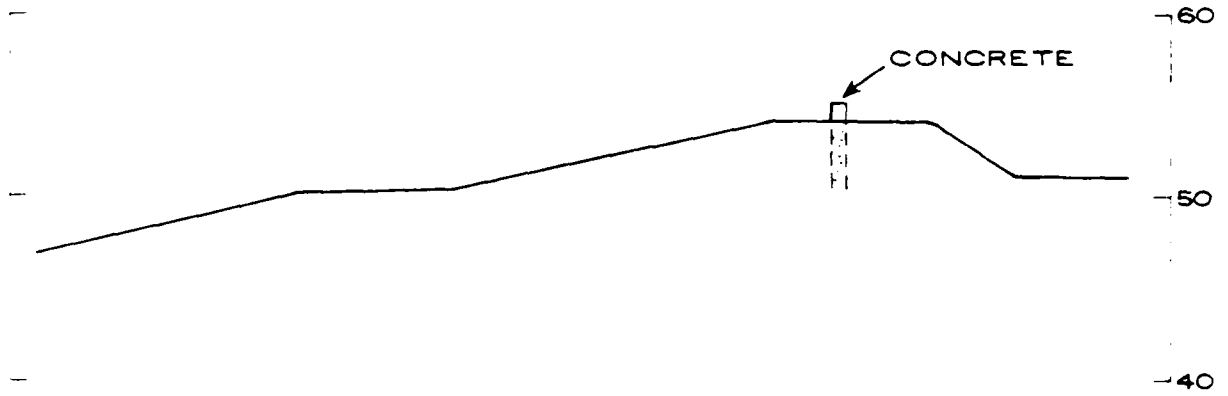
KNOX DAM
X-SECTIONS

MEGUNTICOOK RIVER MAINE

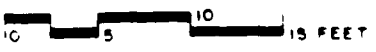
DATE AUGUST 1978



SECTION G



SECTION H



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

KNOX DAM
X-SECTIONS

MEGUNTICOOK RIVER MAINE

APPENDIX C

PHOTOGRAPHS

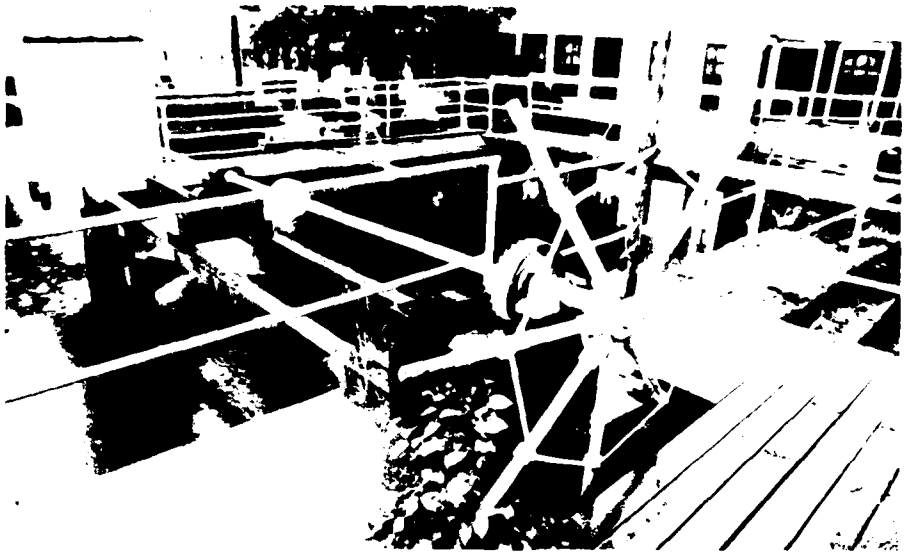
The following are photographs referenced in this report. The black and white photographs were taken at the time of the visual inspection on July 18, 1978. The color photographs were taken later on August 4, 1978. See Sheet B-1.3 for photograph locations and orientations.

K-1

VIEW OF DAM FROM UPSTREAM

K-2

CREST OF DAM



K-3

GATEHOUSE AND CONTROL WHEEL

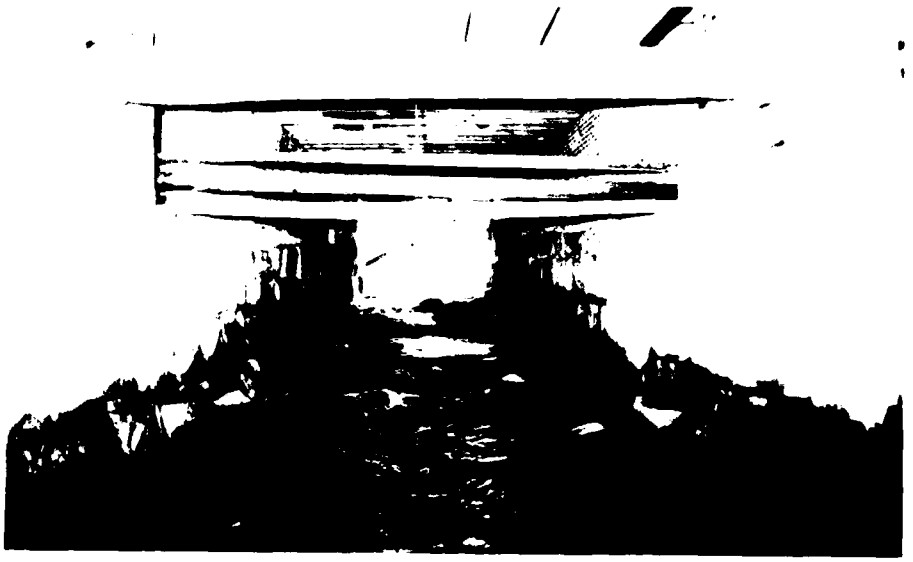
K-4

OUTLET AT DOWNSTREAM SIDE OF KNOX MILL FACTORY BUILDING

K-5

VIEW OF SHOP OVERHEAD IN NUMBER 1

SLUICEWAY UNDER KNOX MILL



K-6

VIEW OF NUMBER 2 SLUICEWAY UNDER KNOX MILL

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

There was no hydrologic or hydraulic data located. Elevations listed in this report are referenced to USGS mean sea level datum by assuming that the normal pond elevation is equal to 50 feet.

a. The drainage area contributing to Knox Dam is about 34.9 square miles. The watershed is very hilly, uncharacteristic of most coastal drainage areas, with elevations ranging from about 28 to 1100 feet at the drainage divide.

b. The pool elevation of the top of the conservative or normal pool is taken as 50 feet.

c. Storage capacity at spillway crest (50 feet) has been estimated to be about 15 acre-feet.

d. The elevation at the top of flood control pool (or full spillway) is 54.6 feet.

e. The storage capacity (incremental) of the flood control pool is about 5 acre-feet.

f. The elevation of the maximum design pool is unknown.

g. Surcharge capacity is unknown.

h. There is no freeboard available at the assumed flood control elevation.

i. The elevation of the top of the dam is 54.6 feet.

j. The elevation of the spillway is about 50 feet, (with flashboards 51 feet), and the length is 51 feet. The spillway is trapezoidal in shape with 1 foot high flashboards as shown on the plans and X-sections in Appendix B-1.

k. The sluice gate opening is 32 inches in width by 36 inches in height. The upstream invert is about 37 feet and the downstream invert is about 28 feet.

l. There is no emergency spillway.

m. There are not any flashboards installed at the dam, although 6-inch long rods are present in the spillway crest allowing for the installation of nonfailing flashboards at least 6 inches high.

n. The elevation of the northerly wing wall is about 105.5 feet. The elevation of the southerly earth embankment is about 104.7 feet.

o. There are no identified hydrometeorological gages in the watershed.

p. The Megunticook River runs in a relatively narrow flood plain from the Knox Dam to the ocean. The river channel is quite steep with an average slope of about 2.7 percent between Knox Dam and the ocean. Reportedly 10-year frequency flood flows (1330 cfs) have not caused appreciable damage.

APPENDIX D-1

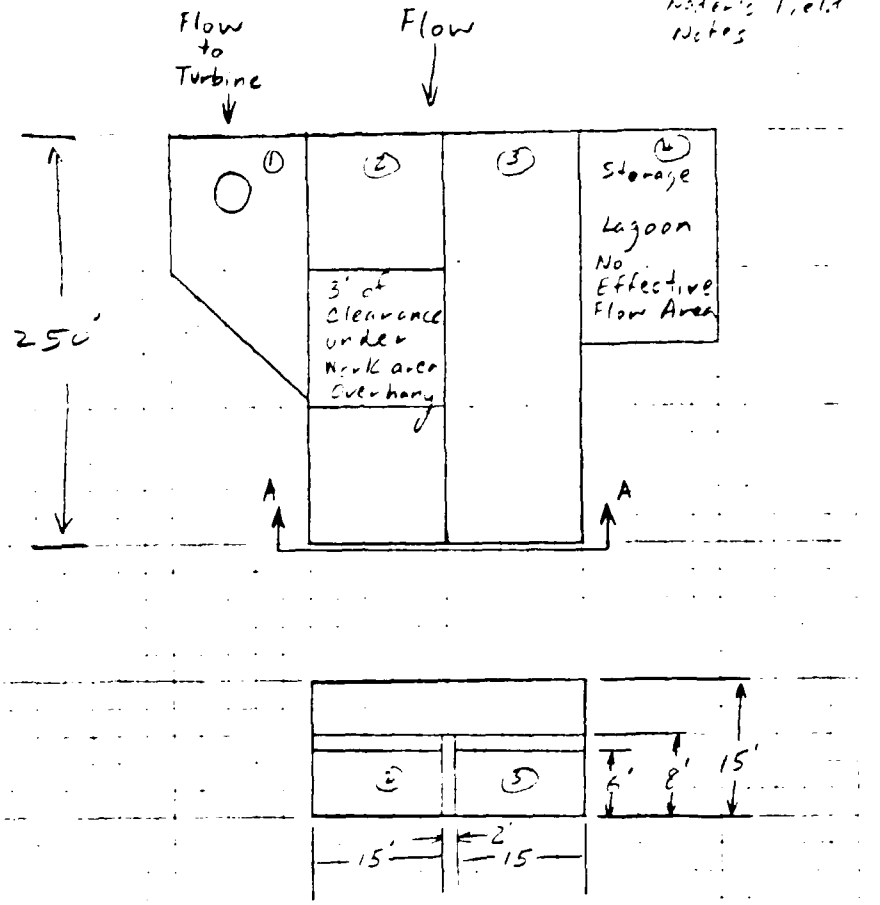
HYDROLOGIC AND HYDRAULIC DETERMINATIONS

No design data is available for the Megunticook Lake Dams. An analysis has been done which includes a hazard determination, estimation of full spillway discharge, and overtopping potential. Tailwater rating curves are not available due to the lack of channel configuration data. Since the Knowlton Dam, which is about 500 feet upstream of the Knox Dam, appears to have a significantly greater hydraulic capacity than the Knox Dam, the Knowlton Dam would have a minimal affect on the hydraulics of the Knox Dam. Flood flow discharges to Knox Dam were calculated by performing a log-Pearson Type III statistical analysis of a similar USGS gaged watershed. The similar watershed was Kettle Brook at Worcester, Mass. (Station Number 01109500). The hydrologic map of the watershed is reproduced as the vicinity map. The analyses are attached to this section.

EDWARD C. JORDAN CO., INC.

PROJECT	CONF BY	JOB NO.
KNOX MILL DAM DATA		
	CHK BY	DATE

from Frank Waters Field Notes



NOTE: Flow through bay (1) goes through turbine and bay (4) necks down into bay (3). The workshop obstruction in bay (2) would probably be washed out, effectly blocking flow in bay (2). The opening at Section A-A on the downstream side of the mill is 6'x15'.

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM HYDRAULICS FINAL FLOWS	CHK BY	DATE 8-22-79

Pool Elev MSL	Survey Datum ELEVATION	WEIRS 1,2,4 (CFS)	WEIR 3	TOTAL CFS [1]	
515	95.5	— Top of Spillway		—	
515	96	70.32			
515	98	760.01			
515	100	1802.05	285.93	2087.98	
515	102	2659.19	2003.99	4663.18	
515	104	2800.22	4498.02	7298.24	
515	106	2873.93	7584.43	10458.36	
515	108	2969.33	11165.64	14134.97	
515	110	3060.04	15180.82	18240.86	
515	112	3147.70	19597.30	22735.00	
515	114	3221.03	24352.98	27574.01	
715	116 *	3315.26	29452.59	32767.85	
715	118	3391.43	34865.53	38257.01	MPF
715	120 120.18	3466.03	40574.63	44040.66	44,600
715	122	3539.01	46565.24	50104.25	
715	124	3610.51	52824.70	56435.21	

MPF = 44,600 cfs @ 120.18 **

120	44040.66
120.18	44,600
122	50104.25

* ORIFICE CONTROLS FROM EL 69.5 UP

** IF CONTROL IS BY DAM AND APPURTENANCE STRUCTURES,

[1] Neglects flow through Control Gate

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
FINAL FLOWS INCLUDING CONTROL GATE	TTE	2563 04
	CHK BY	DATE
	L	8- -78

SPILLWAY FLOW	CONTROL GATE FLOW	TOTAL FLOW cfs	Downstream Channel Pool Elev.	Knox Mill Pond Elev
1299	280	1579	83	99.1
876	305	1181	79	98.25
547	325	872	76	97.5

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM FULL SPILLWAY CAPACITY W/OUT FLASHBOARDS	CHK BY	DATE 2-3-78

'C' from Brater & King, Handbook of Hydraulics, 1976 Pg 5-44 Table 5-11.

$Q = CLH^{3/2}$

$Q_1 = 3.64(51)(99.1 - 94.5)^{3/2} = 1832 \text{ CFS}$

$Q_2 = 1299$ CFS FOR FULL SPILLWAY WITH 1'-FLASHBOARDS

Q_1 & Q_2 are spillway flows only.

Total Flow passing the dam would be:

$1832 + 280 = 2112$ CFS

$1299 + 280 = 1579$ CFS

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
CONTROL GATE	DTB	20563 C4
	CHK BY	DATE
	[illegible]	8-31-78

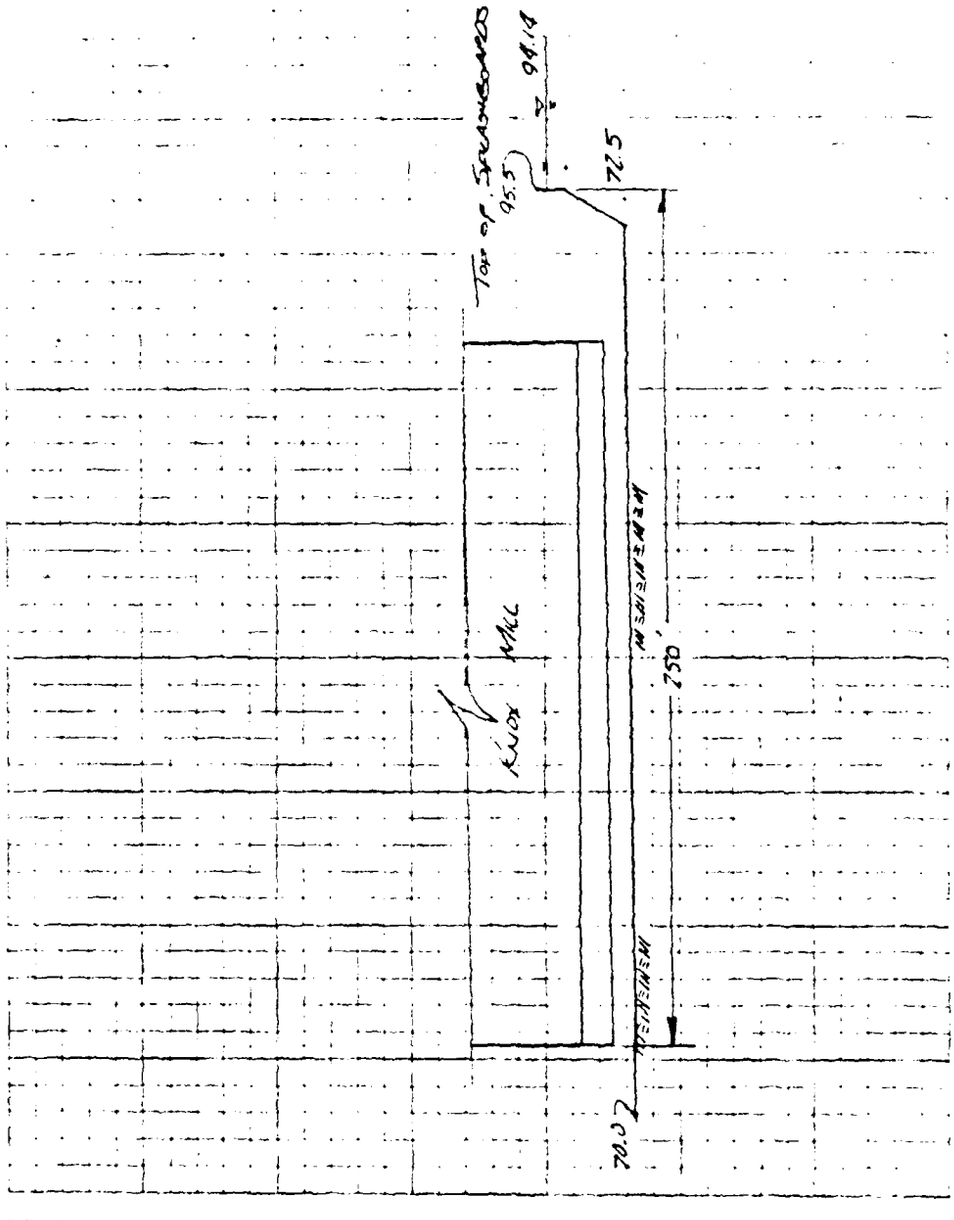
$Q = CA\sqrt{2gh}$ Opening 32" x 56"

$A = \frac{32 \times 56}{144} = 12.44^{\square}$, $c = 0.7$

HEAD, ft.	Q, cfs
1	70
2	99
3	121
4	140
5	156
6	171
7	185
8	198
9	210
10	221
11	232
12	242
13	252
14	261
15	271
16	280
17	288
18	296
19	305
20	313
21	320
22	328
23	335
24	342
25	349

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM	BPD	--593-04
~~SECTION~~ PROFILE - DOWNSTREAM EMBANKMENT	CHK BY	DATE 9-17-78



EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM ORIFICE FLOWS UNDER KNOX MILL	E.P.D	2383-04
	CHK BY B.T.B	DATE 5-17-78

$Q = CA\sqrt{2gh}$

Egton Elev = 70.00'
Opening Ht = 17.00
Ctr

$A = (15')(6) = 90$ SQ. FT.

$C = 0.7$

HEAD	ELEV	$Q = CA\sqrt{2gh}$
3	76	875.63 CFS
4	77	1011.15
5	78	1130.49
6	79	1235.57
7	80	1337.62
8	81	1429.98
9	82	1516.72
10	83	1598.76
11	84	1676.79
12	85	1751.35
13	86	1822.87
14	87	1891.68
15	88	1958.07
16	89	2022.29
17	90	2084.53
18	91	2144.96
19	92	2203.79
20	93	2260.79
21	94	2316.82
22	95	2371.35 — Top of Spillway Doors
23	96	2424.64
24	97	2476.79
25	98	2527.86
27	100	2627.
29	102	2722.59
31	104	2814.91
33	106	2904.29
35	108	2991.01
37	110	3075.28
39	112	3157.30
41	114	3237.24
43	116	3315.26
45	118	3391.48
47	120	3466.03

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM	EC	3593-04
HYDRAULICS - WIER SUMMARY	CHK BY	DATE
	[illegible]	8-19-75

ELEV	WIER 1	WIER 2	WIER 3	WIER 4	TOTAL 1,2,4	TOTAL 1,2,3,4
95	—					
95.5	—					
96	70.32				70.32	
96.5	196.35				196.35	
97	357.91				357.91	
97.5	546.71				546.71	
98	760.01				760.01	
98.5	993.76				993.76	
99	1245.61				1245.61	
99.5	1509.60				1509.60	
100	1780.71	15.34	285.93		1802.05	2083.98
100.5	2075.52	29.63	583.52	32.54	2137.69	2721.21
101	2374.5	47.26	943.57	92.05	2533.81	3477.38
101.5	2728.34	68.96	1373.35	169.10	2966.40	4360.25
102	3076.39	95.36	2008.97	260.35	3435.10	5439.09
102.5	3438.10	125.15	2564.07	363.86	3927.11	6491.18
103	3812.97	154.01	3168.36	478.30	4445.28	7613.64
103.5	4200.55	184.81	3813.54	774.94	5160.30	8974.19
104	4600.45	217.42	4498.02	602.73	5420.60	9515.62
104.5	5012.28	251.74	5218.53	879.70	6142.72	11361.55
105	5435.12	287.71	5974.50	1029.15	6752.58	12727.08
105.5	5870.45	325.24	6763.43	1133.65	7355.34	14148.82
106	6316.19	391.50	7589.43	1352.85	8000.55	15584.98
107	7239.66	446.64	9317.54	1704.79	9391.09	18708.63
108	8204.21	534.42	11165.64	2082.85	10821.48	21987.12
109	9205.15	627.29	13121.96	2495.36	12320.79	25442.75
110	10244.99	725	15180.82	2910.83	13895.87	29066.69
113.02	13590.29	1044.99	21926.95	4314.53	20,203.92	40876.80 - 44,600
115	15985.40	1278.97	26862.82	5347.62	23,387.62	48195.44
120	22512.34	1923.77	40574.63	8273.20	32684.31	73248.94

MPF = 44,600 CFS

1 minus control Gate

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM WEIR ① SPILLWAY HYDRAULICS	[illegible]	[illegible]
	CHK BY	DATE 4-17-79

$Q = CLH^{3/2}$ AVE HEIGHT = 95.5'
LENGTH = 51'

C SHARP CRESTED WEIR
CLAIM = 1' HIGH

FROM BEATER & KING "HANDBOOK OF HYDRAULICS, 1976
PG. 5-44, TABLE 5-11

CREST = 99.19'

ELEVATION	HEAD	C	$Q = CLH^{3/2}$
94.5	—	—	—
95	—	—	—
95.5	0	—	0
96	.5	3.90	70.32
96.5	1	3.85	196.35
97	1.5	3.82	357.91
97.5	2	3.79	546.71
98	2.5	3.77	760.01
98.5	3	3.75	993.76
99	3.5	3.73	1245.61
99.5	4	3.70	1507.60
100	4.5	3.67	1786.71
100.5	5	3.64	2075.52
101	5.5		2374.50
101.5	6		2728.34
102	6.5		3076.39
102.5	7		3438.10
103	7.5		3812.97
103.5	8		4200.55
104	8.5		4600.45
104.5	9		5012.28
105	9.5	3.64	5435.72
105.5	10	3.64	5870.45

EDWARD C. JORDAN CO., INC.

PROJECT		COMP BY	JOB NO.
KNOX MILL DAM WIER (2)		BPD	0593-04
HYDRAULICS		CHK BY	DATE
			5-15-78

GRANITE WALL // TO MILL, ⊥ TO DAM.

$Q = CLH^{3/2}$ AVE ELEV = 99.13

LENGTH = 7

C: BROAD CRESTED WIER

TABLE 10-4 PAGE 282

LINSLEY & FRANZINI, Water-Resources Engineering, 1972.

ELEV	HEAD	C	$Q = CLH^{3/2}$
99.13	0	—	0
100	.37	2.7	15.34 CFS
100.5	1.37	2.64	29.63
101	1.87	2.64	47.26
101.5	2.37	2.7	68.96
102	2.87	2.89	98.36
102.5	3.37		125.15
103	3.87		154.01
103.5	4.37		184.81
104	4.87		217.42
104.5	5.37		251.79
105	5.87		287.71
105.5	6.37	2.89	325.24

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM WIER 3 HYDRAULICS	[illegible]	[illegible]-04
	CHK BY	DATE 9-19-78

LEFT POND WALL

ELEV = 99.2',
LENGTH = 148'

$Q = CLH^{3/2}$

C: BROAD CRESTED WIER
TABLE 10-4 PG 282
LINSLEY & FRANZINI, Water-Resources Engineering, 1972

ELEV	HEAD	C	$Q = CLH^{3/2}$
99.2	0	0	0
100	.80	2.7	285.93 CFS
100.5	1.30	2.66	583.52
101	1.80	2.64	943.57
101.5	2.30	2.70	1393.85
102	2.80	2.89	2003.99
102.5	3.30		2564.07
103	3.80		3168.36
103.5	4.30		3813.84
104	4.80		4498.02
104.5	5.30		5218.83
105	5.80		5974.50
105.5	6.30	2.89	6763.48

EDWARD K. JORDAN JR., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM — WIER #2 HYDRAULICS	BDD	2593-04
	CHK BY	DATE
		6-8-79

RT WOOD WALL

ELEV = 100.0
LENGTH = 35

$Q = CLH^{3/2}$

C: BROAD CRESTED WIER
C = 2.63, From Brater & King, Handbook of Hydraulics, Table 5-3, p 5-40, 1970.

ELEV	HEAD	$Q = CLH^{3/2}$
100	0	0
100.5	.5	32.54 CFS
101	1	92.05
101.5	1.5	169.10
102	2	260.35
102.5	2.5	363.86
103	3	478.30
103.5	3.5	774.94
104	4	602.73
104.5	4.5	878.70
105	5	1029.15
105.5	5.5	1189.65

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
ROCK MILL DAM	[illegible]	[illegible]
HYDRAULICS	CHK BY	DATE
	[illegible]	[illegible]

SUBMERGED WEIR CALCS

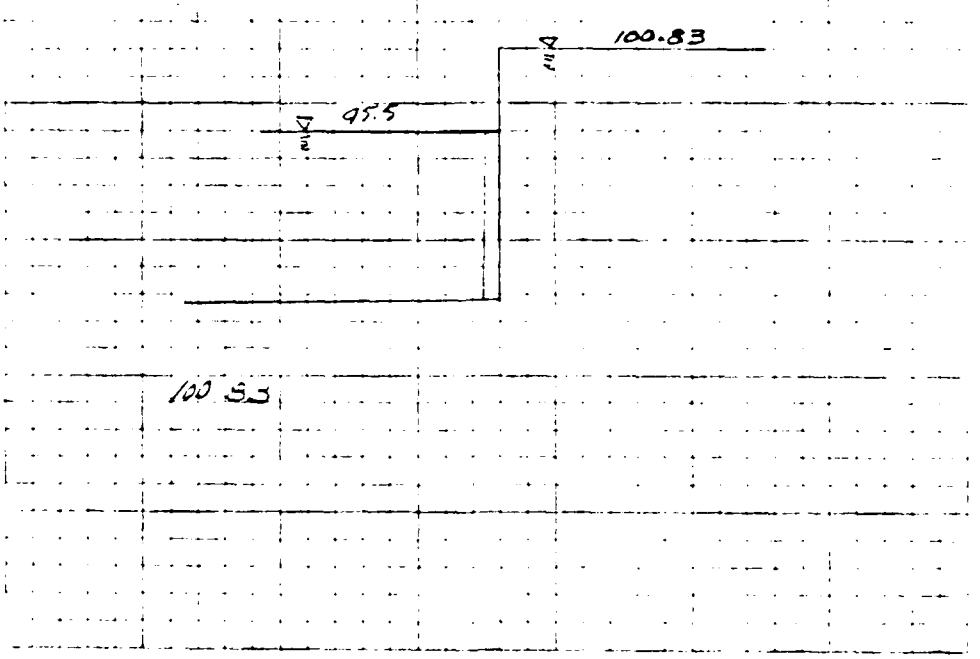
Top of Splashboards: 95.5

Orifice Flow @ 95.5 = 2393.00 CFS

Water Elev at Dam at a Discharge of 2393.00 CFS (Weirs 1, 2, 7 only) =

100.5	2137.69	
(100.83)	2393.00	396.12
101.0	2533.81	135.81

$\frac{X}{.5} = \frac{135.81}{396.12}$ $X = .17$



EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOE NO.
KNOX HILL DAM SUBMERGED SPILLWAY	CHK BY	DATE

Given: Crest 95.5
$H_1 = 97$
$Q = 2876.79$

① Assume. $H_1 = 101$
$Q_1 = 2933.81$

$\frac{97-95.5}{101-95.5} = .27$

$C' = .954$

$Q = (2933.81)(.954) = 2917.25$

② Assume $H_1 = 101.5$
$Q_1 = 2966.40$

$C' = .958$

$Q = (2966.40)(.958) = 2841.81$

$Q = 2876.79$
$\therefore H_1 = 101.07$

Given $H_2 = 100$
$Q_2 = 2769.13$

Assume: $H_1 = 103$
$Q_1 = 4445.28$

$C' = .778$

$Q = .778\,(4445.28) = 3458.43$

EDWARD C. JORDAN CO., INC.

PROJECT KNOX MILL DAM	COMP BY EJD	JOB NO.
	CHK BY STB	DATE 5-21-78

Assume $H_1 = 102$
$Q_1 = 3835.10$

$C' = .707$

$Q = .707 (3835.10) = 2378.15$

Assume $H_1 = 102.5$
$Q_1 = 3927.11$

$C' = .748$

$Q = .748 (3927.11) = 2937.48$

$Q = 2769.13$
$H_2 = 102.35$

Given: $H_2 = 104$
$Q_2 = 2814.91$

Assume $H_1 = 105$
$Q_1 = 7385.34$

$C' = .453$

$Q = (.453)(7385.34) = 3345.66$

Assume $H_1 = 104.5$
$Q_1 = 6142.72$

$C' = .351$

$Q = .351 (6142.72) = 2156.09$

$Q = 2814.91$
$H_1 = 104.78$

EDWARD G. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM	BPD	20552-04
SUBMERGED SPILLWAY	CHK BY	DATE
		9-22-79

GIVENS: $H_2 = 106$
$Q = 2904.29$

ASSUME: $H_1 = 106.5$
$Q_1 = 8000.55$

$C' = .323$

$Q = .323(8000.55) = 2584.18$

ASSUME $H_1 = 107$
$Q_1 = 9391.09$

$C' = .416$

$Q = .416(9391.09) = 3906.69$

$\therefore H_1 = 106.62$
$Q = 2904.29$

GIVENS: $H_2 = 108$
$Q = 2991.01$

ASSUME: $H_1 = 107$
$Q_1 = 12320.79$

$C' = .375$

$Q = .375(12320.79) = 4620.30$

ASSUME $H_1 = 108.25$
$Q = 11189.98$

$C' = .209$

$Q = .209(11189.98) = 2338.71$

$\therefore H_1 = 108.10$
$Q = 2991.01$

EDWARD C. JORDAN CO., INC.

PROJECT KNOX MILL DAM	COMP BY BPD	JOB NO. 2-593-A
	CHK BY BTB	DATE 8-22-78

GIVEN $H_2 = 110$
$Q = 3075.28$

ASSUME $H_1 = 110.5$
$Q_1 = 14692.21$

$C' = .255$

$Q = .255(14692.21) = 3746.51$

ASSUME $H_1 = 110.1$
$Q_1 = 14045.89$

$C' = .144$

$Q = .144(14045.89) = 2022.61$

$H_1 = 110.34$
$Q = 3075.28$

GIVEN $H_2 = 112$
$Q = 3157.30$

ASSUME $H_1 = 112.5$
$Q_1 = 18069.09$

$C' = .255$

$Q = .255(18069.09) = 4607.62$

ASSUME $H_1 = 112.1$
$Q_1 = 17374.81$

$C' = .144$

$Q = .144(17374.81) = 2501.97$

$H_1 = 112.22$
$Q = 3157.30$

FORM 121

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL DAM SUBMERGED SPILLWAY	BPD	20503-01
	CHK BY	DATE
		5-22-79

GIVEN: $H_2 = 114$
$Q = 3237.24$

ASSUME $H_1 = 1145$
$Q_1 = 21676.02$

$C' = .225$

$Q = .225(21676.02) = 4877.11$

ASSUME $H_1 = 114.1$
$Q_1 = 20903 = 95$

$C' = .144$

$Q = .144(209036.95) = 3014.92$

$\therefore H_1 = 114.15'$
$Q = 3237.24$

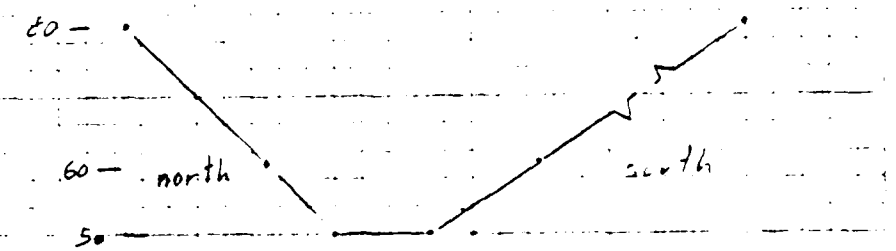
ORIFICE FLOWS GOVERN FROM THIS POINT ON.

OK

ORIFICE HAS FULL CONTROL

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX DAM [illegible] - VALLEY SECTION UPSTREAM OF KNOX MILL	CHK BY	DATE



200'	100'	146'	150'	650'

$S \approx 0.01$, $n = 0.05$ (gross streets? some trees)

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

ELEV. above MSL	DISCHARGE cfs
55	7260
60	27799
62	35563
63	46273
64	53425
65	62435

∴ MPF @ approximately Elev. 63'

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
	CHK BY	DATE

Flow @ El. 55:

$$Q = \frac{1.486}{0.05}\left(1012\right)\left(\frac{1012}{270}\right)^{2/3}\left(0.01\right)^{1/2}$$

$$Q = \underline{7260 \text{ CFS}}$$

Flow @ El 60:

$$Q = \frac{1.486}{0.05}\left(2650\right)\left(\frac{2650}{400}\right)^{2/3}\left(0.01\right)^{1/2}$$

$$Q = \underline{27,799 \text{ CFS}}$$

Flow @ El 62:

$$Q = \frac{1.486}{0.05}\left(3360\right)\left(\frac{3360}{500}\right)^{2/3}\left(0.01\right)^{1/2}$$

$$Q = \underline{35583 \text{ CFS}}$$

Flow @ El 65:

$$Q = \frac{1.486}{0.05}\left(5131\right)\left(\frac{5131}{620}\right)^{2/3}\left(0.01\right)^{1/2}$$

$$Q = \underline{62,435 \text{ CFS}}$$

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
	CHK BY	DATE

Flow @ El 64:

$$Q = \frac{1.486}{0.05}(4550)\left(\frac{4550}{580}\right)^{2/3}(0.01)^{1/2}$$

$Q = 53,425$ cfs

Flow @ El 63:

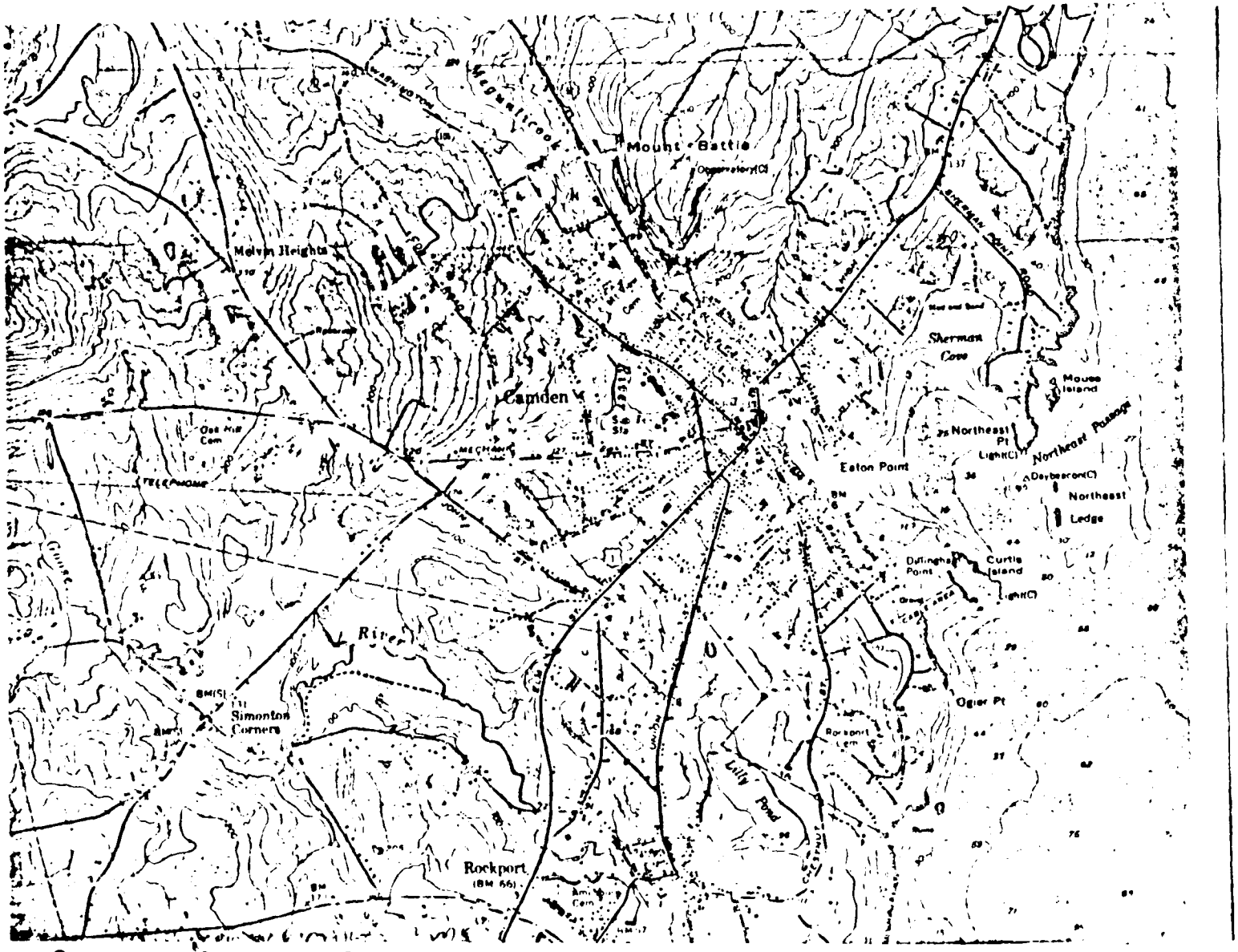
$$Q = \frac{1.486}{0.05}(4011)\left(\frac{4011}{525}\right)^{2/3}(0.01)^{1/2}$$

$Q = 46,273$

MPF = 44,600

MPF El ≅ 63'

NOT EL 75.7 as indicated in Dam Hydraulics, Valley Section would control indicating MPF pool of 63'.


Mount Battie
Melvin Heights
Camden
Sherman Cove
Mouse Island
Northeast Pt
Northeast Passage
Eaton Point
Daybeacon(C)
Northeast Ledge
Curtis Island
Dillingham Point
Ogier Pt
Simonton Corners
Rockport
(BM 66)
Lilly Pond

PROJECT	COMP BY	JOB NO.
FAILURE OF SOUTH WING WALL	[illegible]	205304
	CHK BY	DATE
	[illegible]	[illegible]-30-7[illegible]

FLOW @ FULL SPILLWAY ≅ 1300 CFS

LENGTH OF SOUTH WING WALL = 148'

$$Q_{p2} = \tfrac{8}{27} W_b \sqrt{g}\, Y_0^{3/2}$$

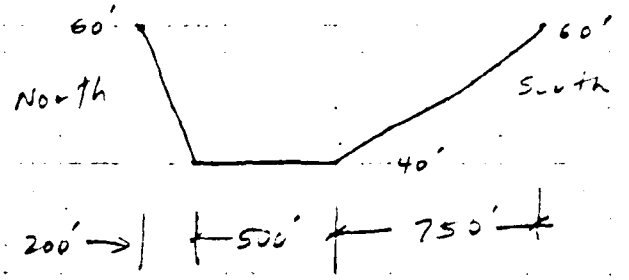
$Y_0 = 6'$

$W_b = 0.4(148) \cong 59$

$$Q_{p2} = \tfrac{8}{27}(59)\sqrt{g}\, 6^{3/2} = 1460 \text{ CFS}$$

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
RATING CURVE @ INT. OF MECHANIC & WASHINGTON STS.	LTD	05534
	CHK BY	DATE
	L.	8-30-78



$$S = \frac{20}{300} = 0.0667$$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$n = 0.05$

Q @ 42' :

$$Q = \frac{1.486}{0.05}\left(500 \times 2\right)\left(\frac{500 \times 2}{510}\right)^{2/3}\left(0.067\right)^{1/2}$$

$Q = 12{,}054$ CFS

Q @ 41' :

$$Q = \frac{1.486}{0.05}\left(500\right)\left(\frac{500}{500}\right)^{2/3}\left(0.067\right)^{1/2}$$

$Q = 3846$ CFS

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
RATING CURVE (CONT.)	LTL	2053 04
	CHK BY	DATE
	ILL	8-30-78

SINCE Qpl from a breaching of the south wing wall is 1460 CFS and 1' of depth of flow will conduct a flow of about 3850 CFS, it may be concluded that sheet flow through the street of London to the ocean would occur if the south wall were breached. There would be damage in the flood plain.

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
KNOX MILL POND STORAGE	CHK BY	DATE 2-22-78

Area of Knox Mill Pond = 1.1 Acres

Depth from crest to bottom @ dam = 13.4'

Assume Constant depth of 13.4'

Storage @ Crest, S:

$S = 13.4 - (1.1) = 14.7$ Ac-Ft

$\sim$ 15 Ac-Ft

Storage @ Full Spillway (El 54.35):

$S = (13.4 + 4.35)(1.1) = 19.52$

$\sim$ 20 Ac-Ft

Incremental Storage = 5 Ac-Ft

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
DAM FAILURE HYDROGRAPHS	[illegible]	[illegible] 54
	CHK BY	DATE
	[illegible]	6-25-78

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

$W_b = .4\,(51) = 20.4'$

$Y_o = 26.6'$

$$Q_{p1} = \frac{8}{27}\,(20.4)(\sqrt{g})\,26.6^{3/2}$$

$Q_{p1} = \underline{4705\ CFS}$

The tailrace opening under Knox Mill can only conduct 2500 cfs with a pool elev even with full spillway (elev 99.1'). Energy from the dam breaching would be dissipated by the factory. However, there would be the danger of the loss of many lives in the factory.

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	NUMBER	STATE	COUNTY	CONG DIST	STATE	COUNTY	CONG DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
23	03	ME	13	02				KNOX MILL DAM	4412.5	6904.0	18	JUL	78

POPULAR NAME	NAME OF IMPOUNDMENT
	KNOX MILL POND

REGION	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI)	POPULATION
01	MEDUNTICOOK RIVER	CAMDEN	0	4000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC TURAL HEIGHT (FT)	HYDRAU LIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
EARTH	1900	S	27	27	20	15	FED	N	N	N	N	22SEP78

REMARKS

SPILLWAY TYPE	SPILLWAY LENGTH (FT)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PRODUCED (MW)	NAVIGATION LOCKS NO	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
1	51	R	1500	2450										

OWNER	ENGINEERING BY	CONSTRUCTION BY
CAMDEN WATER & POWER CO		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
EDWARD C JORDAN CO, INC	18	JUL	78	PL 92-367

REMARKS

END

FILMED

8-85

DTIC