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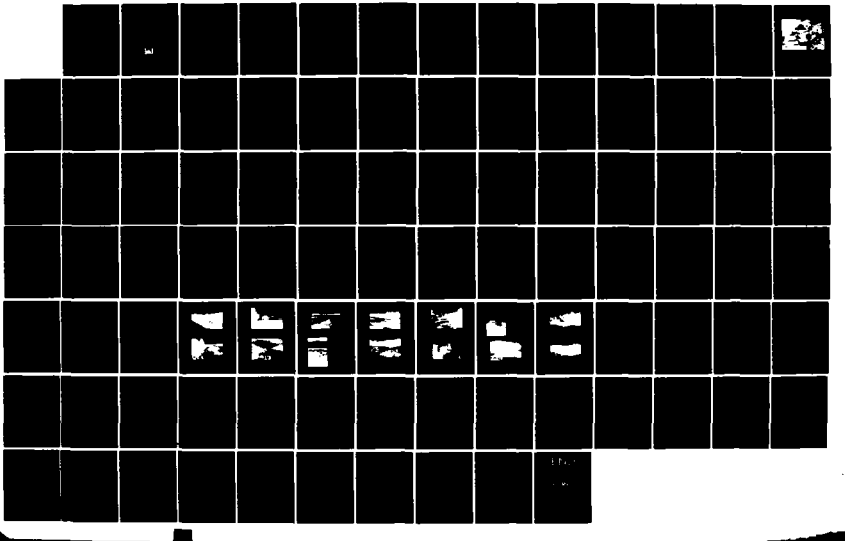

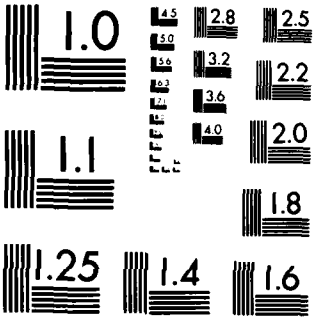

CONNECTICUT RIVER BASIN
NORTH BROOKFIELD, MASSACHUSETTS

HORSEPOND DAM
MA 00950

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

JUNE, 1981

UNCLASSIFIED

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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
North Brookfield, Massachusetts
Horse Pond Brook

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

The dam is 1900 ft. long and has a hydraulic height of 35.2 ft. The dam is considered to be in fair condition. It is intermediate in size with a hazard potential of significant. Extensive vehicle tresspassing and consequent erosion of the upstream and downstream slopes of the dam and the crests of the three dikes are of major concern.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

AUG 26 1981

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Horsepond Dam (MA-00950) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Quality Engineering, and to the owner, Commonwealth of Massachusetts, Department of Environmental Management, Water Resources Commission, Boston, MA. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Quality Engineering for your cooperation in this program.

Sincerely,

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

Incl
As stated

HORSEPOND DAM

MA 00950

CONNECTICUT RIVER BASIN
NORTH BROOKFIELD, MASSACHUSETTS

PHASE I - INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.:	MA 00950
Name of Dam:	Horsepond Dam
City:	North Brookfield
County and State:	Worcester County, Massachusetts
Stream:	Horse Pond Brook
Date of Inspection:	December 5, 1980

Horsepond Dam is owned by the Commonwealth of Massachusetts, and operated by the Department of Environmental Management, Water Resources Commission. The dam is a multi-purpose facility located in the eastern portion of North Brookfield, Massachusetts and is used for flood control and fish and wildlife development. The dam, an earth embankment structure with a reinforced concrete core wall, creates an impoundment with a storage of 1,700 acre-feet. It is 1,900 feet long and has a hydraulic height of 35.2 feet. There are three dikes in saddles near the left end of the dam. The principal spillway is a 30-inch reinforced concrete pipe and discharges to Horse Pond Brook. It acts as the low level outlet. The emergency spillway is a 200-foot long earth embankment on the right side of the dam and also discharges overland through a wooded area to Fivemile River.

As a result of the visual inspection and a review of available data, Horsepond Dam is considered to be in fair condition. Major concerns are: extensive vehicle trespassing and consequent erosion of the upstream and downstream slopes of the dam and the crests of the three dikes; lack of erosion protection on the crest of the dam; wheel tracks on the downstream slope of Dike C; and trees growing in the reservoir and at the downstream end of the emergency spillway.

The dam is classified as intermediate in size and a significant hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood range for this dam is the 1/2 Probable Maximum Flood (PMF) to full PMF. Since the dam is a significant hazard and is in the intermediate size range, the PMF was utilized for the hydrologic analysis. The test flood inflow was estimated to be 7,830 cubic feet per second (cfs) and resulted in an outflow discharge estimated to be 4,600 cfs, which would result in the test flood elevation approximately the elevation of the top of the dam. The maximum spillway

capacity with the water level at the dam crest was estimated to be 4,200 cfs, which is approximately the test flood discharge. A major breach to Horsepond Dam would increase the stage along the immediate downstream channel leading to Fivemile River to approximately 8 feet. Such a breach would cause Spencer Road, Hines Bridge Road, and the Lake Lashaway Dam at State Route 2 downstream of the dam to be overtopped. It is estimated that approximately 15 houses along the shore of Lake Lashaway would be affected and that they would be subjected to 2-5 feet of flooding.

It is recommended that the owner engage a qualified registered professional engineer to: determine the cause of erosion on the downstream dam face; specify and oversee repairs for erosion occurring from vehicle trespassing; specify and oversee construction of adequate erosion protection for the crests of the dam and dikes; and inspect the dam for seepage during periods of high pond levels. The owner should also replace the inlet trash rack and grate, remove specified vegetation, trees, and brush from the dam site, repair vehicular damage and all eroded areas, and limit dam access to authorized vehicles only. A visual inspection should be made once a month. A surveillance program should be established for use during and after a heavy rainfall, and a downstream warning program developed.

The recommendation and remedial measures are described in Section 7 and should be addressed by the owner within one year after receipt of this Phase I Inspection Report.

Howard Shaevitz, P.E.
Project Manager
M.P.E. No. 28447

SCHOENFELD ASSOCIATES, INC.
Boston, Massachusetts

This Phase I Inspection Report on Horsepond Dam (MA-00950) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
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, 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 analysis involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

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

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

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

HORSEPOND DAM

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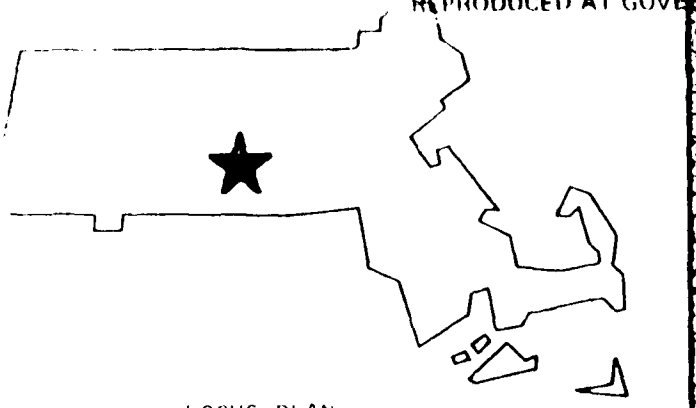
APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

OVERVIEW PHOTOGRAPHY
HORSEPOND DAM



LOCUS PLAN

NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

HORSEPOND DAM
LOCATION PLAN

North Brookfield, Massachusetts USGS Quad North Brookfield, Mass.	Scale 1:24,000

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
HORSEPOND 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. Schoenfeld Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to Schoenfeld Associates, Inc. under a letter of October 30, 1980 from Colonel William E. Hodgson, Jr., Deputy Division Engineer. Contract No. DACW33-81-C-0010 has been assigned by the Corps of Engineers for this work.

b. Purpose

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

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

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

1.2 Description of Project

a. Location. Horsepond Dam is located on Horse Pond Brook approximately 700 feet upstream of Fivemile River in the town of North Brookfield, Massachusetts. Fivemile River flows into Lake Lashaway on the North Brookfield-East Brookfield town line. The outflow from Lake Lashaway is the East Brookfield River. It flows into the Quaboag River. The dam is shown on the U.S.G.S. quadrangle sheet for North Brookfield, Massachusetts. Its approximate coordinates are N42°-16'-48" and W72°-02'-30". The location of the dam is shown on the preceding page.

b. Description of Dam and Appurtenances. Horsepond Dam is an earth embankment structure having a reinforced concrete core wall. The drawings obtained from the owner indicate that the dam is 1,900 feet long and has a maximum structural height of 41 feet. The height from the top of the dam to the downstream invert of the low-level outlet is 35 feet. Both the upstream and downstream slopes of the embankment are covered with coarse grass and weeds which have not been mowed. The crest of the dam consists of sand and gravel. The drawings indicate that there are four zones to the embankment, consisting of clayey sand and gravel, silty sand, clean sands and gravel, and a 50-foot berm.

Appurtenant structures consist of three dikes in saddles near the left end of the dam, an inlet riser, a 30-inch low-level outlet, and an outlet impact basin. Dike A is a 120-foot long earthen dike located approximately 200 feet from the left abutment of the dam. Dike B is a 50-foot long earthen dike located approximately 370 feet west southwest of Dike A. Dike C is a 270-foot long earthen dike located approximately 120 feet south of Dike B. The top width of each dike is 14 feet. The emergency spillway is a 200-foot long, 50-foot wide earth embankment having side slopes of 3H:1V, and discharges overland to Fivemile River. The 30-inch outlet is located in the center portion of the dam and discharges to Horse Pond Brook.

c. Size Classification. The dam is considered to be intermediate in size because the hydraulic height is 35.2 feet and the storage is 1,700 acre-feet. This is in accordance with the Recommended Guidelines for Safety Inspections for Dams, which defines an intermediate dam as having a storage capacity of 1,000 to 50,000 acre-feet.

d. Hazard Classification. The potential for hazard posed by this dam is classified as significant. This is in accordance with the Recommended Guidelines for Safety Inspection for Dams, which defines a significant structure as one which poses a threat to a few lives. A major breach to Horsepond Dam would result in the overtopping of Spencer Road, Hines Bridge Road, and the Lake Lashaway Dam at State Route 9. In addition, approximately 15 houses along the shores of Lake Lashaway would be affected. They would be subjected to 2-5 feet of flooding.

e. Ownership. The dam is owned by the Commonwealth of Massachusetts.

f. Operator. The dam is operated and maintained by the Commonwealth of Massachusetts, Department of Environmental Management, Water Resources Commission, Division of Water Resources, 100 Cambridge Street, Boston, Massachusetts 02202. The director of the Commission is Mr. William Kennedy. The operator of the dam is Mr. Michael Beshara, senior civil engineer. His telephone number is (617) 727-3267.

g. Purpose of Dam. Horsepond Dam is a multi-purpose facility designed for flood control and fish and wildlife development.

h. Design and Construction History. Horsepond Dam, completed in 1964, forms part of the Upper Quabog River Watershed Project. It was built under the Watershed Protection and Flood Prevention Act by the Massachusetts Water Resources Commission (WRC) and the Southern and Northwestern Worcester County Conservation Districts, with the assistance of the U.S. Soil Conservation Service.

i. Normal Operation Procedures. The level of the water surface is self-regulated by the inlet structure. The riser has no control mechanism of any kind.

1.3 Pertinent Data

a. Drainage Area. The area tributary to Horsepond Dam consists of 2,600 acres (4.1 square miles) of rolling terrain. There is no development in the watershed. The maximum watershed elevation is at about 1,115 feet; the reservoir full elevation is at 678.7 feet.

The area around the dam is mostly wooded. There are no cottages or dwellings along the shoreline.

b. Discharge at Dam Site

(1) Outlet works for Horsepond Dam consist of an inlet riser, a 30-inch principal spillway which acts as a low level outlet, and an outlet impact basin. The invert of the outlet is at 645.0. Maximum discharge of the pipe when the water surface is at the top of the dam (elevation 678.7) is about 110 cfs. The emergency spillway is a 200-foot long, 50-foot wide earth embankment. When the water surface is at the top of dam, the spillway will have a capacity of 4,200 cfs.

(2) Daily records of maximum water surface elevation are not maintained.

(3) The emergency spillway and outlet capacity with the water surface at the top of the dam is approximately 4,310 cfs at elevation 678.7.

(4) The emergency spillway and outlet capacity with the water surface elevation at the test flood elevation of 678.75 is approximately 4,600 cfs.

(5) The gated spillway capacity at the normal pool elevation is not applicable.

(6) The gated spillway capacity at the test flood elevation is not applicable.

(7) The total spillway capacity at the test flood elevation is 4,200 cfs at 678.75 elevation.

(8) The total project discharge at the top of dam is 4,310 cfs at 678.7 elevation.

(9) The total project discharge at the test flood elevation of 678.75 is approximately 4,600 cfs.

c. Elevation (feet NGVD)

(1) Streambed at centerline of dam - 643.5

(2) Bottom of cutoff - 640.6

(3) Maximum tailwater - unknown

(4) Normal pool - 647.3 (fish and wildlife sediment pool)

(5) Flood control pool - 675.0

(6) Emergency spillway crest - 675.0 (not gated)

(7) Design surcharge - unknown

(8) Test flood surcharge - 678.75

(9) Top of dam - 678.7

d. Reservoir (length in feet)

(1) Normal pool - 750

(2) Flood control pool - 5,100

(3) Emergency spillway crest pool - 5,100

(4) Test flood pool - 5,200

(5) Top of dam - 5,200

e. Storage (gross acre-feet)

(1) Normal pool - 20

(2) Flood control pool - 1,339

(3) Emergency spillway crest pool - 1,396

(4) Test flood pool - 1,700

(5) Top of dam - 1,700

f. Reservoir Surface (acres)

(1) Normal pool - 6 (fish and wildlife sediment pool)

(2) Flood control pool - 70

(3) Spillway crest pool - 70

(4) Test flood pool - 80

(5) Top of dam - 80

g. Dam

(1) Type - earth fill with reinforced concrete core wall

(2) Length - 1,900 feet

(3) Hydraulic height - 35.2 feet; structural height - 41 feet

(4) Top width - 14 feet

(5) Side slopes - 3 vertical to 1 horizontal

(6) Zoning - Zone I consists of compacted fill, Class B-2 sand and gravel (SC-GC); Zone II consists of compacted fill, Class B-2 silty sand (SM)

(7) Impervious core - reinforced concrete

(8) Cutoff - perforated corrigated pipe 10 inches in 3/4-inch stone

(9) Grout curtain - none

(10) Other - none

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway

(1) Type - the emergency spillway is a section of the gravel road which provides access to the site; topsoil with grass slope at 0.0285 feet/feet
the principal spillway is a 30-inch concrete pipe located in the central part of the dam

(2) Length of weir - emergency spillway: 200 feet long by 50 feet wide
principal spillway: 15 feet

(3) Crest elevation - emergency spillway: 675.0
principal spillway: 650.0

(4) Gates - emergency spillway: none
principal spillway: none

(5) U/S channel - emergency spillway: the upstream channel is the upstream slope of the dam
principal spillway: the upstream channel is below the normal water surface elevation of the pond

(6) D/S channel - emergency spillway: there is no defined channel
principal spillway: Horse Pond Brook discharges 700 feet into Fivemile River

(7) General - emergency spillway: discharges overland to Fivemile River
principal spillway: riser structure at upstream end of spillway and impact basin at downstream end

j. Regulating Outlet

(1) Invert - 645.0 upstream; 643.0 downstream

(2) Size - 30-inch reinforced concrete pipe, 193 feet long

(3) Description - the outflow enters Horsepond Brook which is an earth channel with a bottom width of 10 feet and a sideslope of 1:1; the channel runs in an easterly direction for approximately 700 feet where it meets Fivemile River

(4) Control mechanism - a riser structure with an elevation of 650.0 is located on the upstream end of the principal spillway

(5) Other - none

SECTION 2
ENGINEERING DATA

2.1 Design

Both design and as-built drawings were obtained from the Massachusetts Water Resources Commission. The drawings show plans of the dam and storage area as well as elevations, sections, and construction details of the dam and all appurtenances. Design calculations were obtained from the Soil Conservation Service.

2.2 Construction

No construction records were available for use in evaluating the dam. The dam was constructed in 1964 by Welch and Coor Construction Company, Inc., Springfield, Massachusetts.

2.3 Operation

The level of the water surface is controlled by the riser structure. It has no control mechanism of any kind.

2.4 Evaluation

a. Availability. The engineering data used in the preparation of this report are presented in Appendix B.

b. Adequacy. Available engineering data and design drawings are considered adequate for a Phase I investigation, although seepage problems could not be evaluated because of the low water elevation.

c. Validity. The field investigation indicated that the external features of Horsepond Dam have not changed substantially from the design drawings of 1964.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Horsepond Dam was conducted on December 5, 1980. The field inspection team consisted of personnel from Schoenfeld Associates, Inc., D. Baugh Associates, Inc., and Geotechnical Engineers, Inc. Two representatives from the Soil Conservation Service and one from the Massachusetts Water Resources Commission were also present. Inspection checklists, completed during the field site visit, are included in Appendix A. Selected photographs of the dam are contained in Appendix C.

Horsepond Dam is a flood-control and fish and wildlife development dam. At the time of the inspection the water level in the reservoir was approximately at the elevation of the riser inlet.

b. Dam. The dam is an earth embankment structure, with a reinforced concrete core wall approximately 1,900 feet long.

Both the upstream and downstream slopes of the embankment are in fair condition, although they are covered with coarse grass and weeds which have not been mowed (Photo No. 1). Trespassing by both two-wheel and four-wheel vehicles and consequent erosion, however, is very extensive, particularly at the contact between the downstream slope and the left abutment (Photo No. 2), on the downstream slope in the vicinity of the impact basin (Photo No. 3), along the entire downstream toe of the dam, and near the toe of the upstream slope between the low-level outlet and the right abutment (Photo Nos. 4, 5, and 6). These vehicle intrusions have left the upstream face and the entire toe of the downstream face rutted with some erosion noted on the northerly downstream face. No other signs of distress in the upstream and downstream faces were visible.

The crest of the dam consists of sand and gravel and is totally bare of vegetation. Vehicles are apparently driven frequently over the entire length of the crest and are responsible for this lack of any stabilizing grasses on a portion of the spillway/dam crest. This condition is not as advanced as the one previously mentioned, however.

No seepage was observed anywhere along the downstream face of the dam, although it must be noted that at the time of inspection the pool elevation was low.

c. Appurtenant Structures. The emergency spillway is a 200-foot long earth embankment at the right end of the dam (Photo No. 7). It is excavated in sands and gravels at the right abutment. The spillway consists of grass-stabilized earth. There is a sparse growth of grass and weeds in the bottom and on the side slopes of the channel. The channel discharges into an area that is completely covered with trees (Photo No. 8). The overall condition of the spillway is good, although some areas have been bared by vehicular traffic.

The design drawings show three dikes in saddles near the left end of the dam. All three dikes lie on the alignment of a dirt road which extends north from the dam.

Dikes A and B appear to be in good condition, with no signs of distress. All have moderate grassy vegetation on both their upstream and downstream dike faces.

Dike A, which is the one closest to the left end of the dam, is so low that it is not distinguishable during a visual inspection.

Dike B, which is the second closest to the dam, is also very low and is distinguishable only because of the presence of vetch which was planted on the downstream side of the dike.

Dike C is the only dike which has a significant height. There was no water against the upstream side of the dike at the time of the inspection. The dirt road on the crest of the dike is completely bare of vegetation or other type of erosion protection (Photo No. 9). Both the upstream and downstream slopes of the dike are covered with a dense growth of coarse weeds and grass. Vehicle tracks along the downstream roe of the dike are bare of vegetation and there is significant erosion on the downstream slope near the left abutment where the dirt road runs off the top of the dike.

Other appurtenant structures consist of an inlet riser (Photo No. 10), 30-inch reinforced concrete pipe outlet and outlet impact basin (Photo No. 11). All are in good condition, although the inlet riser did not have a trash rack and grate at the time of inspection though there were provisions for one.

Two 8-inch CMP drains were discharging a small amount of water into the left and right sides of the headwall structure at the impact basin. These appear to be toe drains. The southerly drain was dry, but the northerly drain was flowing at one-quarter of capacity.

Three observation wells were observed near the toe of the dam between the impact basin and the right abutment.

d. Reservoir. The area immediately adjacent to the pond is moderately sloped and well vegetated with brush and small- to medium-sized tress. Many of the trees are growing in the reservoir area, above the level of the conservation pool but below the elevation of the crest of the dam. No evidence of significant sedimentation in the reservoir was observed.

The shoreline shows no signs of sloughing or erosion (Photo No. 12). A rapid rise in the water level of the pond would not endanger life or property.

e. Downstream Channel. There are essentially two downstream channels. One channel is Horse Pond Brook and was excavated from the low-level outlet in an easterly direction to the Fivemile River (Photo No. 13). A zone about 25 feet wide on each side of this channel is maintained free of trees and brush. The second channel is the apparent remnant of Horse Pond Brook, where it flowed before construction of the dam. Water was flowing in a ditch along the perimeter of what appears to be a low berm next to the downstream toe of the dam in the vicinity of this second channel (Photo No. 14). The entire area downstream of the dam appears to be a natural swamp which existed before the dam was built. Because of the generally swampy nature of the area at the downstream toe it appears likely that the water flowing in this ditch is primarily groundwater intercepted by the ditch and that it is not significantly affected by seepage from the reservoir, which was at a low level at the time of the inspection.

The man-made downstream channel is in good condition and the area adjacent to it is free of brush and trees.

3.2 Evaluation

On the basis of the visual inspection the dam is judged to be in fair condition.

Very extensive vehicular traffic and consequent erosion on the upstream and downstream slopes of the dam could lead to breaching of the dam if not prevented.

The crest of the dam is used as a roadway and is completely bare of vegetation or other erosion protection. Erosion of the crest and breaching could occur if the dam were to be overtopped. The crests of Dikes A, B, ad C are all used as roadways and are completely bare of vegetation or other erosion protection. Erosion of the crests and breaching could occur if the dikes are overtopped.

Wheel tracks on the downstream slope of Dike C near the left abutment and on the downstream toe area could become a focus for seepage and piping when there is water behind the dike, or for erosion at any time.

Trees growing in the reservoir may be a source of branches and logs which could plug the low-level outlet during flood flows.

Trees growing at the downstream end of the emergency spillway at the left abutment might catch debris and reduce the capacity of the spillway to the extent that the dam might be overtopped during flood periods.

Grass and coarse weeds growing on both the upstream and downstream slopes of the dam make it very difficult to inspect those slopes adequately.

The absence of a trash rack and grate on the riser structure could result in debris and brush blocking the 30-inch outlet pipe.

Because the water level in the reservoir was very low at the time of the inspection it was not possible to evaluate whether there are any seepage problems when the reservoir is at high levels.

The general structural condition of the dam is fair. The visual inspection revealed only a few negative items leading to this assessment, including:

(1) Some erosion on northerly downstream slope.

(2) Embankment damage due to vehicular intrusion.

(3) Lack of vegetation control (primarily grasses) on the dam embankments.

(4) Lack of a trash rack and grate on the inlet riser.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Horsepond Dam is a multi-purpose facility used for flood control and fish and wildlife development. The level of the water surface is controlled by a riser located at the upper end of the low-level outlet.

b. Description of Any Warning System in Effect. No written warning system or emergency preparedness system exists for the dam.

4.2 Maintenance Procedures

a. General. The Commonwealth of Massachusetts, Department of Environmental Management, Water Resources Commission, Division of Water Resources, is responsible for maintenance of the dam. There are no established procedures or manuals. The dam is inspected each spring by representatives of the owner, the Soil Conservation Service and the Town of North Brookfield. Any repairs are made during the summer months by a Contractor engaged by the owner. The owner inspects the repair work after completion.

b. Operating Facilities. No formal maintenance procedures for the operating facilities were disclosed.

4.3 Evaluation

The current operational and maintenance procedures require improvement to insure that normal problems can be remedied within a reasonable period of time. The dam and appurtenant structures should be visually inspected once a month.

The owner should also establish a surveillance program for use during and immediately after heavy rainfalls. A downstream warning program to follow in case of emergency should also be developed.

SECTION 5
EVALUATION OF HYDROLOGIC/HYDRAULIC FEATURES

5.1 General

Horsepond Dam is an earth embankment structure having a reinforced concrete core wall. According to design drawings, the dam is 1,900 feet long and has a hydraulic height of 35.2 feet. The principal spillway is a 30-inch culvert located in the center of the dam and discharges to Horse Pond Brook. The riser structure on the upstream end of the principal spillway, with an elevation of 650.0, acts as the low level outlet for the impoundment. The emergency spillway is a 200-foot long earth embankment on the right side of the dam. The emergency spillway discharges to Fivemile River. The crest consists of sand and gravel and is totally bare of vegetation.

5.2 Design Data

Hydrological and hydraulic design data were obtained from the Soil Conservation Service, 451 West Street, Amherst, Massachusetts 01002.

5.3 Experience Data

Daily readings of the water surface elevation are not taken.

5.4 Test Flood Analysis

The hydrologic evaluation was performed utilizing detailed design information obtained from the Soil Conservation Service, data gathered during the field inspection and watershed size. The test flood range is the 1/2 PMF to full PMF for this intermediate structure. The full PMF test flood was selected because the dam falls on the upper end of the intermediate size range. The drainage basin is essentially mountainous; however, the "rolling" curve from the Corps of Engineers set of guide curves was used to account for the large reservoir surface area as compared to the size of the drainage area.

Based on an estimated maximum probable flood peak flow rate of 1,910 cfs per square mile and a drainage area of 4.1 square miles, the test flood inflow was estimated to be 7,830 cfs. The test flood was routed through the dam in accordance with the Corps of Engineers procedure for Estimating Effect of Surcharge Storage on Maximum Probable Discharge. The water surface was assumed to be at elevation 647.3 prior to the flood routing. The project discharge was estimated to be 4,600 cfs.

This analysis indicated that the test flood elevation would approximate the elevation of the top of dam. The maximum spillway capacity with the water level at the dam crest was therefore estimated to equal the test flood discharge. The emergency spillway channel has adequate capacity to handle the test flood discharge.

5.5 Dam Failure Analysis

The impact of dam failure with the reservoir surface at the dam crest was assessed utilizing the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs provided by the Corps of Engineers. The analysis covered a reach extending approximately 4.2 miles downstream to a point where the Fivemile River reaches and overtops Lake Lashaway Dam and State Route 9. Based on this analysis, Horsepond Dam was classified as a significant hazard.

The flow prior to the breach was estimated to be 4,300 cfs. As a result of a major breach, the flow would increase to 83,000 cfs. Because the reaches are flat and wide, the antecedent flow was not considered when the stage increases were computed.

A major breach to the Horsepond Dam would increase the stage along the immediate downstream channel of Horse Pond Brook by approximately 8 feet. Such a breach would cause Spencer Road, Hines Bridge Road, and the Lake Lashaway Dam at State Route 9 downstream of the dam to be overtopped. It is estimated that approximately 15 houses along the shore of Lake Lashaway would be affected. They would be subjected to 2-5 feet of flooding as a result of the breach.

SECTION 6
EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The general structural stability of the earth embankment dam is fair as evidenced by the vertical, horizontal, and lateral alignment. Damage to dam embankments by vehicular intrusion does not compromise structural stability. No seepage through the dam could be detected nor could evidence of past seepage be found which would indicate structural problems.

The following conditions observed during the visual inspection are indicative of problems that could result in long-term structural instability.

(1) Very extensive trespassing and consequent erosion on the upstream and downstream slopes of the dam could lead to breaching of the dam if not controlled.

(2) The crest of the dam is used as a roadway and is completely bare of vegetation or other erosion protection. Erosion of the crest and breaching could occur if the dam were to be overtopped.

(3) The crests of Dikes A, B, and C are all used as roadways and are completely bare of vegetation or other erosion protection. Erosion of the crests and breaching could occur if the dikes are overtopped.

(4) Wheel tracks on the downstream slope of Dike C near the left abutment and on the downstream toe area could become a focus for seepage and piping when there is water behind the dike, or for erosion at any time.

6.2 Design and Construction Data

Design drawings are available for this dam. The drawings show that the embankment is zoned. Zone I consists of the core and a connecting horizontal blanket having a maximum thickness of 4 feet under the upstream shell. This zone is specified as clayey sand and gravel. Zone II, consisting of the upstream and downstream shells, is specified as a silty sand. Zone III consists of a short blanket drain having a minimum thickness of 3 feet at the downstream toe and is specified as clean sands and gravels. Zone IV is a berm extending about 50 feet upstream from the upstream toe of the dam, apparently to prevent a sliding failure in the foundation.

The design data indicate that the foundation is predominantly sand and silty sand, with occasional glacial till and occasional stiff clay. Peat, having a maximum thickness of 3 feet and an average thickness of 2 feet, covered approximately one-quarter of the area where the embankment was built. No bedrock was encountered in any of the borings or test pits that were made during the design studies.

The drawings call for drain pipes in the short blanket drain at the downstream toe of the dam, and these are apparently the drains that were observed in the right and left walls of the headwall at the impact basin. The drawings also call for six anti-seep collars on the low-level outlet pipe.

Apparently no seismic analysis of the stability of the dam was made.

6.3 Post-Construction Changes

No post-construction changes were observed.

6.4 Seismic Stability

This dam is in Seismic Zone 2 and, in accordance with the Phase I guidelines, no seismic analysis is warranted.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. After consideration of the available information, the results of the visual inspection, contact with the owner, and hydraulic/hydrologic studies, the general structural condition of Horsepond Dam is judged to be fair. The following conditions are indicative of potential long-term problems:

(1) Extensive trespassing by unauthorized vehicles and consequent erosion on the upstream and downstream slopes of the dam could lead to breaching of the dam if not controlled.

(2) The crest of the dam is used as a roadway and is completely bare of vegetation or other erosion protection. Erosion of the crest and breaching could occur if the dam were to be overtopped.

(3) The crests of Dikes A, B, and C are all used as roadways and are completely bare of vegetation or other erosion protection. Erosion of the crests and breaching could occur if the dikes are overtopped.

(4) Wheel tracks on the downstream slope of Dike C near the left abutment and on the downstream toe area could become a focus for seepage and piping when there is water behind the dike, or for erosion at any time.

(5) Trees growing in the reservoir may be a source of branches and logs which could plug the low-level outlet.

(6) Trees growing at the downstream end of the emergency spillway at the left abutment might catch debris and reduce the capacity of the spillway.

(7) The absence of the trash rack and grate on the riser could result in debris and brush blocking the 30-inch outlet pipe.

b. Adequacy of Information. The information obtained from the design drawings and the results of the visual inspection are adequate for the purposes of this Phase I inspection, although grass and coarse weeds growing on the upstream and downstream slopes of the dam make it impossible to inspect those slopes adequately. The low level of water in the reservoir at the time of the inspection make it impossible to evalute whether there are any seepage problems when the reservoir is at high levels.

c. Urgency. The owner should implement the recommendations in 7.2 and 7.3 within one year after receipt of this Phase I report, except as noted.

7.2 Recommendations

The following investigations should be carried out and needed corrections performed under the direction of a registered engineer qualified in the design and construction of dams.

(1) Determine the cause of erosion on the downstream dam face.

(2) Specify and oversee construction of repairs for the erosion that has occurred as a result of trespassing on the upstream and downstream slopes of the dam and on the downstream slope and downstream toe area of Dike C.

(3) Specify and oversee construction of adequate erosion protection for the crests of the dam and Dikes A, B, and C.

(4) Inspect the dam for seepage during periods of high pond levels.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Replace the trash rack and grate immediately. Prior to replacement, however, the owner should inspect the pipe to insure that no debris or brush have collected in it.

(2) Remove vegetation from the inlet area.

(3) Remove trees and brush between the downstream end of the spillway at the left abutment and the Fivemile River.

(4) Limit dam access to authorized vehicles only.

(5) Visually inspect the dam and appurtenant structures once a month.

(6) Mow the grass on a regular basis.

(7) Engage a registered professional engineer qualified in the design and construction of dams to make a comprehensive technical inspection of the dam once every year.

(8) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency.

7.4 Alternatives

There are no practical alternatives to the remedial measures described in Section 7.3.

APPENDIX A

INSPECTION CHECK LIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Horsepond Dam

DATE Dec. 5, 1980

TIME 10:20

WEATHER Clear, Cold

W.S. ELEV. 650.1 UPSTREAM
643.9 DOWNSTREAM

PARTY:

1. Howard Shaevitz, SAI
2. Peter Austin, DBA
3. Ronald Hirschfeld, GEI
4. Ernie Struzziero, MWRC
5. Larry Boutiette, SCS
6. Bill Sutcliffe, SCS
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	Howard Shaevitz	
2.	Structural Stability	Peter Austin	
3.	Soils and Geology	Ronald Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam, MA DATE Dec. 5, 1980

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	678.7
Current Pool Elevation	650.1
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	Crest is slightly irregular
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	Severe trespassing apparently due to both 2-wheel & 4-wheel vehicles
Sloughing or Erosion of Slopes or Abutments	Significant erosion in vehicle tracks
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Some water flowing in ditch around downstream edge of berm at downstream toe in vicinity of old channel
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	Two CMP drains discharge in concrete structure at downstream end of low level outlet
Instrumentation System	3 wells at downstream toe
Vegetation	Grass and coarse weeds

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	Dike A
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
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	None
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Crest is bare sand & gravel; coarse weeds & grass on slopes

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	Dike B
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
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	None
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None
Vegetation	Crest is bare sand & gravel; coarse weeds & grass on slopes; vetch on downstream slope

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	Dike C
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
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	Roadway down downstream slope at left abutment. Vehicle tracks down downstream slope at right abutment.
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Wheel tracks on downstream slope of downstream toe area.
Sloughing or Erosion of Slopes or Abutments	Significant erosion in roadway at left abutment
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Crest is bare sand & gravel; coarse weeds & grass on slopes

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Intake Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Not visible beneath pond
Rock Slides or Falls	None
Log Boom	None
Debris	None
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	Not applicable
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	None

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Control Tower NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Not applicable
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
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 Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Transition & Conduit NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Unknown
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Outlet Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Good
Rust or Staining on Concrete	None
Spalling	None
Erosion or Cavitation	None observed
Visible Reinforcing	None
Any Seepage or Efflorescence	None observed
Condition at Joints	Good
Drain Holes	None observed
Channel	
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Good

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Some trees growing in channel
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees overhang channel
Floor of Approach Channel	Sand and gravel
b. Weir and Training Walls	Not Applicable: "Spillway" is the crest of the dam, which is earth embankment
General Condition of Concrete	
Rust or Staining	
Spalling	Cracks sporadically located along the floor
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	Not applicable
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Many trees growing in channel beyond cut section of spillway
Floor of Channel	Sand and gravel
Other Obstructions	Trees as noted above

PERIODIC INSPECTION CHECKLIST

PROJECT Horsepond Dam DATE Dec. 5, 1980

PROJECT FEATURE Service Building NAME

DISCIPLINE NAME

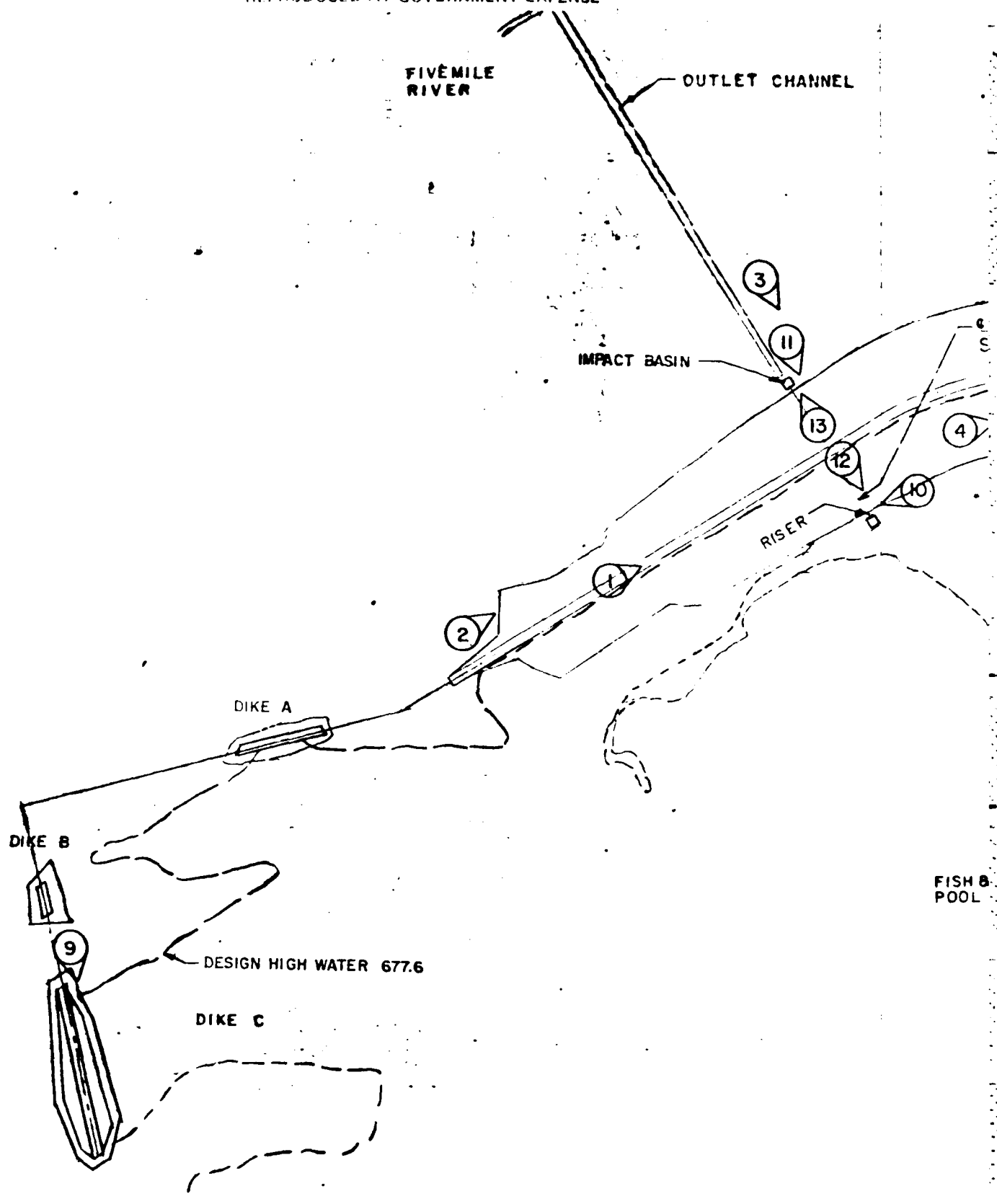
AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	Not applicable
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

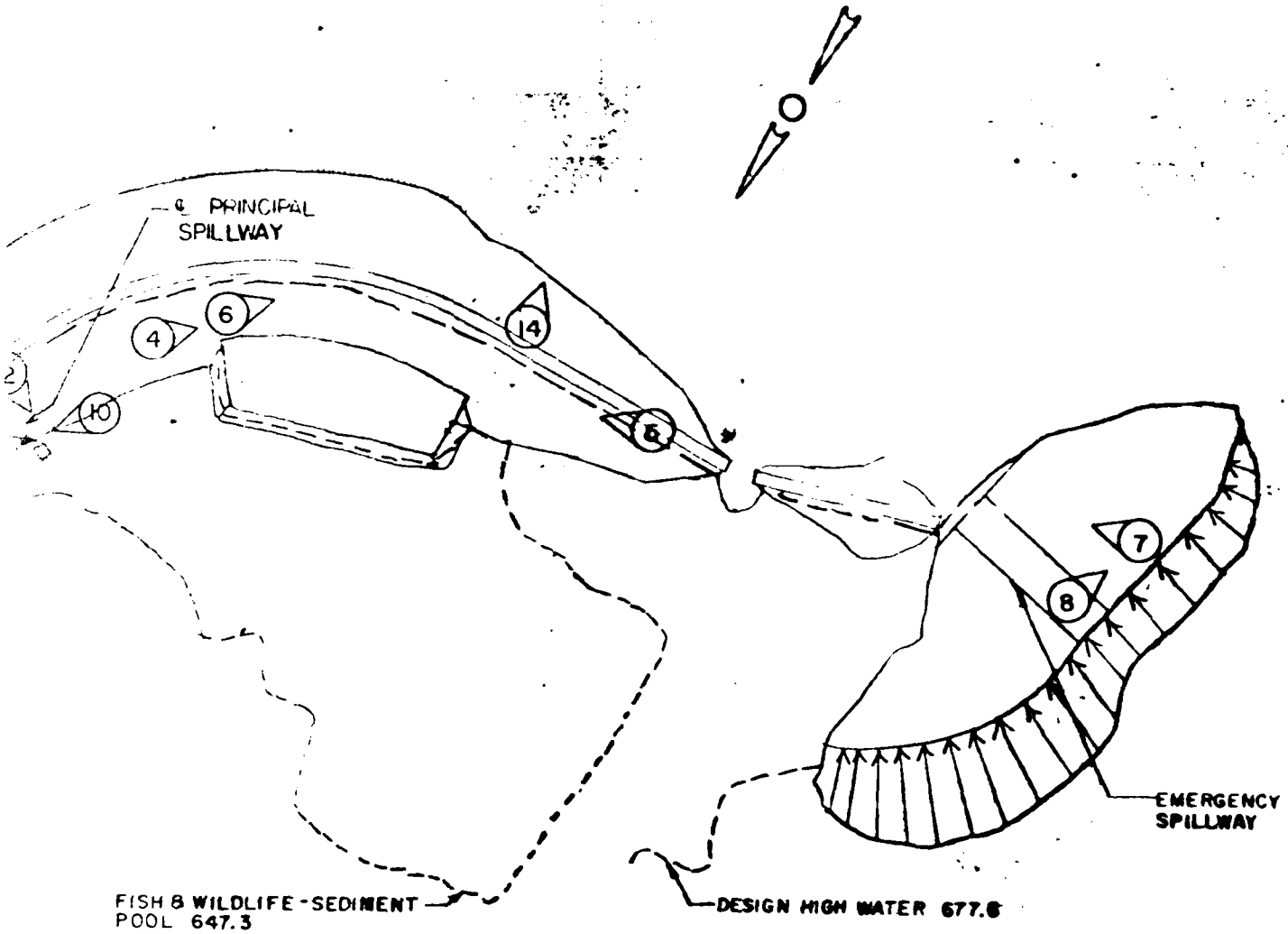
Available Engineering Data

Plans of Horsepond Dam were obtained from the Massachusetts Department of Environmental Management, Water Resources Commission, 100 Cambridge Street, Boston, Massachusetts 02108. The drawings are dated 1964.



5 NUMBER AND ORIENTATION OF PHOTOGRAPH AS IN APPENDIX C*

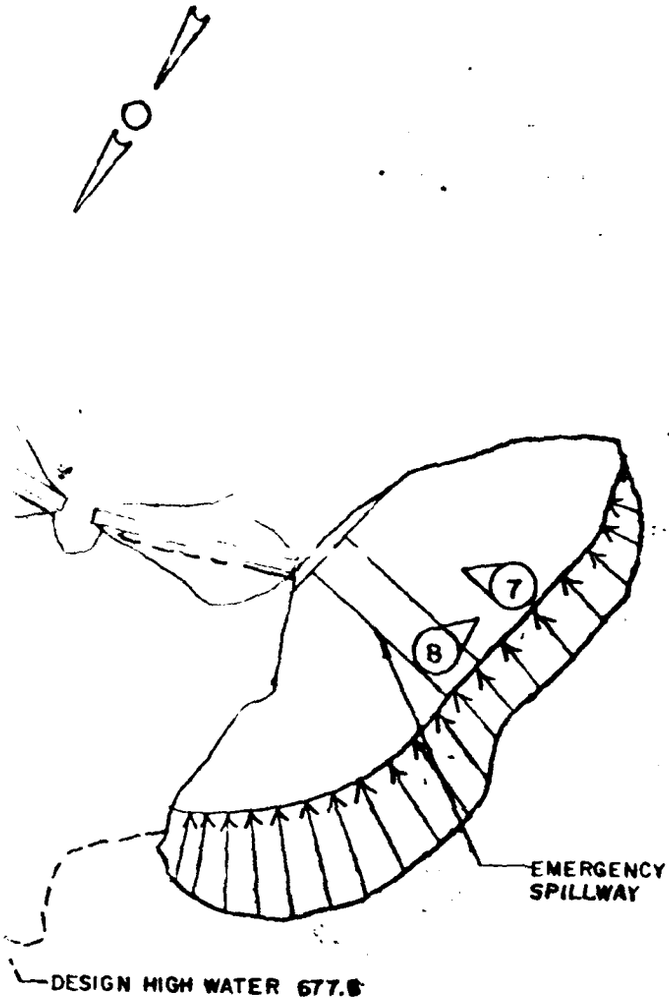
EL



NATIONAL PROGRAM OF
NON FEDERAL

HORSEPOND

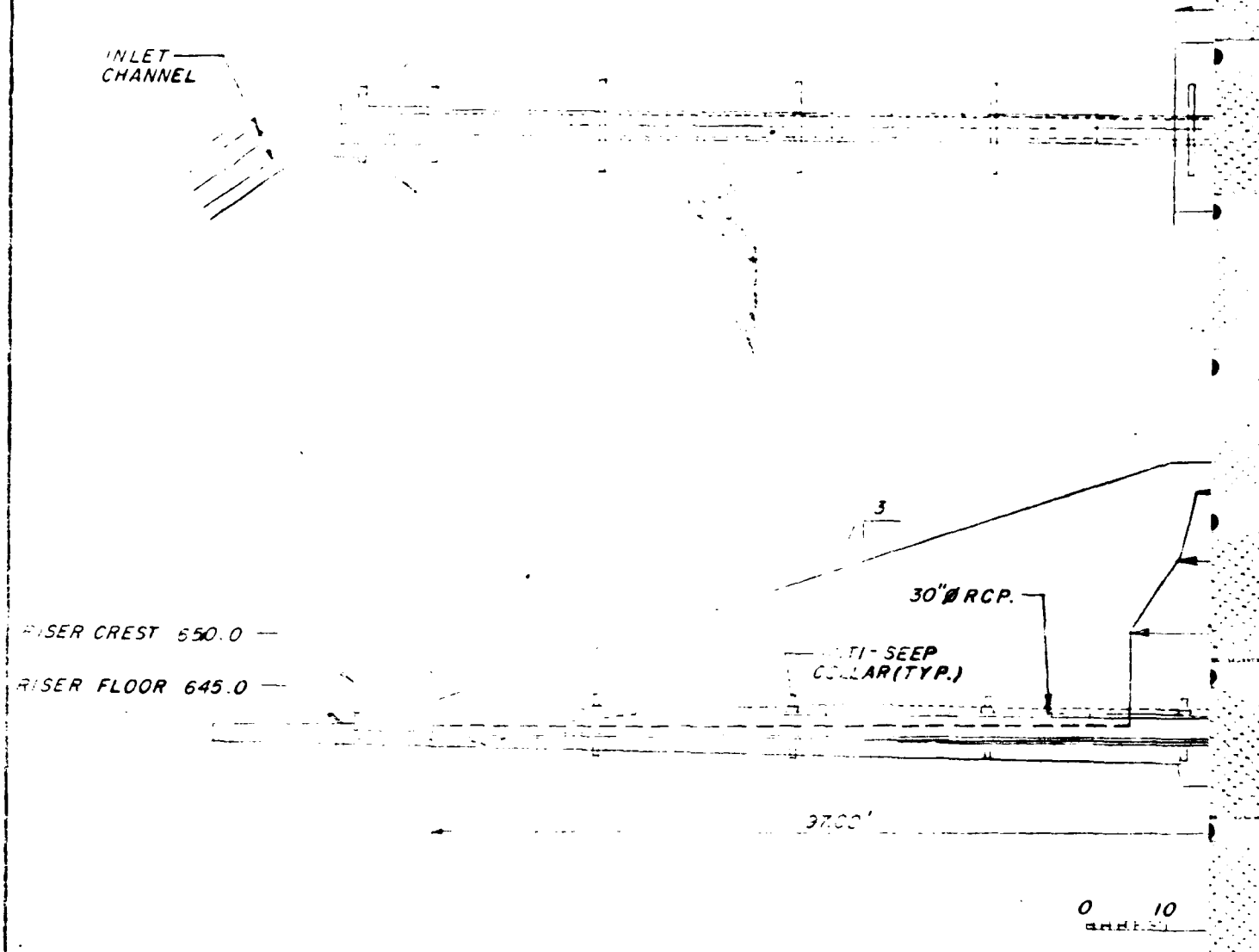
North Brookfield, Massachu



NATIONAL PROGRAM OF INSPECTION OF
NON FEDERAL DAMS

HORSEPOND DAM

North Brookfield, Massachusetts | Scale 1" = 40'



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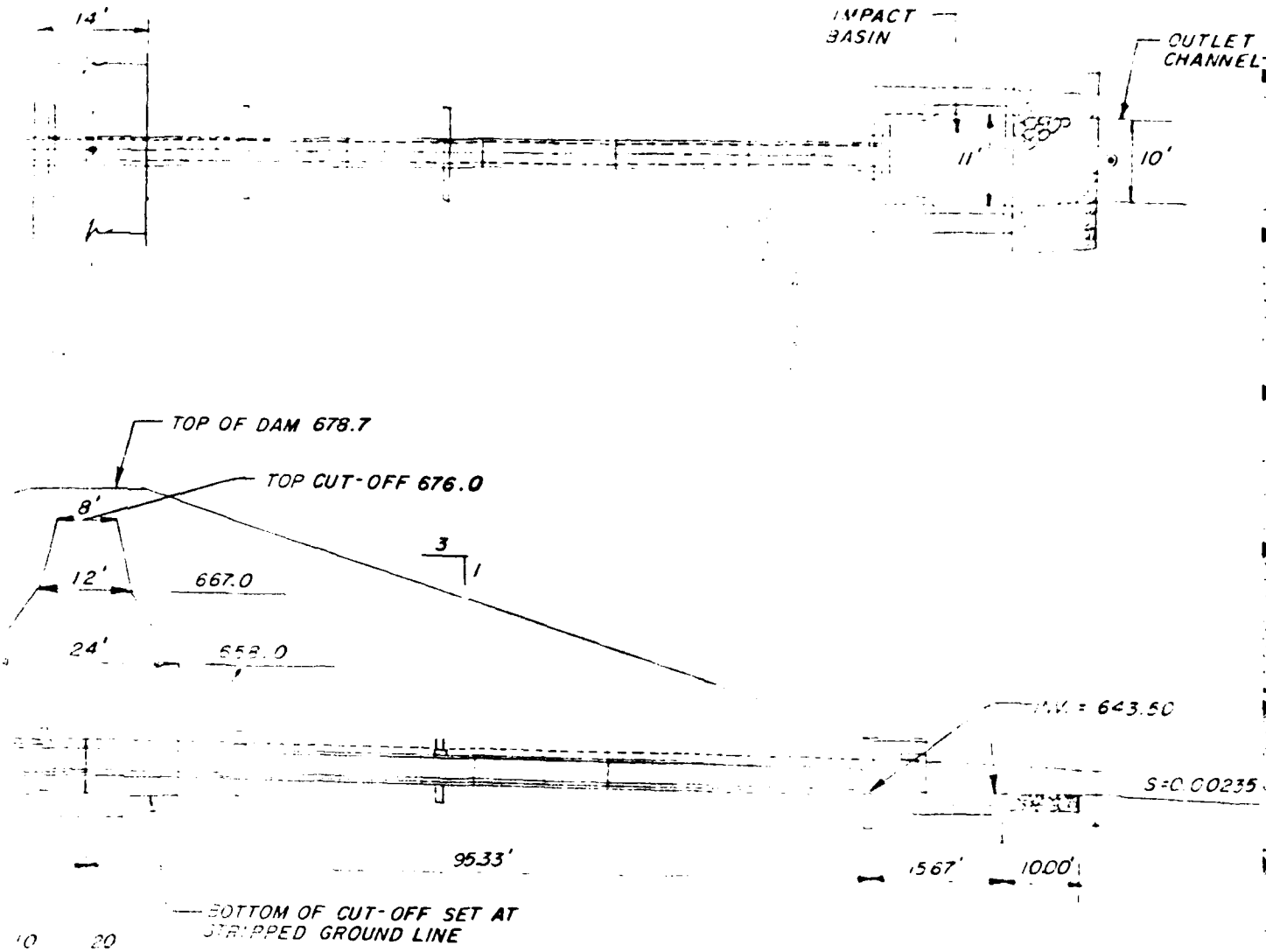

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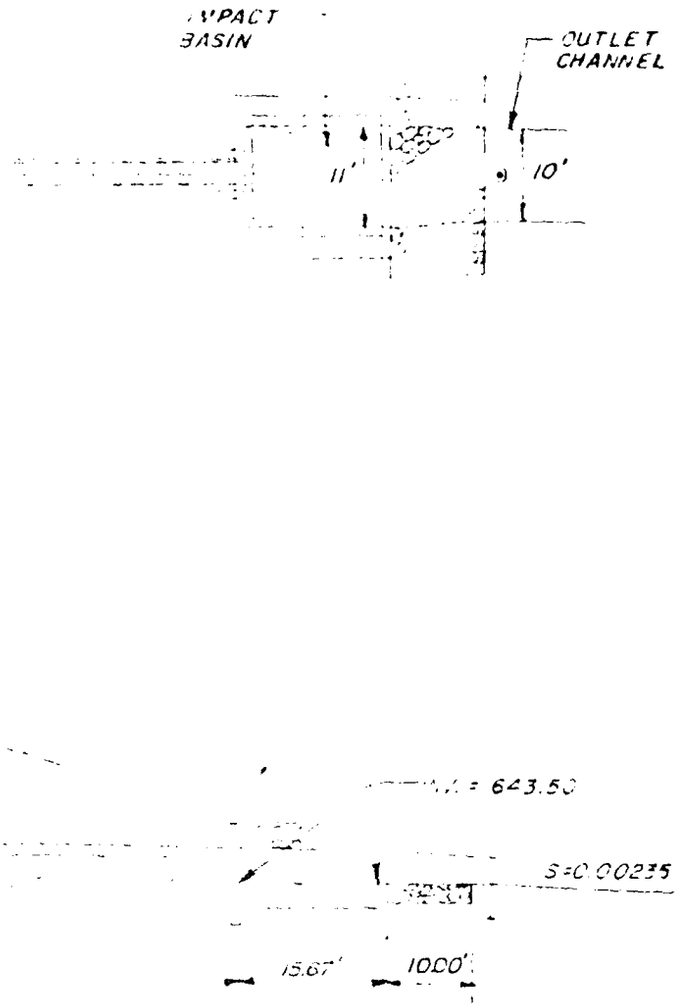
NON FEDERAL DAMS

HORSEPOND DAM

North Brookfield, Massachusetts | Sc



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS	
HORSEPOND DAM	
North Brookfield, Massachusetts	Scale 1" = 20'

A-AS-TRIAL
3/2/76

OPERATION AND MAINTENANCE
INSPECTION RECORD

U.S. Dept. of Agriculture
Soil Conservation Service

Project UPPER QUABOAG RIVER W/S Inspection Date 5-5-80

Site Name/No. HORSE POND Type MULTIPLE PURPOSE

Type of Inspection: Special ☐ Annual ☒ Structure Operation: Satisfactory ☒ Unsatisfactory ☐

Sponsoring Local Organization: DIV. OF WATER RESOURCES

Present for Inspection: ERNIE STRUZZIERO, WRC; HARRY BOUTETTE & ARNOLD PITMAN, SCS; BOB RUSSELL, GEORGE ROSEBROOKS, CHARLEY PERKINS, DISTRICT SUPERVISORS

ITEM	Condition * S or U	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Completed
1. Vegetation	U	CUT BRUSH FROM UPSTREAM & DOWNSTREAM SIDES.	1000	JUNE 1980
2. Fences	U	REMOVE BARBED WIRE FROM OUTLET CHANNEL & IMPACT BASIN	25	JUNE 1980
3. Principal Spillway	U	PICK-UP AND REMOVE DEBRIS FROM RISER AND U/S TOE. PATCH IMPACT BASIN WHERE CHIPPED.	1300	JUNE 1980
4. Emergency Spillway	U	FILL IN & REPAIR RUTS	1000	JUNE 1980
5. Embankment & Riprap	U	REMOVE STONE FROM IMPACT BASIN AND REPLACE AT SIDES.	300	JUNE 1980
6. Reservoir Area				
7. Gates or Valves				
8. Outlet Channels	U	REMOVE GROWTH FROM ALONG BOTH SIDES	500	JUNE 1980
9. Structure Drainage Outlets				
10. Access Rd.	U	REPAIR SINGLE LEAF GATE; INSTALL METAL POSTS. (6). BLOCK ACCESS TO E.S.	500	JUNE 1980
11.				

REMARKS: (over)

* S = Satisfactory; U = Unsatisfactory

Arnold Pitman (District Conservationist) Laurence Boutette (Project Engineer) Ernie Struzziero (SLO Representative)

(Report due, annually: July 1)

1/22/76

INSPECTION RECORD

Soil Conservation Service

Project Upper Rusdog W/S Inspection Date 8/22/78

Site Name/No. Hoverpad Type Multiple-Purpose

Type of Inspection: Special ☐ Annual ☒ Structure Operation: Satisfactory ☒ Unsatisfactory ☐

Sponsoring Local Organization: Div of Water Resources

Present for Inspection: Ernie Struzzieri Roy Fisher, Art Coolidge SCS
Geo. Rosebrooks, Souther SD & Jon Smith NW CD

ITEM	Condition * S or U	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Complet
1. Vegetation	S			
2. Fences	U	Cables broken Replace with gate at Rt Abut. Entrance	2000	Jul 1979
3. Principal Spillway	S			
4. Emergency Spillway	U	Repair & revegetate Vehicle damage on side slope	500	July 1979
5. Embankment & Riprap	S			
6. Reservoir Area	U	Repair damaged area by vehicle - smooth, loam & reseed	500	July 1979
7. Gates or Valves	S			
8. Outlet Channels	U	Continue brush removal from outlet channel	1000	July 1979
9. Structure Drainage Outlets	S			
10. Access Rd.	S			
11. Dike	S			

REMARKS: (over)

* S = Satisfactory; U = Unsatisfactory

Howland E. Fisher (District Conservationist) (Project Engineer)

Ernest Struzzieri (SLO Representative)

(Report due, annually: July 1)

1979

QUABOAG RIVER WATERSHED

9)

HORSEPOND SITE

1. Place 12' entrance gate according to spec.
   Gate to be supplied by W.R.
   Gate stored @ F & P yard in Clinton
   1- 4" x 6' lally column embedded in concrete leaving
   3' opening from gate
2. Repair all sides slopes - damaged by vehicle, reloam and reseed damaged area and Emergency Spillway
3. Repair all damaged areas by vehicles
   @ Reservoir Area - re-loam and re-seed
4. @ Outlet channel remove brush and tree growth
   complete length of channel
5. Place gravel length of Top of Dam and areas that have been damaged
6. Place three 4" dia x 6' lally columns embedded in concrete at discharge side of channel and repair barbed wire fence.
7. Remove all trash and debris in Area
8. Cement around plaque

SUCKER SITE

1. Remove debris @ Trash Rack and along embankment
2. Cut brush and growth along both sides of channel
3. Clean-out area @ culver drain near entrance
4. Paint entrance gate

APPENDIX C

SELECTED PHOTOGRAPHS

(Index to Photographs is Found in Appendix B)

Photo No. 1 - View from crest at location of low-level outlet showing crest, upstream slope and right abutment. Both abutments are sand and gravel.

Photo No. 2 - Downstream slope of dam viewed from left abutment. Wheel tracks on lower portion of slope.

Photo No. 3 - Impact basin for principal spillway. Major trespassing and erosion problem on downstream slope on both sides of outlet.

Photo No. 4 - Evidence of trespassing and erosion on upstream slope where it meets berm.

Photo No. 5 - Upstream slope and berm view from right side of dam.

Photo No. 6 - Close-up view of wheel ruts on berm between riser and right end of dam.

Photo No. 7 - View of emergency spillway from right abutment looking upstream.

Photo No. 8 - View downstream from right bank of emergency spillway.

Photo No. 9 - Dike C and right dike abutment viewed from left dike abutment. Sand and gravel road on crest, no vegetation.

Photo No. 10 - Riser for principal spillway. Note supports for missing trash rack and grate.

Photo No. 11 - Close-up of impact basin at downstream end of principal spillway.

Photo No. 12 - View upstream from crest; riser structure is in foreground

Photo No. 13 - View downstream along Horsepond Brook at outlet of principal spillway.

Photo No. 14 - Standing water in drainage ditch at downstream edge.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

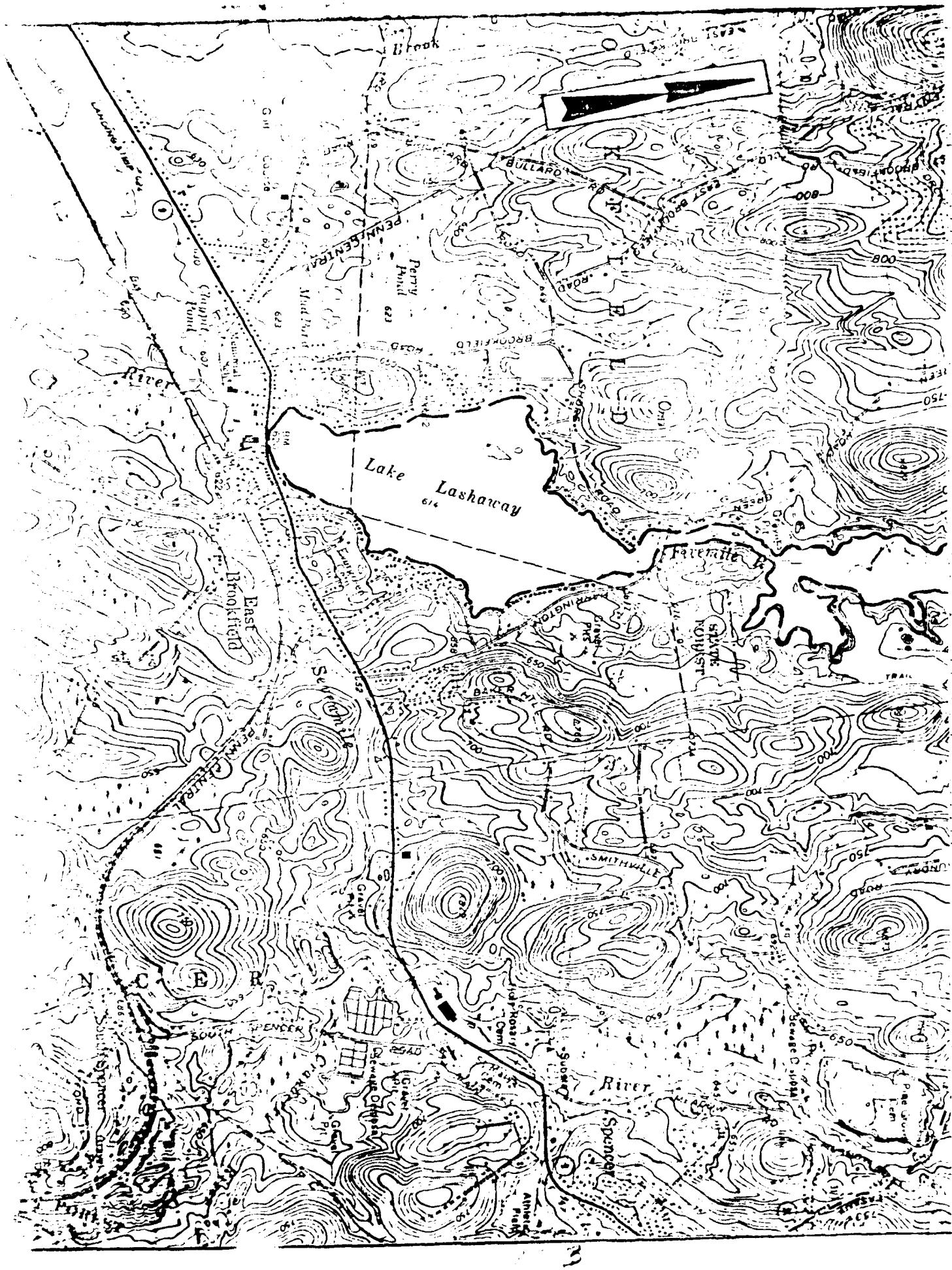

HORSEPOND
Bowkers Hill
Dwane Pond
Newell Hill
Bell Hill
Horse Pond Dam
River
North Brookfield
Walnut Hill
Hogh Hill

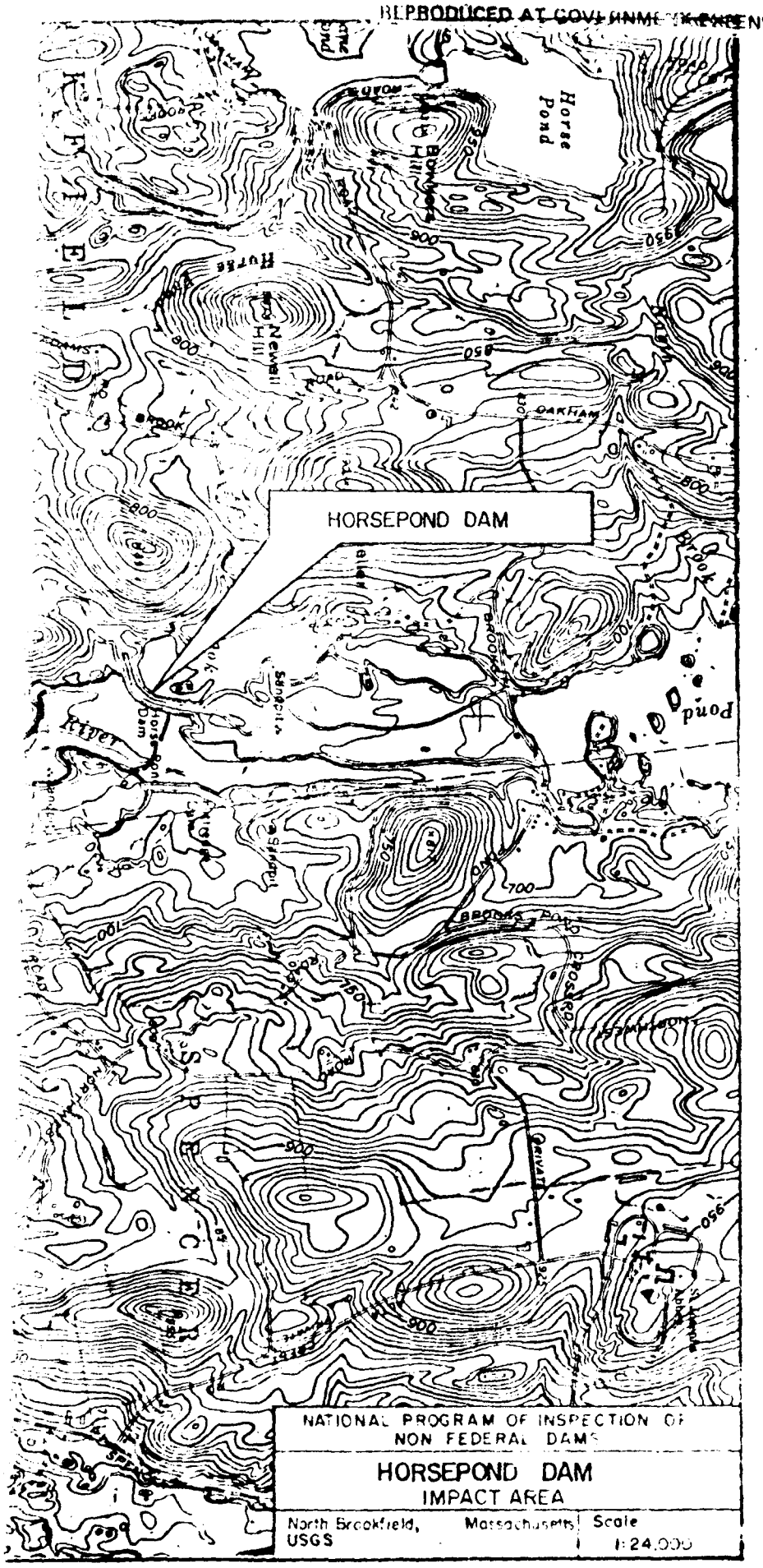

Curley Pond
Horse Pond
Brooks Pond
NORTH BROOKFIELD
NATIONAL PROGRAM OF IN
NON FEDERAL D
HORSEPOND D
DRAINAGE ARE
North Brookfield, Massachusetts
USGS Quad North Brookfield, M

NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

HORSEPOND DAM
DRAINAGE AREA

North Brookfield, Massachusetts USGS Quad North Brookfield, Ma.	Scale 1: 24,000





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JOB HORSE PD. DAM
SHEET NO. 1 OF 18
CALCULATED BY GUS S. DATE 23 MAR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

TEST FLOOD ANALYSIS

Choose spillway design flood (SDF)

Classification - Size: Intermediate
Hazard: Significant

Use probable maximum flood (PMF) as SDF

From PMF guide curves for rolling terrain:

For drainage area = 4.1 mi^2

Q_{p_1} = 1910 csm

$Q_{p_1} = 4.1\ mi^2 (1910\ cfs/mi^2) = \underline{\underline{7831}}\ cfs$

Surcharge Storage Routing

$$Q_{p_2} = Q_{p_1} - Q_{p_1}\left(\frac{STOR}{19}\right)$$

* SEE NOTE, SH 2/18.

ELEVATION ABOVE NGVD (FT.)	SURCHARGE* STORAGE (AC FT)	STOR (IN)	Q_{p_2} (CFS)
665	180	1.2	7336
660	380	1.7	7130
665	660	3.0	6595
670	970	4.4	6018
675	1339	6.1	5317
678.7	1700	7.8	4616
680	1830	8.4	4369

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JOB HORSE RD. DAM
SHEET NO. 2 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

TEST FLOOD ANALYSIS (cont.)

*NOTE: surcharge storage = total storage − 70 ac-ft, where 70 ac-ft = normal storage at principal spillway permanent stoplog crest el. 647.3.

Develop discharge rating curve at dam ...

▽Principal spillway is 30" Ø RCP

Emergency spillway is a 100 ft-long, 50 ft wide earth embankment, sideslopes of 3H:1V; use weir equation, $Q = CLH^{3/2}$ w/ C = 2.8.

Dam embankment itself is 1900 feet long and 14 feet wide at the crest, use weir equation w/ C = 3.0

ELEVATION ABOVE NGVD (FT)	Q ▽ PRIN. SP'W'Y (CFS)	Q EMER. SP'W'Y (CFS)	Q EMB'K'T (CFS)	Q TOTAL (CFS)
655.0	60			60
660.0	74			74
665.0	85			85
675.0	105			105
675.8	106	406		512
677.0	108	1631		1739
678.7	111	4200		4311
679.0	112	4749	937	5798
679.5	113	5707	4079	9899
680.0	114	6731	8449	15294

▽ Discharge data supplied by SCS, Amherst, Mass.

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JOB HORSE PD. DAM
SHEET NO. 3 OF 18
CALCULATED BY GWS DATE 25 MAR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

TEST FLOOD ANALYSIS (cont.)

See SH 5/18 for surcharge storage routing curve and discharge rating curve for dam.

From curve intersection:

Outflow, Q = 4600 cfs

@ elevation 678.75

The test flood event would result in a water surface elevation approximately level with top of dam.

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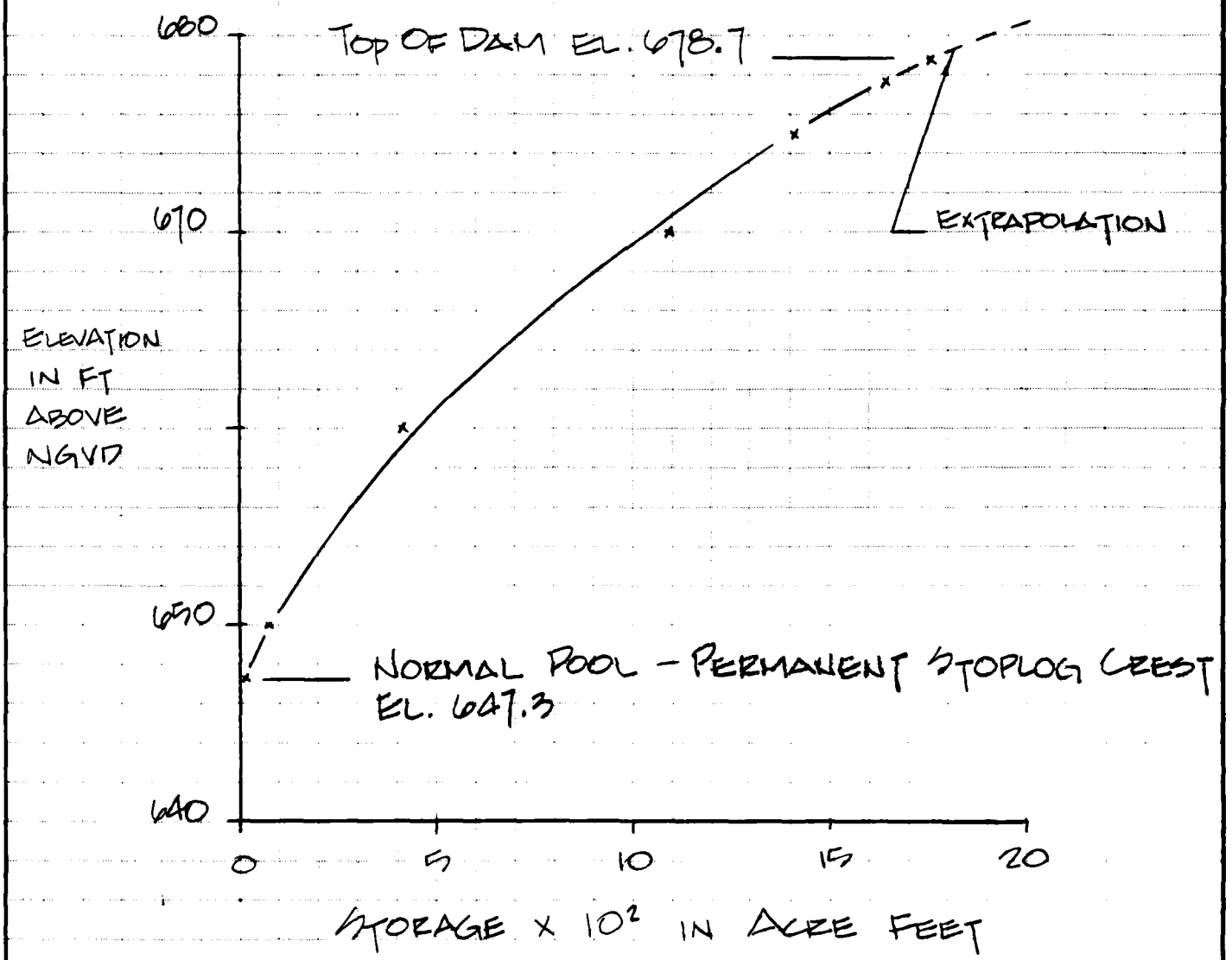
JOB HORSE PD. DAM
SHEET NO. 4 OF 18
CALCULATED BY GILS S. DATE 24 MAR 81
CHECKED BY U. SHMUTZ DATE APRIL 27, 1981
SCALE

ELEVATION Vs. STORAGE*



* SURCHARGE STORAGE = TOTAL STORAGE - 70 AC-FT

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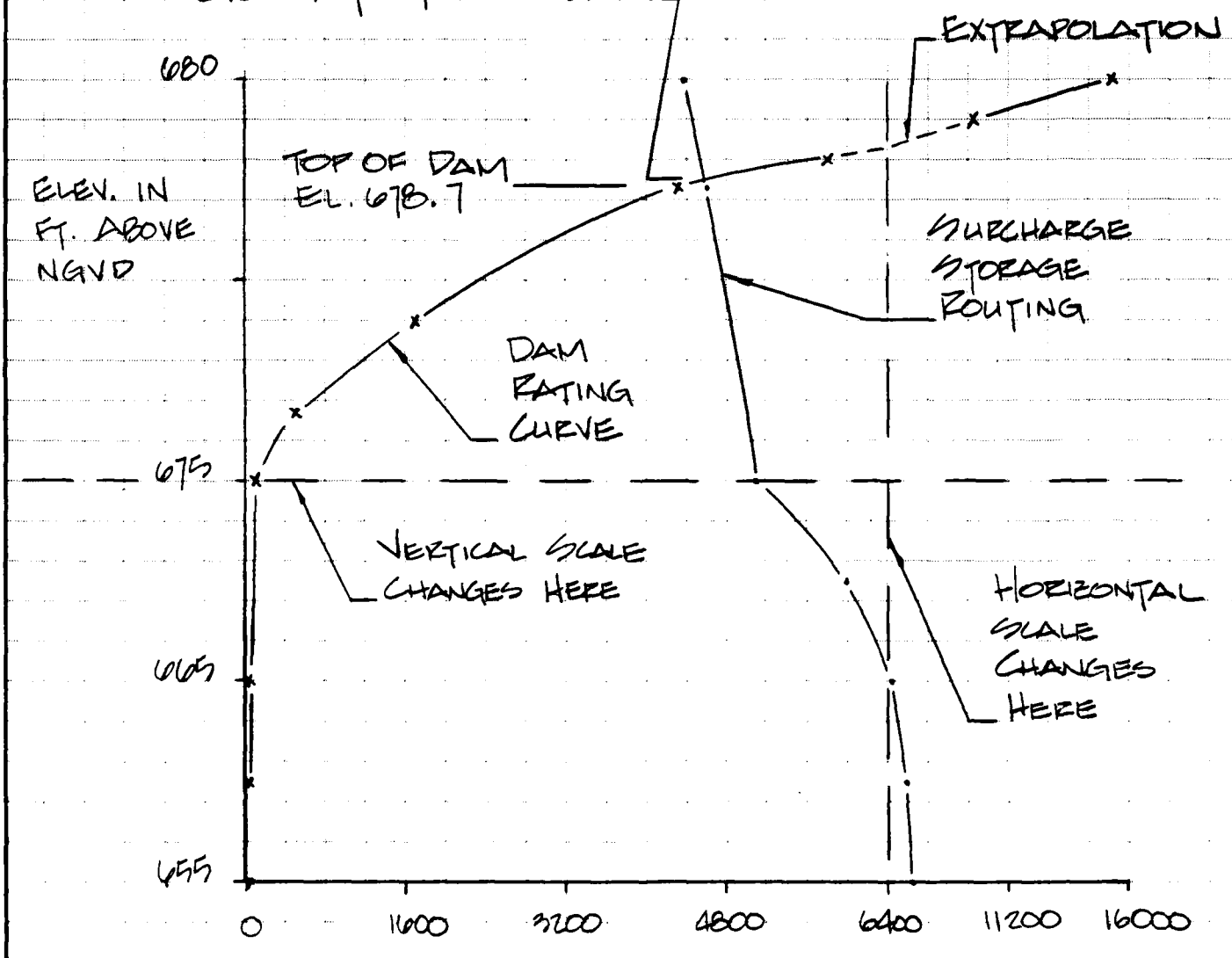
JOB HORSE RD. DAM
SHEET NO. 5 OF 18
CALCULATED BY GLISS. DATE 24 MARCH
CHECKED BY W. SIMEVITE DATE APRIL 27, 1981
SCALE

ELEVATION VS. DISCHARGE

CURVE INTERSECTION @ EL. 678.75
Q = 4600 CFS
WATER SURFACE WOULD BE APPROXIMATELY LEVEL WITH TOP OF DAM



DISCHARGE IN CFS

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JOB HORSE PD. DAM
SHEET NO. 6 OF 18
CALCULATED BY GLS S. DATE 25 MAR 81
CHECKED BY H S SHAFFER DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS

Compute breach outflow, Q_{p_1}

$$Q_{p_1} = 8/27\ W_b \sqrt{g}\ H_o^{3/2}$$

Use $W_b = 300$ ft. $H_o = 30$ ft.

$$Q_{p_1} = 8/27\,(300)\sqrt{32.2}\,(30)^{3/2} = 82881, \text{ say } \underline{\underline{83000}}^{*} \text{ cfs}$$

REACH 1

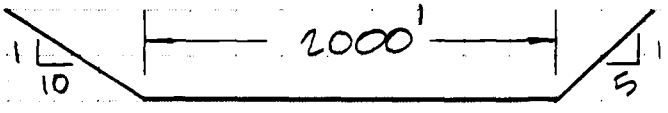
Downstream limit is 700 feet east of downstream toe of dam.

Length = 700 ft. $S = 0.003$

Composite "n" value = 0.07

Develop discharge rating curve for reach using Manning equation:

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



TYP. X-SECT. LKG UPSTREAM

* Disregard antecedent flow from emergency spillway of 4311 cfs.

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JOB HORSE PD. DAM
SHEET NO. 7 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 1 (cont.)

STAGE ABOVE CHANNEL INV. (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	4030	2030	7421
4	8120	2061	23613
6	12270	2091	46534
8	16480	2121	75363
9	18608	2136	91848

See rating curve, SH 18/18.

$Q_{P_1} = 83000$ cfs stage = 8.5 ft.

$V_1 = \frac{\text{area (length)}}{43560} = \frac{17544(700)}{43560} = 281.9$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 83000\left(1 - \frac{281.9}{1770}\right) = 69781$ cfs

stage = 7.6 ft $V_2 = \frac{151633(700)}{43560} = 251.2$ ac-ft.

$V_{AVG} = 266.6$ ac-ft.

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 83000\left(1 - \frac{266.6}{1770}\right) = 70498$ cfs.

stage = 7.7 ft.

No damage would be expected along this reach.

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JOB HORSE PD. DAM
SHEET NO. 8 OF 18
CALCULATED BY GUS S. DATE 25MAR81
CHECKED BY H. SHEWITT DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

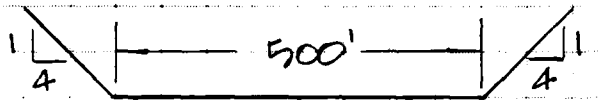
REACH 2

Length = 1900 ft. $S = 0.003$

Composite "n" value = 0.07

Develop discharge rating curve for reach using Manning equation:

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



TYP. X-SECTION

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	1016	516	1861
6	3144	549	11733
9	4824	574	23247
12	6576	599	37814
15	8400	624	54039
18	10296	648	73861

See rating curve, SH 18/18.

$Q_{P_1} = 70498$ cfs stage = 17.3 ft.

$V_1 = \frac{\text{area}(\text{length})}{43560} = \frac{9847(1900)}{43560} = 429.5$ ac-ft $< \frac{1770}{2}$ ∴ OK

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JOB HORSE PD. DAM
SHEET NO. 9 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H. SHAVITZ DATE March 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 2 (cont.)

$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{3}\right) = 70498\left(1 - \frac{429.5}{1770}\right) = 53391$ cfs

stage = 14.9 ft $\quad V_2 = \frac{8338(1900)}{43560} = 363.7$ ac-ft

$V_{AVG} = 396.6$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{3}\right) = 70498\left(1 - \frac{396.6}{1770}\right) = 54702$ cfs

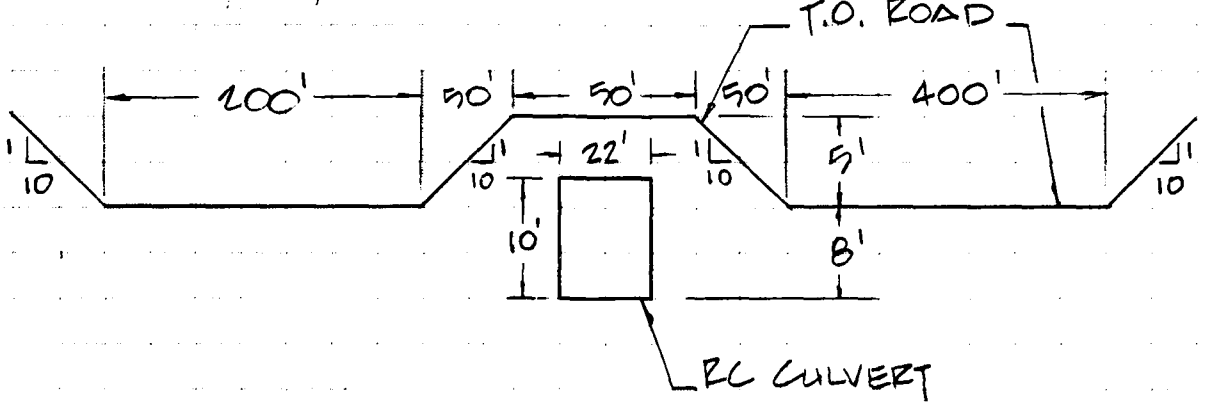
stage = 15.1 ft.

No damage would be expected along Reach 2.

REACH 3

Downstream limit is Spencer Road Bridge.

Develop rating curve at bridge. Use FHA-HEC 5 charts to rate culvert and weir equation, $Q = CLH^{3/2}$, w/ C = 2.5 for flow over road.



ELEVATION LOOKING DOWNSTREAM

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JOB HORSE RD. DAM
SHEET NO. 10 OF 18
CALCULATED BY GUS G. DATE 25 MAR 81
CHECKED BY H. SILVERITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

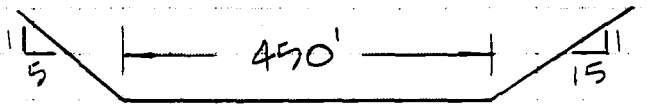
REACH 3 (cont.)

STAGE ABOVE CULVERT INV (FT)	Q CULVERT (CFS)	Q WEIR (CFS)	Q TOTAL (CFS)
4	475 *		475
9	1515 *	1550	3065
12	2200	136000	138800
15	2860	25010	27870
17	3300	353365	38665
19	3520	49327	52847

See rating curve, SH 18/18.

$Q_{P_1} = 54702$ cfs

stage = 19.4 ft.



TYP. X-SECT. L'K'G UPSTREAM FROM SPENCER RD.

Length = 1800 ft.

$V_1 = \frac{\text{area (length)}}{43560}$

$V_1 = \frac{12494(1800)}{43560} = 516.3$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{5}\right) = 54702\left(1 - \frac{516.3}{1770}\right) = 38746$ cfs

stage = 17.0 ft. $V_2 = \frac{9095(1800)}{43560} = 375.8$ ac-ft

$V_{AVG} = 446.1$ ac-ft

* Obtained using Manning equation w/ $n = 0.04$, $s = 0.005$

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JOB HORSE PD. DAM
SHEET NO 11 OF 18
CALCULATED BY GUS S. DATE 25MAR81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 3 (cont.)

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{5}\right) = 54702\left(1 - \frac{446.1}{1770}\right) = 40915$ cfs

stage = 17.3 ft stage increase = 8 ft.

Spencer Road would be overtopped by 9.3 feet at its lowest point. Appreciable damage to the road surface could occur. Loss of life is a remote possibility.

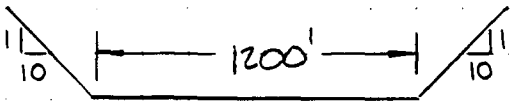
REACH 4

Length = 2500 ft. $S = 0.0025$

Composite "n" value = 0.06

Develop rating curve for reach using Manning equation:

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



TYP. X-SECTION

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	2440	1240	4757
4	4960	1280	15184
6	7560	1321	30038
8	10240	1361	48827

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JOB HORSE PD. DAM
SHEET NO. 12 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H. SHAPIRO DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 4 (cont.)

See rating curve, SH 18/18.

$Q_{P_1} = 40915$ cfs stage = 7.2 ft

$V_1 = \frac{\text{area}}{435160}(\text{length}) = \frac{91538}{435160}(2500) = 525.6$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2\,(\text{TRIAL})} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 40915\left(1 - \frac{525.6}{1770}\right) = 28765$ cfs

stage = 5.8 ft. $V_2 = \frac{7296}{435160}(2500) = 418.7$ ac-ft

$V_{AVG} = 472.2$ ac-ft.

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 40915\left(1 - \frac{472.2}{1770}\right) = \underline{\underline{30000}}$ cfs

stage = 6.0 ft.

No damage would be expected along Reach 4.

REACH 5

Downstream limit is Hines Bridge Road.

Hines Bridge Road would pose little obstruction to a breach flow of 30000 cfs. Therefore, this crossing is treated as an open channel using the Manning equation:

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

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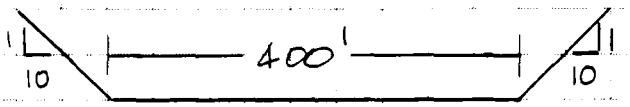
JOB HORSE PD. DAM
SHEET NO. 13 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H SHMUTZ DATE APRIL 2, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 5 (cont.)

Length = 2200 ft.



TYP. X-SECTION

$S = 0.001$

Composite "n" value = 0.07

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
3	1290	460	1725
6	2760	521	5644
9	4410	581	11447
12	6240	641	19143
14	7560	681	25315
16	8960	722	32317

See rating curve, SH 18/18.

$Q_{P_1} = 30000$ cfs stage = 15.4 ft.

$V_1 = \frac{\text{area}(\text{length})}{43560} = \frac{8532(2200)}{43560} = 430.9$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 30000\left(1 - \frac{430.9}{1770}\right) = 22697$ cfs

stage = 13.0 ft. $V_2 = \frac{6890(2200)}{43560} = 348.0$ ac-ft

$V_{AVG} = 389.5$ ac-ft

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JOB HORSE PD. DAM
SHEET NO. 14 OF 18
CALCULATED BY GUS G. DATE 25 MAR 81
CHECKED BY H. SHAUTZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 5 (cont.)

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{5}\right) = 30000\left(1 - \frac{389.5}{1770}\right) = \underline{23398}\ cfs$$

stage = 13.4 ft stage increase = 8.1 ft.

Hines Bridge Road would be overtopped by more than ten feet of water. Appreciable damage to the road surface could result. Loss of life is a remote possibility.

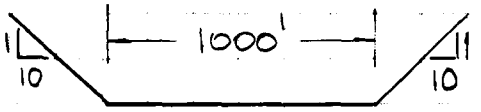
REACH 6

Length = 3000 ft. $S = 0.001$

Composite "n" value = 0.06

Develop rating curve for reach using Manning equation:

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



TYP. X-SECTION

See rating curve, SH 18/18.

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	2040	1040	2509
4	4160	1080	8024
6	6360	1121	15880
7	7490	1141	20611
8	8640	1161	25849

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JOB HORSE PD. DAM
SHEET NO. 15 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H. STRAUITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 6 (cont.)

Q_{P_1} = 23398 cfs stage = 7.8 ft.

$V_1 = \frac{\text{area}(\text{length})}{43560} = \frac{8408(3000)}{43560} = 579.1$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2\,(TRIAL)} = Q_{P_1}(1 - \frac{V_1}{S}) = 23398(1 - \frac{579.1}{1770}) = 15743$ cfs

stage = 6.0 ft. $V_2 = \frac{6360(3000)}{43560} = 438.0$ ac-ft

V_{AVG} = 508.6 ac-ft

$Q_{P_2} = Q_{P_1}(1 - \frac{V_{AVG}}{S}) = 23398(1 - \frac{508.6}{1770}) = 16675$ cfs

stage = 6.2 ft.

No damage would be expected along Reach 6.

REACH 7

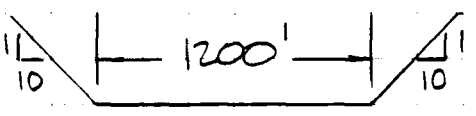
Downstream limit is upstream end of Lake Lashaway.

Length = 1000 ft. S = 0.001

Composite "n" value = 0.06

Develop rating curve for reach using Manning equation:

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



TYP. X-SECTION

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JOB HORSE FD. DAM
SHEET NO. 16 OF 18
CALCULATED BY GWS DATE 25 MAR 81
CHECKED BY H. SHAEVITZ DATE MARCH 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 7 (cont.)

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	2440	1240	3008
4	49160	1280	96057
5	62570	1300	13974
6	75796	1321	19136

see rating curve, SH 18/18.

Q_{P_1} = 16675 cfs stage = 5.4 ft.

$V_1 = \frac{\text{area (length)}}{43560} = \frac{6772(1000)}{43560} = 155.5$ ac-ft $< \frac{1770}{2}$ ∴ OK

$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1-\frac{V_1}{5}\right) = 16675\left(1-\frac{155.5}{1770}\right) = 15210$ cfs

stage = 5.2 ft. $V_2 = \frac{(6510)(1000)}{43560} = 149.4$ ac-ft

$V_{AVG} = 152.5$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1-\frac{V_{AVG}}{5}\right) = 16675\left(1-\frac{152.5}{1770}\right) = \underline{15238}$ cfs.

stage = 5.2 ft.

No damage would be expected along Reach 7.

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JOB HORSE PD. DAM
SHEET NO. 17 OF 18
CALCULATED BY GUS S. DATE 25 MAR 81
CHECKED BY H SHAEVITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 8 LAKE LASHAWAY

Lake Lashaway surface area = 285 acres*. Half of the total storage at Horse Pd. (1770/2 = 885 ac-ft) stored at Lake Lashaway would result in a surcharge of less than 3 feet on the lake.

The dam at Lake Lashaway also serves as part of the highway embankment for State Route 9. The crest of the spillway is located about 15 feet below the top of the road. Also, water would not exit the lake at any point other than the spillway should the surcharge stage reach 15 feet. Therefore, the large surcharge storage capacity of Lake Lashaway and the swampy reaches of the East Brookfield River downstream of the lake preclude the need for further extension of the breach analysis.

Approximately fifteen structures along the shores of Lake Lashaway would be subject to less than 2 feet of flooding in the event of a breach.

Horse Pond Dam is classified as Significant Hazard.

* At normal pool.

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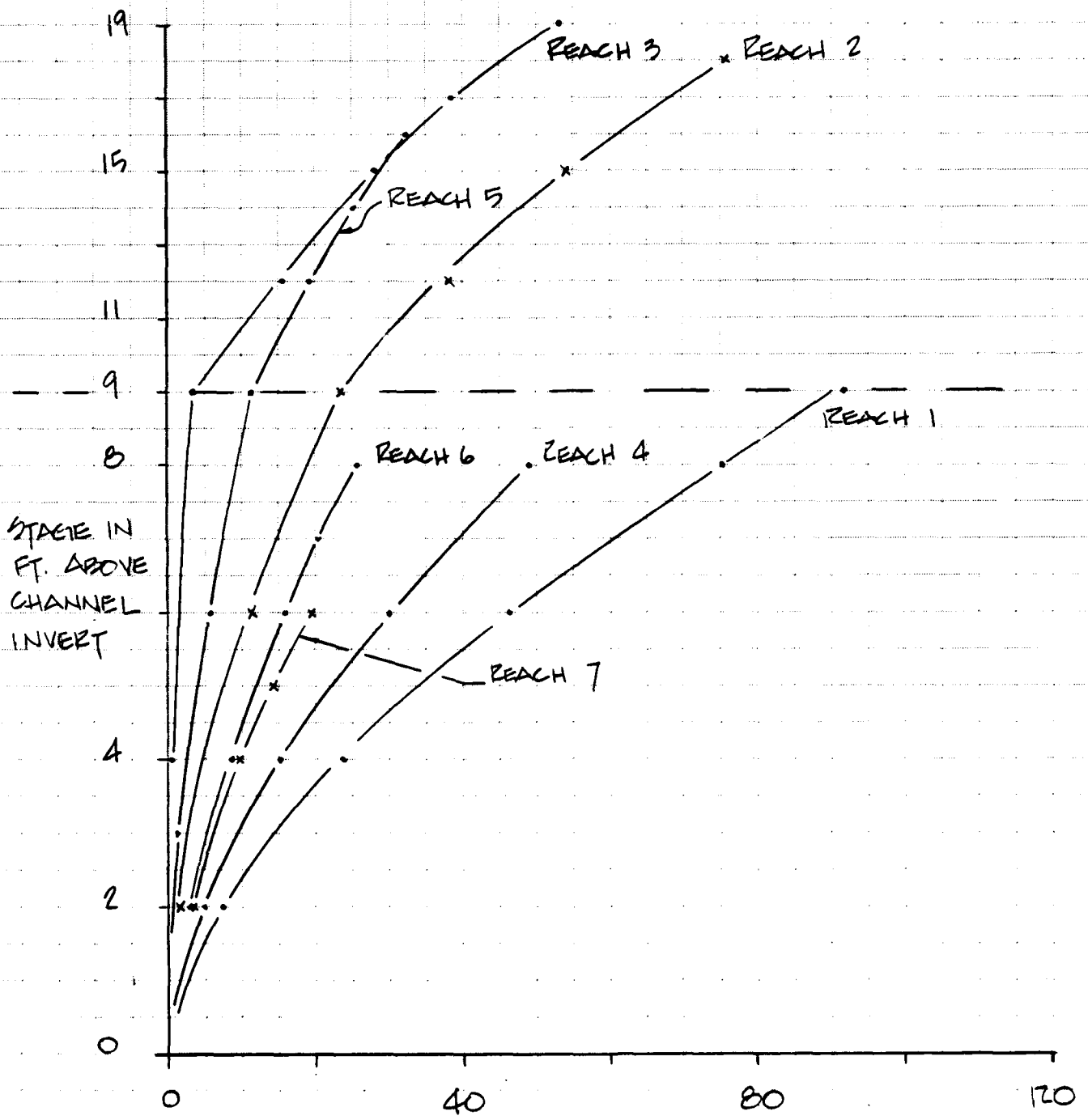
JOB HORSE PD. DAM
SHEET NO. 18 OF 18
CALCULATED BY GUS S. DATE 20 MAR 81
CHECKED BY H. SHAEITZ DATE APRIL 2, 1981
SCALE

BREACH ANALYSIS - REACH RATING CURVES



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

DTIC