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NEW ENGLAND DIV AUG 78

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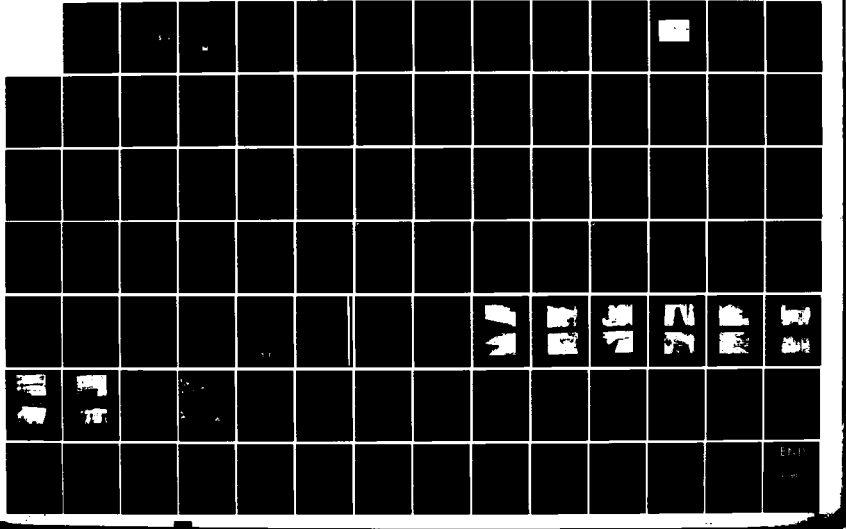

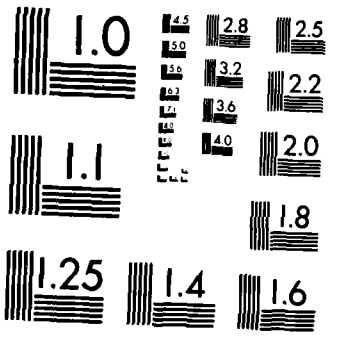

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PISCATAQUA RIVER BASIN
MIDDLETON, NEW HAMPSHIRE

SUNRISE LAKE DAM
NH 00310

STATE NO 157.01

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)

DAMS, INSPECTION, DAM SAFETY,

Piscataqua River Basin
Middleton, New Hampshire
Unnamed tributary of the Cocheco River

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

THe dam is 19 ft. high and is 665 ft. long. It is an earthen embankment with a downstream vertical dry stone masonry wall. The dam is in poor condition. There are some major concerns which should be implemented. Based on size and hazard classifications in accordance with Corps guidelines, the test flood is the Probable Maximum Flood.

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SUNRISE LAKE DAM

NH 00310

PISCATAQUA RIVER BASIN
MIDDLETON, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00310
Name of Dam:	Sunrise Lake Dam
Town:	Middleton
County and State:	Strafford County, New Hampshire
Stream:	Unnamed tributary of the Cocheco River
Date of Inspection:	21 June 1978

BRIEF ASSESSMENT

Sunrise Lake Dam is 19 feet high, averages about 16 feet wide and is 665 feet long. It is an earthen embankment with a downstream vertical dry stone masonry wall. The central section upstream-side wall is also vertical dry masonry with a concrete facing. Beyond the central section, the upstream slopes are faced with riprap. It has a 3'x3' low-level gate, mechanically operated, located below an 8' wide by 2' high uncontrolled spillway. Maximum storage capacity is about 2,000 acre-feet. Sunrise Lake is now used for recreation; it is 1.2 miles long and has a surface area of over 250 acres.

The dam is in poor condition. Major concerns are as follows: seepages near the downstream toe of the dam, bulge in the downstream vertical wall, inadequate spillway discharge capacity, construction of two residences immediately downstream of the dam, deterioration and spalling of the concrete facing on the upstream vertical masonry wall, and trees and brush growing on the dam.

Based on size and hazard classifications in accordance with Corps guidelines, the test flood is the Probable Maximum Flood. A PMF outflow of 2200 cfs (673 csm) would overtop the dam by 1.4 feet; therefore the spillway is considered inadequate. The spillway will pass 45 cfs, or 2 percent of the PMF. A major breach at maximum pool would probably result in the loss of more than 10 lives and appreciable property damage.

The owner, Sunrise Lake Lands Association should retain the services of a registered professional engineer and implement his consideration of the recommendations given in Section 7.2. within one year after receipt of this Phase I Report. The operating and maintenance measures recommended in Subsection 7.3.b. should be implemented within six months after receipt of this Phase I Report. Until these recommendations are considered, the owner should perform immediately an appreciable lowering of the lake to provide interim storage because of the inadequacy of the spillway.

Warren A. Guinan
Project Manager
N.H. P.E. No. 2339

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

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

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

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers (OCE), 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 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.

CONTENTS

REPORT

APPENDICES

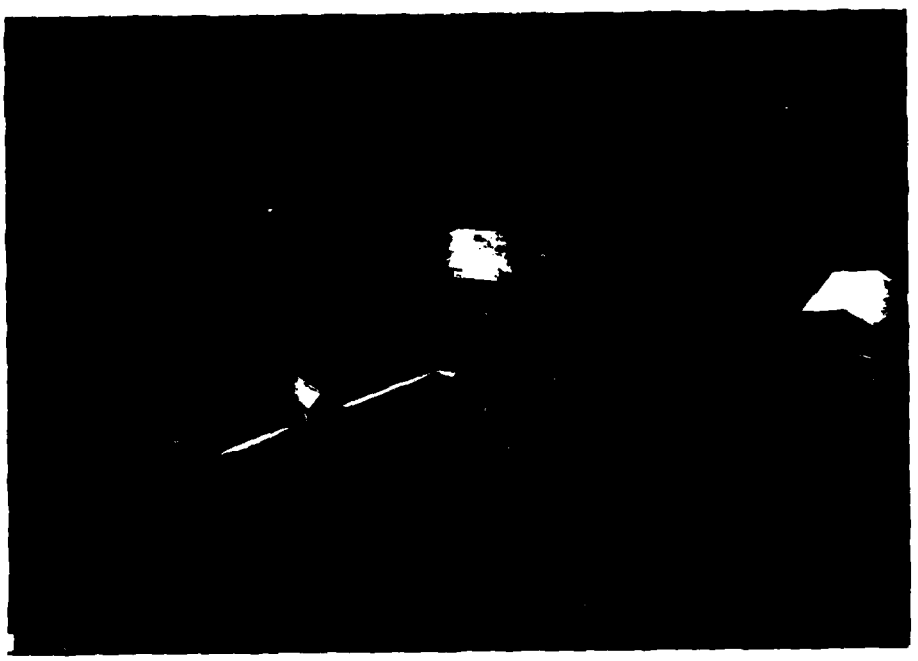
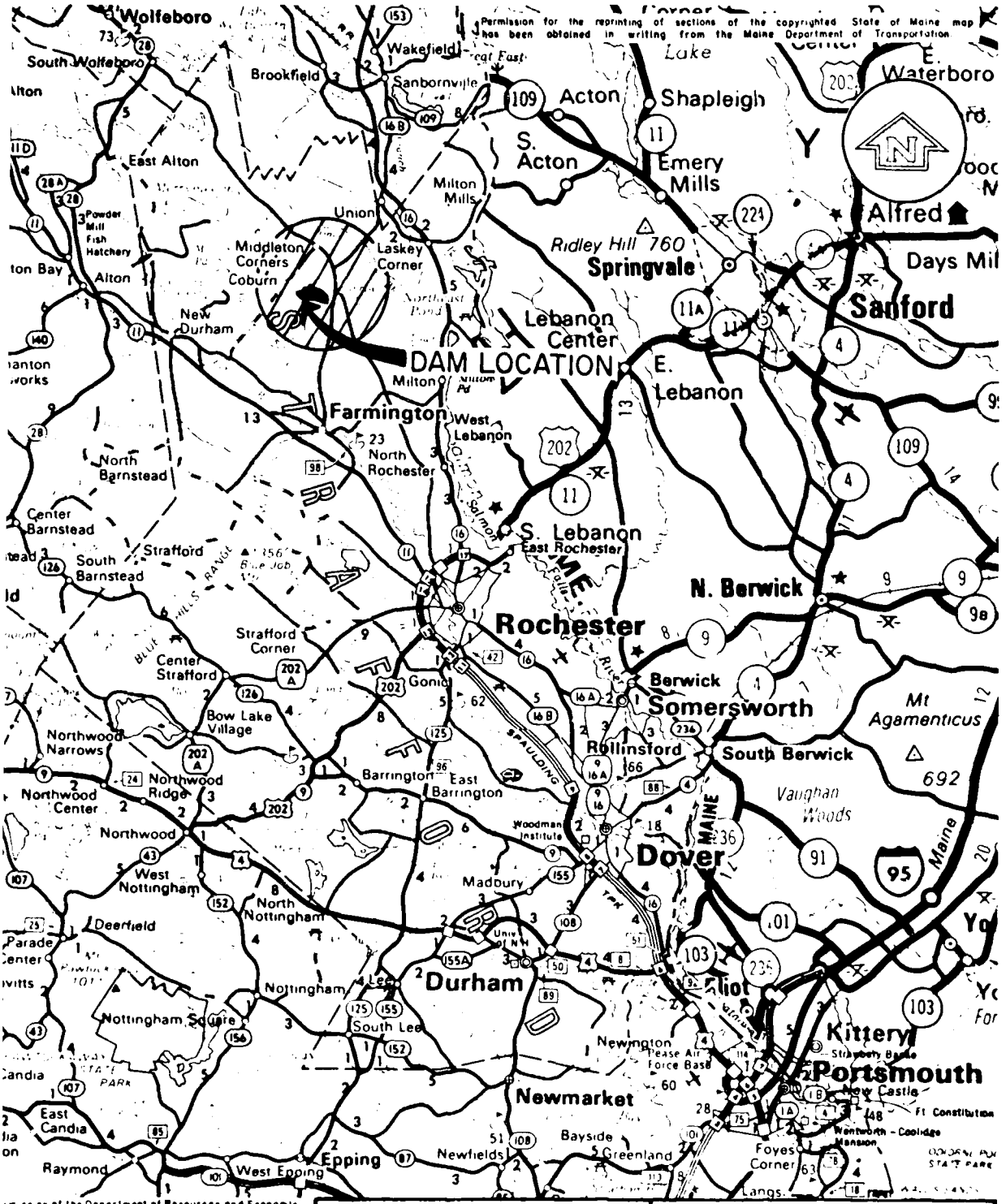


Figure 1 - Overview of Sunrise Lake Dam.



Anderson-Nichols & Co., Inc.	U.S. ARMY ENGINEER DIV NEW ENGLAND
CONCORD NEW HAMPSHIRE	CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SUNRISE LAKE DAM
LOCATION MAP

SUNRISE LAKE — NEW HAMPSHIRE

			SCALE 1" = 5 M.
			DATE AUGUST 1978

SCALE IN MILES

0 5

ED ON STATE OF NEW HAMPSHIRE-
MAINE OFFICIAL HIGHWAY MAPS

NATIONAL DAM INSPECTION REPORT
PHASE I INSPECTION REPORT
SUNRISE LAKE 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. Anderson-Nichols & Company, Inc. 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 Anderson-Nichols under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0329 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

Location. Sunrise Lake Dam is located in the Town of Middleton, New Hampshire. Sunrise Lake Dam spans an unnamed tributary to the Cocheco River. The dam is about 2 miles above the tributary's confluence with the Cocheco River, which is a major tributary of the Piscataqua River. The dam is shown on the U.S.G.S. Quadrangle, Alton, New Hampshire with coordinates approximately at N 43° 27' 12", W 71° 04' 55", Strafford County, New Hampshire (See Location Map page vii.)

b. Description of Dam and Appurtenances. Sunrise Lake Dam is an earthen embankment contained by a downstream vertical dry masonry (stone) wall. The upstream face of the dam contains

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Inspection. The visual inspection revealed two areas of possible stability problems:

(1) seepage at the downstream toe of the dry masonry wall at several locations and

(2) bulge in the downstream dry masonry wall.

Trespassing on the crest of the dam could lead to serious erosion over the long-term if it is not stopped. Tree roots that cross the crest of the dam could also lead to piping during periods of high reservoir level after roots have decayed.

Other problems noted during the visual inspection do not have an immediate impact on the structural stability. However, if left uncorrected, they could lead to long-term instability. These include the deteriorated condition of the upstream concrete facing, inadequate spillway capacity, trespassing on the crest of the dam, the poor condition of the gatehouse, and activities at the residences next to the downstream toe of the dam.

b. Design and Construction Data. No information regarding the original design and construction were disclosed. Available design drawings indicate the original upstream stone masonry was refaced with concrete and a new gate installed in 1939. However, no information is available about the as-constructed dimensions or the character of the earth fill used in constructing the dam.

c. Operating Records. No records pertinent to the structural stability of the dam were disclosed.

d. Post-Construction Changes. In 1939, the central portion of the upstream side of the dam was faced with a reinforced concrete wall and a new low-level outlet gate installed.

e. Seismic Stability. This dam is in Seismic Zone 2 and hence does not have to be evaluated for seismic stability according to the OCE Recommended Guidelines.

recommended test flood is the Probable Maximum Flood. The test flood inflow for Sunrise Lake Dam, having a drainage area of 3.27 square miles, was determined to be 2780 cfs (850 csm). The test flood discharge after routing was determined to be 2200 cfs (673 csm).

SECTION 5
HYDROLOGIC AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. Design Data. No original hydrologic and hydraulic design data (circa 1877) were disclosed for Sunrise Lake Dam. However, hydrologic and hydraulic information, dating from the ownership of the structure by the Old Colony Woolen Company (about 1920) to the present ownership by the Sunrise Lake Lands Association, were found and assessed to determine their acceptability in evaluating the overtopping potential of Sunrise Lake Dam.

b. Experience Data. No information regarding past overtopping of Sunrise Lake Dam was found.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping at the time of the inspection. Debris may partially obstruct the spillway opening and cause a serious reduction in the capacity of the spillway during a flood occurrence.

d. Overtopping Potential. The inadequacy of the spillway and the current operating procedures make overtopping potential great during periods of high runoff. Sunrise Lake Dam is unable to pass the test flood without overtopping. The water depth over the dam embankment was calculated to be 1.4 feet. In fact, the spillway capacity is only 2 percent of the test flood.

Sunrise Lake Dam is classified as being intermediate in size having a maximum storage of 1,900 acre-feet. The normal recreation level has a surface area of 257 acres, which is equivalent to 12 percent of the watershed.

To determine the hazard classification for Sunrise Lake Dam, the impact of failure of the dam at maximum pool was assessed using Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to Farmington, a distance of about 5 miles. Failure of Sunrise Lake Dam at maximum pool would probably result in an increase in stage of approximately 9 feet. An increase in water depth of this magnitude would probably result in the loss of more than 10 lives and appreciable property damage.

As a result of the analysis described above, Sunrise Lake Dam was classified - High Hazard. Using OCE Recommended Guidelines for Safety Inspection of Dams, the

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed. The dam has been operated by the Sunrise Lake Lands Association since 1971. During the summer months, the gate is closed, allowing for control of the lake level by discharge over the spillway. The water elevation through the recreational season is maintained reasonably constant at 666 ft. MSL.

In the fall, the gate is operated, and the lake level drawn down 3 to 4 feet. In addition, every nine years the lake is lowered 9 feet, allowing abutters to make improvements to their shoreline. The next scheduled nine-foot drawdown is for 1985.

4.2 Maintenance of Dam

Sunrise Lake Dam is maintained by the Sunrise Lake Lands Association. No formal maintenance procedures were disclosed. When the lake is drawn down, the condition of the dam is visually checked, and minor repairs are made if deemed necessary. An attempt is made to keep vegetative growth to a minimum.

4.3 Maintenance of Operating Facilities

The dam is visited by Mr. Guy Richardson, the operator, on a weekly basis.

No formal maintenance schedule for the operating mechanisms was disclosed. The gate is operated periodically. (See Section 4.1)

4.4 Description of Any Warning System in Effect

No description of any warning system was disclosed.

4.5 Evaluation

Because of the poor condition of the dam, the present assessment reflects major problems that are not amenable to simple operating and maintenance procedures. However, the operating and maintenance procedures for Sunrise Lake Dam, consisting of a weekly program of inspection, should insure that all minor problems encountered can be remedied within a reasonable period of time. The Sunrise Lake Lands Association should also establish a surveillance and warning program to follow in the event of flooding.

repaired, could lead to cracking of the facing and piping through the embankment.

The construction of cottages near the downstream side of the dam and consequent removal of the vegetation, combined with the seepage that is occurring between the dam and the camps, could lead to long-term integrity problems.

The leakage around the conduit opening does not indicate piping at present; however, it could affect the integrity of the dam and should be corrected.

downstream slope of the dike and the valley downstream of the dike are covered with trees and brush.

d. Reservoir Area. The watershed above the reservoir is gently to steeply sloping and heavily wooded. (See Appendix C - Figure 17.) Many cottages occupy the shoreline. Little sedimentation was observed in the reservoir.

e. Downstream Channel. The bottom of the channel downstream of the overflow spillway and low-level outlet is covered with sand, gravel, and boulders. Trees and brush are growing adjacent to the channel. The channel itself contains some debris (See Appendix C - Figure 18.)

Two dwellings, one apparently built within the last few years and the other now under construction, are located immediately downstream of the dam west of the gatehouse. (See overview photo - Figure 1.) The construction of these residences has resulted in removal of the vegetative cover close to the downstream toe. Water wells have been installed near the downstream side of the dam at these buildings.

3.2 Evaluation

Based on the visual inspection, the condition of Sunrise Lake Dam is poor.

Several seepages were noted near the downstream toe, one of which may have resulted in piping (although it was not possible to reach a conclusion on the basis of the visual inspection as to whether or not piping had occurred). These seepages are large enough and sufficiently widespread that they could lead to instability. Operating records, which are described elsewhere in this inspection report, indicate that major seepage has been observed at least since 1950 and that sometime prior to 1954, backfill was required for a hole in the crest of the embankment east of the spillway.

A significant bulge in the downstream dry masonry wall east of the gatehouse is evidence that the stability of that wall is marginal in that location, and may be marginal elsewhere.

The trees growing on and near the downstream side of the dam could lead to stability problems if a tree blows down and its roots are pulled out during a storm, or if a tree dies or is cut, and its roots decay.

The deterioration and spalling of the concrete facing on the upstream side of the central section of the dam, if not

Several seepages were observed immediately downstream of the dam, both east and west of the gatehouse. (See Appendix C - Figure 11.) The discharge water was clear from these seepages at the time of the inspection. Sand was noted at the surface near one seepage, but it was not possible to determine whether this sand was part of the natural ground or whether piping has taken place at this seepage.

Two dwellings, one apparently built within the last few years and the other now under construction, are located immediately downstream of the dam west of the gatehouse. (See overview photo - Figure 1.) The construction of these residences has resulted in removal of the vegetative cover close to the downstream toe. Water wells have been installed near the downstream side of the dam at these buildings. No other adverse effects of the construction were visible.

c. Appurtenant Structures. The gatehouse is in poor condition. (See Appendix C - Figure 12.) During the inspection the sluice gate was opened and closed with a minimum of effort. The gate operating mechanism appeared to be well maintained. Although flow was coming out of the discharge unit, it could not be determined whether the gate was leaking. However, leakage in the masonry face of the dam about two feet around the conduit opening was observed. The leak was clear.

The small uncontrolled spillway is about 14 feet above the invert of the outlet conduit. (See Appendix C - Figure 13.) The spillway is 8 feet wide by 24 feet long, with 2-foot sidewalls. (See Appendix C - Figure 14.) The sidewalls are of cut stone; the apron appears to be a concrete slab. The concrete shows signs of spalling. (See Appendix C - Figure 15.) The gatehouse rests upon concrete slabs. These slabs span the 8-foot spillway. Thus, the upstream opening of the spillway is subject to collecting debris and could become clogged or blocked rather easily. A small wooden box (pile trash rack) has been constructed around the gatehouse, presumably to collect debris. (See Appendix C - Figure 12.) Several timbers in this box are considerably rotted above the water line.

At the southeast end of Sunrise Lake is a dike that prevents flow from discharging from the reservoir into Dames Brook. The dike is about 270 feet long, 7 feet high, 50 feet wide at the crest, and with 1.8 feet of freeboard at the time of the inspection. (See Appendix C - Figure 16.) Wolfeboro Road runs along the crest of the dike. Trees and brush are growing on the upstream slope and erosion that is caused by runoff from the roadway is actively taking place. An area near the north end of the dike is used as a bathing beach, and a house is sited near the south abutment. The

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Sunrise Lake Dam is a low dam which impounds a reservoir of intermediate size. The watershed above the reservoir is gently to steeply sloping and heavily wooded. The downstream area is gently sloping and heavily wooded. There is a low dike at the southeastern end of Sunrise Lake about 1.1 miles from the dam.

b. Dam. Sunrise Lake Dam is an earthen embankment about 19 feet high, 665 feet long, 14 to 26 feet wide at the crest, and with a freeboard of 1.8 to 2.5 feet at the time of inspection. The downstream face of the dam is a vertical dry masonry wall for its entire length. (See Appendix C - Figure 2.) The upstream face of the dam contains a central section with a vertical dry masonry wall, faced with concrete, for a distance of about 47 feet east and 57 feet west of the gatehouse. (See Appendix C - Figure 3.) Between this central section and the abutments, the upstream face is riprapped. (See Appendix C - Figure 4.) An apparent corewall is visible midway between the upstream and downstream edges of the crest for a short distance west of the central section of the dam; the visible portion of the wall is made of concrete block. (See Appendix C - Figure 5.)

The crest of the central section of the dam is covered with grass. The crest between the central section and the abutments is covered with grass and brush, and there is a path which appears to have been made by foot and motorcycle traffic. (See Appendix C - Figure 6.)

The concrete facing on the upstream side of the central section of the dam, which was built in 1939, is badly deteriorated and spalled. (See Appendix C - Figures 7, 8, and 9.) Brush is growing on the upstream facing between the central section and the west abutment. Brush and trees are growing on the crest and on the upstream face between the central section and the east abutment. (See Appendix C - Figure 10.) Near the top of the downstream dry masonry wall are some trees and stumps. An extensive growth of trees and brush was noted immediately downstream of the dam next to the downstream dry masonry wall.

East of the gatehouse, the downstream dry masonry wall has a substantial bulge; minor bulges were noted elsewhere.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Sunrise Lake Dam. Two blueprint plans of the 1939 rehabilitation of the structure by Alonzo B. Reed Engineers of Boston, Massachusetts were found. (See Appendix B.)

2.2 Construction

No information concerning the original construction was disclosed. The only data found pertaining to the 1939 reconstruction were the plans mentioned in Section 2.1 above.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Only a limited amount of data pertaining to the actual design and construction of Sunrise Lake Dam were disclosed. A search of the files of the NHWRB revealed only a limited amount of recorded information.

b. Adequacy. The information obtained from extensive data collection efforts was not sufficient to determine the hydraulic characteristics of Sunrise Lake Dam. Supplemental data established by field investigation was needed to complete the hydraulic analysis. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on visual inspection and hydrologic and hydraulic analysis.

c. Validity. The visual inspection is generally consistent with the 1939 reconstruction plans for the exposed portions of the dam.

(2) Length of weir - 8'

(3) Crest elevation - 666' MSL

(4) Gates - not applicable

(5) U/S Channel - Sunrise Lake

(6) D/S Channel - The downstream channel consists of a small open channel with sand, gravel, and boulders on the bottom. Trees and brush are growing adjacent to the channel.

f. Reservoir Surface (acres)

(1) Top of dam - 270 (based on Wolfeboro Road Dike)

(2) Test flood pool - 287

(3) Flood control pool - not applicable

(4) Recreation pool - 257

(5) Spillway crest - 257

g. Dam

(1) Type - earthen embankment with the downstream side faced by a nearly vertical dry masonry wall. A portion of the upstream face in the vicinity of the outlet facilities consists of a vertical dry masonry wall that has been refaced with concrete. The remainder of the upstream face is riprapped.

(2) Length - 665' (measured)
- 720' (from past inspection reports)

(3) Height - 19' (structural height)

(4) Top width - ranges from 13' to 15' (earth crest); top width at the spillway - 23'

(5) Side slopes - vertical

(6) Zoning - unknown

(7) Impervious core - concrete block corewall visible for short distance west of spillway - extent unknown.

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel. The outlet through the dam is built integrally with the dam's downstream wall. The upstream invert of the opening is about 2 feet higher than the bottom of the channel at the outfall. The downstream portal is 30 inches wide and 28 inches high. A 3' x 3' gate is fitted to the upstream portal.

i. Spillway

(1) Type - ungated

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

(6) Total spillway capacity at maximum pool elevation - 45 cfs @ 667.6' MSL.

(7) Total project discharge during test flood - 2200 cfs @ 669.3' MSL.

c. Elevation (ft. above MSL) (Elevations are relative to assumed spillway elevation; see (5) below.)

(1) Top of dam - Dam embankment - 667.9; Wolfeboro Road Dike - 667.6

(2) Test Flood - 669.3

(3) Full Flood control pool - not applicable

(4) Recreation pool - 666

(5) Spillway crest - 666 (obtained from U.S.G.S. Quadrangle sheet and assumed to be spillway elevation)

(6) Upstream portal invert low-level conduit - 651.5

(7) Streambed at centerline of main dam - 649 (downstream below gated outlet measured 7/26/78)

(8) Maximum tailwater - unknown

(9) Design surcharge (original design) - unknown

d. Reservoir (miles)

(1) Length of maximum pool - 1.2

(2) Length of recreational pool - 1.2

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 1,370

(2) Flood control pool - not applicable

(3) Test Flood pool - 2,450

(4) Top of dam - 1,900 (based on Wolfeboro Road Dike)

The earliest reported repair to Sunrise Lake Dam is the reconstruction of the gatehouse in 1938. In 1939, the upstream masonry wall wa. refaced with concrete and a new gate installed. Sometime between 1950 and 1954, the downstream masonry was relaid where found necessary. Also in this period a hole in the embankment on the top of the dam to the left of the spillway was backfilled, and a leak along the downstream face at the angle in the embankment to the right of the spillway was plugged. Most recently, in the spring of 1977, trees and brush along the embankment were removed.

i. Normal Operational Procedures. No formal operating and maintenance procedures were disclosed for Sunrise Lake Dam. The normal lake elevation during the summer months is about 666 feet MSL. This level is maintained, with the gate closed, by discharge over the uncontrolled spillway, and is dependent on the natural hydrologic conditions of the watershed. After the recreational season, the lake is lowered 3 to 4 feet by operating the 3' x 3' gate. The dam is visited weekly.

j. Regulating Outlets. A low-level outlet, fitted with a 3 x 3-foot wooden gate is nearly centrally located in the dam. The outlet is vertically below the 8-foot wide ungated spillway. The invert of the outlet is 14.5 feet lower than the spillway crest. The gate is operated mechanically from a small gatehouse that is built over the spillway.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 3.27 square miles (2,090 acres) of gently to steep sloping wooded terrain. The normal recreation level has a surface area of 257 acres, which is equivalent to 12 percent of the watershed.

b. Discharge at Damsite

(1) Outlet Works (conduits) - 28" high x 30" wide @ Invert Elevation 651.5' MSL. Capacity at spillway crest elevation - 135 cfs @ 666' MSL.

(2) The maximum known flood discharge at the damsite is unknown. No records of past overtopping were disclosed.

(3) Ungated spillway capacity at maximum pool elevation - 45 cfs @ 667.6' MSL.

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

a central section of vertical dry masonry wall. Beyond the central section, riprap covers the upstream face. The dam is 19 feet high, ranges from 14 to 25 feet wide at the crest, and is 665 feet long. The central sections contain an 8-foot ungated overflow spillway that is located above a low-level gated outlet. A mechanically operated 3'x3' gate has been fitted over this outlet. A small wooden shed covers the operating mechanism. A dike at the southeastern end of the lake prevents outflow in that area. Wolfeboro Road runs across the top of the dike.

c. Size Classification. Intermediate (Hydraulic height-19 feet, Storage - 1,900 acre-feet) based on storage ($\geq$1,000 to <50,000 acre-feet) as given in the OCE Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. High hazard. A major breach would probably result in the loss of more than 10 lives and appreciable property damage.

e. Ownership. Sunrise Lake Dam is reported to have been built for a downstream mill sometime prior to 1877 for water conservation as part of their milling operations. Sometime before 1917, ownership passed to the Rochester Woolen Company. The Old Colony Woolen Company obtained the dam and water rights between 1917 and 1922. Wyandotte Industries Corporation acquired possession of Sunrise Lake Dam and the water rights sometime between 1922 and 1935. On July 29, 1957, the New Hampshire Legislature officially changed the name of the impoundment provided by Sunrise Lake Dam from the Dump Reservoir to Sunrise Lake. Upon liquidation of Wyandotte Industries Corporation in 1971, ownership transferred to the Sunrise Lake Lands Association.

f. Operator. The Sunrise Lake Lands Association is responsible for the operation of Sunrise Lake Dam. The current president of the organization is Mr. Guy Richardson, 16 Lakeshore Drive, Middleton, New Hampshire(mailing address, RFD 1, Union, New Hampshire 03887). Phone (603) 755-3967.

g. Purpose of Dam. Sunrise Lake Dam was originally constructed to impound a reservoir that provided greater industrial water storage for downstream users. However, throughout its history, one of the principal uses of Sunrise Lake has been recreational. Sunrise Lake has been used solely for recreational purposes since ownership passed on to the Sunrise Lake Lands Association in 1971.

h. Design and Construction History. Little information was disclosed concerning the original design and construction of the dam. It is believed that the structure is basically double walled dry masonry with an impervious earth core.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that Sunrise Lake Dam is in poor condition. The major concerns with respect to the long-term integrity of the dam are:

(1) Seepages near the downstream toe of the dam, one of which may have had some associated piping,

(2) Bulge in the downstream dry masonry wall,

(3) Inadequate spillway capacity,

(4) Construction of two dwellings close to the downstream toe of the dam,

(5) Deterioration and spalling of the concrete facing on the upstream side of the central section of the dam,

(6) Evidence from the operating records that a hole in the crest of the embankment east of the gatehouse required backfilling,

(7) Trees and brush growing on the dam,

(8) Leakage around the conduit,

(9) Erosion of the upstream face and trespassing near the abutments of the dike at the southeast end of Sunrise Lake, and

(10) Trees and brush growing on the dike.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the visual inspection.

c. Urgency. The recommendations made in 7.2 below should be implemented by the owner within one year after receipt of this Phase I report. The operating and maintenance procedures in 7.3.b. below should be implemented by the owner within 6 months after receipt of this Phase I report.

d. Need for Additional Investigation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.1.a. above. These problems require the attention of a competent engineer

who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations

The owner should retain the services of a Registered Professional Engineer to:

(1) Evaluate further the hydrology and hydraulics of the dam and reservoir, and design additional spillway discharge capacity.

(2) Specify measures to control or eliminate the seepages downstream of the dam and leakage around the conduit.

(3) Investigate the stability of the downstream dry masonry wall and design remedial measures as needed.

(4) Initiate immediate appreciable lowering of the lake to provide interim storage due to the inadequacy of the spillway.

7.3 Remedial Measures

a. Alternative. Purchase downstream land that would be adversely impacted by dam failure and restrict human occupancy.

b. Operating and Maintenance Procedures. The owner should:

(1) Clear the trees and brush growing on the dam and 50 feet downstream of the dam, remove the roots, and backfill with suitable soil. Maintain the dam and downstream area free of trees and brush.

(2) Establish requirements for the owners of the houses next to the downstream toe to ensure that they do not undertake activities that will adversely affect the stability of the dam.

(3) Monitor the seepage downstream of the dam on a weekly basis.

(4) Establish a surveillance and warning program to follow in event of floodflow conditions or imminent dam failure.

(5) Investigate and determine source of flow from low-level discharge conduit, and repair as required to stop flow.

(6) Repair gatehouse.

(7) Clear the trees and brush growing on the dike and 25 feet downstream of the dike, remove the roots, and backfill with suitable soil. Maintain the dike and downstream area free of trees and brush.

(8) Control trespassing and erosion on the upstream slope and abutments of the dike.

(9) Continue periodic inspection systems on a bi-annual frequency.

APPENDIX A

CHECK LIST - VISUAL INSPECTION

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Sunrise Dam, NH

DATE June 21, 1978

TIME 10:00 a.m.

WEATHER Cloudy, Cool

W.S. ELEV. 666.3 U.S. 649 DN.S.

PARTY:

1. Warren Guinan
2. Robert Langen
3. Stephen Gilman
4. Ronald Hirschfeld
5. John Falcione (6 June 1978)
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	R. Langen	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.	Mechanical	J. Falcione	
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Sunrise Dam, NH DATE June 21, 1978

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	667.9
Current Pool Elevation	666.3
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed
Lateral Movement	Downstream dry masonry wall bulges locally
Vertical Alignment	Good
Horizontal Alignment	See "Lateral Movement" above
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	None observed
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	None observed
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Several seepages
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Sunrise Dam, NH DATE June 21, 1978

PROJECT FEATURE Overflow Spillway NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Approach channel is Sunrise Lake
Slope Conditions	Vertical slopes
Bottom Conditions	Not visible
Rock Slides or Falls	None
Log Boom	Wood plank - badly deteriorated and missing
Debris	None
Condition of Concrete Lining	Not visible
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Fair, surface spalled
Stop Logs and Slots	Slots in granite - no evidence of use.

PERIODIC INSPECTION CHECK LIST

PROJECT Sunrise Dam, NH DATE June 21, 1978

PROJECT FEATURE Overflow Spillway NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Slab over outlet channel
General Condition	Visible portion fair - surface spalled
Condition of Joints	
Spalling	Yes - on surface
Visible Reinforcing	None
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	None
Joint Alignment	None
Unusual Seepage or Leaks in Gate Chamber	Yes
Cracks	Minor
Rusting or Corrosion of Steel	Minor
b. Mechanical and Electrical	
Air Vents	Hand operated sluice gate-maintained in good condition. Operator opened and closed gate with minimum of effort
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECK LIST

PROJECT Sunrise Dam, NH DATE June 21, 1978

PROJECT FEATURE Overflow Spillway NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Stone masonry with concrete surface Concrete missing in one 2'x2' area
Rust or Staining on Concrete	Minor
Spalling	Minor
Erosion or Cavitation	None except where mortar lining is missing
Cracking	Minor
Alignment of Monoliths	Not applicable
Alignment of Joints	Good
Numbering of Monoliths	Not applicable

PERIODIC INSPECTION CHECK LIST

PROJECT Sunrise Dam, NH DATE June 21, 1978

PROJECT FEATURE Outlet Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	Clear leakage noted out to 2' around conduit in masonry face.
Condition at Joints	
Drain holes	
Channel	
Loose Rock or Trees Overhanging Channel	Trees and brush overhanging channel
Condition of Discharge Channel	Fair, consists of sand, gravel and boulders

PROJECT Sunrise Dam, NH

DATE June 21, 1978

PROJECT FEATURE Reservoir

NAME R. Langen

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	Not visible
Changes in Watershed Runoff Potential	Minor
Upstream Hazards	Many homes; lowest is 6' above lake
Downstream Hazards	Two new homes immediately downstream of dam
Alert Facilities	None observed
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None observed

APPENDIX B

INSPECTION REPORTS/SKETCHES

State of New Hampshire

WATER RESOURCES BOARD

37 Pleasant St.
CONCORD 03301

December 7, 1976

Guy Richardson, Pres.
rise Lake Association
l
on, New Hampshire 03887

r Sir:

er the provisions of RSA Chapter 482, Sections 8 through 15, copy
losed, on September 30, 1976, an engineer of the Water Resources Board
pected your dam in Middleton, New Hampshire. This Dam #157.01 is
ssified in the files of this office as a menace structure and as such
t be maintained in a manner not to endanger public safety nor become
lam in disrepair.

a result of this inspection, it was noted that several items of main-
ance or repair are in need of attention:

1. The trees on the embankment are to be removed. This is to prevent possible damage to the embankment or structure by the roots or by an entire tree being uprooted.

2. The seepage located on the left hand side of the dam just downstream from the embankment should be watched. Any increase in this amount of seepage should immediately reported to the Water Resources Board.

cause this dam is classified as a menace structure, we require that you
nd us a proposed schedule of repairs within thirty (30) days. If you
ve any questions, please contact us at your convenience.

Sincerely,

George McGee Sr.

George M. McGee, Sr.
Chairman

M/SCB:L

t.

: Board of Selectmen-Middleton

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Middleton Dam Number: 157.01

f Dam, Stream and/or Water Body: Sunrise Lk

Sunrise Lk Assoc Telephone Number:

g Address: Geo. Richardson RFD 1 . Union NH Pres.

eight of Dam: 10 Pond Area: 350 ± Length of Dam: 700

TION: Earth ?

WORKS: 3 concrete 1' 10" Flashboard

2 & 3 gate in operational condition

NTS: Stone & Concrete in good shape

MENT: Earth with Cinder Block Core on RT side

0.1 Deviation 2.1 upstream [illegible] walls

Trees on [illegible]

ve Sizing, Condition and detailed description for each item, if applicable.

Middleton	TOWN NO. 1	STATE NO. ~~248~~ 157
The Dump Reservoir		
3.25 Sq. Mi.	POND AREA 256.86 Acres	
Gravity	FOUNDATION NATURE OF Earth	
Cut stone, Boulders, Earth		

POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY

F STREAM 18'	TOP OF DAM TO SPILLWAY CRESTS 21-0"	
GTHS TOP OF DAM 8'0"		LENGTH OF DAM 720'
BOVE CREST None		
O	TOP OF FLASHBOARDS	
Y	TO N. T. W.	
R		
UMBER		
AE	H. P. 78 P. C. TIME	
	100 P. C. EFF.	
SES.		
IONS.		

2151

ndotte Worsted Co.	CONTRACTOR	NO.
Rochester, N. H.		
RECEIVED	INVESTIGATED BY	DATE

LY CONSTRUCTED IT Would	BE A MENACE TO THE PUBLIC SAFETY
TO PROVISIONS OF P. L. CHAP. 218, SECTS 15-26? Yes	

RECEIVED	CHECKED BY	DATE
IS		
APPROVED BY COMMISSION	COMMISSION CONSTRUCTION INSPECTOR	

TION APPROVAL	CHARGES	PAID
TO PERIODIC INSPECTION? Yes		

DAM INSPECTION RECORD

SPECTOR	REPORT	CHARGES	PAID	DATE	INSPECTOR	REPORT	CHARGES	PAID
C. Blake	10/11/35	4.00	10/22/35					
n--Fair								

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

N AT DAM NO. 157.01

Middleton : County Strafford

The Dump Reservoir

Primary ~~Saco~~ PISCATAQUA : Secondary Cocheco

Name

GE AREA

lled Sq. Mi.: Uncontrolled Sq. Mi.: Total 3.25 Sq. Mi.

ION vs. WATER SURFACE AREA vs. VOLUME

Point	Head Feet	Surface Area Acres	Volume Acre Ft.
Max. Flood Height			
Top of Flashboards			
Permanent Crest			
Normal Drawdown		[illegible]	
Max. Drawdown			
Original Pond		256.86	

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

'OIR CAPACITY

	Total Volume	Useable Volume
wdown	ft.	ft.
ume	ac. ft.	ac. ft.
e ft. per sq. mi.		
hes per sq. mi.		

WATER Conservation

Wyandotte Worsted Co.

KS Condition fair

ion By B-15 Date

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

N STATE NO 157.01

Middleton : County ~~Stafford~~ Strafford

The Dump Reservoir

imary ~~Saco~~ PISCATAQUA : Secondary Cocheco

ame

ates—Lat. 43° 25' +13200 : Long. 71° 5' -200

DATA

e area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 3.25 Sq. Mi.

length of dam 720± ft.: Date of Construction

Stream bed to highest elev. 18 ft.: Max. Structure 16 ft.

am : Reservoir

TION Gravity cut stone Boulders earth Faced with concrete

ates

er 1 : Size 3 ft. high x 3 ft. wide

tion Invert : Total Area 9 sq. ft.

JACK SCREW

Gates Conduit

er : Materials

ft.: Length ft.: Area sq. ft.

ment

EARTH - STONE

it—Max. 10 ft.: Min. 0 ft.

-Width 17 — 13 : Elev. ft.

s—Upstream on : Downstream on

h—Right of Spillway 360 : Left of Spillway 351

rials of Construction CONCRETE

h—Total 912 ft.: Net ft.

it of permanent section—Max. 16' ft.: Min. ft.

boards—Type ~~Pine~~ WOOD - : Height 1½ ft.

tion—Permanent Crest : Top of Flashboard

Capacity 60 cfs.: 18.5 cfs/sq. mi.

nts

rials:

oard: Max. 3.0 ft.: Min. ft.

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

Brandotte Worsted Co. Rochester, N. H.

S Condition fair (1915)
FREEBOARD 2 FEET
Sunday outlet 100' spillway 1 gate 3'.

n By Date B-14 March 28, 1938

Form WCC.1-p.2
7/30/37

The purpose of the proposed construction is water power
(Here briefly state use to which stored water is to be put)

The construction will consist of
(Here give brief description of work contemplated including height of dam)
cement facing sixteen feet

All land to be flowed ~~is not~~ is owned by applicant.

Arthur C McEwen

Seal:

Address

Note: This application together with plans, specifications and information and data filed in connection herewith will remain on file in the office of the Water Control Commission

Form WCC.1
7/30/37

THE STATE OF NEW HAMPSHIRE

County of Strafford, ss. Oct. 23, 1939 19

PETITION FOR APPROVAL OF THE CONSTRUCTION OR REPAIR OF

DAM AT Middleton, N. H.

TO THE WATER CONTROL COMMISSION:

In compliance with the provisions of Laws of 1937, c.133, an Act establishing a Water Control Commission,

We, Wyandotte Worsted Company
(Here state name of person or persons, partnership, association, corporation, etc.)

hereby petition the Water Control Commission for approval to ~~construct~~, ~~reconstruct~~, to make repairs to, a dam ~~along~~, or (cross out portion not applicable)
across Cocheco River
(Here state name of stream or body of water)

at a point 13 miles north of Rochester
(Here give location, by distance from mouth of stream,

Strafford
county or municipal boundary)

in the town (s) of Middleton

in accordance with preliminary plans, and specifications filed with this application and made a part hereof.

MEMORANDUM

Case No. C138-C

TO: Richard S. Holmgren, Chief Engineer

RE: Middleton Dam in Rochester - Wyandotte Worsted Company

This dam was finally inspected on October 23, 1939 and the report seems to be missing on the same.

The work on this dam was completed in good order as specified in the petition and I recommend that final approval on the case be given.

Charles D. Colman
Assistant Engineer

CDC:LR.
4/13/40

Field Inspection Report on Dump Reservoir Dam
Middleton

On Monday afternoon, November 8, I inspected Dump Reservoir Dam in Middleton finding the following:

Pond Area: 257 acres
Drainage Area: 3.125 sq.mi. or 2000 acres (total)
1 Inch runoff on net drainage area raises pond 6.8 inches.
15 Year Flood discharge: 257 cfs. or 82 cfs/ sq.mi.
100 Year Flood discharge: 555 cfs. or 178 cfs/sq.mi.

On August 2, 1950, I made a previous inspection and the last shows that repairs have been made which have improved the conditions of the dam over that existing in 1950.

Downstream dry masonry near the gate house has been relaid as necessary. The hole in the embankment on left side of spillway on top of earth dike has been filled. The big leak in the angle of the earth embankment right of spillway has been plugged. There is still some seepage - not serious - in the deep section near the spillway.

Water was about a foot from the top of dam and little or no discharge was being made through the gate. This dam should be operated two feet below the top of dam (no spilling over spillway) except at times of high flow. This would require weekly or at times more frequent visits to the gate house.

The dam and dike seem to be on a relatively pervious foundation with considerable seepage. This is not serious from a stability standpoint but would affect lake level in dry seasons.

In case the dam overtopped, the long length of embankment would probably permit some overtopping without failure. The total length of dam and dike is about 720 feet. If a 100-year flood hit with the gate open, the whole dam and dike would be overtopped by some 3 inches.

This dam should have a spillway 22 feet long, 3 feet deep with 24" automatic failing flashboards to take care of a 100-year flood(disregarding gate discharge). Also, in such a case the full pond would be 24" down from top of dam. When there is 12" surcharge on top of flashboards, there would be a 93 cfs. discharge (neglecting gate). This is about 30 cfs/ sq.mi.

Francis C. Moore
Civil Engineer

11/15/54
fcm:c

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Francis C. Moore
Civil Engineer

11/15/54
fcm:c

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN *Middleton* DAM NO *157.01* STREAM *Trib. to Cocheco River*

OWNER *Wyandotte Worsted Co.* ADDRESS *Rochester, N.H.*

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on *Aug. 2, 1950* accompanied by

NOTES ON PHYSICAL CONDITION

Abutments *Good*

Spillway *Good*

Gates *[illegible] 4' [illegible] on [illegible] 6' each way - seeps leakage in ~~[illegible]~~ masonry.*

~~Other~~ *Embankment: 25' Lt. of the downstream - sizable clear leakage. ~~Also just to right of gate house - cavein in gd. near concrete facing (upstream) Also, small leakage downstream 30' Lt. of spillway~~ [illegible]*

CHANGES SINCE LAST INSPECTION *Repairs by Concrete facing near gate house - very good condition.*

FUTURE INSPECTIONS *Yes*

This dam (is) ~~(is not)~~ a menace because *of [illegible] & head*

REMARKS *Water down 3' from top of dam. [illegible]*

Copy to Owner	Date

[signature]

INSPECTOR

(Additional Notes Over)

N. H. WATER RESOURCES BOARD
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Middleton Dam Number: 157.01

Inspected by: Robert W. Livingston, PE Date: April 16 1970

Local name of dam or water body: Sunrise Lake

Owner: (formerly Wyandotte Worsted Co.) Address: Rochester

Owner ~~was~~/was not interviewed during inspection.

Drainage Area: 3.25 (old records) sq. mi. Stream: Tributary to Cocheco River

Pond Area: 240/257 Acre, Storage _____ Ac-Ft. Max. Head 16 Ft.

Foundation: Type ?, Seepage present at toe - Yes/~~No~~, 30' left of gate 3-9 minor seeps

Spillway: Type concrete, Freeboard over perm. crest: 1'-10",
Width 8', Flashboard height none,
Max. Capacity _____ c.f.s.

Embankment: Type Stone - Earth, Cover grass Width 10';
Upstream slope ? ice to 1; Downstream slope Vertical ~~to 1~~

Abutments: Type stone-concrete facing, Condition: Good, ~~Poor~~, ~~Poor~~ some spalling

Gates or Pond Drain: Size 3'x3' Capacity _____ Type _____
Lifting apparatus jack screw Operational condition unknown

Changes since construction or last inspection: Timber planking around upstream side of gate house - What is purpose of this?

Downstream development: Bridge (2 - 48"ϕ culverts) 100 yds downstream

This dam would/~~would not~~ be a menace if it failed.

Suggested reinspection date: when ice gone

Remarks: No access to gate house over spillway - Only 1' freeboard from present water level to top of dike (TOO HIGH).

DATE: April 21, 1970

FROM: Robert W. Livingston, P.E.
Water Resources Engineer

SUBJECT: Sunrise Lake, Middleton

TO: Vernon A. Knowlton
Chief Water Resources Engineer

The details of my inspection are on the Inspection Report. The following is a list of improvements I feel would be necessary if the Water Resources Board acquired dam ownership:

(1) Either lower the lake level operation or raise the dike (L=720'). In either case the dike needs some fill in low spots.

(2) Must have additional spillway length. There is an area at end of right dike on property apparently of Sunrise Lake Estates that probably would be suitable for this construction.

(3) Rebuild gate house - Present house is in poor condition.

(4) A property and water rights title search should be made. It would appear that a camp at end of left dike is encroaching on the dike structure itself.

RWL/jb

WATER RESOURCES BOARD

SITE EVALUATION DATA

OWNER: Sunrise Lake Assoc TELEPHONE NO.

MAILING ADDRESS: Guy Richardson RFD 1 Union Nit Pres

SITE LOCATION (TOWN OR CITY) Middleton

NAME OF STREAM OR WATERBODY: Sunrise LK

QUADRANGLE: LOCATION:

HEIGHT OF (PROPOSED, EXISTING) DAM 16 LENGTH 700'

TYPE OF (PROPOSED, EXISTING) STRUCTURE Ston wall and Earth embankment 3'

DRAINAGE AREA 3 1/4 Sm POND AREA 250 A ±

AVAILABLE ARTIFICIAL STORAGE: PERMANENT: TEMPORARY: TOTAL

EXISTING DEVELOPMENT DOWNSTREAM OF (PROPOSED, EXISTING) STRUCTURE

Camp 100' downstream Face of dam Town Rd 500' Downstream

POTENTIAL DEVELOPMENT DOWNSTREAM OF (PROPOSED, EXISTING) STRUCTURE

POTENTIAL DAMAGE DOWNSTREAM OF STRUCTURE (EXPLAIN IN DETAIL AND INCLUDE ANY POTENTIAL LOSS OF LIFE ESTIMATE)

OTHER COMMENTS:

CLASS OF STRUCTURE -- ~~NON-MENACE~~: (MENACE) ~~A~~ (C) DAM # 151.01

DATE OF INSPECTION: 30 Sep 26

SIGNED J B Smith

SIGNATURE

B-4 DATE:

Dam No. _____

SPILLWAY: Length: _____ Freeboard: _____

SEEPAGE: Location, estimated quantity, etc.

100' Lt of Spillway Small seepage
No Silt evident

Changes Since Construction or Last Inspection:

Tail Water Conditions:

Overall Condition of Dam: Good to Fair

Contact With Owner: yes

Date of Inspection: 30 Sept 76 Suggested Reinspection Date 1 Yr

Class of Dam: Minor C

Signature B B Smith

Date _____

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Ocean NO. 1 — [illegible]
RIVER The Dump Reservoir MILES FROM MOUTH ____ D.A.SQ.MI. [illegible]
TOWN Middleton OWNER Wyandotte Worsted Mills, Exeter
LOCAL NAME OF DAM
BUILT ____ DESCRIPTION Gravity — Cutstone, Boulders, Earth on Earth

POND AREA-ACRES 2[illegible] DRAWDOWN FT. ____ POND CAPACITY-ACRE FT. ____
HEIGHT-TOP TO BED OF STREAM-FT. 18 MAX. ____ MIN. ____
OVERALL LENGTH OF DAM-FT. 720 MAX. FLOOD HEIGHT ABOVE CREST-FT. ____
PERMANENT CREST ELEV. U.S.G.S. ____ LOCAL GAGE ____
TAILWATER ELEV. U.S.G.S. ____ LOCAL GAGE ____
SPILLWAY LENGTHS-FT. 8 FREEBOARD-FT. [illegible]
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST None
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST

REMARKS Condition Fair
Into Dames Br, Cocheco R

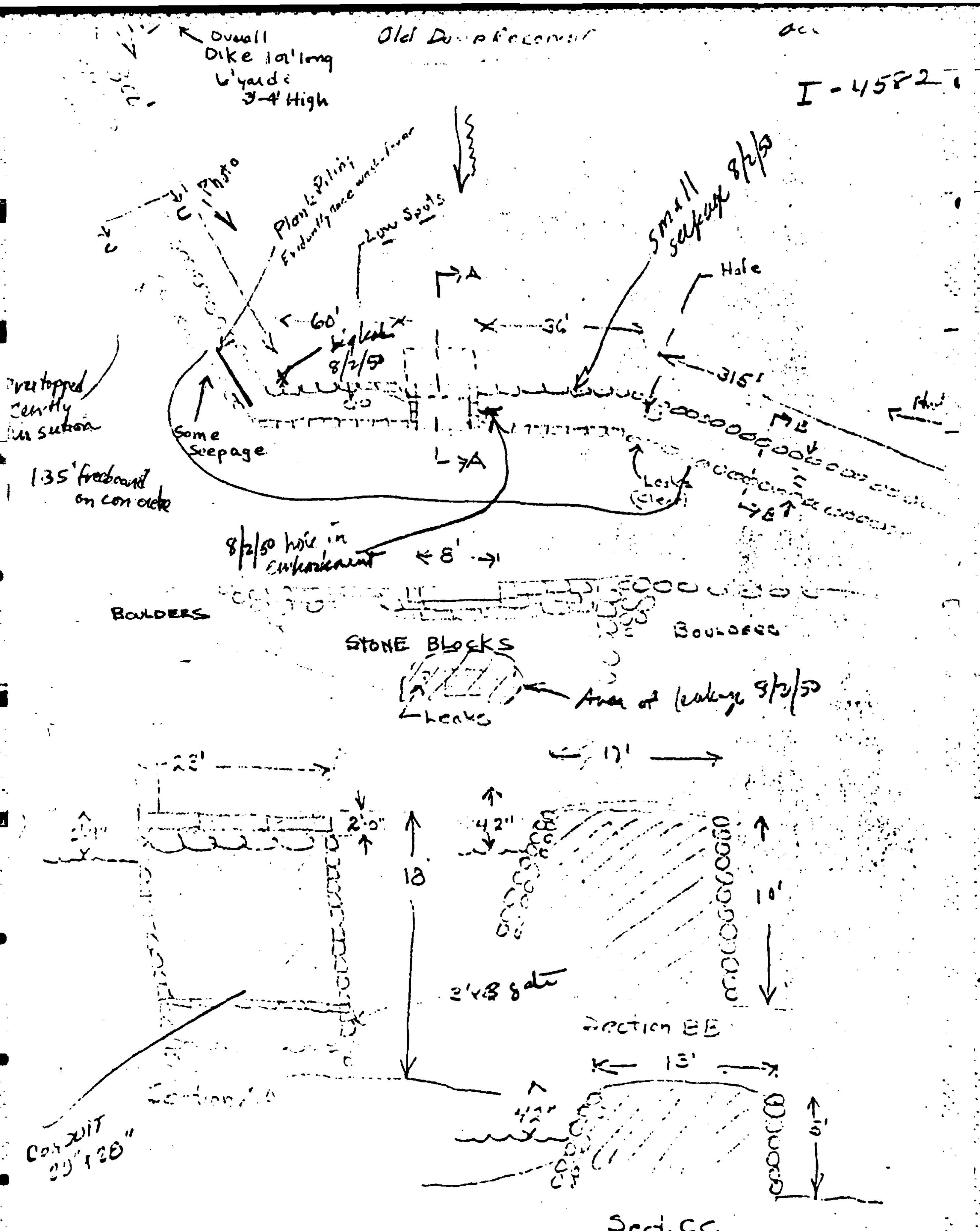
POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE

USE Conservation

REMARKS

DATE 7/24/35



I-4582
Overall
Dike 10'long
6'wide
3-4' High
Photo
Plank Piling
Low Spots
Small seepage 8/2/50
Hole
60'
36'
315'
8/2/50
Some Seepage
1.35' freeboard on concrete
Leaks
8/2/50 hole in embankment
8'
BOULDERS
STONE BLOCKS
Area of leakage 8/2/50
Leaks
22'
17'
2'0"
4'2"
18
10'
2'x8 gate
Section BB
13'
CONDUIT
Sect. CC

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD I-4582

TOWN	Middleton	TOWN NO. 1	STATE NO. 157.01
RIVER STREAM	The Dump Reservoir		
DRAINAGE AREA	3.85 Sq. Mi.	POND AREA	256.86 Acres
DAM TYPE	Gravity	FOUNDATION NATURE OF	Earth
MATERIALS OF CONSTRUCTION	Cut stone, Boulders, Earth		
PURPOSE OF DAM	POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTION—PUBLIC UTILITY		
HEIGHTS TOP OF DAM TO BED OF STREAM	18'	TOP OF DAM TO SPILLWAY CRESTS	2'-0"
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM	8'0"	LENGTH OF DAM	720'
FLASHBOARDS TYPE, HEIGHT ABOVE CREST	None		
OPERATING HEAD CREST TO N. T. W.		TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.			
GENERATORS, NUMBER KINDS & K. W.			
H. P. 90 P. C. TIME 100 P. C. EFF.		H. P. 75 P. C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS INSPECTIONS, REMARKS			

OWNER- Wyandotte Worsted Co.

CONDITION- Fair

MENACE- Yes. Will be subject to periodic inspection.

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made July 24, 1935 according to notification to owner dated July 15, 1935, and bill for same is enclosed.

Samuel J. Lord
Hyd. Eng.

Sept. 15, 1935
Copy to Owner

Map No. 1. Town Middleton

Data by U.S.G.S. File

Owner Old Colony Woolen Company

River or Stream The Dump Reservoir

Public Utility No Drainage Area 9.3 sq. mi.

Type of Construction Stone and dirt

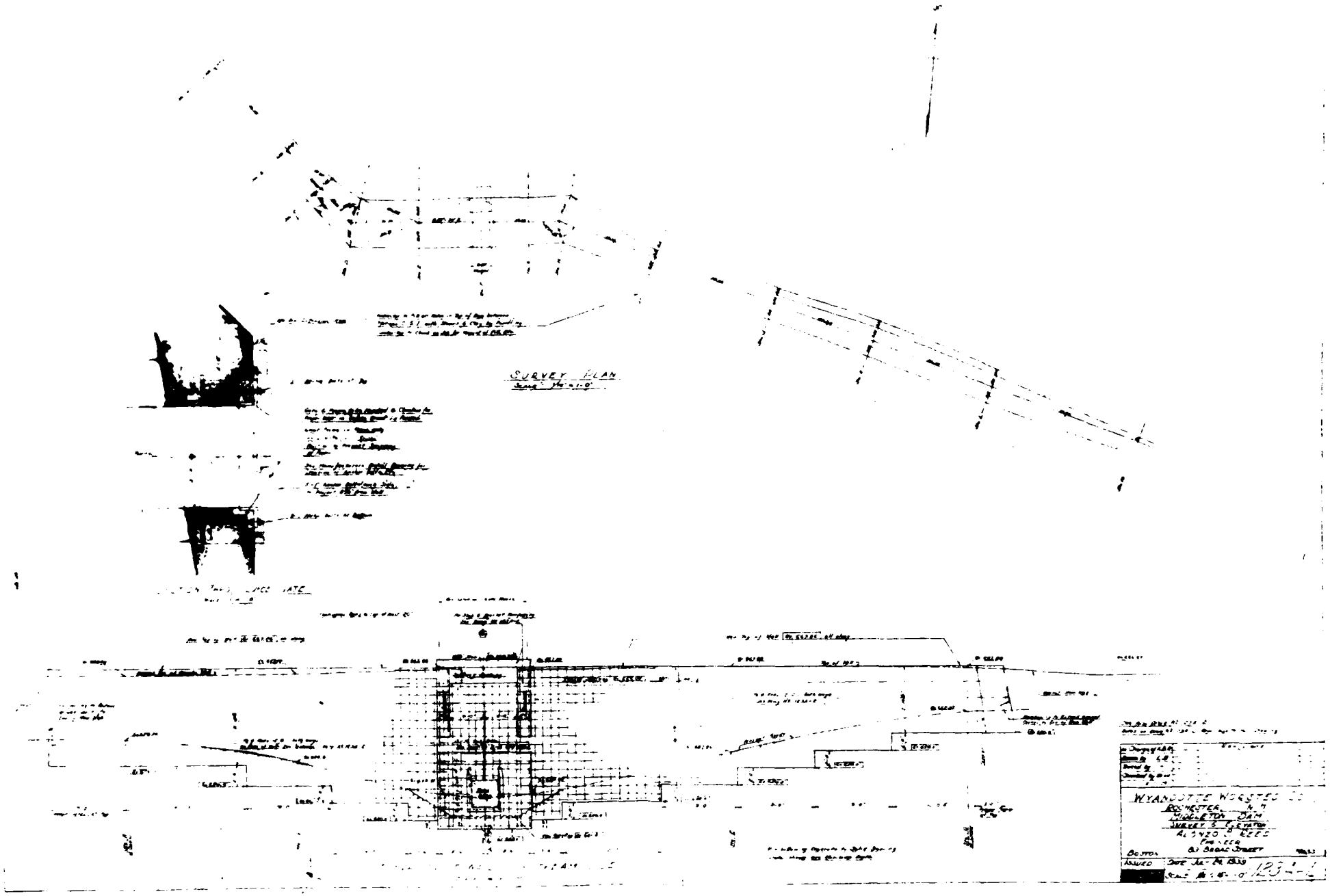
Height 18 ft. Operating Head ft.

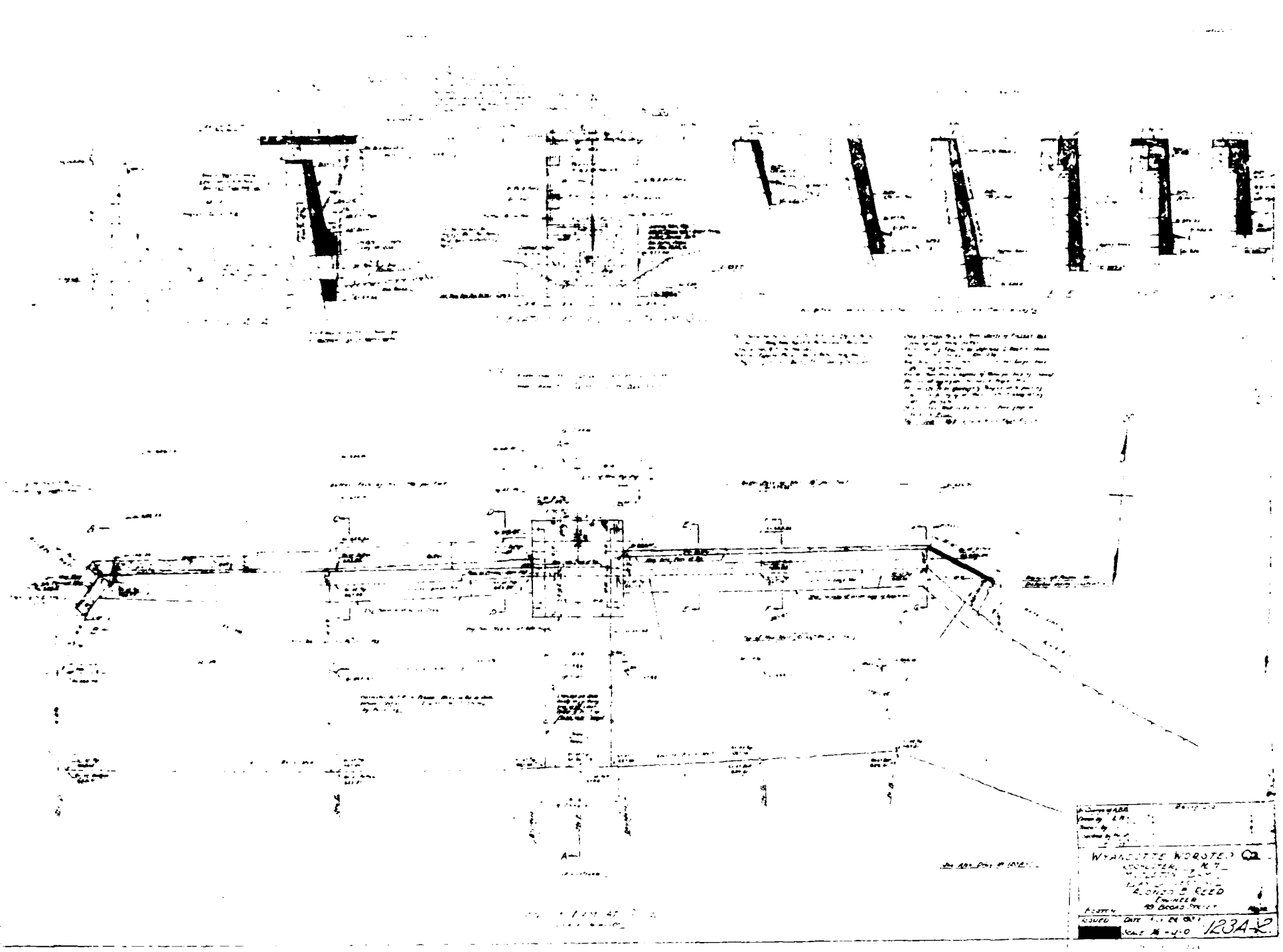
Length 500 ft. Spillway Length (No. 1) 18 ft. (No. 2) ft.

Would Failure of Dam do Harm? No

Present Condition Fair Date 1922

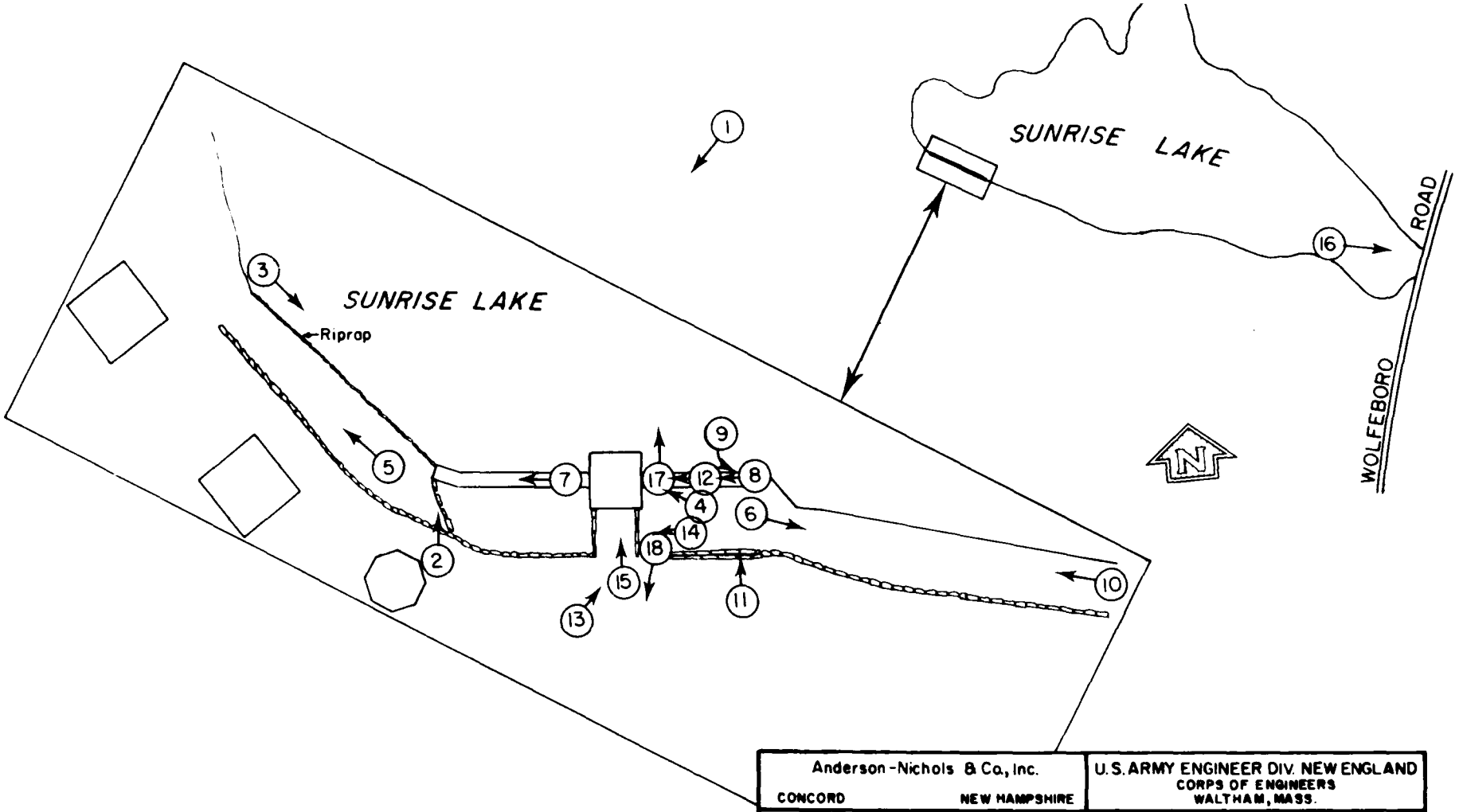
5710


SURVEY PLAN
WYANDOTTE WORSTED CO.
BOSTON
ISSUED



APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SUNRISE LAKE DAM
PHOTO INDEX

SUNRISE LAKE NEW HAMPSHIRE

SCALE: NOT TO SCALE

DATE: AUGUST 1978

Figure 2 - Looking north along the downstream face of the dam, west of the outlet works.

Figure 3 - Looking towards the center of the dam, taken near the northwest abutment.

Figure 4 - Looking at the upstream face of the northwest embankment.

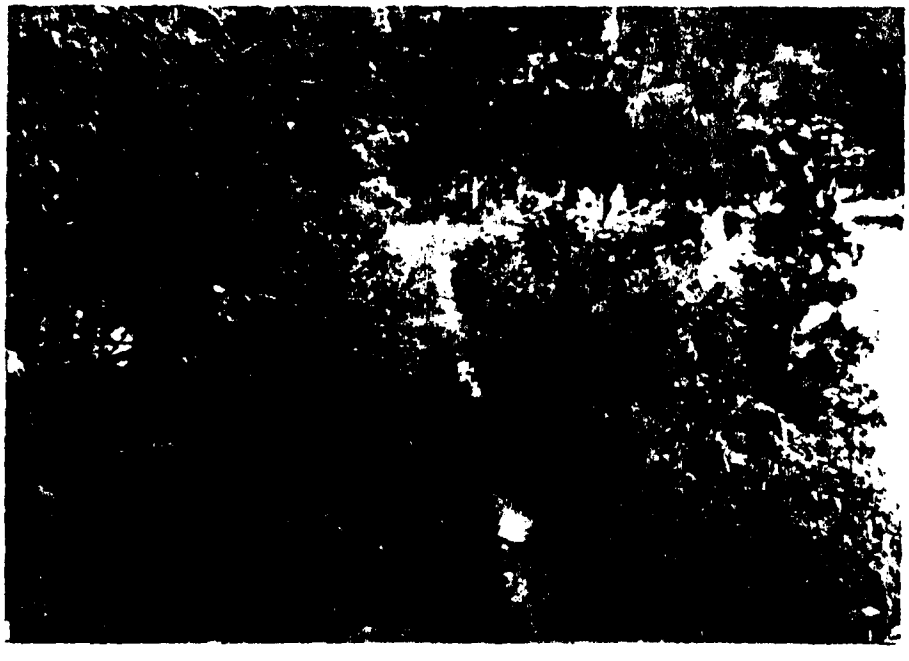


Figure 5 - Looking northwest along the crest of the northwest embankment. Note the concrete block wall near the center of the crest.

Figure 6 - Looking east along the crest of the embankment from the vicinity of the gatehouse.

Figure 7 - Looking west along the upstream face of the dam, taken from the vicinity of the gatehouse. Note the residence immediately downstream of the dam in the upper left corner of the photo.

Figure 8 - Spalled concrete along the upstream face of the dam. The bottom of the gatehouse is visible at the top of the photo.

[illegible] - Cracks in the [illegible] of the [illegible] facing.

Figure 10 - Looking northwest along the crest of the embankment, taken in the vicinity of the east abutment.

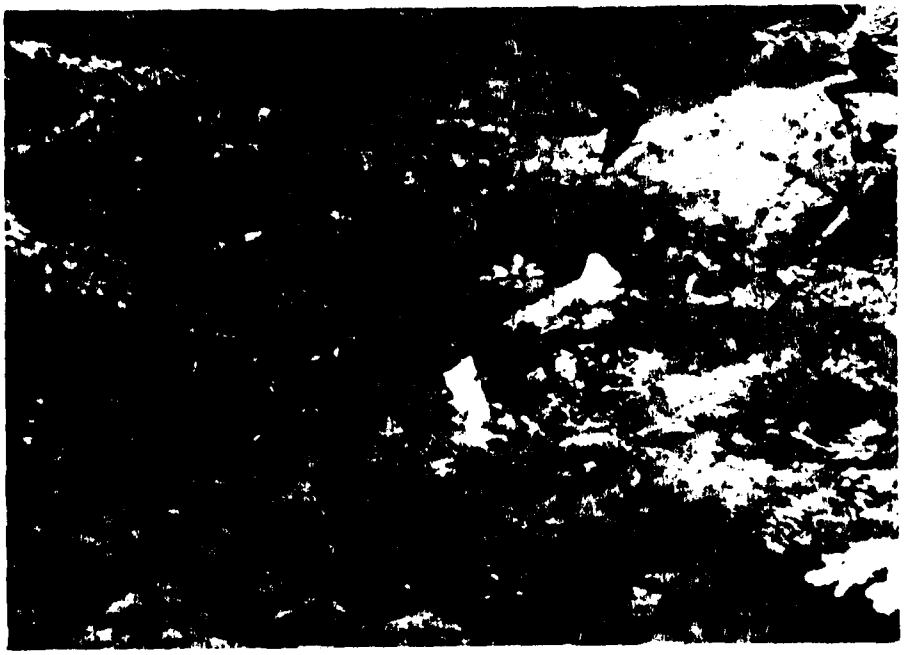


Figure 11 - Seepage at the toe of the east embankment of Sunrise Lake Dam.

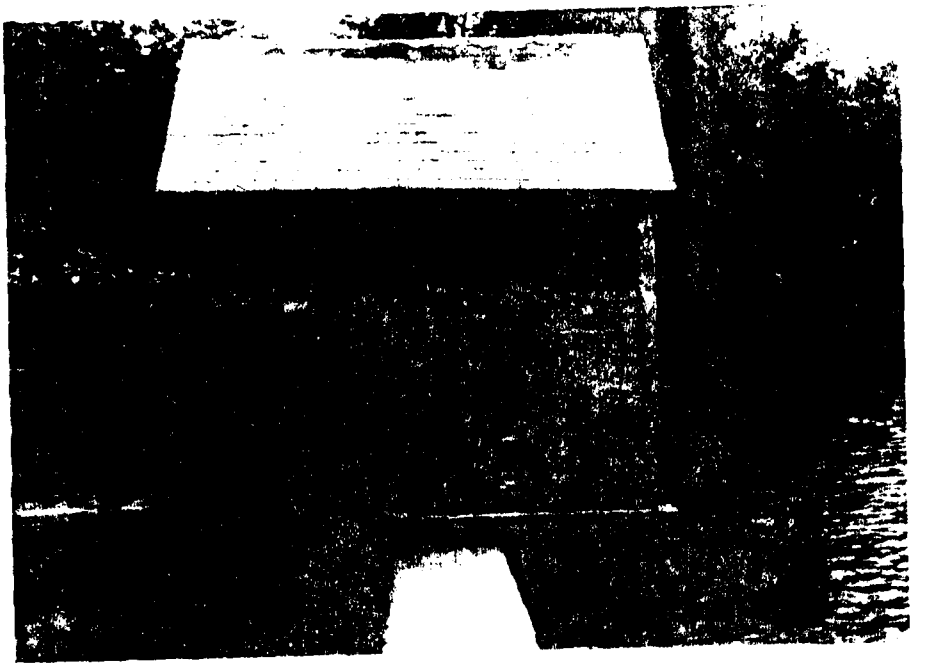
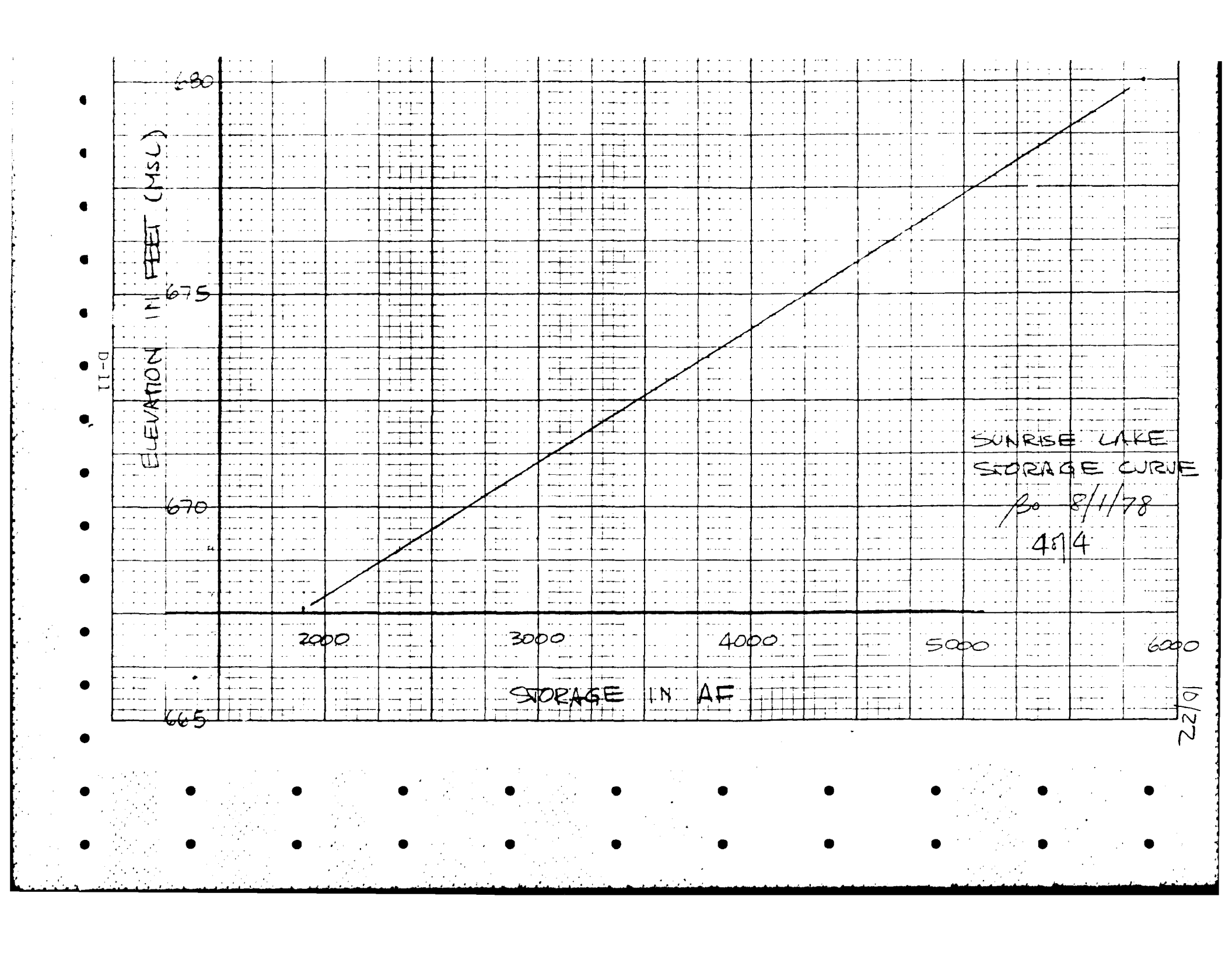
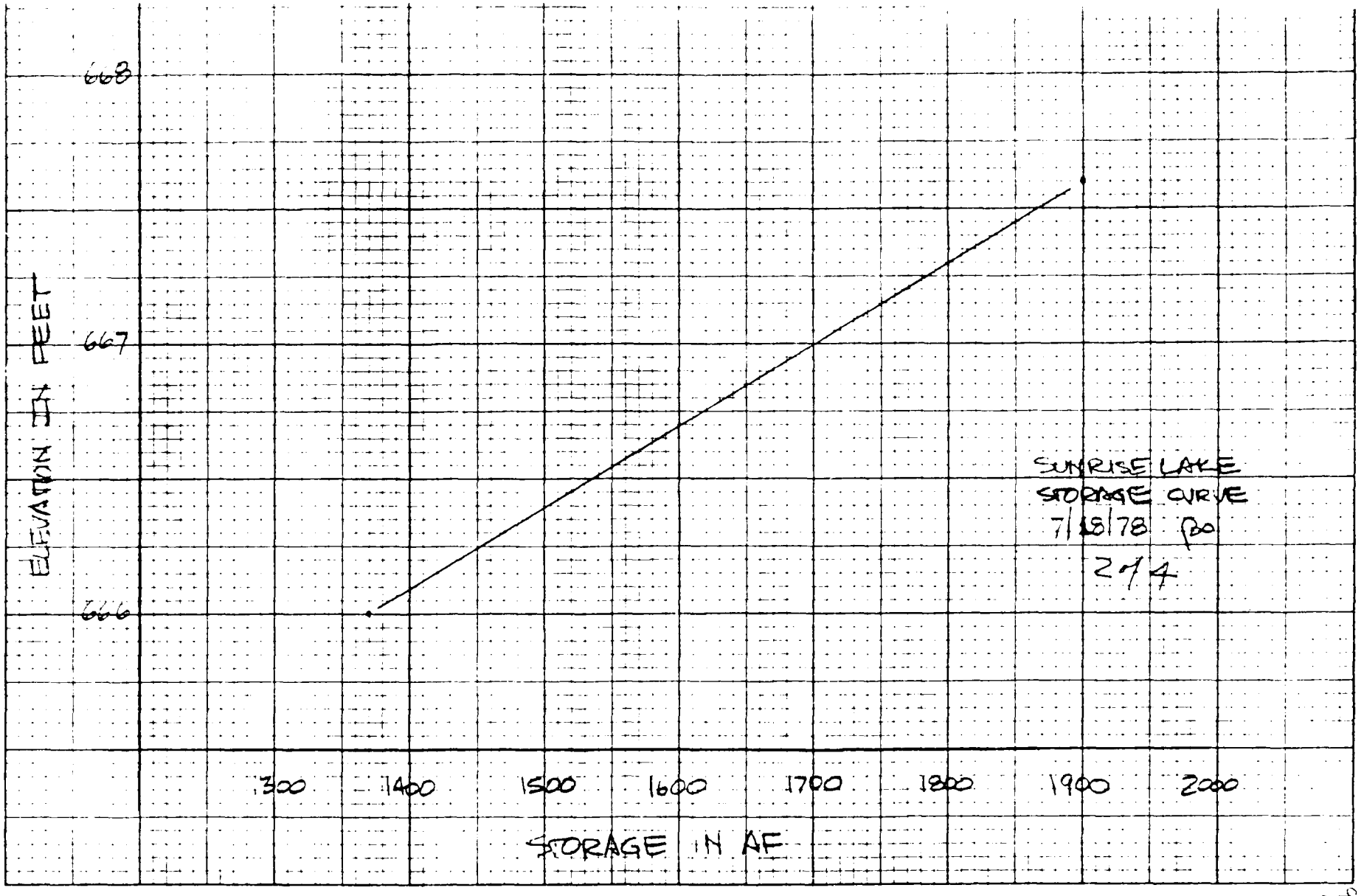
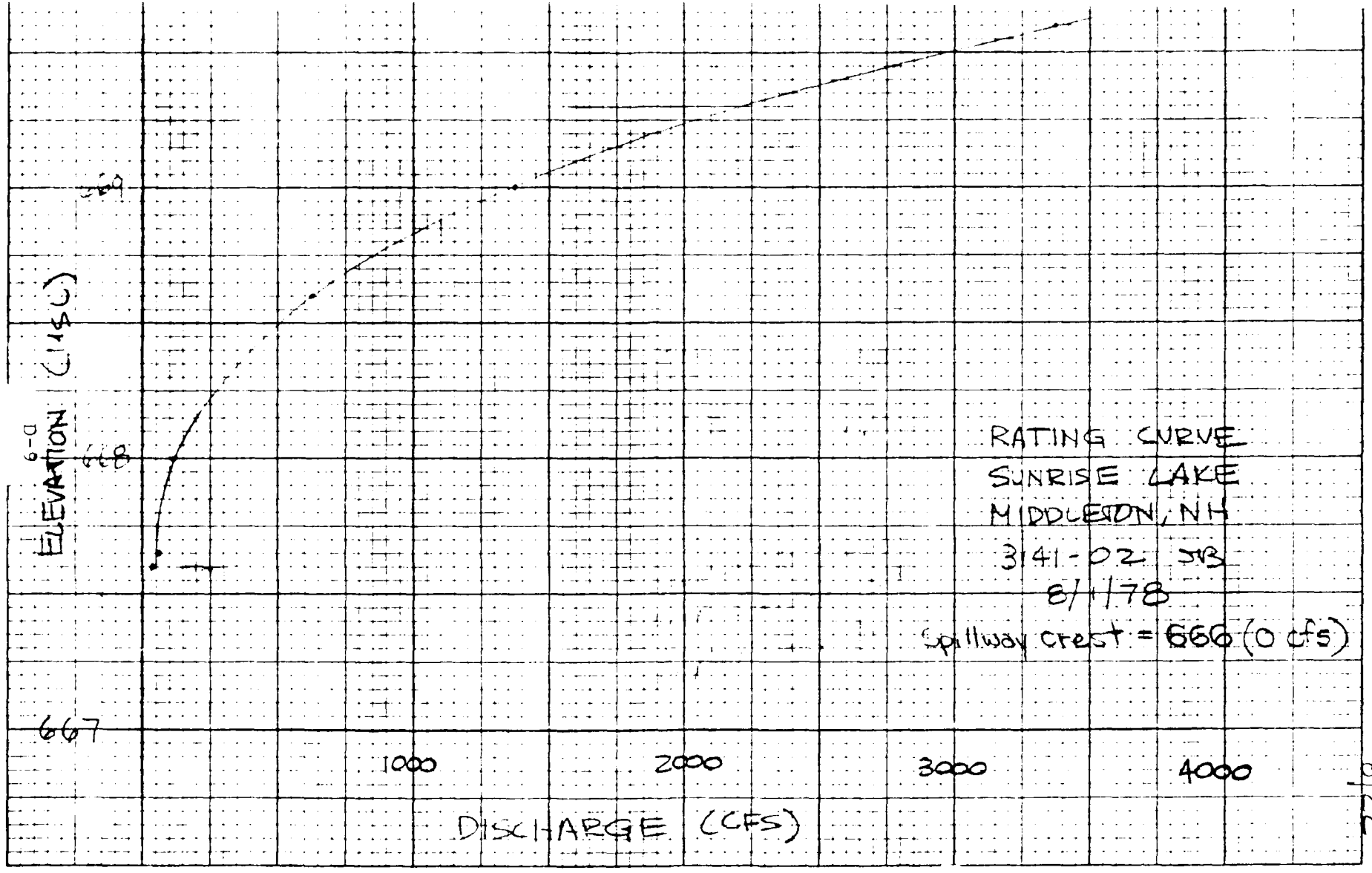


Figure 12 - looking west at the side of the gate-house.

Figure 13 - looking upstream at the outlet works from the west bank of the downstream channel.


ELEVATION IN FEET (MSL)
680
675
670
665
2000
3000
4000
5000
6000
STORAGE IN AF
SUNRISE LAKE
STORAGE CURVE
8/1/78
4 of 4
D-11
22/91


668
667
666
ELEVATION IN FEET
1300
1400
1500
1600
1700
1800
1900
2000
STORAGE IN AF
SUNRISE LAKE
STORAGE CURVE
7/28/78 PD
214


ELEVATION (MSL)
669
668
667
1000
2000
3000
4000
DISCHARGE (CFS)
RATING CURVE
SUNRISE LAKE
MIDDLETON, NH
3141-02 JWB
8/1/78
Spillway crest = 666 (0 cfs)

6-D

8/22

SURCHARGE HEIGHT TO PASS Q_{P_2}

$Q_{P_2} = 1830$ cfs

From Rating Curve : elev = 669.18

SURCHARGE = 669.18 − 666 = 3.18'

FROM STORAGE CURVE:

STOR@ 669.18 = 2400 AF
STOR@ 666 = 1370 AF

VOL OF ABOVE SURCHARGE = 1030 AF

$$1030 \text{ AF} \times \frac{1}{3.27} \times \frac{1}{640} = 0.492 \text{ ft}$$

$0.492' = 5.9''$ OVER BASIN

AVE SURCHARGE & PEAK OUTFLOW (Q_{P_2})

$\left.\begin{array}{l} \text{STOR}_1 = 6.5'' \\ \text{STOR}_2 = 5.9'' \end{array}\right\}$ AVE = 6.2"

$$6.2'' \times 3.27 \text{ mi}^2 \times \frac{1 \text{ ft}}{12''} \times \frac{640 \text{ A}}{1 \text{ mi}^2} = 1081 \text{ AF}$$

$1081 \text{ AF} + 1370 \text{ AF} \cong 2450 \text{ AF}$

2450 AF $\Rightarrow$ elev = 669.3

669.3 $\Rightarrow$ Q_{P_2} = 2200 cfs

$Q_{P_2} = 1100$ cfs $\Rightarrow$ 668.88

as a check against ½PMF

½PMF = 2780 × 0.5 = 1390 cfs

elev = 669.0 ±

VOLUME OF SURCHARGE

STOR @ 669.45 = 2500 AF
STOR @ 666.0 = 1370 AF

∴ $STOR_1$ (SURCHARGE = 1130 AF

$$1130\ AF \times \frac{1}{3.27\ sq\ miles} \times \frac{1\ mi^2}{640A} = 0.54\ ft$$

0.54′ = 6.5 inches of RUNOFF OVER BASIN

$$Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR_1}{19}\right)$$

$$= 2780 \times \left(1 - \frac{6.5}{19}\right)$$

$$= 1830\ cfs$$

5/22

) @ elev 669.6 = 2nd flow area @ WOLFEBORO RD

DAM $\begin{cases} Q = CLH^{3/2} \\ (2.7)(785)(0.6)^{3/2} + 578 = 1563 \end{cases}$

WOLFEBORO RD $\begin{cases} Q = CLH^{3/2} \\ (2.7)(155)(1.95)^{3/2} + 14 = 1140 \end{cases}$

$\begin{cases} Q = CLH^{3/2} \\ (2.6)(91)(0.6)^{3/2} + 39 = 149 \\ (2.6)(89)(1.7)^{3/2} + 9 = 522 \end{cases}$

671

TOT Q = 1563 + 1140 + 671
= 3374

) @ elev 669.45

DAM $\begin{cases} Q = CLH^{3/2} \\ = (2.7)(776)(0.45)^{3/2} + 578 = 1210 \end{cases}$

WOLFEBORO RD $\begin{cases} Q = CLH^{3/2} \\ = (2.7)(150)(1.80)^{3/2} + 14 = 992 \end{cases}$

$Q = CLH^{3/2}$

$(2.6)(86)(0.45)^{3/2} + 39 = 106$
$(2.6)(87)(1.55)^{3/2} + 9 = 446$

552

TOT Q = 1210 + 992 + 552
= 2754

5. @ elev 669.0

DAM

$Q = CLH^{3/2}$

$(2.7)(21)(0.7)^{3/2}$ =	33	✓
$(2.7)(71)(0.3)^{3/2}$ =	31	✓
$(2.7)(609)(0.2)^{3/2}$ =	147	✓
$(2.7)(31)(0.3)^{3/2}$ =	14	✓
$(2.7)(243)(0.2)^{3/2}$ =	59	✓
$(2.7)(65)(0.3)^{3/2}$ =	29	✓
$(2.7)(25/2)(0.6)^{3/2}$ =	16	✓
$(2.7)(155)(0.3)^{3/2}$ =	69	✓
$(2.7)(185/2)(0.4)^{3/2}$ =	63	✓
$(2.7)(15)(0.2)^{3/2}$ =	4	✓
$(2.7)(208)(0.2)^{3/2}$ =	50	✓
spillway =	63	✓
	578	

OLFEBORO ROAD

$Q = CLH^{3/2}$

$= (2.7)(115)(1.35)^{3/2} + 14 = 501$

W Weir

$Q = CLH^{3/2}$

$(2.6)(73 \div 2)(0.55)^{3/2} = 39$

$(2.6)(80)(1.1)^{3/2} + 9 = 249$

288

TOT $Q = 578 + 501 + 288 =$

1367 cfs

3/22

3. @ elev 668 = TOP OF DAM

SPILLWAY $\begin{cases} Q = CLH^{3/2} \\ = (2.8)(8)(668-666)^{3/2} = 63 \text{ cfs} \end{cases}$

WOLFEBORO RD $\begin{cases} Q = CLH^{3/2} \\ = (2.7)(50)(668-667.65)^{3/2} + 14 = 42 \text{ cfs} \end{cases}$

low weir $\begin{cases} Q = CLH^{3/2} \\ = \begin{cases} (2.6)(32\div 2)(667.9-667.65)^{3/2} \Rightarrow 5.2 \\ (2.6)(32\div 2)(667.9-667.7)^{3/2} \Rightarrow 3.7 \\ (2.6)(66)(668-667.9)^{3/2} \Rightarrow 5.4 \end{cases} \\ \qquad\qquad 14.3 \end{cases}$

TOT = 63 + 42 + 14 = 119 $\Rightarrow$ 120 cfs

4. @ elev 668.6 = SLAB OF GATE HOUSE

DAM $\begin{cases} Q = CLH^{3/2} \\ (2.7)(35\div 2)(668.6-668)^{3/2} = 2.2 \\ (2.7)(30\div 2)(668.6-668.5)^{3/2} = 1.3 \\ (2.7)(305\div 2)(668.6-668.3)^{3/2} = 17.7 \\ (2.7)(130\div 2)(668.3-668.0)^{3/2} = 28.8 \\ (2.7)(25\div 2)(668.6-668.0)^{3/2} = 15.7 \\ (2.7)(185\div 2)(668.6-668.2)^{3/2} = 63.2 \\ (2.7)(30\div 2)(668.6-668.4)^{3/2} = 3.6 \\ \text{spillway} = 63 \\ 265.3 \Rightarrow 265 \text{ cfs} \end{cases}$

WOLFEBORO RD $\begin{cases} Q = CLH^{3/2} \\ = (2.7)(70)(668.6-667.65)^{3/2} + 14 = 239 \Rightarrow 240 \text{ cfs} \end{cases}$

low weir $\begin{cases} Q = CLH^{3/2} \\ = (2.6)(75)(668.6-667.9)^{3/2} + 9 = 123 \Rightarrow 125 \text{ cfs} \end{cases}$

630 cfs

BO
7/26/78

HYDRAULICS
SUNRISE LAKE
3141-02

See attached cross-sections for weir information

FROM PMF DETERMINATION: PMF = 2780 cfs

- ASSUMING GATE CLOSED

RATING CURVE COMPUTATIONS

@ elev 667.6 = low point of Wolfeboro Rd.

- DISCHARGE IS entirely over spillway

$Q = CLH^{3/2}$ $C = 2.8$, $L = 8.0'$, $H = 667.6 - 666 = 1.6'$

$Q = (2.8)(8)(1.6)^{3/2}$

$Q =$ **45 cfs**

@ elev 667.65 = low point @ RIGHT of DAM

$Q = CLH^{3/2}$
$= (2.8)(8)(1.65)^{3/2} = 47$ cfs } DAM

$Q = CLH^{3/2}$ $C = 2.7$
$H = 667.65 - 667.6 = 0.5'$
$L = 30 \div 2 = 15$ } WOLFEBORO

$Q = (2.7)(15)(0.5)^{3/2} = 14$ cfs

TOT $Q = 14 + 47 = 61 \approx$ **60 cfs**

HYDROLOGY

6/29/78
BO

SUNRISE LAKE DAM

STEP 1:

PROBABLE MAXIMUM FLOOD DETERMINATION (PMF)

RE: PRELIMINARY GUIDANCE FOR ESTIMATING MAXIMUM PROBABLE DISCHARGES IN PHASE I DAM SAFETY INVESTIGATIONS, NED - COE, MARCH 1978

USING FLAT & COASTAL CURVE TO DETERMINE PMF PEAK INFLOW

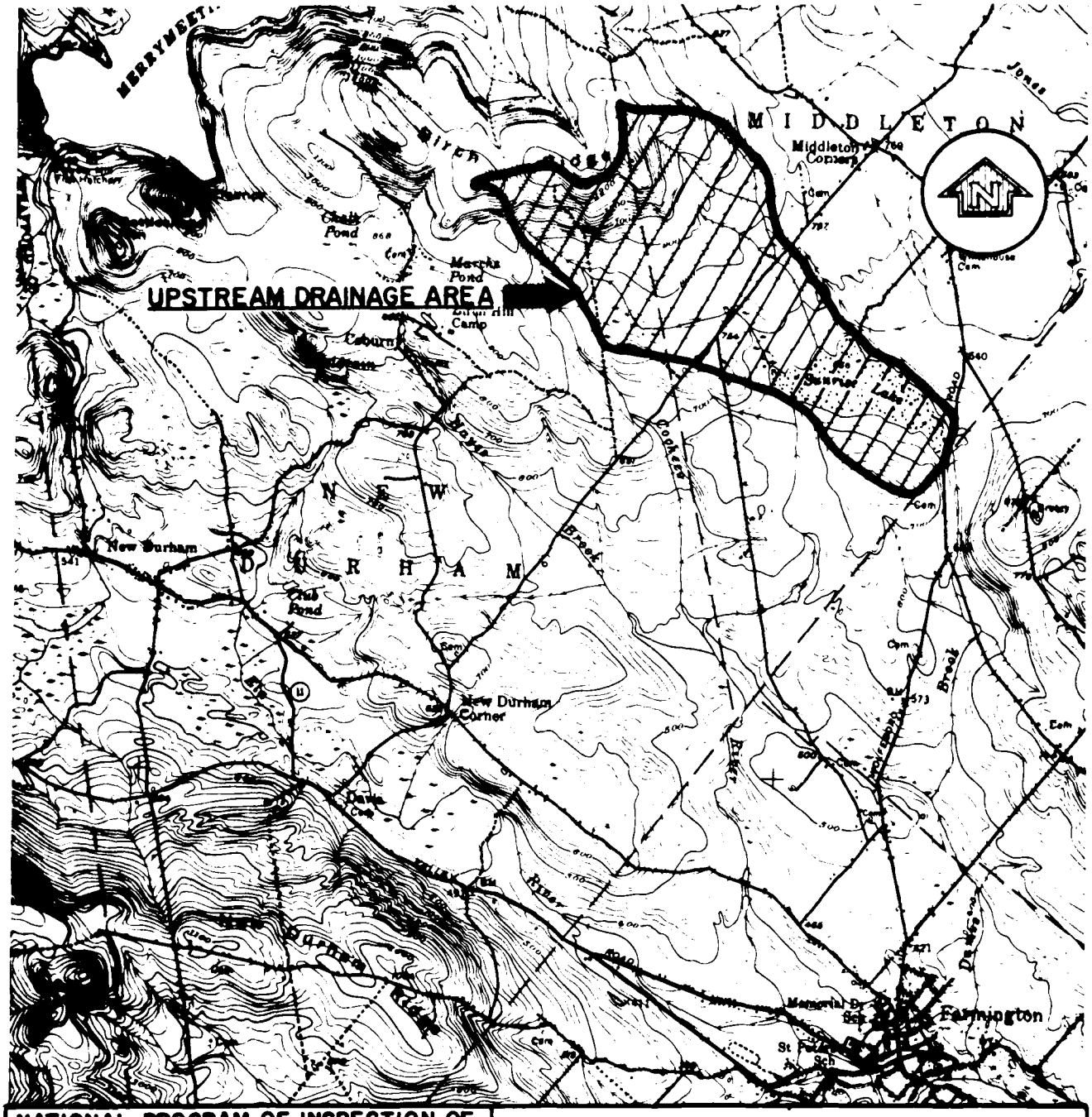
DA = 3.25 sq miles (WRB 70)
= 3.26 sq miles (WRB 59)
= 3.12 sq miles (WRB 60)
= 3.27 sq miles (ANCO 78)
= 3.0 sq miles (COE 74)

PMF @ DA = 3.27 sq miles

PMF = 850 cfs/sq mile

PMF = 850 cfs/sq mile × 3.27 sq miles

PMF = 2780 cfs



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SUNRISE LAKE DAM

MIDDLETON, NEW HAMPSHIRE

REGIONAL VICINITY MAP

AUGUST 1978

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

1 ½ 0 1 2

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEET ALTON, N.H. 1957.

APPENDIX D

HYDROLOGY/HYDRAULICS

Figure 16 - Overview of Wolfeboro Road Dike at the southeast end of Sunrise Lake.

Figure 17 - Looking at the reservoir from the crest of Sunrise Lake Dam.

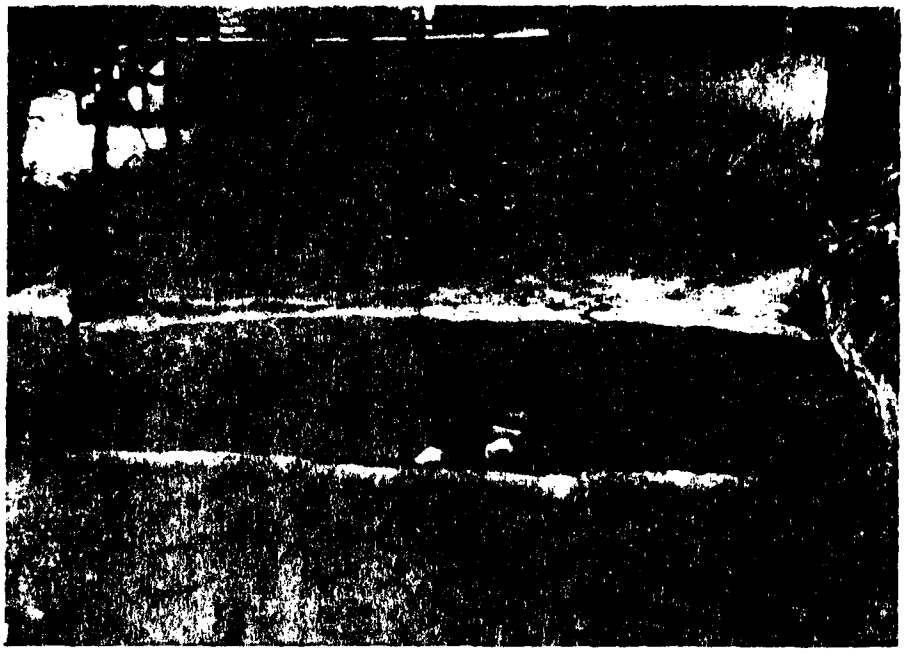


Figure 14 - Looking west towards the uncontrolled overflow spillway.

Figure 15 - Looking upstream at the uncontrolled overflow spillway and the base of the [illegible].

HAZARD ANALYSIS – USING MAXIMUM POOL ELEVATION OF 667.9' msl TO DETERMINE BREACH DISCHARGE

STORAGE @ TIME OF FAILURE = 2000 ACRE-FT.

STEP 2 $Q_{P1} = \frac{8}{27} W_b \sqrt{g} \, y_o^{3/2}$

where: W_b = Breach width
g = 32.2 ft/sec²
y_o = pool elev. → river bed

@ SUNRISE DAM

$W_b = 100'$
$g = 32.2$ ft/sec²
$y_o = 667.9' - 652.6' = 15.3'$

FROM ABOVE EQUATION: $Q = 10,062.$ cfs

USE THE RATING CURVE ESTABLISHED FROM TYPICAL SECTION OF D/S REACH #1

Q of 10,062. cfs → STAGE 9'
REACH LENGTH = 9240'
AREA @ 9' STAGE ≈ $25 + \frac{1}{2}(9)(10+410) = 1915$ ft²
VOLUME OF REACH #1 = $(9240)(1915) \div 43560$ ft²/acre = 406. acre-ft

$Q_{P2} = 10,062.\left(1 - \frac{406}{2000}\right) = 8019.$ cfs
STAGE = 8'
AREA ≈ 1600' VOLUME ≈ 318 acre-ft.

$Q_{P2} = 10,062\left(1 - \frac{2162}{2000}\right) = 8240.$ cfs
STAGE = 8'

∴ USE 8' STAGE ALONG D/S REACH #1

ROAD @ D/S REACH #1, CAPACITY ≈ 1137 ± cfs.

@ STAGE 8', Q = 8240 cfs road will most likely suffer severance. Since this structure will provide little storage use $Q_{P1} = 8240$ for reach #2

USE THE RATING CURVE ESTABLISHED FROM TYPICAL SECTION OF D/S REACH #2

Q of 8240 cfs ⟶ STAGE 10.5'
REACH LENGTH = 18216'
AREA @ 10.5' STAGE ≈ $25 + \frac{1}{2}(10.5)(10+360) = 1968$ ft²
VOLUME OF REACH #2 = $(18216)(1968) \div 43560 = 823$ ac-ft

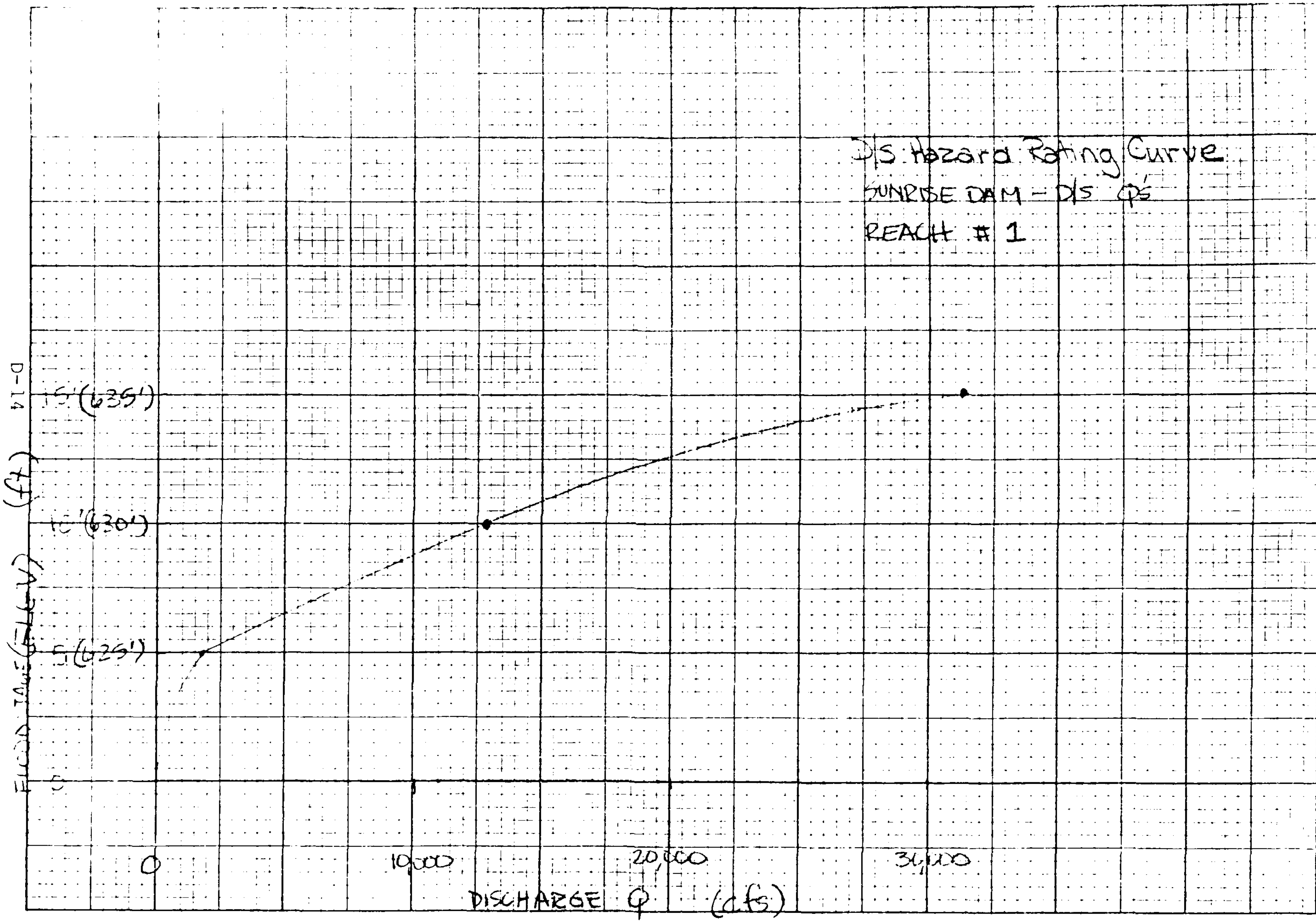
$Q_{P2} = 8240\left(1 - \frac{823}{2000}\right) = 4849$ cfs.

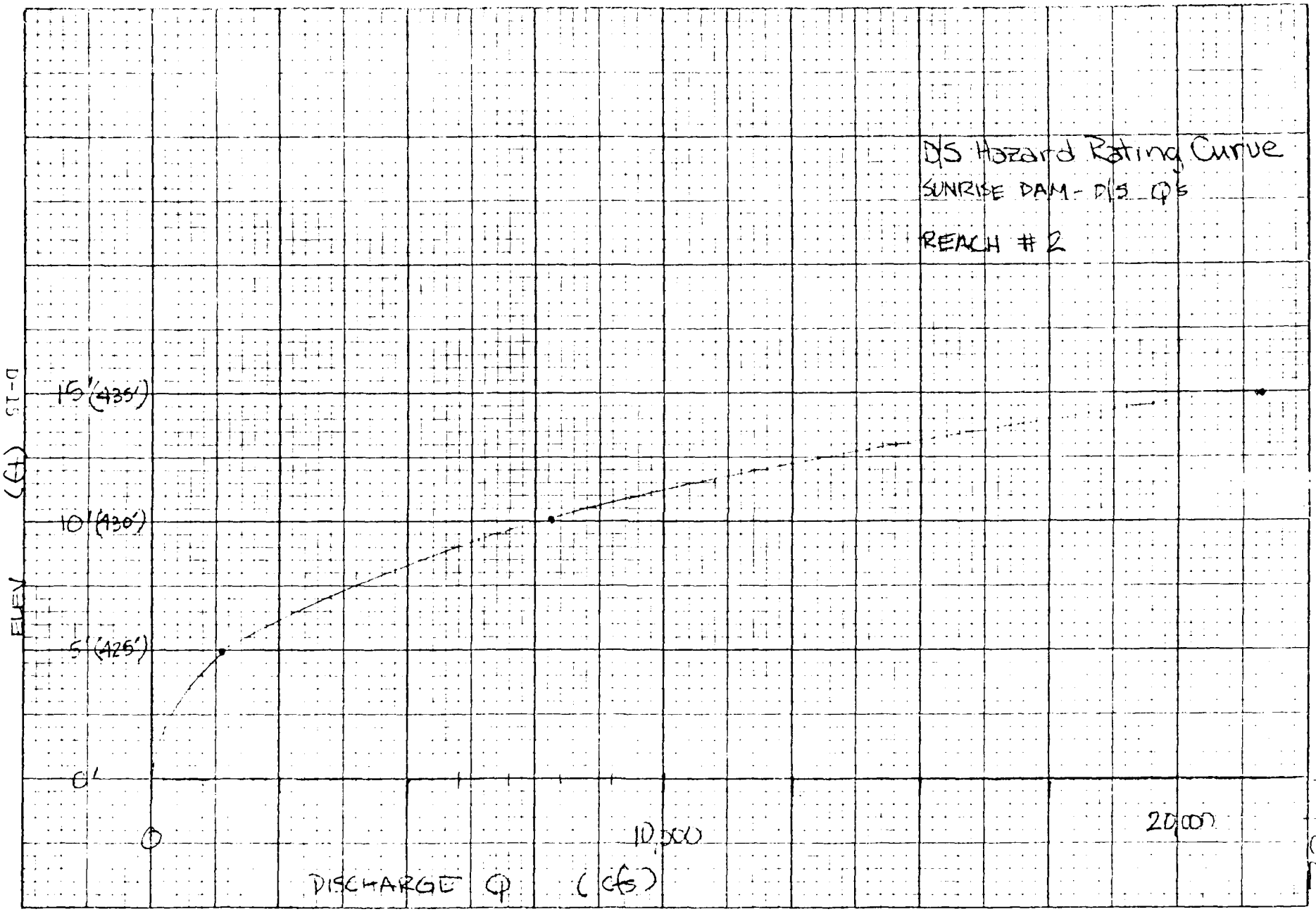
STAGE = 8'
AREA ≈ $25 + \frac{1}{2}(8)(280+10) = 1185$
VOLUME OF REACH #2 = $(1185)(18216) \div 43560 = 495$

$Q_{P2} = 8240\left(1 - \frac{659}{2000}\right) = 5524.$ cfs

STAGE = 9'

∴ USE 9' STAGE ALONG D/S REACH #2


D/S Hazard Rating Curve
SUNRISE DAM – D/S Q's
REACH # 1
15'(635')
10'(630')
5(625')
0
(ft)
0
10,000
20,000
30,000
DISCHARGE Q (cfs)


D/S Hazard Rating Curve
SUNRISE DAM - D/S Q's
REACH #2
15' (435')
10' (430')
5' (425')
0'
ELEV (ft)
0
10,000
20,000
DISCHARGE Q (cfs)

DETERMINE HEIGHT @ REACH #2 (FARMINGTON) @ TEST FLOOD ELEVATION OF 669.3' (PROBABLE MAXIMUM FLOOD) —— ASSUME NO BREACHING

REACH 1

REFER TO RATING CURVE - SUNRISE DAM
DISCHARGE @ 669.3' = 2200 cfs.
Q of 2200 cfs —— STAGE 6.0'
REACH LENGTH = 9240'
X-SECTIONAL AREA ≈ 25 + ½(6)(10+280) = 895 ft²
VOLUME = (895)(9240) ÷ 43560 = 190. acre-ft
TOTAL STORAGE @ 669.3' = 2450 Acre-ft

Q_{P2} (TRIAL) = $Q_{P1}(1 - V_1/S)$

= 2200(1 − 190/2450)
= 2029 cfs

STAGE = 6'
X-SECT. AREA = 895 ft²
VOLUME = 190 acre-ft
] REACH #1

ASSUME ROAD AT D/S END OF REACH #1 PROVIDES LITTLE STORAGE

Q = 2029 cfs
REFER TO RATING CURVE REACH 2 ⟶ STAGE 6'
REACH LENGTH = 18216 ft.
X-SECTIONAL AREA = 25 + ½(6)(10+220) = 715 ft²
VOLUME = (18216)(715) ÷ 43560 = 299 acre-ft.

Q_{P2} (TRIAL) = $2029(1 - \frac{299}{2450})$ = 1856 cfs

STAGE @ 1856 cfs = 5.5 ft.
X-SECTIONAL AREA = 25 + ½(5.5)(10+200) = 603 ft²
VOLUME = (603)(18216) ÷ (43560) = 252 acre-ft

$Q_{P2} = 2029\left(1 - \frac{231}{450}\right) = 1838.$ cfs.

Q = 1838 cfs
STAGE = 5.5'
X-SECT. AREA = 603 ft²
VOLUME = 252 acre ft
] REACH 2

∴ ASSUME 5.5' FLOOD STAGE INTO FARMINGTON DURING P.M.F CONDITIONS WITHOUT BREACHING

DETERMINE HEIGHT @ REACH #2 (FARMINGTON) @ TEST FLOOD ELEVATION OF 669.3' (PROBABLE MAXIMUM FLOOD) WITH BREACHING, TAKING INTO ACCOUNT TAILWATER

ASSUME 100' BREACH WIDTH

REACH 1

$Q_{P1} = 8/27\, W_b \sqrt{g}\; y_0^{3/2}$

$W_b = 100'$

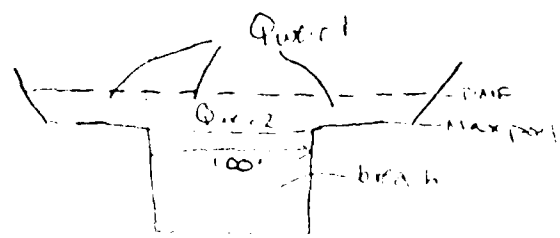
$g = 32.2$ ft/sec²

y_0 = pool elev. → riverbed (669.3 − 652.6) = 16.7'

$Q_{P1} = 8/27\,(100)\sqrt{32.2}\,(16.7)^{3/2}$

$= 11{,}474$ cfs.

ADD $Q_{breach} + Q_{weir}$



$Q_{...2} = C L H^{3/2}$

where $C = 2.7$
$L = 100'$
H = height at PMF. − height at max pool
$= 669.3 - 667.9' = 1.4'$

$Q_{...2} = 2.7(100)(1.4)^{3/2}$
$= 447.$ cfs

...ce $Q_{weir} = 2029$ cfs (refer to p. 3)

$Q_{weir} = 2029\,cfs - 447\,cfs$
$= 1582$ cfs.

$\therefore Q_{TOTAL} = 11,474 + 1582$ cfs
$= 13,056$ cfs.

STAGE = 10'
X-SECTIONAL AREA = $25 + \frac{1}{2}(10)(10+460) = 2375$ ...
VOLUME = $(2375)(9240) \div 43560 = 504$ ac-ft

Q_2(TRIAL) = $13,056(1 - 504/2450)$
$= 10,726$ cfs

STAGE = 9'
X-SECT. AREA = $25 + \frac{1}{2}(9)(10+410) = 1915$ ...
VOLUME = $(1915)(9240) \div 43560 = 406$ ...

$Q_{P2} = 13,056(1 - 455/2450)$

$= 10,631$ cfs.

STAGE = 9'
VOLUME = 406 ac ft.

REACH 1

ASSUME FLOW @ D/S END OF REACH PROVIDES LITTLE STORAGE

REACH 2

$Q = 10,631$ cfs.

REFER TO RATING CURVE (REACH #2) STAGE = 11.5'
REACH LENGTH = 18216 ft.
X-SECT AREA = $25 + \frac{1}{2}(11.5)(10 + 40) = 2382$ sq ft
VOLUME = $(2382)(18216) \div (43560) = 996$ ac ft.

Q_{P2} (TRIAL) $= 10,631\ (1 - 996/2450)$
$= 6309$ cfs

STAGE = 9.5'
X-SECT. AREA = $25 + \frac{1}{2}(9.5)(10 + 340) = 1685$ sq ft
VOLUME = $(1685)(18216) \div 43560 = 706$ ac ft.

$Q_{P2} = 10,631\ (1 - 706/2450)$
$= 6735$ cfs.

STAGE = 9.5'
X-SECT AREA = 1685 sq ft
VOLUME = 706 ac ft

REACH 2

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

∴ THE INCREASE IN STAGE AFTER BREACHING AT REACH 1, ASSUMING THE Q FROM THE REST OF THE DRAINAGE AREA IS NOT AT PEAK, IS

$$9.0' - 6.0' = 3.0'$$

THE INCREASE IN STAGE AT REACH 2 UNDER THE SAME CONDITIONS IS:

$$9.5' - 5.5' = 4.0'$$

FIND PEAK FLOW OF PROBABLE MAXIMUM FLOOD AT FARMINGTON CONTRIBUTED BY DRAINAGE AREA IN BETWEEN SUNRISE LAKE DAM AND FARMINGTON (WHERE ELA RIVER JOINS COCHECO RIVER)

DRAINAGE AREA $\approx 20.5\ mi^2$

REFER TO GRAPH IN "PRELIMINARY GUIDANCE FOR ESTIMATING MAXIMUM PROBABLE DISCHARGES IN PHASE I DAM SAFETY INVESTIGATIONS" NEW ENGLAND C.O.E., MARCH, 1978.

USE FLAT & COASTAL CURVE

PMF in $cfs/mi^2 = 620.$

$\therefore Q_{PMF} = 620\ cfs/mi^2 \times 20.5\ mi^2 = 12{,}710\ cfs.$

ADD TO Q OBTAINED FROM BREACH OF SUNRISE DAM AT PMF, AT REACH 2

$12{,}710 + 6938 = 19{,}648.\ cfs.$

REFER TO RATING CURVE (REACH #2) STAGE = 14.5'

·3141

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

ROAD CAPACITY ANALYSIS AT D/S REACH # 1

ROAD DATA: OPENING AREA = 11.6'W x 5.'H = 58 ft²
LENGTH = 25'
H.W. AVAILABLE = 2.2'

ORIFICE EQ'N

$K_f = \frac{29.1\,(.015)^2 25}{(1.75)^{4/3}}$ $n = .015$, $L = 25.'$, $R = 58/33.2 = 1.75$

$= .078$

Entrance + exit losses ≈ 1.1

∴ TOTAL K ≈ 1.2

$K = 1/C^2$ $\quad 1.2 = \frac{1}{C^2}$ $\quad \therefore C = .91$

$Q = CA\sqrt{2gh}$

Assume wsel @ top of RAD

$Q = .91(58)\sqrt{2(32.2)7.2}$

$= 1137$ cfs.

$C = .91$
$A = 58$
$g = 32.2$
$h = 2.2 + 5 = 7.2$

CC/CC

9/25/78

Sunrise Lake Dam - Gate Capacity

Calculate gate capacity with pool @ spillway crest:

GIVEN: Size of opening - 28" high (2.33') BY 30" wide (2.5')
Elev to be tested - 666' MSL (spillway crest)
u/s invert - 651.5' MSL

$Q = CA\sqrt{2gh}$ ORIFICE EQUATION

$K = \frac{1}{C^2}$ $Kf = \frac{29 n^2 L}{R^{4/3}}$ $n = 0.02$

$Kf = 0.58$ $L = 25'$

$R = \frac{A}{P} = \frac{5.83}{9.66} = 0.60$

entrance & exit losses = 1.10

$K_{TOT} = 1.1 + 0.6 = 1.7$

$1.7 = \frac{1}{C^2}$ $1.7C^2 = 1$ $C^2 = 0.59$ $C = 0.77$

Q capacity @ spillway crest (666' MSL)

$h = 666 - 651.5 + 1.17 = 15.67$

$Q = (0.77)(6)(\sqrt{2(32.2 \times 13.33)})$

$Q = \underline{135 \text{ cfs}}$

APPENDIX F

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

END

FILMED

7-85

DTIC