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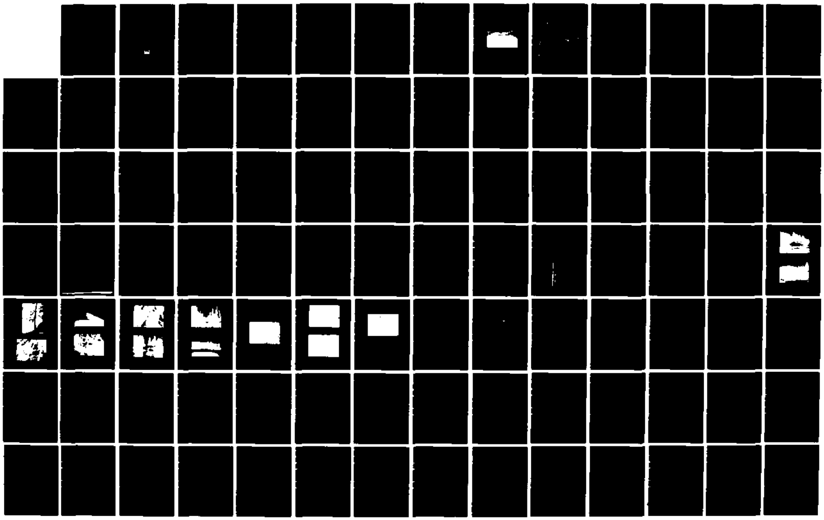

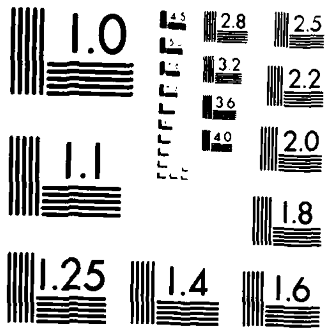

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

CONNECTICUT RIVER BASIN

HARRISVILLE, NEW HAMPSHIRE

SEAVER RESERVOIR DAM

N H 00094

STATE NO 109.11

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

JULY 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Harrisville New Hampshire
Minnewawa Brook

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

The dam has a hydraulic height of 28 ft. and is 325 ft. long. It is an earth-fill embankment with a vertical 4 ft. square concrete drop inlet spillway which discharges into a horizontal reinforced concrete pipe outlet. The dam is in very poor condition. There are various major concerns which must be corrected. The dam is small in size with a significant hazard potential.

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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: NH00094
Name of Dam: Seaver Reservoir Dam
Town: Harrisville
County and State: Cheshire County, New Hampshire
Stream: Minnewawa Brook
Date of Inspection: April 30, 1979; June 18, 1979

BRIEF ASSESSMENT

Seaver Reservoir Dam has a hydraulic height of 28 feet, a topwidth of 30 feet and is 325 feet long. It is an earthfill dam with a vertical 4-foot-square concrete drop-inlet spillway which discharges into a horizontal 36" diameter reinforced concrete pipe outlet. A 4-foot-square low-level gate controls this discharge. An earthen emergency spillway, 120 feet long, is located on the southeastern point of the reservoir. The dam spans a reach of Minnewawa Brook and is located in southwest New Hampshire. Maximum storage capacity is about 680 acre-feet. Seaver Reservoir Dam is used for recreational purposes. The pond is about 1600 feet in length with a surface area of about 45 acres.

The dam is in very poor condition. Major concern is the inadequate spillway capacity, the erosion and trees growing on the downstream slope, a bulge in the retaining wall above the downstream toe, a large depression in the downstream slope above the outlet pipe, and the severe deterioration of the visible portions of the outlet pipe. Minor concerns are brush and tree stumps on the upstream slope.

The dam is of small size and significant hazard classification based on height and storage volume and potential for a loss of 0-2 lives and appreciable property damage in event of a breach. In accordance with Corps guidelines, the test flood may range from the 100-year to ½ the Probable Maximum Flood (PMF). Because the dam's storage capacity is in the upper range of the size classification, ½ PMF was selected as the test flood. The test flood inflow of 2,660 cfs was obtained by summing the ½ PMF outflow from Silver Lake and Childs Bog Reservoir Dam Phase I Inspection reports and applying the 'mountainous' guide curve to the subdrainage area. Routing of this inflow through the reservoir resulted in neglible surcharge storage effects on reducing peak inflows. Therefore, the test flood inflow equals the routed test flood outflow. The routed test flood outflow of 2,600 cfs (605 csm) at elevation 1205.6' MSL would overtop the dam by 1.3 feet (4.6 feet over the spillway crest; 3.3 feet over the emergency spillway crest). The drop-inlet spillway will pass 204 cfs and the emergency spillway will pass 618 cfs before the main dam embankment is overtopped. The combined spillway discharge of 822 cfs is 31 percent of the routed test flood outflow.

The owner, New Hampshire Water Resources Board, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection report.

Warren A. Guinan

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

PREFACE

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

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

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

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

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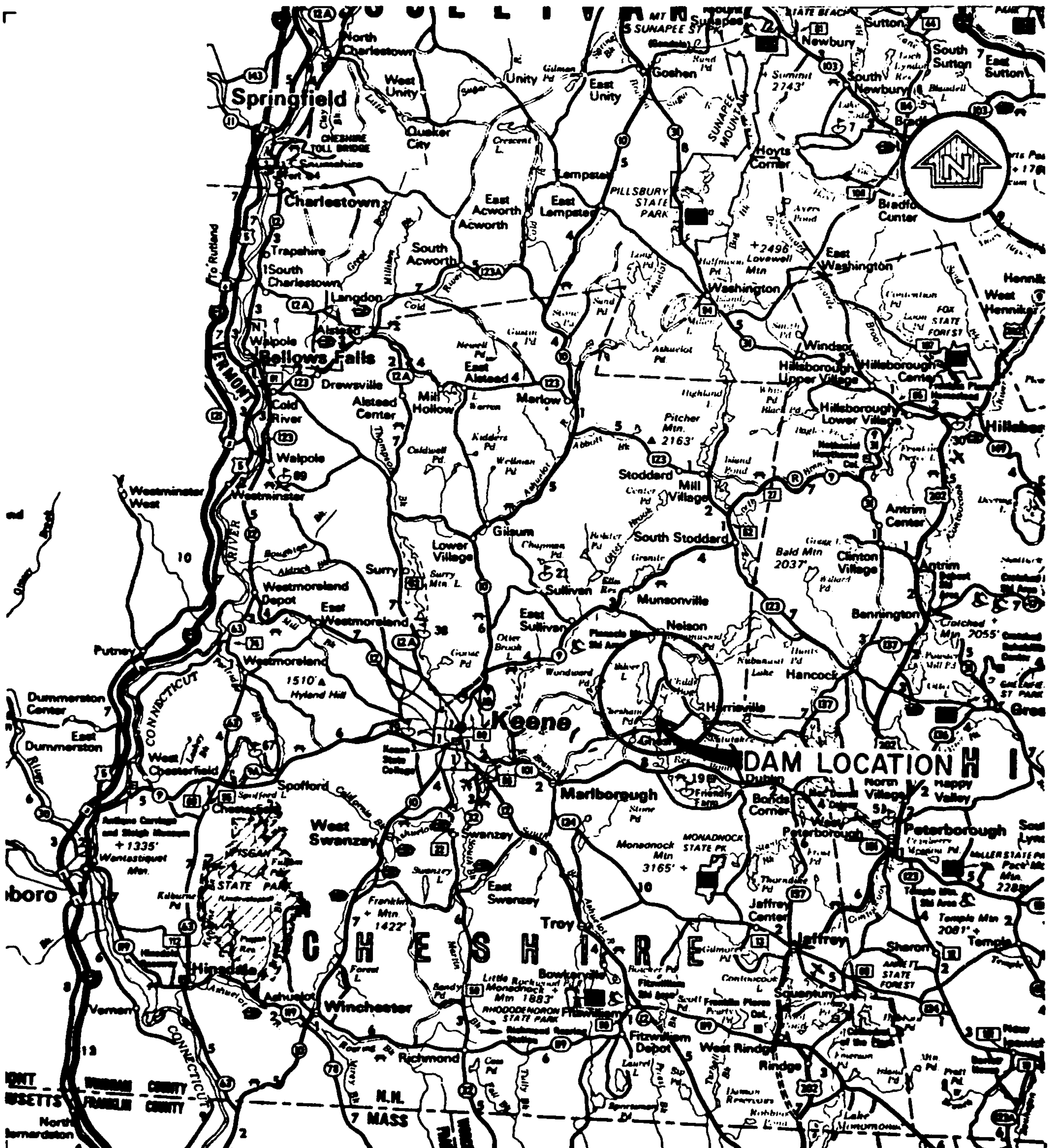
June 1979

Figure 1 - Overview of Seaver Reservoir Dam.



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SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW HAMPSHIRE OFFICIAL HIGHWAY MAP.

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

SEAVER RESERVOIR DAM LOCATION MAP

MINNEWAWA BROOK NEW HAMPSHIRE

SCALE: SEE BAR SCALE

DATE: JULY 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
SEAVER RESERVOIR 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 November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract DACW33-79-C-0009 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. Seaver Reservoir Dam is located in the Town of Harrisville, New Hampshire and is an impoundment in the upper reach of Minnewawa Brook. After discharging through the dam, Minnewawa Brook flows 0.5 mile south to Chesham Pond. After discharging from Chesham Pond, Minnewawa Brook flows in a southwesterly direction for about 7 miles to its confluence with Otter Brook to form the Branch. The Branch then continues another 2.5 miles to Keene, New Hampshire where it joins the Ashuelot River. The Ashuelot River is a major tributary in the Connecticut River Basin. Seaver Reservoir Dam is shown on U.S.G.S. Quadrangle, Monadnock, New Hampshire with coordinates approximately at N 42° 56' 34", W 72° 07' 05", Cheshire County, New Hampshire. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Seaver Reservoir Dam is an earthfill dam, 325 feet long with a hydraulic height of 28 feet. A gravel road crosses its crest and is about 30 feet wide. A wooden service bridge perpendicular to the dam embankment near the center extends out about 46 feet to a 4-foot square concrete drop-inlet, the principal spillway, contained in a riser that is 25 feet high. The low-level outlet is about 25 feet below the top of the crest of the drop-inlet. It is a 36" diameter horizontal concrete outlet pipe approximately 120 feet long. Discharge is controlled by a gate which is regulated by an operating mechanism, mounted on a steel grill platform, on top of the concrete rise. (See Appendix B.) Stoplogs can be placed immediately upstream of the gate to an elevation 11 feet below the drop-inlet crest. The impoundment also has an earthen emergency spillway at the southeastern tip of the reservoir which is covered with brush and trees. The crest of the emergency spillway is about 1.3 feet above the principal spillway crest and is approximately 120 feet long.

c. Size Classification. Small (hydraulic height - 28 feet; storage - 680 acre-feet) based on height and storage ($\geq$ 25 feet to $<$ 40 feet and $\geq$ 50 to $<$ 1000 acre-feet) as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant Hazard. A major breach could result in the loss of 0-2 lives and appreciable property damage. (See Section 5.1 f.)

e. Ownership. Seaver Reservoir Dam was built by Ashuelot Gas & Electric Company in 1924. Ownership was transfered around 1930 to the Public Service Company of New Hampshire and in 1968 to the New Hampshire Water Resources Board (NHWRB).

f. Operator. The current owner and operator of Seaver Reservoir Dam is the NHWRB, Mr. Vernon K. Knowlton, Chief Engineer, 37 Pleasant Street, Concord, New Hampshire 03301 Phone: (603) 271-3406.

g. Purpose of Dam. The dam was originally constructed for storage purposes and is currently utilized for recreation.

h. Design and Construction History. Seaver Reservoir Dam was designed and constructed in 1924 by L.H. Shattuck, Inc., Engineers for the Ashuelot Gas & Electric Company, as part of the Minnewawa Development Project. Two sheets of original design plans were disclosed which were done by L.H. Shattuck, Inc., Engineers and dated February 1924. They are entitled "Plans and Sections" (#101.2) and "Outlet and Spillway Chamber" (#101.3). Under ownership by the NHWRB, improvements were made to the drop-inlet riser in 1976. The plan for these repairs, dated July 1976, was obtained. These repairs consisted of removing the existing trashrack, and adding a stoplog section upstream of the gate containing 18 stoplogs to elevation 1190 and a smaller trashrack. This provided another surface level control for the pond and improved the accessibility to the trashrack for cleaning.

i. Normal Operating Procedures. The dam is visited on a weekly basis by a maintenance staff member of the NHWRB. Conditions at the dam are checked and recorded in a log. Drawdown is done in the fall (approximately ten feet) to provide storage for spring freshets.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 4.4 square miles (2,816 acres) of mountainous wooded terrain. Silver Lake and Childs Bog Dams are located in the upstream watershed. The normal surface area of Seaver Reservoir is 45 acres which constitutes about 2 percent of the watershed.

b. Discharge at Damsite.

(1) Outlet works - drop-inlet concrete box 4-foot square @ invert elevation 1176.0' MSL. Adjoining outlet 36" diameter reinforced concrete pipe extends for 120 feet at approximate invert elevation 1176.5' MSL.

(2) Maximum discharge at damsite is unknown.

(3) Drop-inlet spillway capacity @ top of dam - 204 cfs @ 1204.3' MSL

(4) Emergency spillway capacity @ top of dam - 618 cfs @ 1204.3' MSL

(5) Total spillway capacity @ top of dam - 822 cfs @ 1204.3' MSL

(6) Drop-inlet spillway capacity @ test flood elevation - 209 cfs @ 1205.6' MSL

(7) Emergency spillway capacity @ test flood elevation - 1,470 cfs @ 1205.6' MSL

(8) Total project discharge @ test flood elevation - 2,660 cfs @ 1205.6' MSL

c. Elevation (feet above MSL)

(1) Streambed @ centerline of dam - 1176 (at downstream toe)

(2) Maximum tailwater - unknown

(3) Upstream invert low-level outlet - 1176.5

(4) Recreation pool - 1201 (drop-inlet spillway crest)

(5) Full flood control pool - not applicable

(6) Drop-inlet spillway crest - 1201

Emergency spillway crest - 1202.3

(7) Design Surcharge (original design) - unknown

(8) Top of dam - 1204.3

(9) Test flood pool - 1205.6

d. Reservoir (feet)

(1) Length of maximum pool - 2100

(2) Length of pool at principal spillway crest - 1850

(3) Length of pool at emergency spillway crest - 2000

(4) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 466

(2) Flood control pool - not applicable

(3) Principal spillway crest pool - 466

(4) Emergency spillway crest pool - 555

(5) Top of dam - 680

(6) Test flood - 760

f. Reservoir Surface (acres)

(1) Recreation pool - 45

(2) Flood control pool - not applicable

(3) Drop-inlet spillway crest - 45

(4) Emergency spillway crest - 48

(5) Test flood pool - 54

(6) Top of dam - 52

g. Dam

(1) Type - earthen embankment with drop-inlet spillway (principal) and emergency spillway.

(2) Length - 325' (does not include 120' emergency spillway remotely located from damsite)

(3) Height - 28' (structural height)

(4) Topwidth - 30'

(7) Establish a round-the-clock surveillance program for use during and immediately after heavy rainfall and also a downstream warning system to follow in case of emergency conditions.

7.4 Alternatives

None.

7.2 Recommendations

The owner should engage a qualified Registered Professional Engineer to:

(1) Perform a more detailed investigation to evaluate spillway adequacy and overtopping potential.

(2) Investigate the depression on the downstream slope above the alignment of the spillway discharge pipe, and design appropriate remedial measures, if needed.

(3) Dewater and inspect the spillway outlet pipe; design repairs for the spillway discharge pipe.

(4) Design repairs for the stone retaining wall at the downstream toe of the dam.

(5) Design repairs for the erosion of the channel banks immediately downstream of the spillway outlet.

(6) Design appropriate erosion protection for the crest of the dam.

(7) Design repairs for the erosion on the downstream slope.

(8) Design and supervise procedures for clearing brush, stumps, and trees on the upstream and downstream slopes of the dam.

The owner should implement the recommendations that result from the above studies.

7.3 Operating and Maintenance Procedures. The owner should:

(1) Clear trees, root systems, brush, logs, debris, and stone walls 25 feet on either side of the downstream channel for a distance of 100 feet downstream from the dam and then backfill properly.

(2) Clear trees, root systems, brush, logs, and debris from the emergency spillway and 25 feet on either side of the downstream channel for a distance of 100 feet downstream and backfill properly.

(3) Clear away the trash on the downstream face of the dam.

(4) Clean out the sediment that blocks the downstream channel at the outlet of the spillway discharge pipe.

(5) Continue to visually inspect the dam and appurtenant structures.

(6) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once a year.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Seaver Reservoir Dam is in very poor condition. The major concerns are:

(1) An inadequate spillway capacity.

(2) Depression in the downstream slope above the alignment of the spillway outlet pipe.

(3) Large bulge in the retaining wall at the downstream toe.

(4) Deteriorated condition of the outlet end of the concrete spillway-discharge pipe.

(5) Partial blockage of the outlet end of the spillway-discharge pipe by sediment.

(6) Dense growth of trees and brush in the emergency spillway channel.

(7) Erosion of the right bank of the discharge channel at the toe of the dam.

(8) Stumps and brush on the upstream slope; trees on the downstream slope and immediately downstream of the dam.

(9) Lack of erosion protection on the crest; trespassing and erosion on the downstream slope.

(10) Trash dumped on the downstream slope which makes it difficult to monitor for the development of seepage.

b. Adequacy of Information. 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. Urgency. The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation. No additional information is needed to complete this Phase I evaluation. Additional hydrologic and hydraulic study should be made to design additional spillway capacity.

No evidence of a concrete headwall was observed at the downstream end of the spillway discharge pipe.

c. Operating Records. No operating records pertinent to the stability of the dam are available.

d. Post-Construction Changes. A drawing dated June 1976 indicates that the spillway riser was repaired and modified at that time.

e. Seismic Stability. This dam is located in Seismic Zone 2 and in accordance with the Phase I guidelines does not warrant seismic analysis.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual examination indicates the following evidence of potential problems:

(1) Depression in the downstream slope above the alignment of the spillway outlet pipe.

(2) Large bulge in the retaining wall at the downstream toe.

(3) Deteriorated condition of the outlet end of the concrete spillway-discharge pipe.

(4) Partial blockage of the outlet end of the spillway - discharge pipe by sediment.

(5) Dense growth of trees and brush in the emergency spillway channel.

(6) Erosion of the right bank of the discharge channel at the toe of the dam.

(7) Stumps and brush on the upstream slope; trees on the downstream slope and immediately downstream of the dam.

(8) Lack of erosion protection on the crest; trespassing and erosion on the downstream slope.

(9) Trash dumped on the downstream slope which makes it difficult to monitor seepage or the development of seepage.

In addition, logs, debris, trees overhanging the discharge channel, and stone walls, which are apparently remnants of an old mill building foundation, could contribute to temporary damming of the discharge channel during periods of floodflow.

b. Design and Construction Data. Two drawings dated February 1924 show the plan and cross sections of the dam. These drawings show that the design called for a homogeneous cross section of "fine clay material" with 18-inch riprap layer on a 6-inch blanket of "bank gravel" on the upstream slope, a blanket of "pervious material" under the downstream shell, a coarse rock drain at the downstream toe, and a low concrete headwall at the downstream end of the spillway discharge pipe. On the basis of the visual inspection it was confirmed that the riprap had been placed on the upstream slope. No evidence of the rock toe was observed along most of the length of the dam. The stone retaining wall that acts as a headwall at the downstream end of the spillway discharge pipe is higher than the rock toe shown on the drawing and has a near vertical face as compared to the 2H:1V slope shown on the drawings for the rock toe.

A breach of Seaver Reservoir Dam was analyzed from the dam through Chesham Pond to a point about one mile downstream of Chesham Pond Dam. The breach was assumed to occur with pool level at top of dam and develop to the toe of the dam. The time for a breach to develop with a bottom width of 50 feet and vertical sideslopes was determined to be about one hour. A breach of this magnitude resulted in a discharge of 10,930 cfs. The breach discharge was routed downstream and resulted in the following stages and discharges:

> At Chesham Pond Dam the water surface would rise from top of dam elevation of 1156.4' MSL to 1160.7' MSL, overtopping the dam by 4.3 feet. A rise in Chesham Pond of 4.3 feet could cause property damage to five cottages on its shoreline. Damage could possibly occur to the road crossing located immediately downstream of Chesham Pond Dam. The routed discharge of 5,060 cfs would continue downstream. One trailer located about 200 feet downstream of the dam, could be inundated by 2.2 feet of water, possibly causing damage to the structure and cause loss of 0-2 lives.
>
> The road crossing, ½ mile downstream of the dam, could be overtopped by 4.0 feet with a breach discharge of 4,655 cfs. This amount of overtopping could cause damage to the culvert and the roadway. Two houses located just upstream of the road may be subjected to basement flooding and property damage. (See Appendix C - Figure 11.)
>
> The next road crossing, one mile downstream of the dam, could be overtopped by 2.2 feet with a breach discharge of 4,090 cfs. This amount of overtopping could possibly damage the gravel roadway and culvert. (See Appendix C - Figure 12.) The reach between these two road crossings provides a large storage area for attenuation of the breach wave itself. (See Appendix C - Figure 13.) One house in this reach may be subjected to basement flooding.

A breach of Seaver Reservoir Dam could result in the loss of 0-2 lives and appreciable property damage. Additional damage could possibly occur if the breach discharge caused overtopping failure of Seaver Reservoir or Chesham Pond Dams. Based on this analysis, Seaver Reservoir Dam was classified <u>Significant Hazard</u>.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Seaver Reservoir Dam is an earthfill dam which impounds a reservoir of small size. The dam contains runoff from a 4.4 square mile drainage area. Silver Lake and Childs Bog are present in the upstream watershed. The total length of the dam is 325 feet; the emergency spillway is 120 feet long and the drop-inlet (principal spillway) is a 4-foot square box. The main dam has a gravel road across its crest. The dam embankment is 3.3 feet above the principal spillway crest. The emergency spillway is 1.3 feet above principal spillway crest.

b. Design Data. No hydrologic and hydraulic design data were found.

c. Experience Data. No hydrologic or hydraulic experience data were obtained.

d. Visual Observations. At the time of inpsection, no visual evidence was noted of damage to any portions of the dam caused by excessive discharges.

e. Test Flood Analysis. Seaver Reservoir Dam is classified small in size having a hydraulic height of 28 feet and a maximum storage capacity of 680 acre-feet; the dam was determined to have a significant hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood may range from the 100-year to ½ the Probable Maximum Flood (PMF). Because the dam's storage capacity is in the upper range of the size classification, ½ PMF was selected as the test flood. The test flood inflow of 2,660 cfs was obtained by summing the ½ PMF outflow from the Silver Lake and Childs Bog Dam Phase I Inspection Report and applying the 'mountainous' guide curve to the subdrainage area. Routing of this inflow through the reservoir resulted in negligible surcharge storage effects on reducing peak inflows. Therefore, the test flood inflow equals the routed test flood outflow. The routed test flood outflow of 2,660 cfs (605 csm) at elevation 1205.6' MSL would overtop the dam by 1.3 feet (4.6 feet over spillway crest). The drop-inlet spillway will pass 206 cfs and the emergency spillway will pass 618 cfs before the main dam embankment is overtopped. The combined spillway capacity of 824 cfs is 31 percent of the routed test flood outflow.

f. Dam Failure Analysis. The impact of failure of the dam with pool level at top of dam was assessed. Because of the tandem relationship of Childs Bog, Seaver Reservoir, and Chesham Pond Dams, all three dams were analyzed through the use of the Corps of Engineers HEC-1DB computer program. With this analysis, it could be determined how much overtopping would occur at each dam under various breach conditions.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

Seaver Reservoir Dam is owned and operated by the New Hampshire Water Resources Board (NHWRB). The normal lake level is maintained by the drop-inlet spillway crest. In the fall the lake is drawn down approximately ten feet to provide storage for spring freshets.

4.2 Maintenance of Dam

NHWRB is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

Throughout the year the dam is visited on a weekly basis by a maintenance staff member of the NHWRB. A weekly log is kept on conditions at the dam site. The gate was not operated during the inspection; however, the mechanism appeared to be in satisfactory condition. Overflow at the principal spillway was passing through the gate and outlet pipe.

4.4 Description of Any Warning System in Effect

No written warning system was found.

4.5 Evaluation

The operation and maintenance procedures, consisting of a weekly program of inspection, should ensure that all minor problems encountered can be remedied within a reasonable period of time.

A depression in the downstream slope directly above the alignment of the spillway outlet pipe may be evidence of piping into the spillway outlet pipe or through the stone retaining wall at the toe of the dam in the vicinity of the outlet pipe. The large bulge in the stone retaining wall at the downstream toe of the dam indicates that the wall is on the verge of failure. If it fails, the discharge end of the spillway outlet pipe might be blocked, and seepage, erosion, and piping could develop on the downstream slope itself. The deteriorated condition of the concrete spillway pipe indicates that it might collapse and block the spillway discharge.

Stumps, up to about 12 inches in diameter, remain on the upstream slope. As the roots of these stumps rot, serious seepage problems may result.

The emergency spillway is in poor condition. It is covered with a heavy growth of trees and brush and could easily be plugged during periods of high flows.

Brush growing on the upstream slope will grow into trees if not cleared. Also, many trees were noted on the downstream slope and immediately downstream of the toe of the dam. If the trees blow over and their roots are pulled out, or if a tree dies and its roots rot, serious seepage and erosion problems may result. The sand and gravel road on the crest of the dam has neither paving nor vegetation, thus making it susceptible to erosion. Trespassing has led to significant erosion on the downstream slope of the dam in the vicinity of the outlet of the spillway pipe. Continued trespassing and erosion could threaten the integrity of the dam. Trash dumped on the downstream face of the dam makes it difficult to observe seepage which might be taking place now or which might develop in the future.

Logs and debris in the downstream channel, trees adjacent to the channel which might blow over, and stone walls which are apparently remnants of an old mill building foundation could result in temporary damming of the discharge channel during periods of floodflow. The dense growth of trees and brush in the emergency spillway channel could result in blockage of the channel during floodflow, and would thus increase the risk of overtopping the main dam embankment.

only minor areas of corrosion. The low-level gate operating mechanism appeared to be well-maintained and in good operating condition.

(2) Service Bridge. A 46-foot-long wooden bridge serves as access to the low-level gate operating mechanism at the drop-inlet spillway. (See Appendix C - Figure 6.) The two longitudinal members are pressure treated wood approximately 18" in diameter at the butt end. Each of these timbers was observed to be in good condition. Transverse wood decking is 2" nominal untreated wood plank. The wood planking was observed to be surface weathered with little evidence of structural deterioration. It is possible that during high flows the service bridge could become dislodged making the outlet mechanism inaccessible.

(3) Spillway Outlet Pipe. Only a small portion of the outlet pipe downstream of the dam was visible at the time of the inspection. (See Appendix C - Figure 7.) The outlet is a reinforced concrete pipe. The visible portion of the pipe was observed to be severely deteriorated with large pieces of concrete missing, leaving only the reinforcing steel visible. It could not be determined from the inspection whether the remainder of the pipe was as severely deteriorated. On a subsequent visit to the damsite on September 13, 1979, a close-up photograph was taken of the low-level (spillway) outlet pipe. (See Appendix C - Figure 8.)

(4) Emergency Spillway. At the southeastern tip of the reservoir there is an emergency spillway. (See Appendix C - Figures 9 and 10.) The spillway itself is broad and flat, and does not have a well-defined channel. It is covered with a heavy growth of trees and brush. A concrete core wall, 10 inches wide, 3 feet deep and projecting about 1½ inches above ground surface, is shown on design drawings but was not observed in the field. This spillway is 120 feet long and 20 feet wide.

d. Reservoir Area. The watershed above the reservoir is rolling and heavily wooded. (See Appendix C - Figure 11.) No camps or other structures were observed on the shore of the reservoir. Sedimentation in the reservoir appears to be insignificant.

e. Downstream Channel. The channel downstream of the dam is filled with sediment several inches above the invert of the spillway. (See Appendix C - Figure 12.) The right bank of the channel immediately next to the stone retaining wall at the toe of the dam has been eroded. Many trees overhang the channel. At several locations there are logs across the channel and brush and other debris in the channel. Remnants of several dry stone masonry walls were noted on both sides of the channel; apparently this was the site of a former mill building.

3.2 Evaluation

Based on the visual inspection, Seaver Reservoir Dam is in very poor condition.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Seaver Reservoir Dam is a low dam which impounds a reservoir of small size.

b. Dam. Seaver Reservoir Dam is an earth embankment with a hydraulic height of 28 feet, 325 feet long, and 30 feet wide at the crest. The crest of the dam carries a gravelled roadway. (See Appendix C - Figure 2.) No evidence of erosion of the crest was observed. The upstream face of the dam has a slope of approximately 2H:1V. Brush is growing on the upstream slope above reservoir level and there are a number of tree stumps, up to about 12 inches in diameter, on the upstream slope. (See Appendix C - Figure 3.) Riprap on the upstream slope extends from about 2 feet above reservoir level at the time of the inspection to an unknown elevation below water level. The downstream slope of dam is earthen and has a slope of approximately 1.5H:1V. A heavy growth of trees and some brush were noted on the downstream slope. Trespassing has resulted in significant erosion on the downstream slope in the vicinity of the spillway outlet pipe. Trash has been dumped at several locations on the downstream slope. The downstream toe is retained behind a vertical stone wall about 4 feet high at the discharge end of the spillway pipe. There is a major bulge in this wall and it appears to be on the verge of collapse. (See Appendix C - Figure 4.) Upslope from this wall, and directly above the alignment of the spillway discharge pipe, is a depression about one foot deep and 3 feet in diameter. (See Appendix C - Figure 5.)

c. Appurtenant Structures

(1) Concrete Box Spillway Inlet. The principle spillway of Seaver Pond Dam is a concrete drop-inlet box located approximately 46 feet upstream of the dam. (See Appendix C - Figure 6.) The concrete box is 4-foot square inside at the crest. A low-level outlet operating mechanism is located on the top of the box. A visual inspection of the outlet box during low water condition revealed that the concrete is in good condition. The lower portion of the concrete box has been repaired recently by facing the outside walls with approximately 8 inches of new concrete. The lower portion is approximately 4 feet wide by 6 feet long. Approximately 10 feet below the top of the concrete box is a shallow stoplog facility and trashrack that is used to control a lower water level.

The concrete box was observed to be in good condition. The only visual evidence of deterioration was minor surface erosion of the concrete exposing some of the coarse aggregate. The steel grating covering the top of the box appeared to be in good condition with

SECTION 2
ENGINEERING DATA

2.1 Design

Two sheets of original design plans were obtained from NHWRB files that were drawn by L.H. Shattuck, Inc., Engineers dated February 1924. They are entitled "Plan and Sections" and "Outlet and Spillway Chamber". The plan for riser repairs done by NHWRB was also obtained (See Appendix B.)

2.2 Construction

A complete construction diary recorded by L.H. Shattuck, Inc., Engineers, is available in the NHWRB files.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. Design plans were obtained from the files of the NHWRB; construction diary is available in NHWRB files.

b. Adequacy. The final assessments and recommendations of the investigation are based on the plans obtained of the dam, the visual inspection and the hydrologic and hydraulic calculations.

c. Validity. The dam as seen on the visual inspection generally conforms to the disclosed design plans and the plan for riser repairs with the exception of the 4-foot dry masonry wall at the downstream toe. The original plans show a downstream pervious blanket under the fill with rockfill toe.

(6) D/S Channel - The downstream channel is not well defined. Trees, brush and grass are growing in the channel. After discharging through the emergency spillway, the water would flow down to a meadow where it joins a tributary then flows into Chesham Pond about 0.3 miles downstream.

(5) Sideslopes - 2H:1V upstream face and 1.5H:1V downstream face

(6) Zoning - none per original design plans

(7) Impervious core - none per original design plans

(8) Cutoff - 4 foot deep by 4 to 8 feet wide shown on plans

(9) Grout curtain - none shown on plans

h. <u>Diversion and Regulating Tunnel</u> - not applicable

i. <u>Spillway</u>

(1) Type - a vertical concrete 4-foot-square drop inlet riser which discharges into a 36-inch horizontal concrete pipe.

(2) Size - 4-foot-square drop-inlet riser; 36" diameter horizontal outlet. (16 feet of weir)

(3) Crest elevation - 1201' MSL

(4) Gates - none

(5) Low-level - 3-foot square concrete conduit which discharges into the 36" diameter concrete pipe controlled by a slide gate.

(6) U/S Channel - The approach channel consists of Seaver Reservoir. The banks of the reservoir are heavily wooded.

(7) D/S Channel - The channel immediately downstream flows in a narrow, bouldery channel approximately 5-10 feet in width. Trees and brush cover the banks. Approximately 0.15 miles downstream it flows into Chesham Pond.

j. <u>Emergency Spillway</u>

(1) Type - brush and tree covered earthen channel which is not well defined.

(2) Width - 20' (approximate)

(3) Crest elevation - 1202.3' MSL

(4) Length - 120' (approximate)

(5) U/S Channel - The approach channel consists of Seaver Reservoir. The approach from the reservoir to the crest is a tree and brush filled swampy area.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Seaver Reservoir Dam, NH

DATE November 30, 1978
April 30, 1979
June 18, 1979

TIME 1030 (4/30/79)

WEATHER Sunny, Hot (4/30/79)

W.S. ELEV. U.S. 1201 (4/30/79) DN.S. 1177 (4/30/79)

PARTY:

1. Ronald Hirschfeld 6/18/79) GEI
2. Katherine Somerville (11/30/78; 6/18/79) ANCo
3. Claire Plaud (6/18/79) ANCo
4. Steven Gilman (11/30/78; 4/30/79) ANCo
5. Warren Guinan (11/30/78; 4/30/79) ANCo
6.
7.
8.
9.
10.

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Hydrology/Hydraulics	W. Guinan/K. Somerville	
2. Structural Stability	S. Gilman	
3. Soils & Geology	R. Hirschfeld	
4.		
5.		
6.		
7.		
8.		
9.		
10.		

PERIODIC INSPECTION CHECKLIST

PROJECT Seaver Reservoir Dam, NH

DATE April 30, 1979
June 18, 1979

PROJECT FEATURE Dam Embankment

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	1204.3' MSL
Current Pool Elevation	1201' MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Trespassing on downstream slope at spillway
Sloughing or Erosion of Slopes or Abutments	Erosion of downstream slope at spillway
Rock Slope Protection - Riprap Failures	Riprap on upstream face in poor condition where observable above water surface.
Unusual Movement or Cracking at or Near Toe	Depression about one foot deep in downstream slope above spillway pipe. Erosion of right bank of channel immediately downstream of spillway outlet.
Unusual Embankment or Downstream Seepage	
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Extensive tree growth on downstream slope. Brush and stumps of trees up to 12"-diameter on upstream slope.

PERIODIC INSPECTION CHECKLIST

PROJECT Seaver Reservoir Dam, NH

DATE April 30, 1979 June 18, 1979

PROJECT FEATURE Control Tower

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good - bottom portion newer concrete
Condition of Joints	None visible
Spalling	None visible
Visible Reinforcing	None
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	None
Joint Alignment	Not applicable
Unusual Seepage or Leaks in Gate Chamber	None visible
Cracks	None
Rusting or Corrosion of Steel	None
b. Mechanical and Electrical	Manual gate operating mechanism
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Seaver Reservoir Dam, NH DATE April 30, 1979 / June 18, 1978

PROJECT FEATURE Outlet Structure & Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Outlet pipe - submerged Appears to be concrete End of pipe deteriorated
Rust or Staining	
Spalling	
Erosion or Cavitation	End of pipe deteriorated
Visible Reinforcing	At end of discharge pipe
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	None
Channel	
Loose Rock or Trees Overhanging Channel	Many trees overhanging channel. Remnants of mill building walls next to channel.
Condition of Discharge Channel	Poor. Logs across channel.

PERIODIC INSPECTION CHECKLIST

PROJECT Seaver Reservoir Dam, NH

DATE April 30, 1979 June 18, 1979

PROJECT FEATURE Principal Spillway

NAME

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Not observable beneath water surface
b. Weir and Training Walls	
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	None
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	Remnants of mill building stone walls on both sides of channel.
Trees Overhanging Channel	Many large trees
Floor of Channel	Boulders, sand, and gravel
Other Obstructions	Logs across channel

PERIODIC INSPECTION CHECKLIST

PROJECT Seaver Reservoir Dam, NH	DATE April 30, 1979 June 18, 1979
PROJECT FEATURE Service Bridge	NAME
DISCIPLINE	NAME

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	
Bearings	
Anchor Bolts	None
Bridge Seat	
Longitudinal Members	Creosote poles - 18" 2 each
Underside of Deck	
Secondary Bracing	
Deck	Untreated wood, weathered
Drainage System	None
Railings	None
Expansion Joints	None
Paint	None
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

PROJECT Seaver Reservoir Dam

DATE June 18, 1979

PROJECT FEATURE Reservoir

NAME K. Somerville

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	None visible
Changes in Watershed Runoff Potential	None
Upstream Hazards	None
Downstream Hazards	Inhabited structures at low elevations on Chesham Pond
Alert Facilities	None posted
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None posted

APPENDIX B

ENGINEERING DATA

Seaver's Reservoir, Harrisville, N.H.:

Drainage Area:	4.2 sq. miles (or about 2690 acres)
Pond Area:	42 acres.
Shore line:	0.9 miles
Elevation:	1195 feet above Mean Sea Level

Like Chesham Pond, little recreational development has taken place along this pond as it was drawn down after the spring runoff. However, the State plans to maintain a more uniform summer level which should provide excellent fishing, boating and swimming. Also, there has been transferred about 30 acres of frontage along the south side of the pond connecting the Reservoir to the town road. This land is a potential park site. This dam was built in 1924.

Child's Bog Reservoir, Harrisville, N.H.:

Drainage Area:	1.4 sq. miles (about 800 acres)
Pond Area:	105.4 Acres
Shore Line	2.1 miles
Elevation:	1375 feet above Mean Sea Level

Little development recreationally exists at Child's Bog Reservoir due to wide summer level fluctuation. With State operation, a nearly uniform level will be maintained for recreational use. This dam was raised in 1926.

Conveyed with this dam are three parcels of land offering public access to the Reservoir. Two of these tracts border the reservoir offering good access to the pond for boats and swimming.

Howe Reservoir, Harrisville and Dublin, N.H.:

Drainage Area:	10.3 sq. miles (or about 6,600 acres)
Pond Area:	257.8 Acres
Shore Line:	5.5 miles
Elevation	1272 feet above Mean Sea Level

This reservoir has been drawn nearly dry in summers but will be maintained at a recreational level by the State. Both public and private development will result from a stable lake level. With its ready access from N.H. Route #101, good public access for boats will be afforded. There is little land except at the dam site transferred at this site.

Highland Lake, Stoddard and Washington, N.H.:

Drainage Area:	29.7 sq. miles (or about 19,000 acres)
Pond Area:	679.2 acres
Shore Line:	15.7 miles
Elevation:	1,296 feet above Mean Sea Level

KEENE GAS & ELECTRIC COMPANY

MINNEWAWA DEVELOPMENT

STORAGE RESERVOIRS

Reservoir	Area acres	Draw ft.	Capacity million cu. ft.	Watershed sq. Miles Exclusive	Watershed sq. Miles Total
Silver Lake	342	8	111	2.3	2.3
*Childs Reservoir	120	14	52	1.35	1.35
*Seaver Reservoir	42	18	20	.47	4.12
Chisham Pond	70	8	15	4.03	8.15
*aClapp Pond	20	13	8	1.19	1.19
Dublin Pond	242	2	21	1.05	1.05
*eMt. Brook Res.	300	8	65	4.93	5.98
Howe Reservoir	195	14	65	4.53	10.51
*a Russell Pond	39	12	12	.46	10.97
Marlboro Pond	9	15	4	1.79	21.0
Total	1,379		373	22.10	

*Proposed

*a Too expensive for present construction

*e Unsurveyed-Area, Draw & Capacity estimated

NEW HAMPSHIRE WATER CONTROL COMMISSION

Dams on Which Information is Available in the

Town of Harrisville

State No.	Location Stream	Name of Body of Water Created	Owner	Condition
109.01	Minnewawa Brook	Silver Lake	Breed Pond Reservoir Co.	Operable
109.02	" "	Chesham Pond	" " " "	"
109.03	Pratt Brook	Russell Reservoir	Gertrude M. Russell	"
109.04	Nubanusit Brook	----	Cheshire Mill	"
109.05	Pratt Brook	----	Gertrude M. Russell	Ruin
109.06	Minnewawa Brook	----	E. W. Seaver	"
109.07	Nubanusit Brook	----	W. C. Tolman	"
109.08	Nubanusit Brook	Harrisville Pond	Cheshire Mill	Operable
109.09	Nubanusit Brook	----	Ashuelot Nat'l Bank	Ruin
109.10	Nubanusit Brook	Skatutakee Lake	White Mills of N.H.	Operable
109.11	Minnewawa Brook	Seaver Reservoir	Pub.Ser.Co. of N.H.	"
109.12	Pratt Brook	Howe Reservoir	" " " " "	"
109.13	Br.Minnewawa Brook	Childs Reservoir	" " " " "	"
109.14	Nubanusit Brook	----	Cheshire Mill	

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 102.11

Town Harrisville : County Cheshire

Stream Seaver Reservoir

Basin-Primary Conn R. : Secondary Minnewawa

Local Name Seaver Reservoir

Coordinates—Lat. 42° 55' + 9,400 : Long. 72° 10' -9700.

GENERAL DATA

Drainage area: Controlled ... Sq. Mi.: Uncontrolled ... Sq. Mi.: Total 4.2' Sq. Mi.

Overall length of dam 300' ft.: Date of Construction

Height: Stream bed to highest elev. 23' ft.: Max. Structure 21' ft.

Cost—Dam : Reservoir

DESCRIPTION

Waste Gates

Type

Number 1 : Size ... ft. high x 3' dia pipe ft. wide

Elevation Invert : Total Area 22' below top sq. ft.

Hoist

Waste Gates Conduit

Number : Materials

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

Embankment

Type

Height—Max. ... ft.: Min. ... ft.

Top—Width : Elev. ... ft.

Slopes—Upstream ... on ... : Downstream ... on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction Concrete

Length ~~Total~~ (3.5' square) ft.: Net 14' ft.

Height of permanent section—Max. 21.0' ft.: Min. ... ft.

Flashboards—Type : Height ... ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity 135 cfs.: 92 cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. 2.0' ft.: Min. ... ft.

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

OWNER Public Service Co of N H.

REMARKS Use— ~~Storage~~

Tabulation By A. A. N. & R. L. T. Date December 12, 1938.

B&B21284

7205

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

LOCATION AT DAM NO. 109.11

Town Harrisville : County Cheshire

Stream Seaver Reservoir

Basin—Primary Conn : Secondary Minnewawa Bk

Local Name

DRAINAGE AREA

Controlled .... Sq. Mi.: Uncontrolled .... Sq. Mi.: Total 4.2 Sq. Mi.

ELEVATION vs. WATER SURFACE AREA vs. VOLUME

	Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1)	Max. Flood Height			
(2)	Top of Flashboards			
(3)	Permanent Crest			
(4)	Normal Drawdown	19	41	486
(5)	Max. Drawdown			
(6)	Original Pond	U.S.G.S. 1154		

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

RESERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdown	ft.	ft.
Volume	ac. ft.	ac. ft.
Acre ft. per sq. mi.		
Inches per sq. mi.		

USE OF WATER Storage

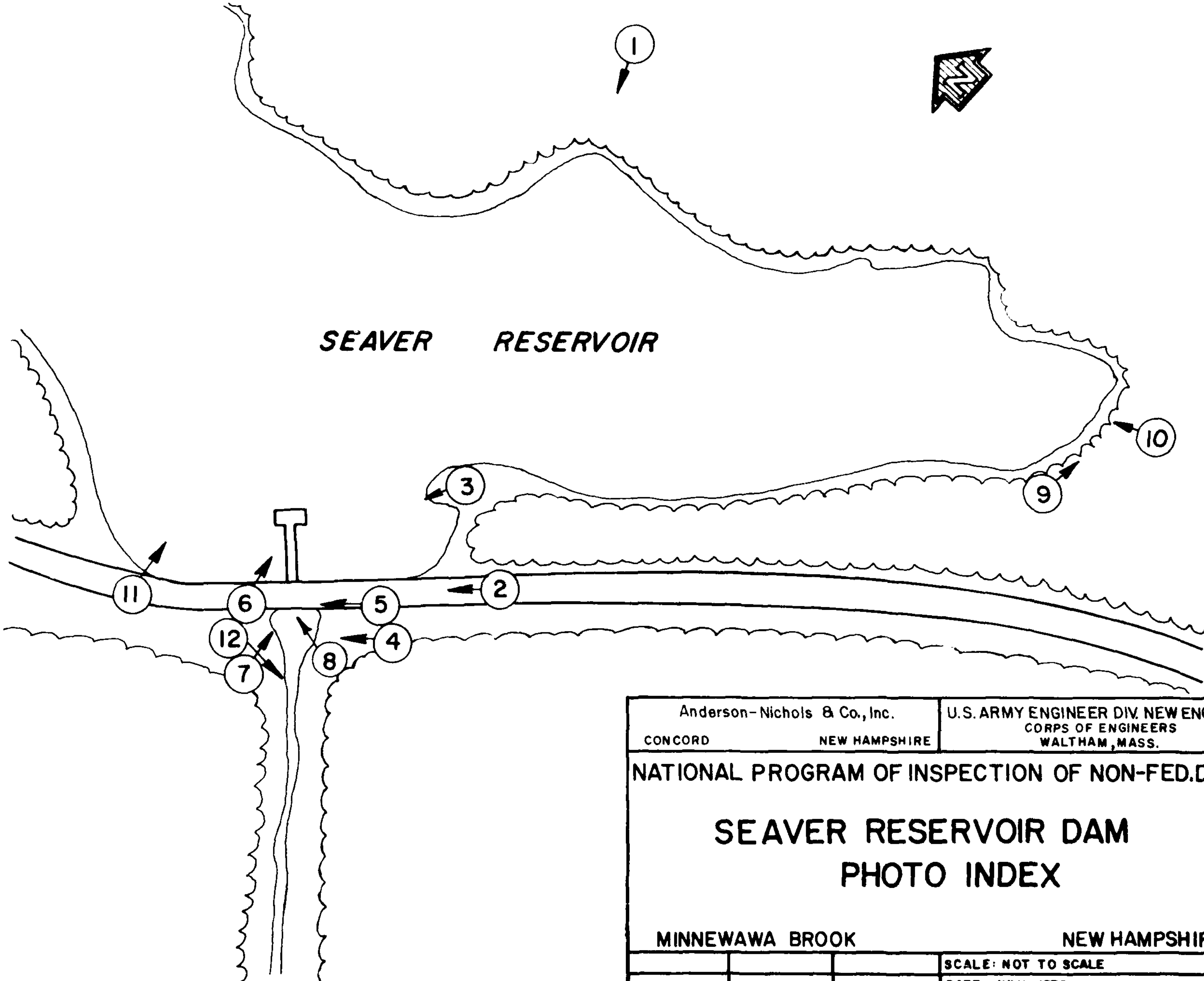
OWNER Public Service Co of N H

REMARKS

Tabulation By A A N & R L T Date December 12, 1938.

April 30, 1979
Figure 2 - Looking northwest across the crest of the dam embankment.

April 30, 1979
Figure 3 - View of upstream face of the dam.



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

SEAVER RESERVOIR DAM
PHOTO INDEX

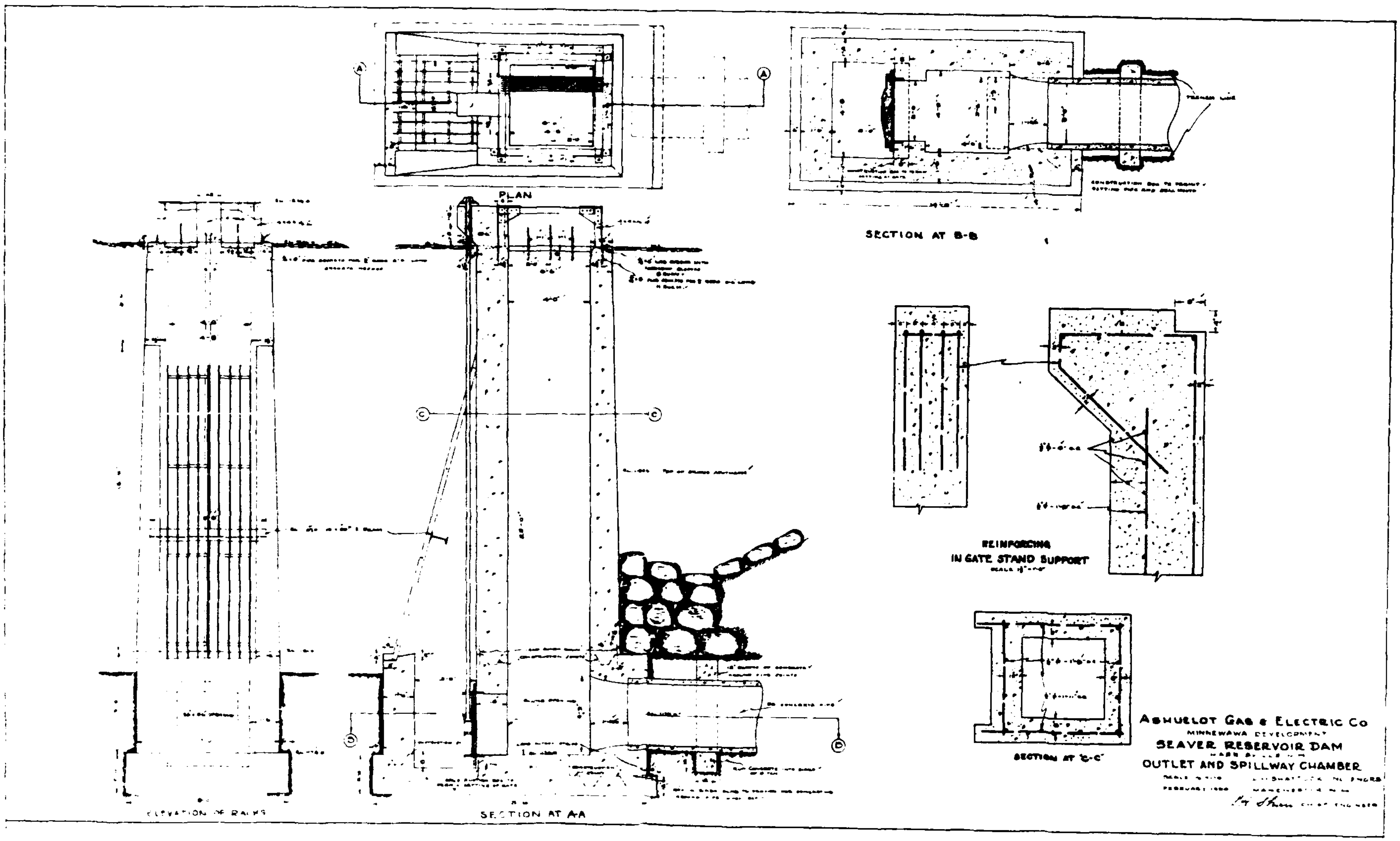
MINNEWAWA BROOK NEW HAMPSHIRE

SCALE: NOT TO SCALE

DATE: JULY, 1979

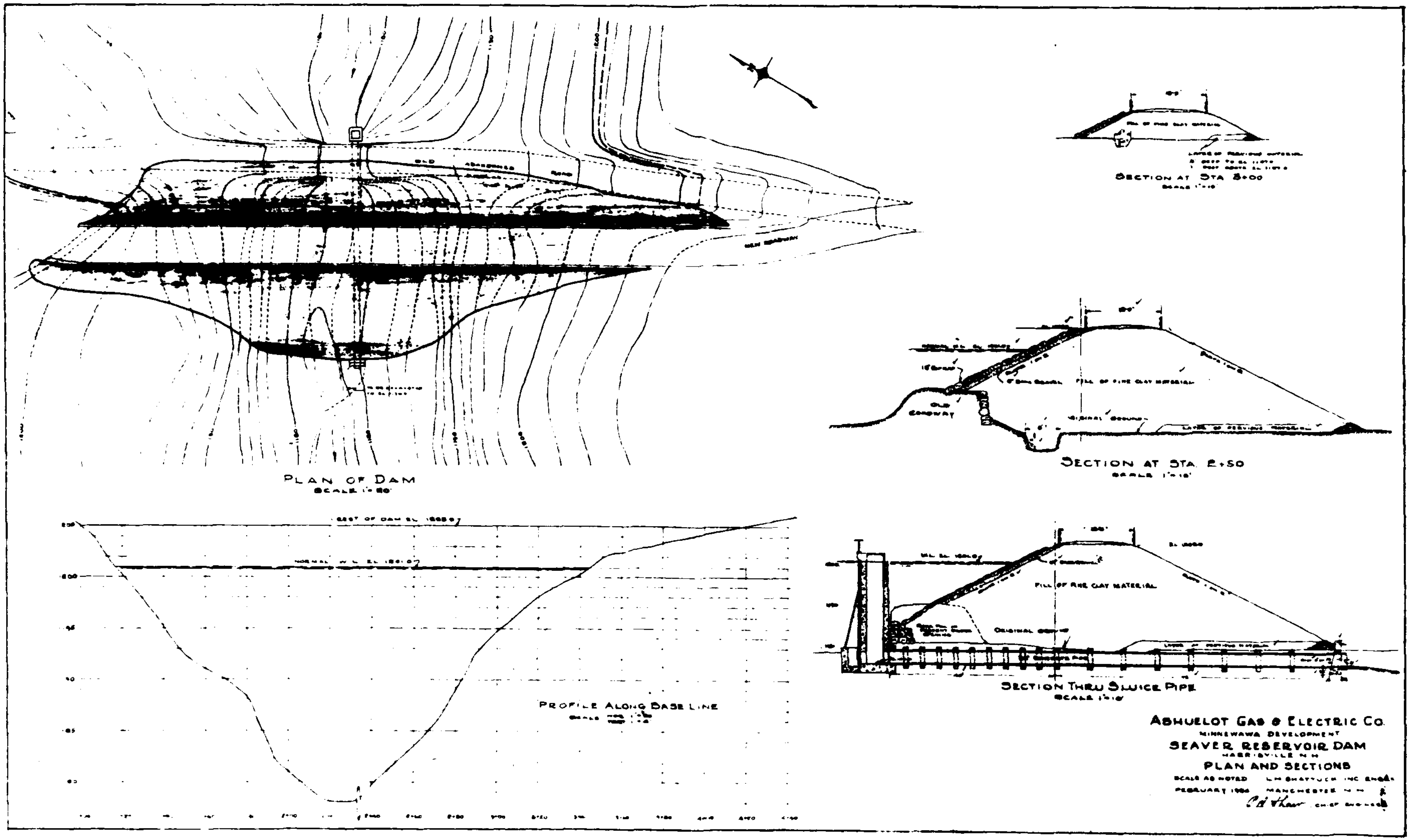
APPENDIX C

PHOTOGRAPHS

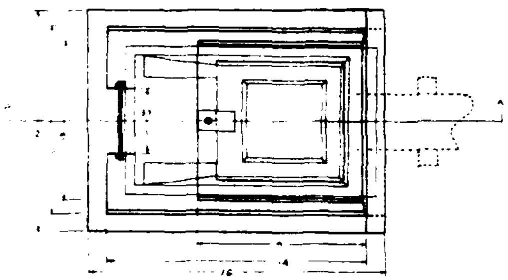


PLAN
SECTION AT B-B
REINFORCING
IN GATE STAND SUPPORT
ELEVATION OF RACKS
SECTION AT A-A
SECTION AT C-C
ASHUELOT GAS & ELECTRIC Co
MINNEWAWA DEVELOPMENT
SEAVER RESERVOIR DAM
OUTLET AND SPILLWAY CHAMBER

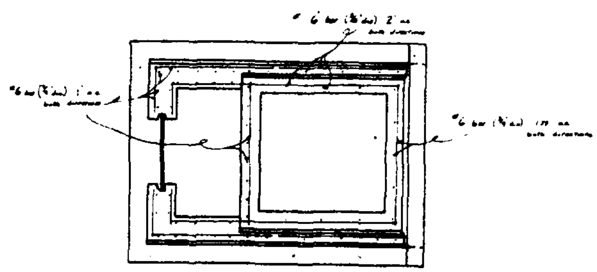
101.3


PLAN OF DAM
SCALE 1"=80'
PROFILE ALONG BASE LINE
SECTION AT STA 8+00
SECTION AT STA 2+50
SECTION THRU SLUICE PIPE
FILL OF FINE CLAY MATERIAL
ORIGINAL GROUND
OLD ROADWAY
ASHUELOT GAS & ELECTRIC CO.
MINNEWAWA DEVELOPMENT
SEAVER RESERVOIR DAM
HARRISVILLE N.H.
PLAN AND SECTIONS
SCALE AS NOTED
FEBRUARY 1926
MANCHESTER N.H.

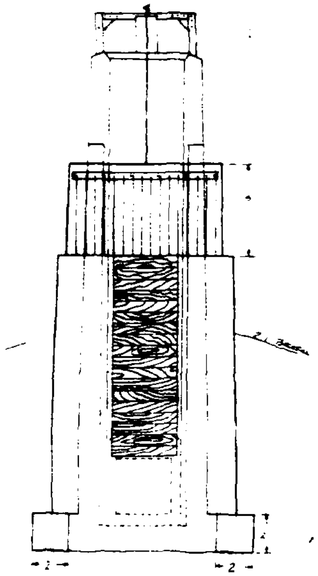
1012



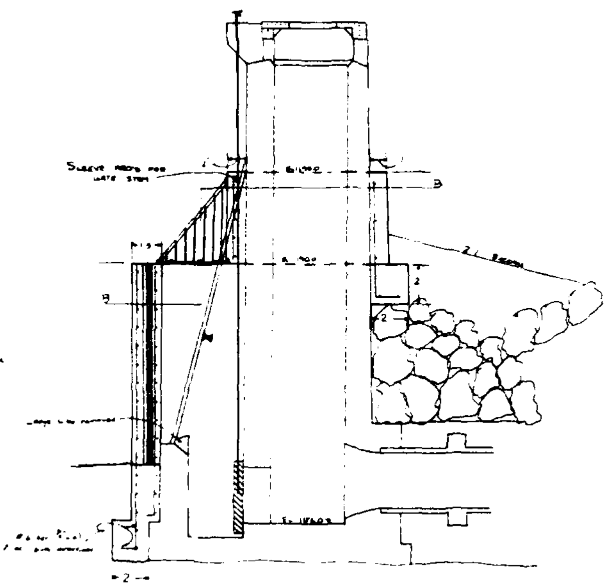
Plan



Section B-B
(New Construction Only)



Elevation of Stop Log Bay



Section A-A

NOTES

RISER CONSTRUCTION:

1. Excavate existing backfill around riser and footing on three sides. Do not disturb back-side (near outflow pipe) material.
2. Remove existing trash rack and save for rebuilding.
3. Remove pointed concrete ledge on wall opposite gate that supported trash rack as shown on the drawings.
4. Remove growth of other material that adheres to riser and footings.
5. Repair gate and stem as required to stop leakage and to improve operation.
6. 2 ft. wide footings to be adjacent to existing footing on three sides and located as shown on the back side of the riser.
7. Install shear transfer pin connectors on 2 ft. centers - all four sides of riser in work area. (In vicinity of crack, pins should be on 1 ft. centers.)
8. Stop log section and reinforcing wall to be 18 inches thick as shown. "Band-Aid" portion - 1 ft. thick on all four sides.
9. Construct new trash rack as indicated using material from old trash rack when possible.
10. Backfill (2:1) 3 sides as indicated.
11. Construct 18 stop logs 4 ft. long x 4 in. x 4 in. (nominal) with 7 holes drilled vertically to accept #14 rebar, i.e., to submerge stop logs in bay.
12. Sleeve for gate stem is required through "Band-Aid" portion.
13. Minimum cover over rebar is to be 2 inches.
14. Construction standard stop log bay for 4 ft. long logs.

OUTFLOW PIPE REPAIR:

1. Repair last section of RCP outflow pipe as required.

Designed by
Drawn by
Traced by
Checked by

Seaver Reservoir Riser Repairs

NEW HAMPSHIRE WATER RESOURCES BOARD
- CONCORD, N.H. -

Scale: | | Date:

REVISIONS
DATE

 109.11

Beaver Reservoir, Harrisville, N. H.
Keene Gas & Electric Co., Owners.
L. H. Shattuck, Inc., Contractors.

Begun June 16, 1924, finished Nov. 26, 1924. New construction: Earth dam, vertical toe wall, dry rubble, up stream face roughly riprapped; cut off trench, outlet or sluice pipe, reinforced cement pipe, cut off walls at joints--intake chamber concrete with inlet and gate at base and spillway inlet at top--auxiliary spillway in natural valley entirely independent and not connected with dam--of ample capacity.

Materials of construction i. e. cement, stone and sand inspected and met standard requirements. The earth material used in dam was good quality adapted to its purpose and well compacted in layers, the method insured it. The crest of dam carries the highway. The revised plans were followed, workmanship good, progress slow. See plans.

See progress reports June 16 to Nov. 26, 1924, inclusive.

Dec. 1, 1924. Samuel J. Lord,
Inspector.

(1924)

Ashuelot Gas & Electric Co. Owners
L. H. Shattuck Co. Inc. Contractors
Harrisville, N. H.
Seaver Reservoir.

Started June 16, 1924. Completed November 26, 1924.
Plans were filed June 10, 1924.

Permission given to go ahead with construction June 20, 1924.

The excavation was started on June 18, 1924. Pouring concrete in cut-off wall was started July 18, 1924. The fill was started August 6, 1924. Completed November 26, 1924.

This is an earth dam 19' high and 230' long. The drainage area is 4.1 sq. miles. This dam was built for storage purposes.

Informal 1515 Docket 883 Order 1555 Plan D-1178

Town No. 11 Town Harrisville No.

Data by L. W. B. File I-1515

Owner ~~Ashuelot Gas & Electric Co. (Seaver Res.)~~

River or Stream Branch, Minnewawa Brook

Public Utility Yes Drainage area 4.1 sq. mi.

Wheel Capacity H. P. { Primary H. P. 90% time }

Type of Construction Earth Fill

Height 19 ft. Operating Head Storage ft.

Length 230 ft. Spillway Length (No. 1) 36" Pipe (No. 2) 40' ft.

Would Failure of Dam do Harm? Yes

Present Condition ~~Good~~ Good Date Oct. ~~1924~~ 1925

7374

109.11

PUBLIC SERVICE COMMISSION

OF

NEW HAMPSHIRE

CONCORD

WILLIAM T. GUNNISON, CHAIRMAN
THOMAS W. D. WORTHEN
JOHN W. STORRS
COMMISSIONERS

WALTER H. TIMM, CLERK
MRS. MARY NAWN GRIFFIN
ASSISTANT CLERK

ADDRESS ALL CORRESPONDENCE TO THE COMMISSION

May 25, 1925

John W. Storrs, Commissioner,
New Hampshire Public Service Commission,
Concord, New Hampshire.

Dear Sir:

On my inspection of the dam at Seaver Reservoir in Harrisville, owned by the Keene Gas and Electric Company, May 21, I found the water at an elevation about two feet below the top of the dam.

The plan on file in our office shows the elevation of the crest of the dam was to be 1205, the elevation of the top of the well 1201 and the top of the spillway as elevated 1202. As they had put about one foot of flashboards on the well it would make the water at about elevation 1202.

There has probably been a settlement in fill on the dam with the frost coming out this spring, so it would seem advisable to have enough more material put on to raise the dam to its proper elevation so that they will have a difference of three feet between the crest of the dam and the spillway.

It would also seem advisable to have a guard rail on both sides of the roadway crossing the dam as it is a public road and an accident could very easily occur. No doubt the company intends to do these things but it would seem advisable to do them as soon as possible.

Respectfully yours,

N. H. PUBLIC SERVICE COMMISSION,

Lyman W. Bagley

Engineer.

*-DW

Harrisville
Page 3 #11

Inspected June 13, 1930.

Seaver Dam

Public Service Company of New Hampshire

This is an earth dam with rip-rap on the upstream face. Pondage very low at the time of inspection as shown by DIVI-11. There is no seepage. The down stream side is well grassed and the sides planted with pines. Owing to the low pondage it was hard to determine the exact condition. From general inspection it appears in good condition.

Formerly owned by the Keene Gas and Electric Company.

DIVI-11

DAMS AND THEIR LOCATIONS IN TOWN OF Harrisville

No.	Location River, Brook, Pond or Lake		Condition Ruins or Operable		Owner	Owner's Address
1.	Silver Lake		Good	1	Breed Pond Co.	Marlborough
2.	Childs Dam		Good	13	Public Service Co. of N.H.	Keene
3.	Seaver	"	Good	11	" "	" "
4.	Symonds Reservoir		Good,	2	Breed Pond Co.	
5.	Howe	"	Good	12	" "	"
6.	Church Pond	3	(Gertrude Russell) Sears,			Cheshire
7.	Box Shop Dam	5	Ruins		Gertrude Russell	"
8.	Cheshire Mills	"	Good	4, 8+14	Cheshire Mills Co.	Keene
9.	Clinic Shop	"	Ruins	9	"	"
10.	Eastman	"	"	6	E. L. Gay.	"
11.						
12.						
13.						
14.						

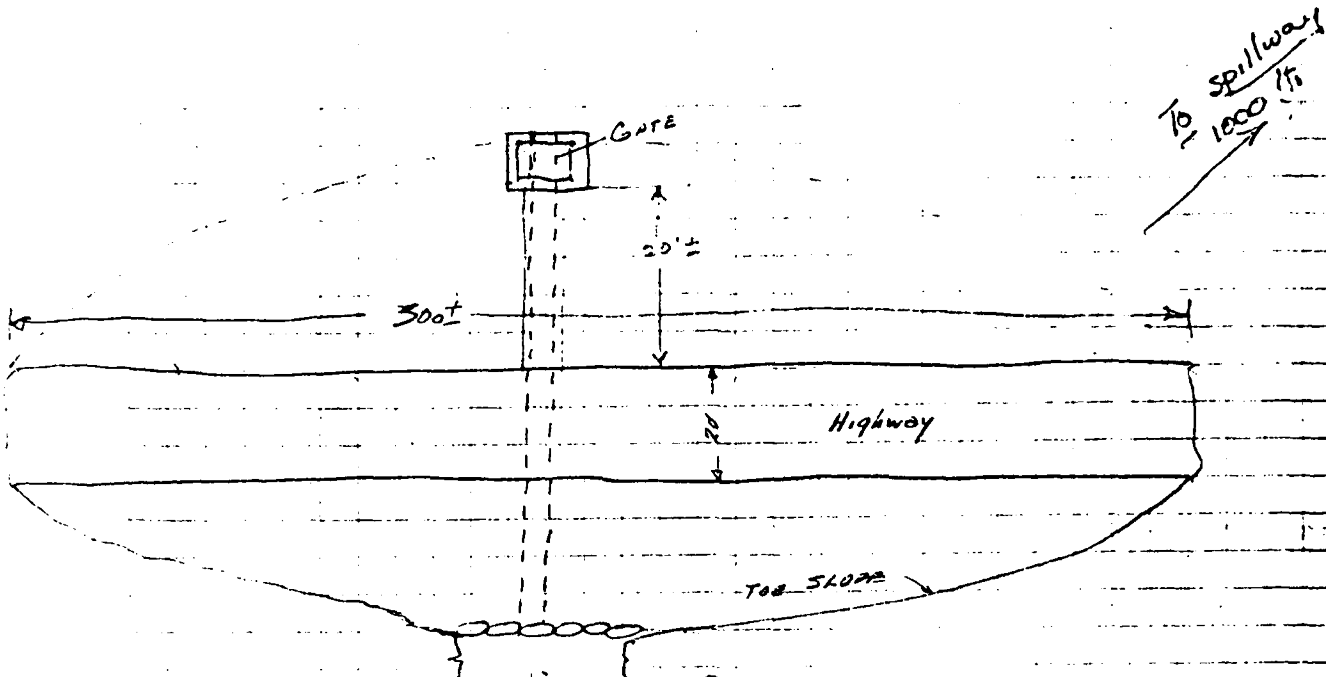
B-8

B. F. Reinick Selectman
Harrisville

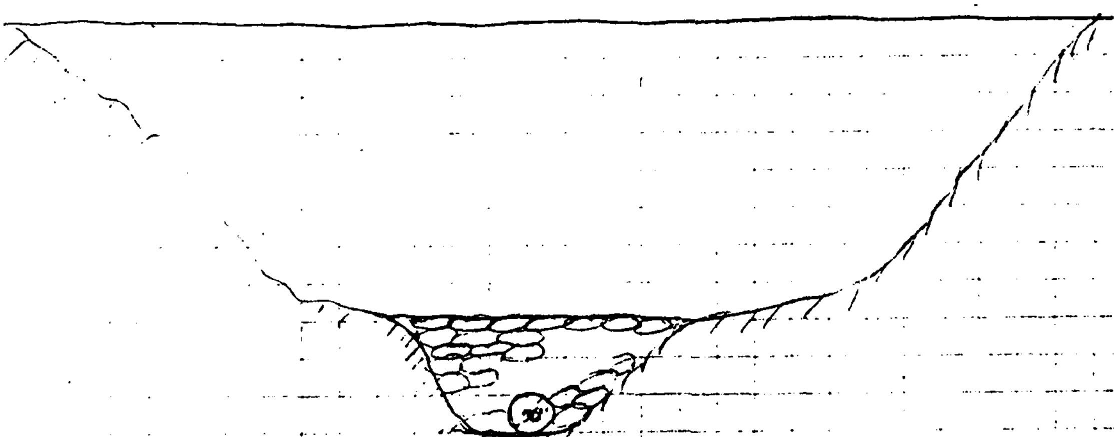
RECD. 8/17/37
DATE Ro
INFORM.
REPORT.
ANSWER
A. 10
FILED
FILE NO.

SEAVER RESERVOIR — HARRISVILLE 10/7/37

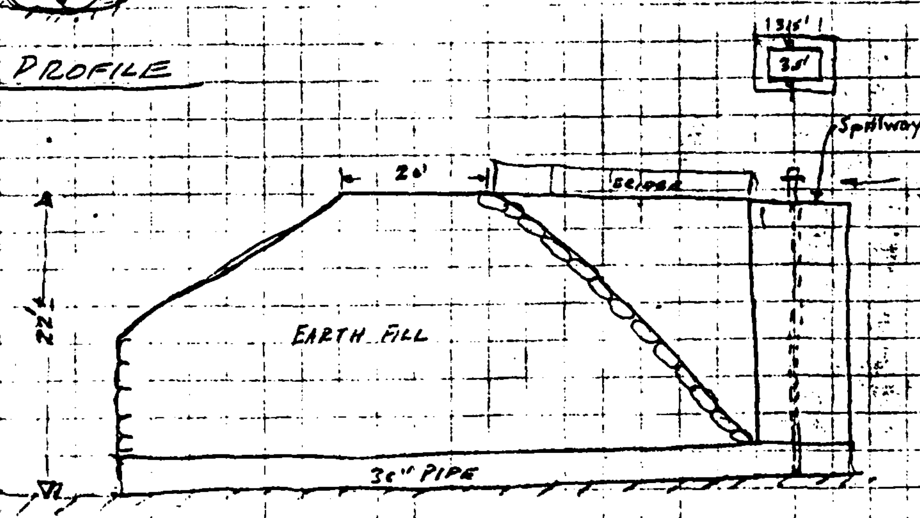
109.11



PLAN



PROFILE



X-SECTION

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 11 109.11 I 1515 49.2 WRB
RIVER Seaver Reservoir MILES FROM MOUTH ____ D.A.SQ.MI 4.1 PSC
TOWN Harrisville OWNER ~~Ashuelot [illegible] Elec. Co.~~ PSC
LOCAL NAME OF DAM ~~Keene Gas & Electric Co.~~ P.S.Co. of N.H.
BUILT ____ DESCRIPTION Earth fill. Highway over it.

POND AREA-ACRES 41 K.G.&E.Co. DRAWDOWN FT. 19.0 . POND CAPACITY-ACRE FT. [illegible]
HEIGHT-TOP TO BED OF STREAM-FT. ~~19~~ 23.7 MAX. ____ MIN. ____
OVERALL LENGTH OF DAM-FT. ~~[illegible]~~ 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. 3.5' square [illegible] FREEBOARD-FT. [illegible]
FLASHBOARDS-TYPE,HEIGHT ABOVE CREST ____

WASTE GATES-NO.	WIDTH MAX.OPENING	DEPTH SILL BELOW CREST
1	3.0' dia. pipe	22. below top

REMARKS ~~Condition Good~~

[illegible] Bk, Ashuelot R.

POWER DEVELOPMENT

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

USE Storage

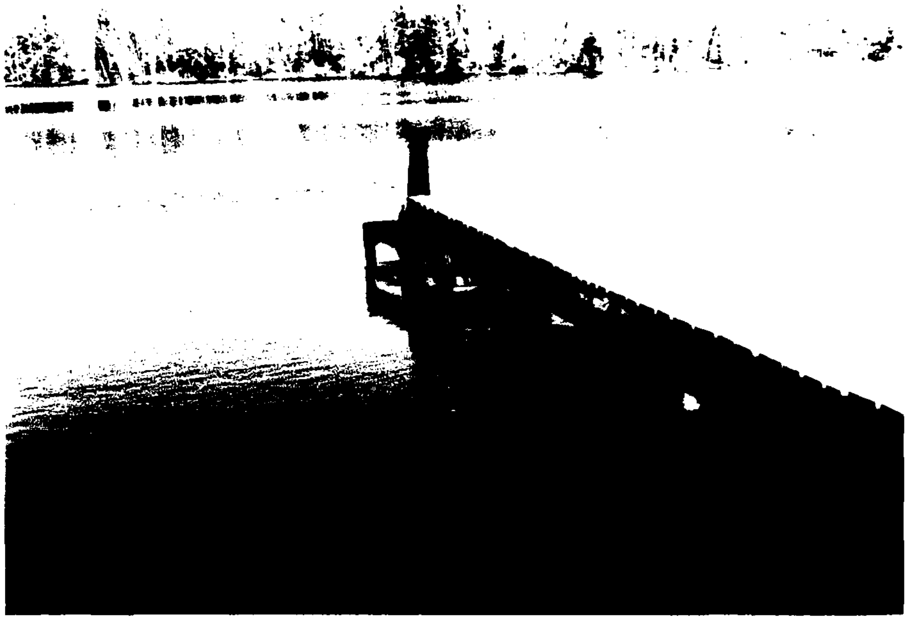
REMARKS Highway Dept. widening road + cutting corners by putting [illegible] fill on pond side 10/7/37. Water 18' below spillway [illegible]. Spillway is over top of hollow concrete [illegible]

DATE 1925 PSC
10/7/37 [illegible] + J.H.S.

B-6

April 30, 1979
Figure 4 - View of bulge in stone wall at downstream toe.

April 30, 1979
Figure 5 - View of the depression located upslope from Figure 4.



April 30, 1979
Figure 6 - Looking at drop-inlet riser and wood access bridge.

April 30, 1979
Figure 7 - Looking at the low-level outlet pipe.

September 13, 1979
Figure 8 - Close-up view of the deteriorated condition of the low-level outlet pipe.

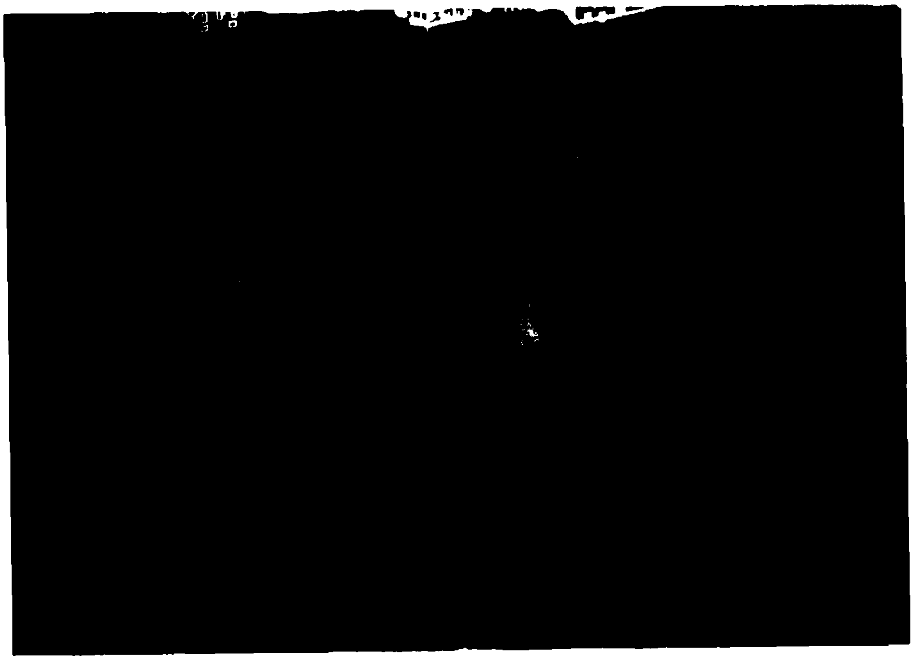
April 30, 1979
Figure 9 - Looking across the emergency spillway located at the southeastern point of the reservoir.

April 30, 1979
Figure 10 - Looking upstream from the emergency spillway.

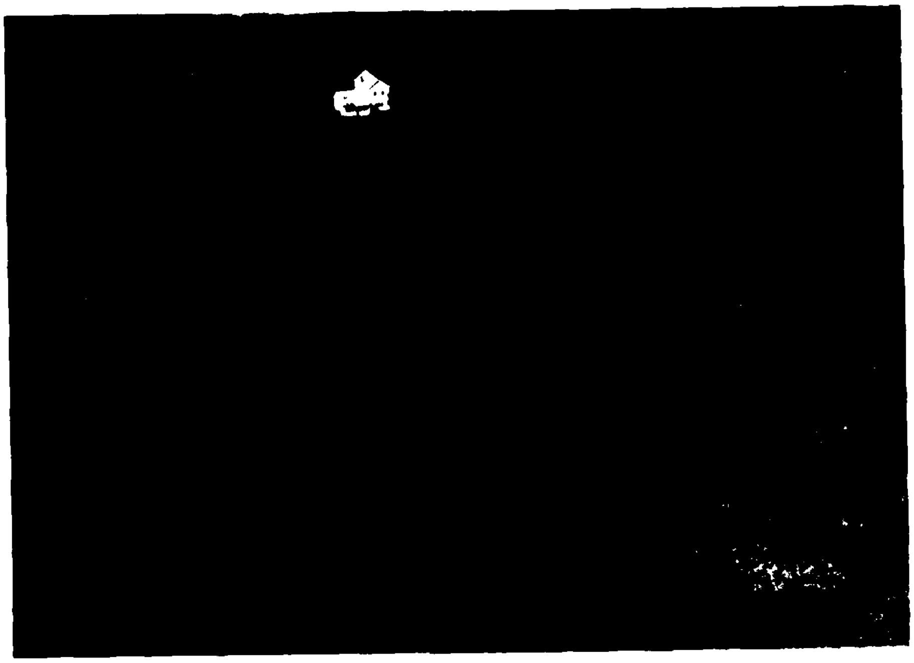
April 30, 1979
Figure 11 - Looking upstream into the reservoir from the dam.

April 30, 1979
Figure 12 - View of the downstream channel from the main dam.

October 1979
Figure 13 - Overview of the road crossing located ½ mile downstream of Chesham Pond Dam.



October 1979
Figure 14 - Overview of the road crossing located one mile downstream of Chesham Pond Dam.

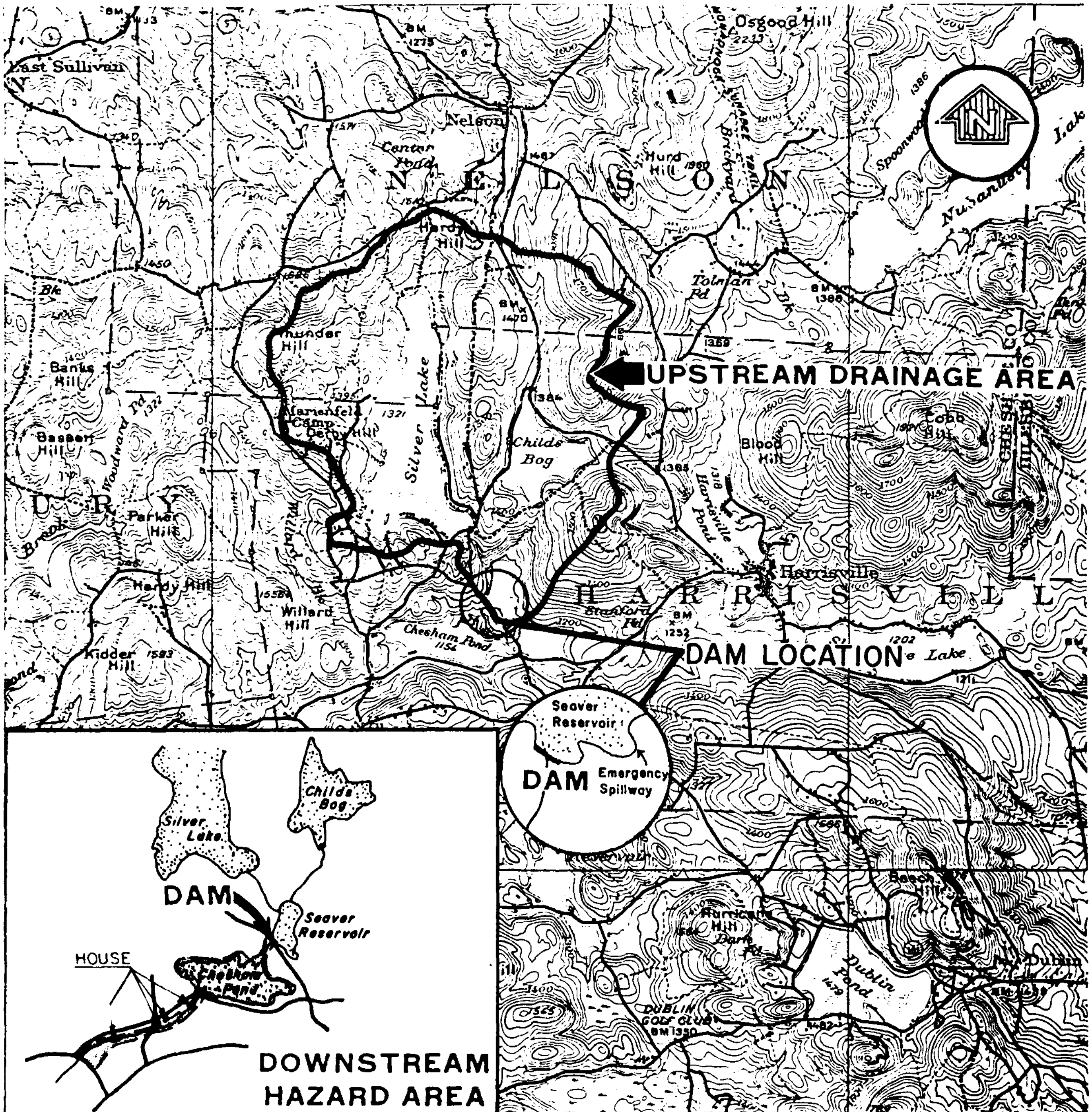


October 1979

Figure 15 - Overview of the reach between the two road crossings shown in Figures 11 and 12 above.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SEAVER RESERVOIR DAM
HARRISVILLE, NEW HAMPSHIRE

REGIONAL VICINITY MAP

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, MONADNOCK, N.H. 1949.

Hydrology / Hydraulics

D.A.: 4.38 mi^2 (includes Silver Lake and Childs Bog)
Size: Small - 28' hydraulic height
680 acre-ft maximum storage
Hazard: Significant
Test Flood: 1/2 PMF

D.A: 0.48 mi^2 (exclusive of Silver Lake and Childs Bog)

From Mountainous curve:
PMF = 2550 CFS/mi^2
2550 x 0.48 mi^2 = 1224 CFS
1/2 PMF = 612 CFS, SAY 610 CFS

From Silver Lake OUTFLOW:
PMF = 1100 CFS
1/2 PMF = 550 CFS

From Childs Bog outflow:
PMF = 3000 CFS
1/2 PMF = 1500 CFS

TOTAL INFLOW TO SEAVER RESERVOIR:
610 CFS + 550 CFS + 1500 CFS = 2660 CFS

Route inflow to Seaver Reservoir to obtain outflow for test flood.

Develop a rating curve for Seaver Reservoir Dam

Drop inlet spillway - 1201' MSL
Emergency spillway - 1202.3' MSL
TOP DAM - 1204.3' MSL

Anderson-Nichols & Company, Inc.

Subject

Sheet No. 2 of

Date 7-5-81

Computed KBS

Checked KD

JOB NO. 3220-05

Seaver Reservoir Dam

Develop rating curve for drop-inlet:

Rating curves to reveal control in drop inlet:

Vertical pipe - 4' x 4' square

Weir eqn: $Q = CLH^{3/2}$

$Q = (2.9)(16)(H)^{3/2}$

Trial #1 assume stage = 1' = 1202' MSL

Q = 46.4 CFS

TRIAL # 1A assume stage = 1.3' : 1202.3 MSL Q = 69 CFS

Trial #2 assume stage = 2' = 1203' MSL

Q = 131 CFS

Trial #3 assume stage = 3' = 1204' MSL

Q = 241 CFS

Trial #3A assume stage = 3.3' = 1204.3' MSL Q = 278 cfs

Trial #4 assume stage = 4 = 1205' MSL

Q = 371 CFS

Trial #5 assume stage = 5' = 1206' MSL

Q = 517 CFS

Trial #6 assume stage = 6' = 1207' MSL

Q = 682 CFS

Trial #7 assume stage = 7' = 1208' MSL

Q = 859 CFS

Trial #8 assume stage = 8' = 1209' MSL

Q = 1050 cfs

Horizontal Pipe - 36-inch RCP ; ℄ = 1178.0' MSL

Orifice equation: $Q = CA\sqrt{2gh}$

$Q = 0.7(7.07)\sqrt{64.4(h)}$

Trial #1 assume stage = 1' over spillway = 1202' MSL

Q = 195 CFS

Trial #2 assume stage = 1.3' over spillway = 1202.3' MSL

Q = 196 CFS

lerson-Nichols & Company, Inc. Subject ______

Sheet No. 5 of ______
Date 7.5.79
Computed KBS
Checked KD

JOB NO. 3220-05 SEAVER RESERVOIR DAM

Horizontal pipe of drop
inlet rating curve (con't)

Trial #3 assume stage = 2' = 1203' MSL
Q = 199 cfs

Trial #4 assume stage = 3' = 1204' MSL
Q = 203 cfs

Trial #5 assume stage = 3.3' = 1204.3' MSL
Q = 204 cfs

Trial #6 assume stage = 4' = 1205' MSL
Q = 206 cfs

Trial #7 assume stage = 5' = 1206' MSL
Q = 210 cfs

Trial #8 assume stage = 6' = 1207' MSL
Q = 214 cfs

Trial #9 assume stage = 7' = 1208' MSL
Q = 218 cfs

Trial #10 assume stage = 8' = 1209' MSL
Q = 221 cfs

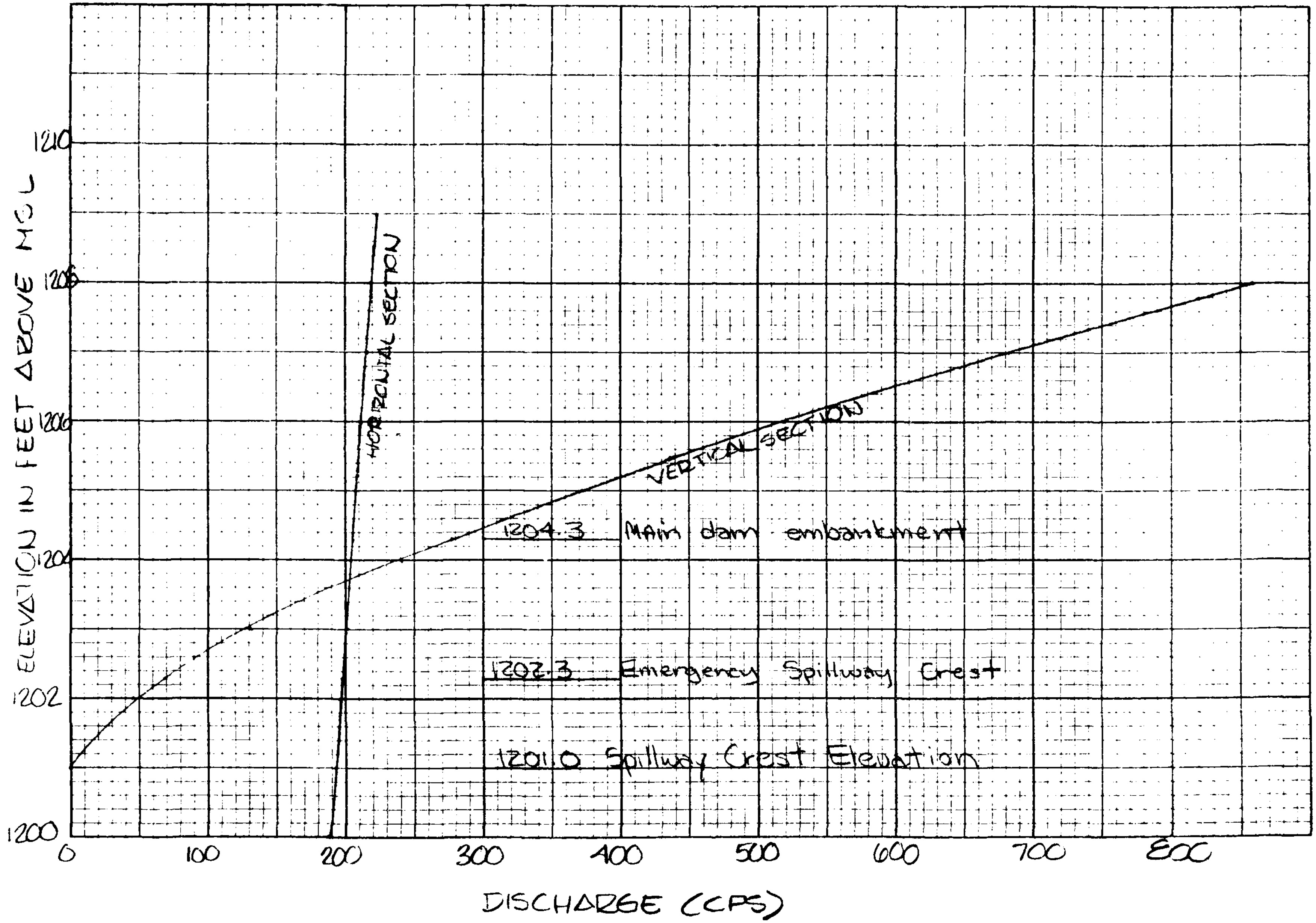
Shift in control can be seen in the composite rating curve on page 4. The vertical section controls until elevation 1203.7' MSL where the control shifts to the horizontal section.

Inlet capacity @ 1202.3' MSL (emergency spillway)
Q = 69 cfs

Inlet capacity @ 1204.3' MSL (top of dam)
Q = 204 cfs

3220-05

SEAVER RESERVOIR DAM
DROP INLET CONTROL
DETERMINATION



1 OF
7/10/79
KD

Develop rating curve data for discharges through the emergency spillway and over the main dam embankment using the appropriate sections shown on page and .
Use the weir equation $Q = CLH^{3/2}$, where 'C' values vary from 2.7 to 2.5 (overbank).

The following is a table calculating the above, including also discharge through the principal spillway inlet.

ELEVATION FT	DROP INLET Q	E. SPILLWAY (low pt 1202.3) L	H	Q	TOP DAM (low pt 1204.3) L	H	Q	COMBINED Q (cfs)
1201	0							0
1202	46							46
1202.3	69	47	0	0				69
1203	131	60	.7	95				226
1203.7	203	77	1.4	344				547
1204	204	80	1.7	479				683
1204.3	206	81	2	618	200	0	0	824
1205	208	88	2.7	1047	235	.7	372	1627
1206	212	92	3.7	1751	270	1.7	1605	3568
1207	216	106	4.7	2863	299	2.7	3558	6637
1208	219	116	5.7	4164	308	3.7	5877	10,260
1209	223	127	6.7	5784	346	4.7	9437	15,444

Using the combined discharge, a composite rating curve can be developed.

DOWNSTREAM HAZARD SUMMARY

A major breach could:

1) Cause Chesham Pond to be overtopped by 4.3 feet. This rise in the level of Chesham Pond could cause property damage to about 4 houses on its shoreline. Loss of life would probably not occur. Some damage may occur to the road crossing immediately downstream of the dam.

2) One trailer, located about 200 feet downstream of the dam, could be inundated by 2.2 feet of water. This could cause damage to the structure and cause loss of 1 or 2 lives.

3.) 1st road crossing (½ mile d/s of dam) would be overtopped by 4.0 feet, possibly causing damage to culvert and roadway. Two houses located just upstream of the road may be subjected to minor property damage.

4) 2ND road crossing (1 mile d/s of dam) would be overtopped by 2.2 feet, possibly causing damage to culvert and gravel roadway. The breach wave itself would be attenuated in this reach between 1st & 2ND road crossings. One house in this reach may be subjected to basement flooding.

Seaver Reservoir Dam was classified Significant Hazard.

son-Nichols & Company, Inc.

Subject

Sheet No. 18 of

Date 7.5.79

Computed KBS

Checked KD

JOB NO. 3220-05

Seaver Reservoir DAM

GATE CAPACITIES

Determine approximate discharge capacities of gates @ top dam = 1204.3' MSL

OUTLET PIPE

$3'\phi = 7.07 \, ft^2$

INVERT OF PIPE = 1176' MSL

Centerline of pipe = 1177.5' MSL

Capacity @ top of dam: 1204.3' MSL

$Q = CA\sqrt{2gh}$

$Q = .7(7.07)\sqrt{64.4(26.8)}$

$Q = 206 \, CFS$

1204.3' MSL

1177.5' MSL

26.8 = head

C = 0.7

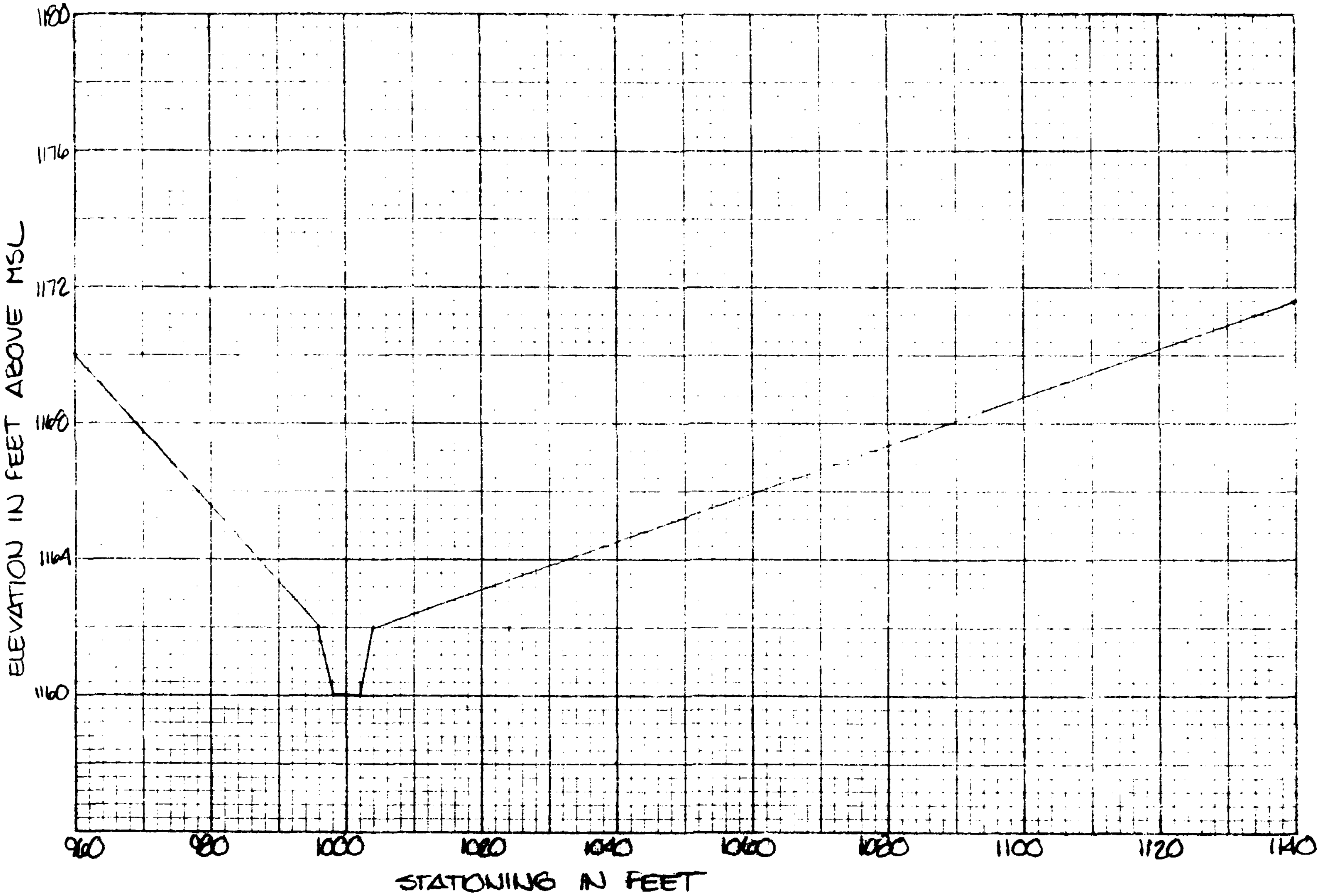
g = 32.2

A = area

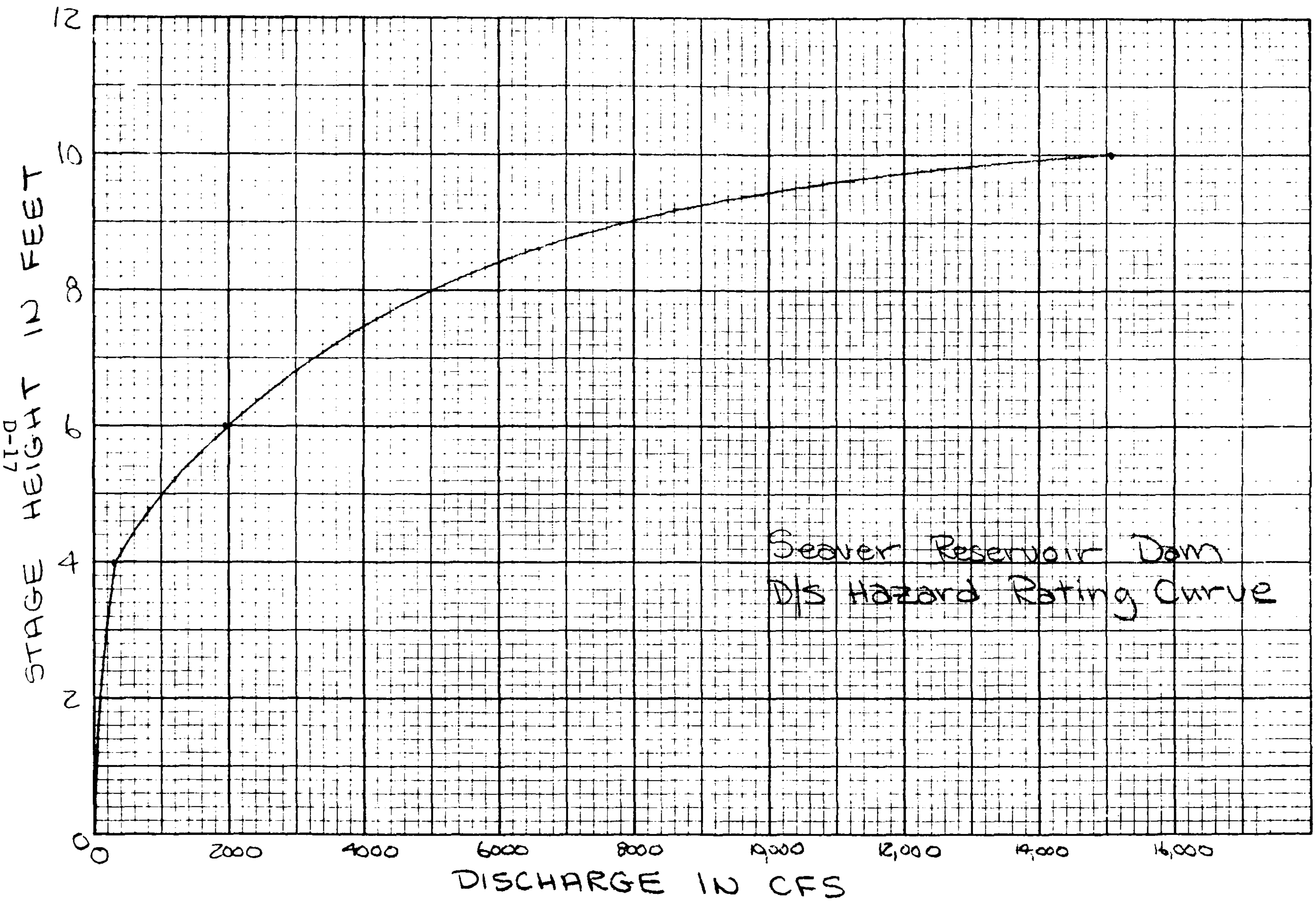
h = head

7/11/79
KD
LW

SEAVER RESERVOIR DAM
TYPICAL DOWNSTREAM X-SEC



17/



Seaver Reservoir Dam
D/S Hazard Rating Curve
STAGE HEIGHT IN FEET
DISCHARGE IN CFS
0
2
4
6
8
10
12
2000
4000
6000
8000
10,000
12,000
14,000
16,000

Using a typical X-section along the reach from the dam to Chesham Pond, establish a discharge rating curve using Manning's Equation:

$$Q = \frac{1.49}{n} \cdot A \cdot R^{2/3} \cdot S^{1/2}$$

where: n = composite 'n'
A = area section (ft²)
R = A/WP (wetted perimeter)
S = slope of reach

Length of reach : 528'
Elev. @ d/s toe : 1176
Elev. @ end reach : 1154 (Chesham Pond)
Slope : 0.04

Trial #1 Assume stage 4'

$A_{channel} = \frac{1}{2}(2)(4+8) = 12$

$A_{TPZD} = \frac{1}{2}(2)(8+45) = 53$

$A_{TOTAL} = 12+53 = 65$

$WP = 70.5$; $R = 65/70.5 = 0.92$

$Q = \frac{1.49}{.07}(65)(.92)^{2/3}(.04)^{1/2} = 262$ cfs

Trial #2 Assume stage 6'

$A_c = 12$

$A_{TPZD} = \frac{1}{2}(4)(45+82) = 254$

$A_T = 12+254 = 266$

$WP = 4+23+60+26.5 = 113.5$

$R = 266/113.5 = 2.3$

$Q = 1979$ cfs

Trial #3 Assume stage 10'

$A_c = 12$

$A_{TPZD} = \frac{1}{2}(8)(119+157) = 1104$

$A_{TOTAL} = 12+1104 = 1116$

$WP = 4+23+120+53.5 = 200.5$

$R = 1116/200.5 = 5.6$

$Q = 15{,}068$ cfs

Using the above trials establish a discharge rating curve.

This is the worst case as it assumes no outflow from Chesham.

Surface area of Chesham Pond = 74 acres
Maximum storage of Seaver Reservoir - 680 ac-ft
This gives a maximum stage of about 9.2'

This stage at Chesham Pond would cause significant property damage and loss of a few lives. There are many inhabited structures involved just downstream of Chesham Pond.

Breach Analysis

Storage @ maximum pool: 680AF
Storage @ normal pool: 466 AF

D.A. = 4.4mi^2

$Q_{p_1} = 8/27\, Wb\sqrt{g}\, y_0^{3/2}$

$Q_{p_1} = 8/27\,(50)\sqrt{32.2}\,(28.3)^{3/2}$
$= .296(50)(5.67)(150.55)$
$= 12,660$ cfs

TOTAL BREACH @ MAX POOL:
12,660 cfs

12,660 CFS ON RATING CURVE (d/s hazard)
= 9.8' STAGE

ANTECEDENT DISCHARGE
discharge through drop inlet
at maximum pool = 69 CFS
69CFS = 1.8'

Wb = breach width
g = 32.2 ft/sec^2
y_0 = pool elev − u/s riverbed
Dam length = 325'
Visual observation of Dam indicated 50' breach width as reasonable.

y_0 = 1204.3
$\underline{1176.0}$
28.3'

1204.3 MAX. POOL

14.7
$\underline{2.5}$
12.2

THEREFORE INCREASE IN STAGE: 8.0' WITH A BREACH

A 8' increase in stage downstream would cause an increase in stage at Chesham Pond where there are several inhabited structures at low elevations causing significant property damage and possible loss of lives.

To evaluate potential for hazard at Chesham Pond find depth of stage on surface area of Chesham from maximum storage of Seaver -

SQUARES IN. SCALE 0 1 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

$(0.104')(4.4mi^2)\left(\frac{640AC}{mi}\right) = 293$ ac-ft

466
293
759 AC-FT

From storage elevation curve:
ELEV: 1205.6' MSL

From this analysis it can be seen that the storage effects of Seaver Reservoir would do little to reduce inflows.

1205.6	1205.6
1202.3	1204.3
3.3'	1.3'

The water depth over the emergency spillway during the ½ PMF test flood would be about 3.3'. The dam would be overlopped by 1.3 feet during the ½ PMF test flood.

ROUTING

For ½ PMF inflow of 2660 CFS (Q_{p1}) at Seaver Reservoir Dam, an elevation of 1205.6' MSL is read from the rating curve.

A storage of 760 AF is read from the storage-elevation curve.

A storage of 466 AF is read from the storage elevation curve at normal pool - 1201.0' MSL.

To convert to inches of runoff:

$$\begin{array}{r} 760 \\ \underline{466} \\ 294 \text{ AF} \end{array}$$

$$294 \text{ AF} \times \frac{1}{4.4 \text{ Mi}^2} \times \frac{1 \text{ mi}^2}{640 \text{ AC}} = .104' = \text{STOR } 1$$

$$0.104'' \times 12''/\text{FT} = 1.253''$$

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{\text{STOR } 1}{19/2}\right) = Q_{p1} \times \left(1 - \frac{1.253}{9.5}\right)$$

$$Q_{p2} = 2310 \text{ CFS}$$

Determine surcharge height to pass Q_{p2} = 1205.5' from rating curve

Determine storage @ 1205.5' MSL from storage elevation curve = 755 AC-FT.

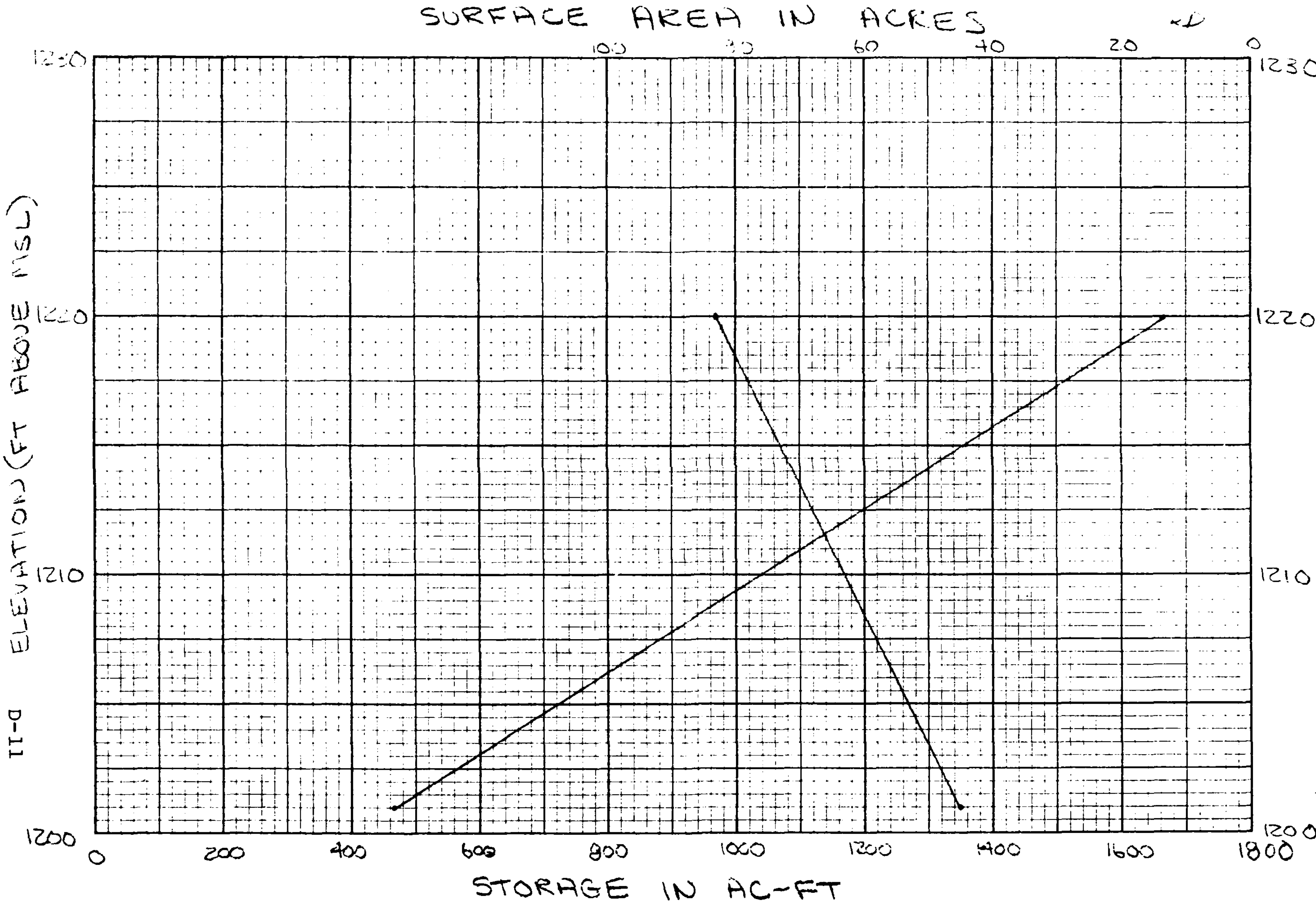
$$\begin{array}{r} 755 \\ \underline{466} \\ 289 \end{array}$$

To convert to inches of runoff:

$$289 \text{ AF} \times \frac{1}{4.4 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{640 \text{ AC}} = .103' = 1.232'' = \text{STOR}_2$$

$$\begin{array}{l} \text{STOR } 1 = 1.253 \\ \underline{\text{STOR } 2 = 1.232} \\ \quad 2 \,|\, \underline{2.485} \\ \quad 1.243 \quad \text{AVG} = 0.104' \end{array}$$

7/11/79
LW


SURFACE AREA IN ACRES
100
80
60
40
20
0
1230
1220
1210
1200
0
200
400
600
800
1000
1200
1400
1600
1800
STORAGE IN AC-FT
ELEVATION (FT ABOVE MSL)

101

lerson-Nichols & Company, Inc.

Subject

Sheet No. 4 of
Date [illegible]/79
Computed KBS
Checked VD

JOB NO. 3220-06

SEAVER RESERVOIR

From USGS QUAD
MONADNOCK, NH (1949)
1" = 1 mi

D.A. = 4.38 mi^2
D.A. (Exclusive of Silver lake and Childs Bog) = 0.48 mi^2
Storage - Reservoir - normal pool = 466 AC-FT

For surface area - ELEVATION CURVE:
1201' RESERVOIR: 0.07 mi^2 = 44.8 acres
1220' CONTOUR: 0.13 mi^2 = 83.2 acres
1240' CONTOUR: 0.17 mi^2 = 108.8 acres

For Storage - elevation curve:

$$V = \tfrac{1}{3} h \left(b_1 + b_2 + \sqrt{b_1 b_2}\right)$$

@ 1201' normal storage = 466 acre-ft

@ 1220 S.A. = 83.2 acres

$V = \tfrac{1}{3}(19)\left(44.8 + 83.2 + \sqrt{(44.8)(83.2)}\right)$

$= 1197$ acre-feet + 466 AF = 1663 AF

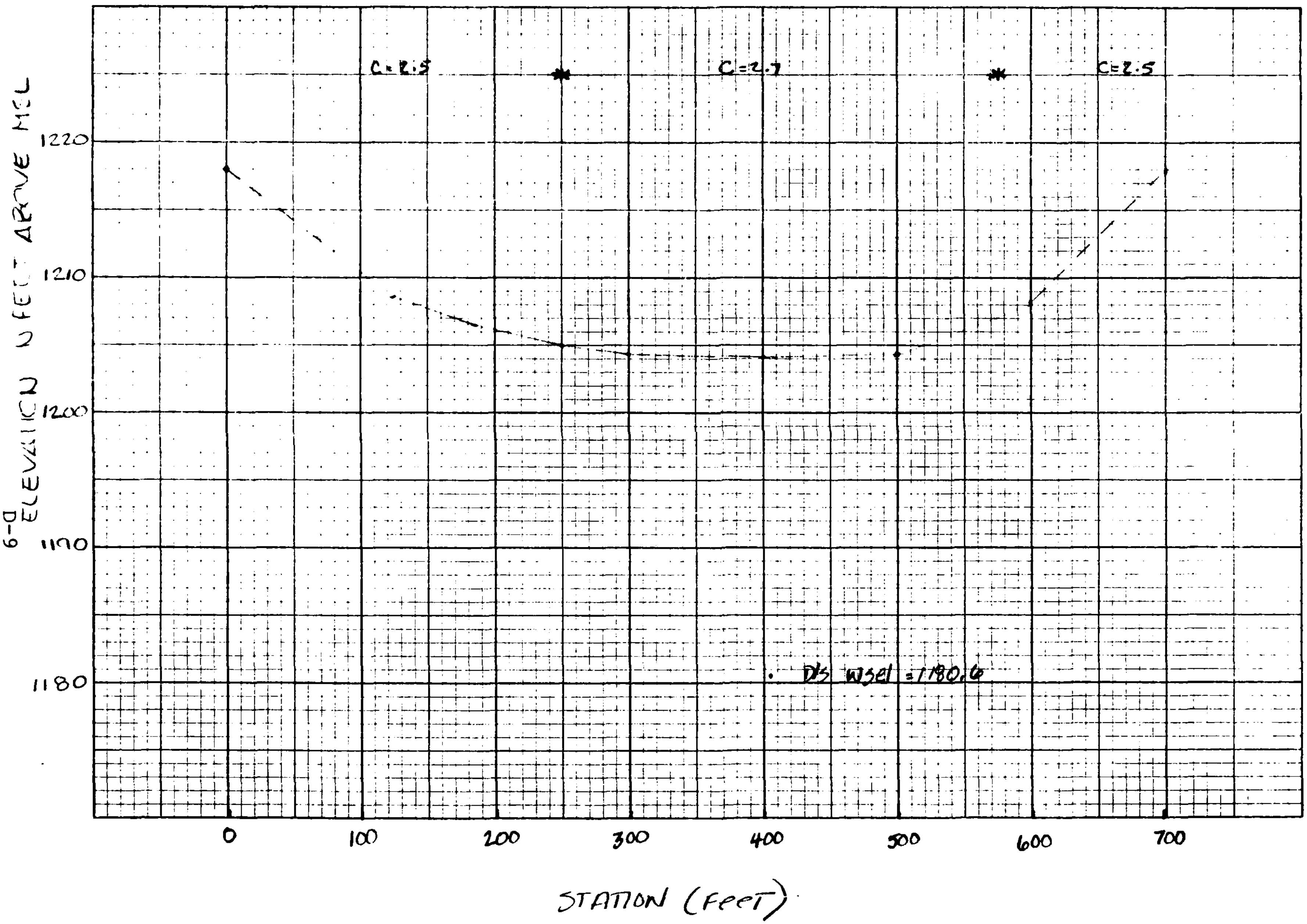
@ 1240 SA = 108.8 acres

$V = \tfrac{1}{3}(20)\left(83.2 + 108.8 + \sqrt{(83.2)(108.8)}\right)$

1914 AF + 1663 AF = 3577 AF

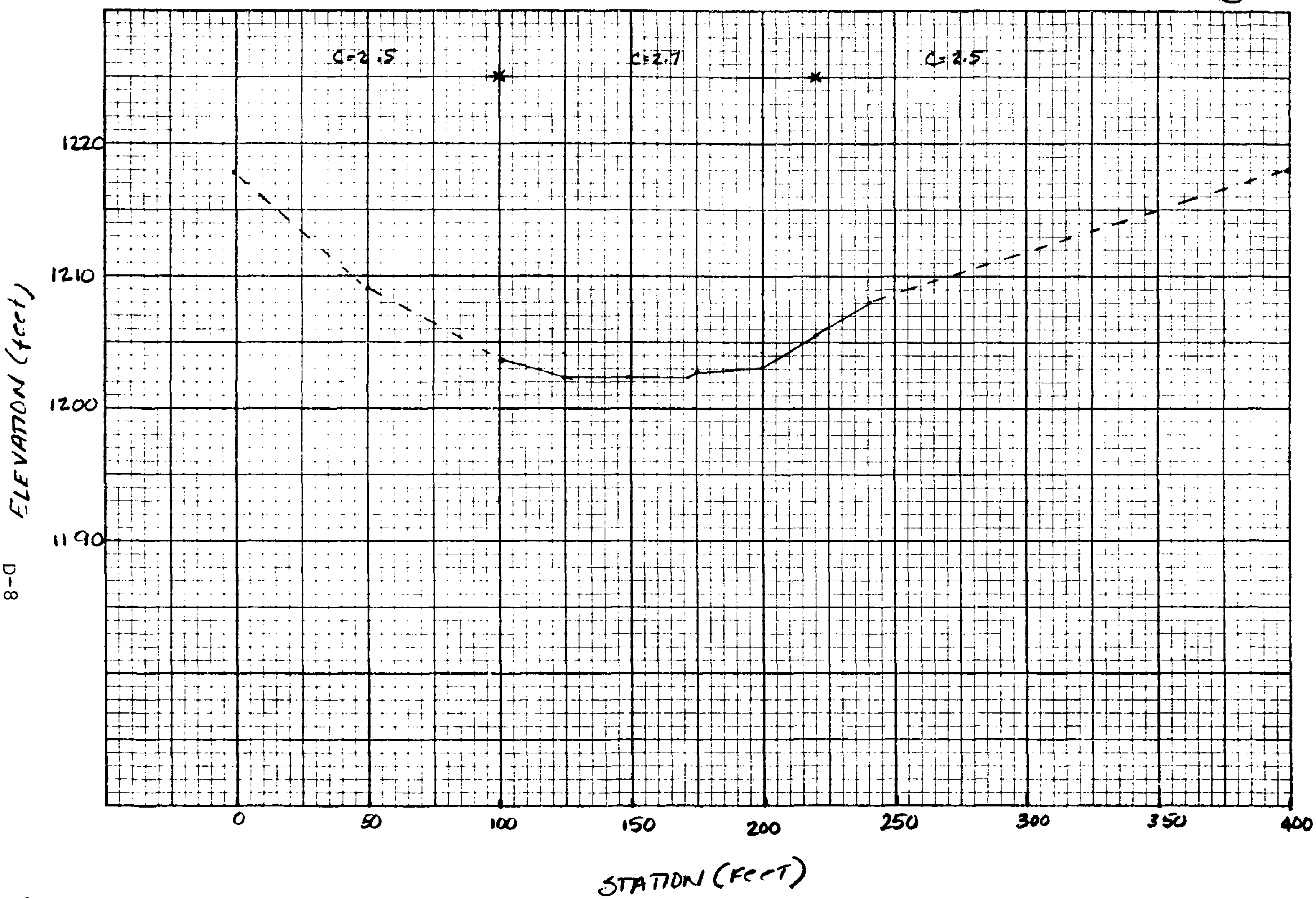
KBS
7·2·79
3220-05
KC

SEAVER RESERVOIR DAM
MAIN DAM EMBANKMENT



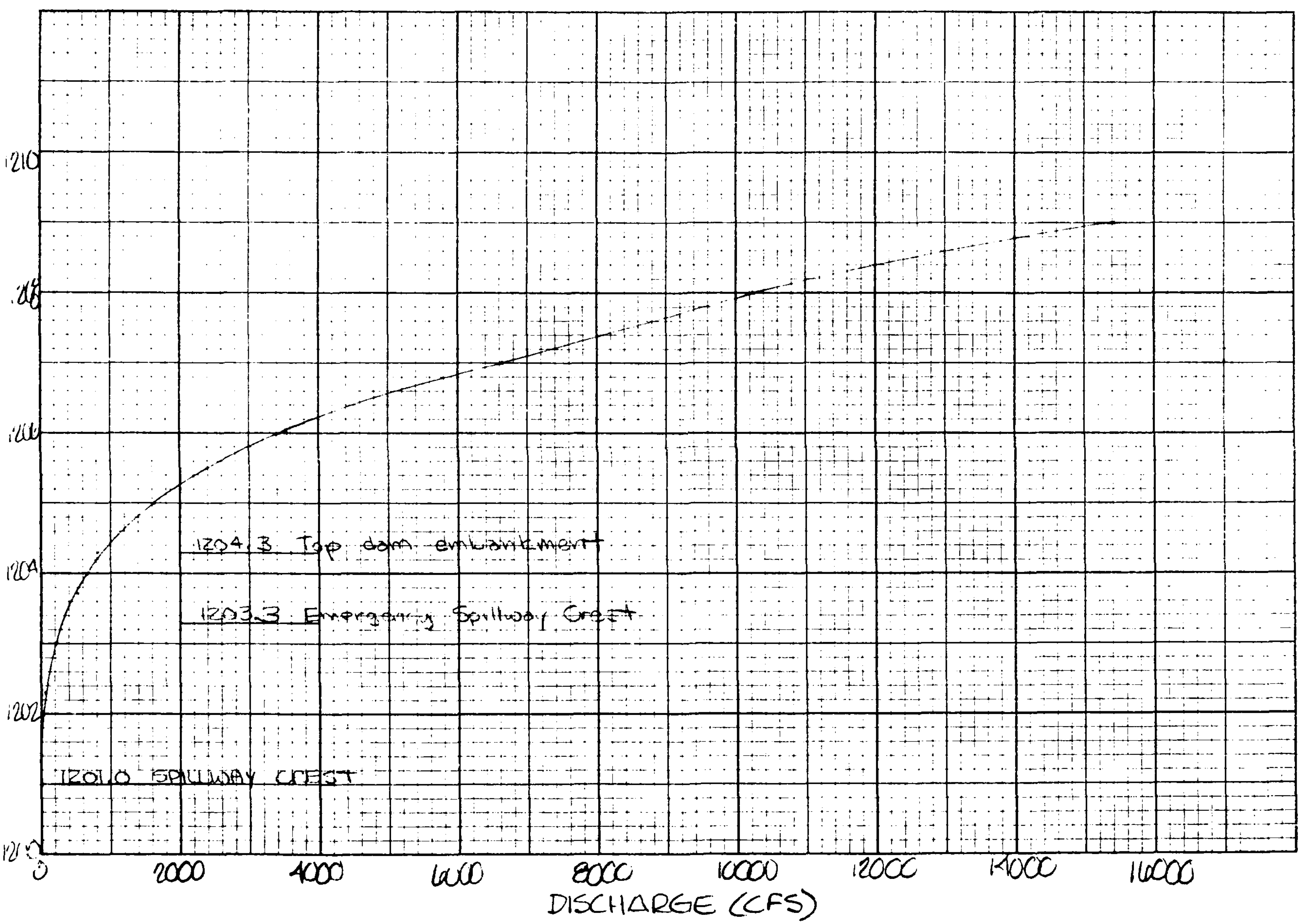
KBS
7/2/79
3220.05
KD

SEAVER RESERVOIR DAM
EMERGENCY SPILLWAY



7 OF

3220-05
CLAVER RESERVOIR DAM
RATING CURVE



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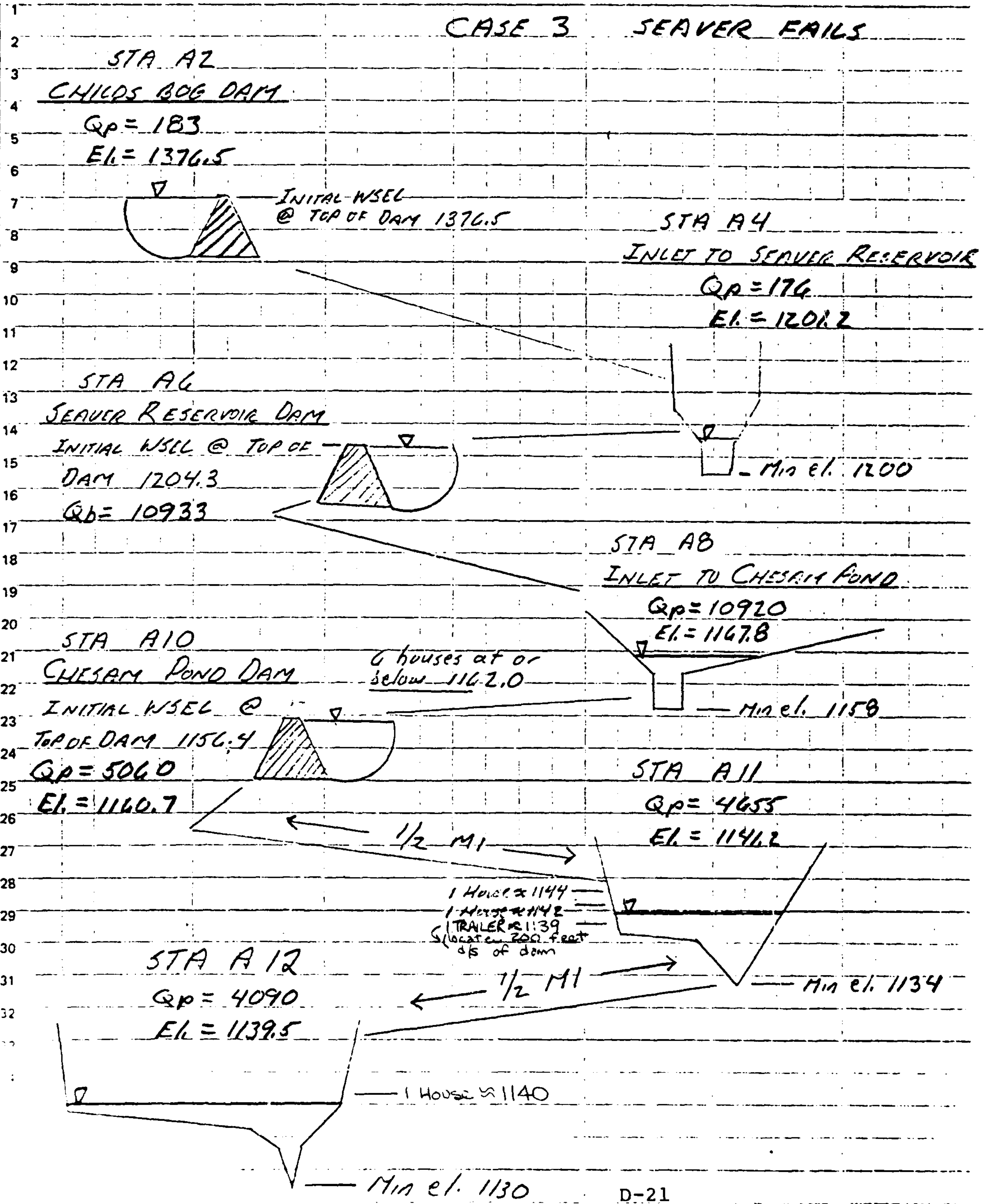
Anderson-Nichols & Company, Inc.

Subject ______

Sheet No. ____ of ____
Date ____
Computed ____
Checked ____

JOB NO.



PLAN 1 - SEAVER & CHESHAM BREACHING (5)/1
PLAN 2 - SEAVER BREACHING

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
A1 CHILDS BOG - SEAVER RESERVOIR - CHESAM POND  DOWNSTREAM HAZARD EVALUATION
A2 NEW HAMPSHIRE DAM NUMBERS  00096.
A3 SEGMENT 3  ROUTE BREACH INFLOW HYDROGRAPH FROM SEAVER BREACH THROUGH CHESAM
B    100       0       5       0       0       0       0       0       0       0
B1     5
J      2       1       1
J1     1
K      0      A8                                       1
K1 ROUTED BREACH HYDROGRAPH FROM SEAVER USED AS INFLOW TO CHESAM
M     -1                                                                 1
N  1988.   1564.   3372.   3914.   5398.   6330.   7792.   8856.  10002.  10625.
N 10942.  10839.   8317.   4926.   2575.   1164.    661.    401.    298.    226.
N   191.    164.    148.    136.    129.    122.    117.    113.    110.    107.
N   104.    102.     99.     97.     95.     93.     92.     90.     88.     87.
N    85.     83.     82.     81.     79.     78.     77.     75.     74.     73.
N    71.     70.     69.     68.     67.     66.     65.     64.     63.     62.
N    61.     60.     59.     58.     57.     56.     55.     54.     53.     52.
N    51.     50.     50.     49.     48.     48.     47.     46.     46.     45.
N    44.     44.     43.     43.     42.     41.     41.     40.     40.     39.
N    38.     38.     37.     37.     36.     36.     35.     35.     34.     34.
K      1     A10                                       1
K1 ROUTE COMBINED HYDROGRAPH THROUGH CHESAM POND
Y                                  1       1
Y1     1                                       -1156.4      -1
Y4 1154.  1154.2  1154.5   1155.  1155.7  1156.4  1156.7   1157.  1157.2  1157.5
Y4 1158.  1158.5   1159.  1159.5   1160.   1161.  1163.2   1164.   1165.
Y5    0.     13.     51.    144.    318.    534.    627.    729.    816.    873.
Y5 1273.   1722.   2286.   2875.   3587.   5673.   984.9  12979.  17015.
$S    0.    180.    300.    460.    630.    700.    985.   1320.   1430.   1800.
$E 1140.   1148.   1151.   1155.  1156.4  1157.2.  1160.  1162.5  1163.2  1165.5
$$ 1154.
$D1156.4
$P    50.      0.   1140.     1.0  1156.4  1156.4
$D    50.      0.   1140.     1.0  1156.4   1170.
K      1     A11                                       1
K1 ROUTE HYDROGRAPH DOWN MINNEWAWA BROOK FOR 1/2 MILE
Y                                  1       1
Y1     1
Y6    .1     .04      .1   1134.   1155.   2500.   .0024
Y7  550.   1155.    700.   1140.    880.   1138.   1000.   1134.   1020.   1138.
Y7 1050.   1140.   1200.   1150.   1280.   1155.
K      1     A12                                       1
K1 ROUTE HYDROGRAPH DOWN MINNEWAWA BROOK FOR ANOTHER 1/2 MILE
Y                                  1       1
Y1     1
Y6   .08     .03     .03   1130.   1145.   2500.   .0016
Y7  950.   1145.   1000.   1140.   1900.   1138.   1980.   1134.   2000.   1130.
Y7 2020.   1134.   2080.   1140.   2105.   1145.
K      1     A13                               1
K1 ROUTE HYDROGRAPH ANOTHER 7000 FT DOWN MINNEWAWA BROOK
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(5)/2

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Y                                     1         1
Y1    1
Y6   .1      .05       .1    1075.     1120.    7000.    .008
Y7  850.   1120.     900.    1100.      980.    1080.     990.   1075.   1010.   1075.
Y7 1020.   1080.    1150.    1100.     1200.    1120.
K    99
```

(3)/3

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	A8	0.00 (0.00)	1	10942. (309.84)(
			2	10942. (309.84)(
ROUTED TO	A10	0.00 (0.00)	1	12096. (342.52)(
			2	5060. (143.28)(
ROUTED TO	A11	0.00 (0.00)	1	11435. (323.80)(
			2	4655. (131.82)(
ROUTED TO	A12	0.00 (0.00)	1	10329. (292.49)(
			2	4090. (115.80)(
ROUTED TO	A13	0.00 (0.00)	1	9705. (274.81)(
			2	3853. (109.10)(

(5)/4

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1156.40	1154.00	1156.40
STORAGE	630.	420.	630.
OUTFLOW	534.	0.	534.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1157.50	1.10	730.	12096.	1.17	1.00	0.00

PLAN 2 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1156.40	1154.00	1156.40
STORAGE	630.	420.	630.
OUTFLOW	534.	0.	534.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1160.71	4.31	1080.	5060.	5.33	1.17	0.00

PLAN 1 STATION A11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	11435.	1144.2	1.17

PLAN 2 STATION A11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	4655.	1141.2	1.33

PLAN 1 STATION A12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	10329.	1141.5	1.42

PLAN 2 STATION A12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
[illegible]	[illegible]	[illegible]	[illegible]

(5)/5

PLAN 1 STATION A13

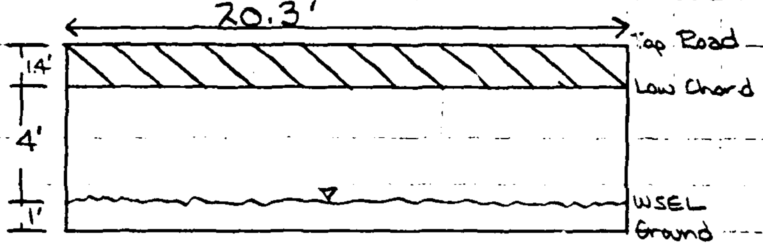
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	9705.	1089.7	1.58

PLAN 2 STATION A13

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	3853.	1084.7	1.75

Evaluate capacity of box culvert located about ½ mile downstream of Chesham Dam.

Road width = 35'



Use the orifice equation to determine the capacity of the culvert at top of road.

$$Q = CA\sqrt{2gh}$$
$$Q = (0.8)(101.5)\sqrt{64.4 \times 3.2} = \underline{1,165} \text{ cfs}$$

Breach Q through reach ≈ 6,470 cfs. Therefore, the culvert will not carry the breach Q. Weir flow will occur over the road along with pressure flow through the culvert. Develop a rating curve for the weir cross section shown on Sheet 3. Use weir equation $Q = CLH^{3/2}$, where $C \approx 2.7$.

Stage (ft. above invert)	Discharge (cfs)
0	0
6.4 (top road)	$Q_{ORIFICE} = 1,165$
7.4	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 4.2}$ $Q_{ORIFICE} = 1,335$ $Q_{weir} = 2.7(100)(1.0)^{3/2} + 2.7(10)(1.0)^{3/2} = 297$ $Q_{TOTAL} = 1,632$

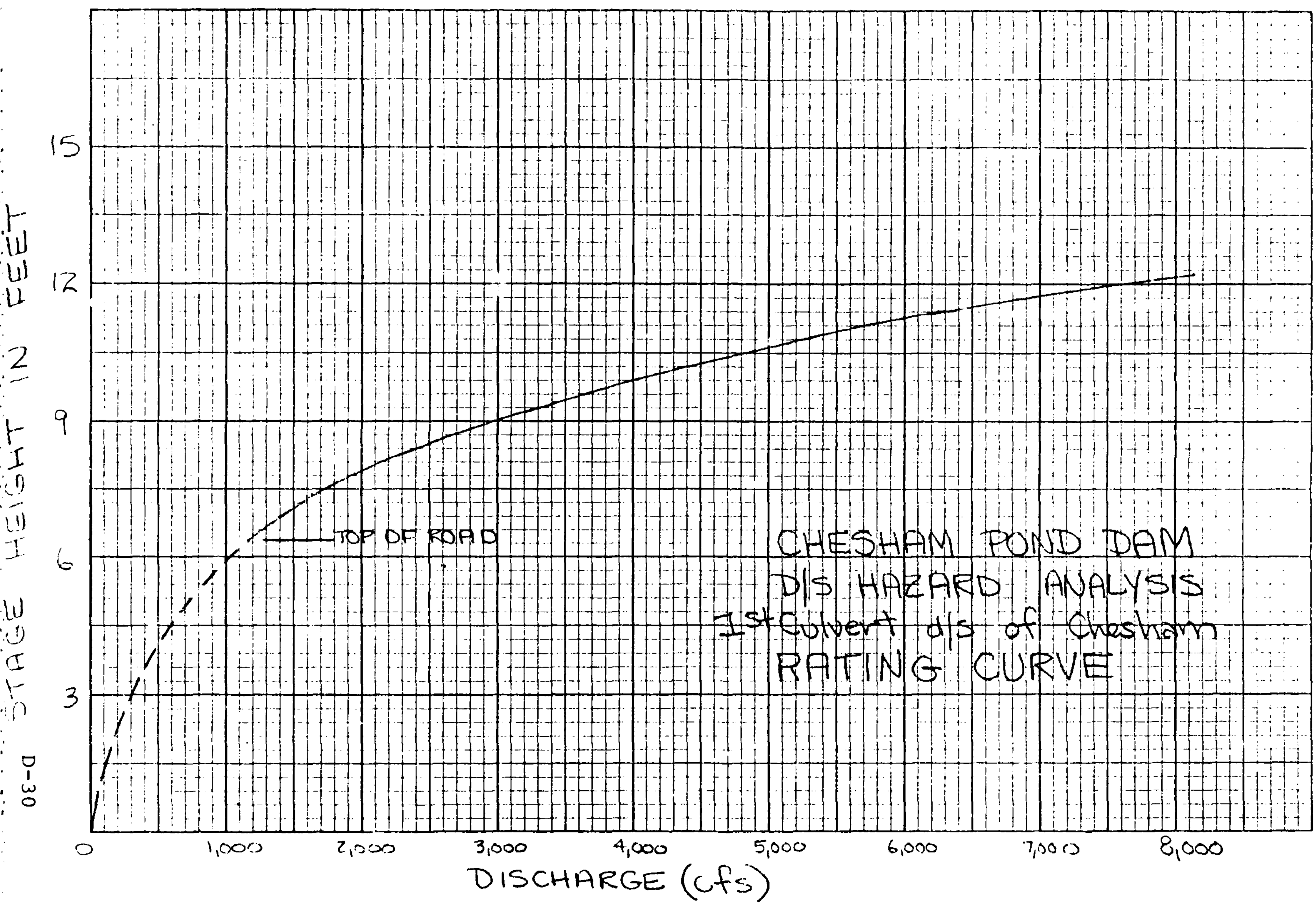
Stage	Discharge (cfs)
8.4	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 5.2} = 1485$
	$Q_{WEIR} = 2.7(100)(2.0)^{3/2} + 2.7(\tfrac{1}{2}16)(2.0)^{3/2} + 2.7(\tfrac{1}{2}20)(2.0)^{3/2} = 901$
	$Q_{TOTAL} = 2{,}386$
9.4	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 6.2} = 1{,}623$
	$Q_{weir} = 2.7(100)(3.0)^{3/2} + 2.7(\tfrac{1}{2}25)(3.0)^{3/2} + 2.7(\tfrac{1}{2}30)(3.0)^{3/2} = 1{,}789$
	$Q_{TOTAL} = 3{,}412$
11.4	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 8.2} = 1{,}866$
	$Q_{weir} = 2.7(100)(5.0)^{3/2} + 2.7(\tfrac{1}{2}41)(5.0)^{3/2} + 2.7(\tfrac{1}{2}50)(5.0)^{3/2} = 4{,}392$
	$Q_{TOTAL} = 6{,}258$
12.4	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 9.2} = 1{,}976$
	$Q_{weir} = 2.7(100)(6.0)^{3/2} + 2.7(\tfrac{1}{2}50)(6.0)^{3/2} + 2.7(\tfrac{1}{2}60)(6.0)^{3/2} = 6{,}151$
	$Q_{TOTAL} = 8{,}127$

Using the above trials, establish a stage/discharge curve. (See Sheet 4.)

Breach Q = 4,655 cfs Stage ≈ 10.4 feet
Antecedent Q (Chesham) ≈ 535 cfs Stage ≈ 4.2 feet
Increase due to breach would be 6.2 feet at road crossing ½ mile d/s of Chesham Dam. The road would be overtopped by 4 feet possibly causing damage to the roadway and culvert.

Sheet 3/8
L. Williams
4/1/80

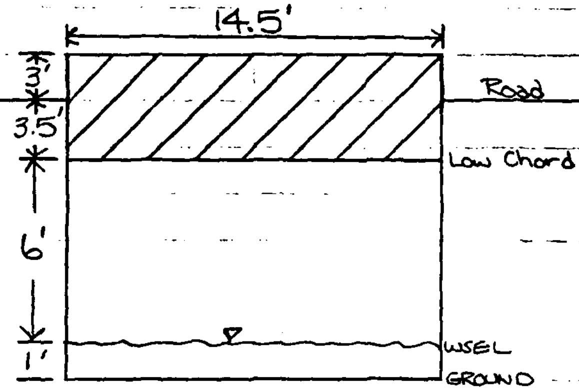
Sheet 4/8
L. Williams



Evaluate capacity of box culvert located about one mile downstream of Cheshom Pond Dam.

Road width = 18'

Gravel Road on left side



Use the orifice equation to determine the capacity of the culvert at top of road.

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

$$Q = (0.8)(101.5)\sqrt{64.4 \times 5.25} = 1{,}493 \text{ cfs}$$

Breach Q through reach ≈ 5,500 cfs. Therefore, culvert will not carry breach Q. Weir flow will occur over the road along with pressure flow through the culvert. Develop a rating curve for the weir cross section shown on Sheet 7. Use weir equation $Q = CLH^{3/2}$ to rate flow over roadway. Assume 'c' is ≈ 2.7.

Stage (ft. above invert)	Discharge (cfs)
0	0
10.5 (top of road)	$Q_{ORIFICE} = 1{,}493$
11.5	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 6.25} = 1629$ $Q_{weir} = 2.7(211)(1.0)^{3/2} + 2.7(\tfrac{1}{2}20)(1.0)^{3/2} + 2.7(\tfrac{1}{2}5)(1.0)^{3/2} = 603$ $Q_{TOTAL} = 2{,}096$ cfs

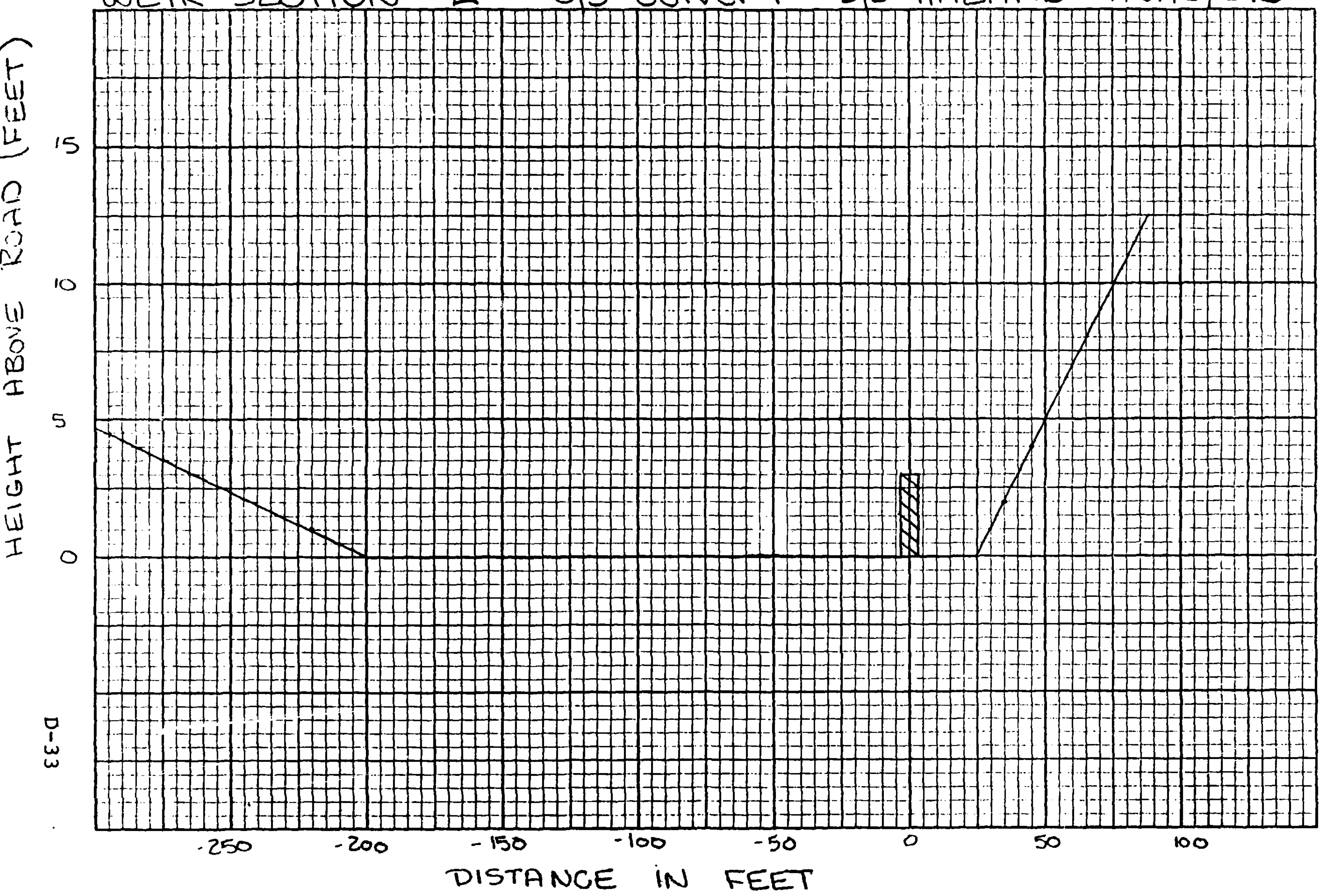
Stage (ft. above invert)	Discharge (cfs)
12.5	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 7.25} = 1{,}755$ $Q_{weir} = 2.7(211)(2.0)^{3/2} + 2.7(\tfrac{1}{2}41)(2.0)^{3/2} + 2.7(\tfrac{1}{2}10)(2.0)^{3/2} = 1{,}806$ $Q_{TOTAL} = 3{,}561$ cfs
14.0	$Q_{ORIFICE} = (0.8)(101.5)\sqrt{64.4 \times 8.75} = 1{,}928$ $Q_{weir} = 2.7(211)(3.5)^{3/2} + 2.7(\tfrac{1}{2}75)(3.5)^{3/2} + 2.7(\tfrac{1}{2}16)(3.5)^{3/2} = 4{,}535$ $Q_{TOTAL} = 6{,}463$

Using the above trials, establish a stage/discharge relationship. See curve on sheet 8.

Breach Q ≈ 4,090 cfs Stage ≈ 12.7 feet
Antecedent Q (Cheshire) 535 cfs Stage ≈ 5.2 feet
Increase due to breach would be 7.5 feet. This increase would overtop the gravel roadway by 2.2 feet, possibly causing damage to the roadway and culvert. The breach wave itself would be attenuated in this reach between 1st and 2nd road crossings due to large storage capacity. The 2nd road crossing would act as a dam and cause this area to fill up, causing a lessened effect downstream.

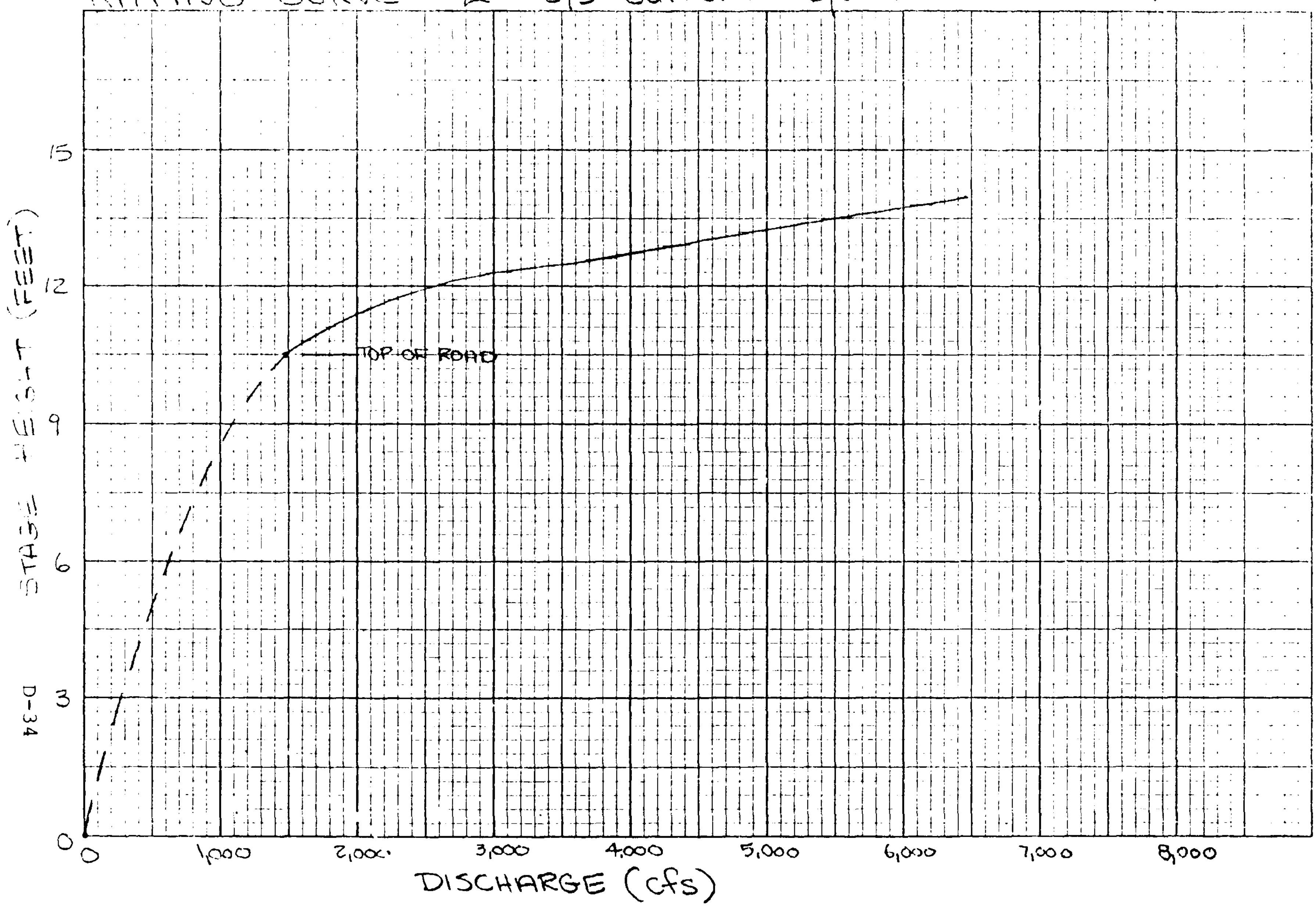
Sheet 7/8
L. Williams
4/10/80

CHESHAM POND DAM
WEIR SECTION - 2ND d/s culvert - D/S HAZARD ANALYSIS



DAM

RATING CURVE - 2ND d/s culvert - D/S HAZARD ANALYSIS



Sheet 8/8
L. Williams
4/10/80

AD-A156 149 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS SEAVER RESERVOIR DAM (..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUL 79 2/2

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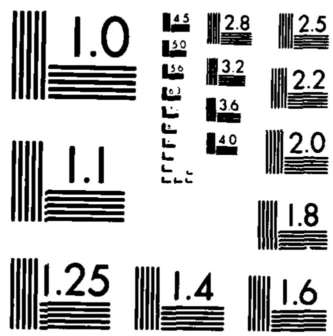

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

APPENDIX E

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

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