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STORRS POND DAM NH 00050 NHWRB 108.07

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## CONNECTICUT RIVER BASIN HANOVER, NEW HAMPSHIRE



PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



# LETTER OF TRANSMITTAL

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FROM THE CORPS OF ENGINEERS TO THE STATE TO BE SUPPLIED BY THE CORPS OF ENGINEERS

#### NATIONAL DAM INSPECTION PROGRAM PHASE I - INSPECTION REPORT BRIEF ASSESSMENT

Identification No.: 00050

Name of Dam: Storrs Pond Dam

Town:

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Hanover

County and State: Grafton, New Hampshire

Stream: Camp Brook

Date of Inspection: October 26, 1979

- Storrs Pond Dam is an earthen embankment structure with an overall length of 140 fast. Maximum height as measured from the crest of the dam to the streambed is 33.75 feet. Top width is 10 feet, and the upstream and downstream embankments are on a 2 1/2 horizontal to 1 vertical slope. The spillway is a circular drop inlet type, with an inside diameter of 10.0 feet and is located near the center of the dam. The discharge tunnel exits on the downstream toe of the dam, and has overall dimensions of 10 feet by 10 feet, with the invert of a circular shape. The outlet works are located at the invert of the left side of the spillway riser. The 2.8 foot wide octagonal opening is controlled by a 3.0 foot diameter gate. The gate is operated by a hand crank at the crest of the riser. There is no means of access to the gate operator from the dam. The dam was constructed in 1934. The impoundmment is used for recreation. A set of drawings of the dam are available, however, no design calculations or construction data were revealed.

The visual inspection revealed that the dam is in fair condition. The visual inspection revealed deterioration of the concrete surface of the spillway and the invert of the spillway discharge tunnel, rotted stumps on the dam, brush and wet vegetation on the crest and slopes, and debris in the downstream channel.

Based on a maximum storage of 520 acre-feet and a height of 34 feet, Storrs Pond Dam falls within the small size classification. The dam's hazard classification has been established as significant based on the potential overtopping of Route 10 by the breach flood wave. Based on the small size of the dam and its significant hazard classification and in accordance with Corps of Engineers Guidelines, the test flood inflow should be of a magnitude ranging from a 100 year frequency flood to 1/2 the Probable Maximum Flood (PMF). One half the PMF was used for the test flood inflow, which is 2940 cfs. The routed test flood outflow of 2420 cfs overtops the dam by approximately 1.8 feet. With the water surface at the top of dam the spillway capacity is approximately 1244 cfs (about 51 percent of the routed test flood outflow).

It is recommended that the owner engage a qualified, registered, professional engineer to (1) design an acceptable means of removing the tree roots and backfilling the voids (2) design adequate slope protection for the upstream slope of the dam (3) investigate spillway adequacy and (4) design repairs for the invert of the spillway discharge tunnel. Remedial measures include development of a downstream warning system and removal of brush and cut vegetation from the crest and slopes of the dam.

The recommendations and remedial measures are described in Section 7 and should be addressed within 1 year after receipt of this Phase I - Inspection Report by the owner.



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Gordon H. Slaney, J.

Gordon H. Slaney, Jr., P.E. Project Engineer

HOWARD NEEDLES TAMMEN & BERGENDOFF Boston, Massachusetts This Phase I Inspection Report on Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the <u>Recommended Guidelines for Safety</u> <u>Inspection of Dams</u>, and with good engineering judgment and practice, and is hereby submitted for approval.

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

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

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SAUL COOPER, Member Chief, Water Control Branch Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR Chief, Engineering Division

THIS SHEET TO BE FURNISHED BY THE CORPS OF ENGINEERS

#### PREFACE

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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 investigations 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 be otherwise 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.

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## APPENDIXES

APPENDIX A - INSPECTION CHECKLIST APPENDIX B - ENGINEERING DATA APPENDIX C - PHOTOGRAPHS APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS





#### NATIONAL DAM INSPECTION PROGRAM PHASE I INSPECTION REPORT STORRS POND DAM

#### SECTION 1 PROJECT INFORMATION

#### 1.1 General

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a. <u>Authority</u>. 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. Howard, Needles, Tammen & Bergendoff 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 Howard, Needles, Tammen & Bergendoff under a letter of October 11, 1979 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-79-C-0060 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. Storrs Pond Dam is located along Camp Brook about 1,000 feet upstream of the Connecticut River in the Town of Hanover, New Hampshire. The dam is shown on U.S.G.S. Quadrangle, Hanover, Vermont-New Hampshire, with approximate coordinates N43°31'17", E72°15'35", Grafton County, New Hampshire. The location of the dam is shown on the preceding page. b. Description of Dam and Appurtenances. Storrs Pond Dam is an earthen embankment structure. Overall length is 140 feet. The maximum height as measured from the streambed to the crest of dam is 33.75 feet. The crest of the dam is 10 feet wide. The upstream and downstream embankments are on a 2 1/2 horizontal to 1 vertical slope. Riprap was placed on the upstream slope near the water line. The crest and downstream slope have a vegetative cover. There is a core wall varying in width from 1.5 to 2 feet constructed of concrete along the center of the dam. The dam is on a ledge foundation.

The spillway is a circular drop inlet located near the center of the dam, and is constructed of concrete. It has a 10 foot inside diameter and the concrete crest is 7.05 feet below the crest of the dam. The crest of the spillway is raised by about 1.5 feet with flashboards constructed of boiler plate and set with steel pins. The flashboards are considered permanent. The drop inlet discharges through a 10 foot square reinforced concrete tunnel through the dam and core wall. The tunnel has a circular shaped invert. The tunnel outlets at the downstream slope directly into the stream channel. The exit is protected by a concrete headwall. A pond drain gate 3.0 feet in diameter is located on the left side of the spillway and is operated by a long stem and hand crank. The opening in the spillway riser structure is octagonal in shape and 2.8 feet across.

Figure 1 located in Appendix B, shows a plan of the dam and its appurtenant structures. Photographs of each structure are shown in Appendix C.

c. <u>Size Classification</u>. Small (hydraulic height - 34 feet, storage - 520 acre-feet) classification based on the height being less than 40 feet and the storage being less than 1,000 acre-feet as given in Recommended Guidelines for Safety Inspection of Dams.

d. <u>Hazard Classification</u>. The potential for damage posed by this dam is classified as significant. Failure of the dam with the water level at the top of dam would result in a flood wave about 4.5 feet high over the Route 10 highway embankment located about 1,000 feet downstream of the dam.

e. <u>Ownership</u>. This dam is owned by the Hanover Improvement Society, P.O. Box 106, Hanover, New Hampshire 03755.

f. Operator. This dam is operated by the Hanover Improvement Society, P.O. Box 106, Hanover, New Hampshire 03755. Telephone No. 603-643-2408.

g. <u>Purpose of Dam</u>. The impoundment is used for recreation.

h. Design and Construction History. This dam constructed in 1934 as a Works Progress Administration project. There is no record of any major modifications to the dam since construction.

i. Normal Operating Procedures. The normal water level is at the crest of the permanent flashboards on the spillway. No data was available regarding any regular operating procedures or how often the site was visited.

#### 1.3 Pertinent Data

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a. Drainage Area. The area tributary to Storrs Pond consists of 2.74 square miles of wooded, mountainous terrain. There is little development as 68 percent of the watershed is part of a water supply catchment area. There are two reservoirs upstream of Storrs Pond which have a total 1.86 square miles of tributary area. Maximum elevation in the drainage basin is 1,280 feet NGVD. There are five peaks over 1,000 feet in the area. Normal pond levels is at about elevation 417.1.

The reservoir is long and narrow being about 3,000 feet long and an average of 230 feet wide. The banks at the downstream end are very steep and wooded. At the upstream end there is a recreation area and camp ground.

#### b. Discharge at Dam Site.

(1) The outlet works consist of a 3 foot diameter gate set at an invert of 392.14. The gate is located on the left side of the drop inlet spillway riser. It is operated by a handwheel at the crest of the drop inlet. When the water surface is at the crest of the permanent flashboards, the maximum capacity of the outlet is about 160 cfs.

(2) There are no records of maximum discharge at the site.

(3) The spillway capacity with the water surface the top of dam, elevation 422.69, would be about 1,244 cfs.

(4) The spillway capacity with the water surface at the test flood elevation of 424.51 would be about 1,360 cfs.

(5) The total project discharge at the test flood elevation of 424.51 is approximately 2,420 cfs.

- c. Elevation (feet above NGVD)
- (1) Streambed at centerline of dam 388.94
- (2) Maximum tailwater unknown

(3) Upstream invert of outlet works - 392.14 (4) Normal pool - 417.14 (5) Full flood control pool - N/A (6) Spillway crest (permanent spillway) - 415.64 (permanent flashboards) - 417.14 (7) Design surcharge - N/A (8) Top Dam - 422.69 (9) Test Flood Surcharge - 424.5 d. Reservoir (miles) (1)Length of Maximum Pool - 0.59 (2) Length of Normal Pool - 0.57 (3) Length of Flood Control Pool - N/A e. Storage (gross acre-feet) (1)Normal Pool - 350 (2) Flood Control Pool - N/A (3) Spillway Crest Pool - 300 (4)Top of Dam - 520 **Reservoir Surface (acres)** f. (1)Normal Pool - 34 (2) Flood Control Pool - N/A (3) Spillway Crest - 34 (4) Test Flood Pool - 34 (5) Top Dam - 34 g. Dam (1)Type - earth (2) Length - 140 feet

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(3) Height - 33.75 feet

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(4) Top Width - 10 feet

(5) Side Slopes - upstream and downstream 2 1/2 horizontal to 1 vertical

- (5) Zoning unknown
- (7) Impervious core conrete
- (8) Cutoff unknown
- (9) Grout Curtain unknown
- (10) Other unknown
- h. Diversion and Regulating Tunnel

See Section j below.

i. Spillway

(1) Type - circular drop inlet

(2) Length of Weir - 10 feet diameter inside. 40.8 feet long around crest of flashboards

(3) Crest Elevation - 415.64 original crest417.14 permanent flashboards

- (4) Gates none
- (5) Upstream Channel none

(6) Downstream Channel - The spillway outlet tunnel discharges to a natural channel immediately downstream of the dam. The channel is in a steep narrow valley for a distance of about 500 feet.

j. <u>Regulating Outlets</u> - The outlet works consist of a 3 foot diameter gate set at an invert of 392.14. The gate is located on the left side of the drop inlet spillway riser. It is operated by a handwheel at the crest of the drop inlet. When the water surface is at the crest of the permanent flashboards, the maximum capacity of the outlet is about 150 cfs.

#### SECTION 2 ENGINEERING DATA

#### 2.1 Design

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A set of drawings (three sheets) are available for Storrs Pond Dam. However, no design calculations or specifications were made available. The dam was constructed in 1934. There is no record of any major modifications to the dam since that time.

#### 2.2 Construction

No construction records are available for use in evaluating the dam.

## 2.3 Operation

No engineering operational data were disclosed.

## 2.4 Evaluation

a. <u>Availability</u>. There is no design engineering data available other than the set of drawings noted in Paragraph 2-1. These plans are available at the New Hampshire Water Resources Board, Concord, New Hampshire.

b. <u>Adequacy</u>. The lack of in-depth 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. <u>Validity</u>. The field inspection indicated that the external features of Storrs Pond Dam substantially agree with those shown on the available plans.

#### SECTION 3 VISUAL INSPECTION

#### 3.1 Findings

1

a. <u>General</u>. The field inspection of Storrs Pond Dam was made on October 26, 1979. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. Inspection checklists, completed during the inspection, are included in Appendix A. At the time of inspection, the water level was approximately 9.3 feet below the concrete crest of the spillway. The upstream face of the dam could only be inspected above this level.

b. Dam. Visual inspection of the dam indicated that it is in fair condition. The dam consists of an earth embankment about 140 feet long and 34 feet high.

#### Upstream Slope

The upstream slope is inclined at 2.5 horizontal to 1 vertical. At the time of inspection, the reservoir had been lowered to facilitate repairs to the concrete drop inlet structure. The upstream slope is shown in Photo No. 3. Note the poor riprap protection on the slope and the area of the slope missing riprap shown in the background of the photo.

Photo No. 7 shows a large dead tree stump located about 1 to 2 feet below the dam crest.

A small excavation on the upstream face below the normal waterline elevation revealed the near surface soils to be silty fine sand and sandy silt. These types of soils are easily eroded and require adequate riprap slope protection to prevent erosion and sloughing.

#### Crest

The crest of the dam is about 16 feet wide and, as shown in Photo No. 4, has an uneven topography. The high and low points varied between one and two feet. It could not be determined whether the variances is above or below the design crest elevation. No significant misalignment of the crest was observed and there was no evidence of instability and sliding of the slopes that would account for the uneven topography of the dam crest.

#### Downstream Slope

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The downstream slope is inclined at 2.5 horizontal to l vertical. The slope, which is shown in Photo No. 5, has been overgrown with brush and trees. At the time of inspection, the trees had been cut, but no stumps had been removed. Photo No. 6 shows a tree stump located a few feet below the dam crest.

c. Appurtenant Structures. Visual inspection of the concrete circular drop inlet spillway, spillway tunnel and pond drain system did not reveal any immediate stability problems. The concrete structure of the circular spillway appeared to be in generally fair condition. However, there was considerable concrete deterioration in the form of cracks and spalling. Repair patches were visible.

The circular spillway structure, as seen in Photo Nos. 8, 9 & 10, consists of three elements: a circular inlet overflow control, a vertical transition (cylindrical structure) and outlet tunnel. The circular spillway structure has provision for crest adjustment which was in place. The spillway structure is located at the toe of the embankment near the center of the Visual inspection revealed that the concrete spillway dam. structure has extensive decay on the top and the side surface. (Photo Nos. 9 & 10). The gate operating mechanism appeared to be operational, as the reservoir level was recently lowered. There was no means of access to the gate operating mechanism. There were remains of supports for a catwalk from the dam to the gate wheel as seen in Photo No. 11. The outlet gate, as seen in Photo No. 13, was subject to some minor leakage but otherwise appeared to be in fair condition.

The outlet tunnel consists of a concrete box structure, size and location of which are shown in Figure 1 in Appendix B. Visual inspection revealed that the bottom slab of spillway tunnel is badly deteriorated. Heavy concrete erosion is concentrated at the center of the tunnel slab. In a few locations the slab erosion is extended to tunnel walls. Cracks and spalling were noted on both walls. There is also evidence of efflorescence, a whitish crystalline deposit on the concrete surface, mostly at the concrete cracks shown in Photo Nos 12 & 14.

The concrete retaining walls at the end of the discharge tunnel, Photo Nos. 15 & 16, are badly deteriorated in the form of cracks and spalling. The left wall Photo No. 17 is separated from the tunnel structure. The wall has moved horizontally approximately 2 inches downstream from its original position. d. Reservoir Area. The reservoir is long and narrow. The downstream end of the pond has very steep banks, up to 60 feet high. The banks are heavily wooded and there are many fallen troes along the shoreline. The reservoir level had recently been lowered to about 9 feet below its normal level.

e. <u>Downstream Channel</u>. The channel downstream of the dam is about 12 feet wide. Just downstream of the dam there is some debris in the channel and overhanging trees as seen in Photo No. 18. For about 500 feet the valley section is about 50 feet wide with high steep banks, which are heavily wooded. Further downstream the channel opens up to an area which has ponded due to the Route 10 highway embankment. The culvert under Route 10 was submerged by the tailwater from the Connecticut River and could not be seen.

#### 3.2 Evaluation

Visual examination indicates that the dam is in fair condition. Visual examination revealed the following:

(a) Deterioration of concrete on the spillway and the floor of the discharge tunnel.

(b) No easy means of access to the outlet gate mechanical operator.

(c) Loss of rip-rap protection on the upstream face of the dam.

(d) Several large stumps on the dam.

(e) Brush and cut vegetation on the crest and downstream face of the dam.

(f) Debris in the channel immediately downstream of the dam.

(g) Downstream movement of the left wingwall of the spillway discharge tunnel.

(h) Many fallen trees along the reservoir shoreline.

(i) The crest of the dam was uneven.

#### SECTION 4 OPERATIONAL PROCEDURES

#### 4.1 Procedure

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Storrs Pond Dam is used for recreation. The normal water level is at the crest of the permanent flashboards on the spillway. The 3 foot diameter outlet is usually closed.

#### 4.2 Maintenance of Dam

There is no regular maintenance procedure in effect. Repairs are made on an as needed basis.

#### 4.3 Maintenance of Operating Facilities

There is no regular maintenance procedure for the operating facilities. Repairs are made as needed.

## 4.4 Description of Warning Systems

There are no warning systems in effect for this facility.

#### 4.5 Evaluation

The current operation and maintenance procedures for this dam are inadequate to insure that problems encountered can be remedied within a reasonable period of time.

The owner should establish a continuing operational and maintenance procedure as well as establishing a warning system to follow in the event of emergency conditions.

#### SECTION 5 HYDROLOGY AND HYDRAULIC ANALYSIS

## 5.1 Evaluation of Features

a. <u>General</u>. Storrs Pond Dam is an earthen structure with an overall length of 140 feet. Maximum height is 33.75 feet as measured from the crest to the streambed. Top width is 10 feet. The upstream and downstream slopes are on a 2 1/2 horizontal to 1 vertical slope. The crest and downstream slope are protected with a vegetative cover. The spillway is a circular drop inlet type located near the center of the dam, with a total weir length of 40.8 feet at the crest of the permanent flashboards. The discharge tunnel is 10 feet square with a circular shaped invert, which discharges to the downstream toe of the dam. The outlet works consist of a 2.8 foot wide octagonal shaped opening on the base and left side of the spillway riser. There is a 3 foot diameter gate which is operated at the crest of the riser with a hand crank.

The reservoir is used for recreation. The dam is classified as small in size with a height of 34 feet and a maximum storage of 520 acre-feet.

b. <u>Design Data</u>. No original hydrologic or hydraulic design data were available.

c. Experience Data. There are no records of maximum discharge at the site.

d. <u>Visual Observations</u>. No evidence of damage to any portion of the project from overtopping was visible at the time of inspection.

Test Flood Analysis. No detailed design e. and operational information are available for this dam. The hydrologic evaluation was performed using information gathered by field investigation, watershed characteristics, and Probable Maximum Flood (PMF) curves prepared by the Corps of Engineers. In accordance with Corps of Engineer Guidelines the significant hazard classification and small size classification of this dam warrants a test flood magnitude ranging from a 100-year frequency flood to 1/2 the PMF. A test flood equal to 1/2 the PMF was used. A test flood inflow of 2,940 cfs is based on a watershed of 2.74 square miles in mountainous terrain. Inflow to Storrs Pond was calculated by adding the routed test flood outflow from Lower Reservoir, 1.86 square miles, to the runoff directly tributary to Storrs Pond.

The routed test flood outflow was determined in accordance with Corps of Engineers Guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharge, and the hydraulic characteristics of the dam. The circular opening drop inlet spillway was considered as a morning-glory type drop inlet. The permanent flashboards were used as a crest, and an inside radius of 6.5 feet was used for the weir calculations. It was assumed that the sharp edge of the crest would approximate the morning-glory spillway hydraulics. Control was at the crest for all flow conditions as the capacity of the discharge tunnel was always greater than the crest capacity. Discharge over the dam crest was computed as flow over a weir. The routing was started with the water surface at the crest of the flashboards. The routed test flood outflow was determined to be approximately 2,420 cfs. As the maximum capacity of the spillway is approximately 1,244 cfs (about 51 percent of the routed test flood outflow) the dam will be overtopped by 1.8 feet.

£. Dam Failure Analysis. The impact of failure of the dam was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs prepared by the Corps of The breach discharge was estimated with the water Engineers. surface at the crest of the dam and a breach width equal to 40 percent of the mid-height length of the dam. Prior to the breach of dam the downstream river stage would be about 6.4 feet with the spillway at a full capacity discharge of 1,244 cfs. Breach of dam would result in a flow of 10,100 cfs. The maximum spillway discharge and breach discharge are not added as it was assumed that the spillway discharge tunnel would be in the part of the dam that failed. The downstream damage was estimated using the Route 10 highway embankment as a control point. The embankment is located 1,000 feet downstream of the dam and about 15 feet above the streambed. The waterway opening under Route 10 is below the tailwater of the Connecticut River. It was not included in the stage-discharge calculations because of its tailwater condition and small size. Using an average valley cross-section in the reach between the dam and Route 10, a reach outflow of 8,960 cfs was computed. This discharge would result in a depth of flow at Route 10 of about 4.5 feet above the roadway surface over an estimated distance of 300 feet. There are no structures between the dam and Route 10. The downstream side of the Route 10 embankment is at the Connecticut River.

#### SECTION 6 STRUCTURAL STABILITY

## 6.1 Evaluation of Structural Stability

a. <u>Visual Observation</u>. The visual inspection of Storrs Pond Dam did not reveal any immediate stability problems however, the poor condition of the riprap and the large amount of tree stumps left on the dam could lead to future stability problems. In addition, further undermining of the walls of the spillway discharge tunnel by erosion could lead to instability of the tunnel.

b. Design and Construction Data. Design drawings dated 1934 indicate the embankment is founded on bedrock and has a reinforced concrete core wall. The core wall is 2 feet wide at the base and tapers uniformly to a width of 1.5 feet. The drawings do not indicate what type of soil was used to construct the embankment.

c. <u>Operating Records</u>. No operating records were made available.

d. Post-Construction Changes. There is no record of \_ny major modifications since construction.

e. <u>Seismic Stability</u>. The dam is located in Seismic Zone 2, and in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

#### SECTION 7 ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

#### 7.1 Dam Assessment

a. <u>Condition</u>. The visual inspection of Storrs Pond Dam indicates that the dam is in fair condition. The inspection revealed the following:

(1) Deterioration of concrete on the spillway and the floor of the discharge tunnel.

(2) No easy means of access to the outlet gate mechanical operator.

(3) Loss of rip-rap protection on the upstream face of the dam.

(4) Several large stumps on the dam.

(5) Brush and cut vegetation on the crest and downstream face of the dam.

(6) Debris in the channel immediately downstream of the dam.

(7) Downstream movement of the left wingwall of the spillway discharge tunnel.

(8) Many fallen trees along the reservoir shoreline, which could clog the spillway opening during high flows.

(9) The crest of the dam was uneven.

The hydraulic analysis reveals that the spillway cannot pass the routed test flood without overtopping the dam.

b. Adequacy of Information. The lack of in-depth 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. <u>Urgency</u>. This dam is in generally fair condition. The recommendations and remedial measures described in Sections 7.2 and 7.3 should be accomplished within 1 year after receipt of this Phase I Inspection Report by the owner.

d. <u>Necessity of Additional Investigation</u>. No additional investigation is needed to complete the Phase I inspection.

## 7.2 Recommendations

The owner should engage a qualified, registered professional engineer to:

- Design an acceptable means of removing the tree roots from the dam and backfilling the voids with appropriate material and
- (2) Design adequate slope protection for the upstream slope of the dam
- (3) Investigate spillway adequacy and consider any modifications if necessary
- (4) Design repairs for the concrete deterioration in the invert of the spillway discharge tunnel
- (5) Determine an elevation to which the crest of the dam should be evened out

## 7.3 Remedial Measures

- (a) Devise a means of access to the outlet gate operator and maintain the gate in operable condition.
- (b) Remove brush and cut vegetation on the crest and slopes of the dam.
- (c) Remove debris from the downstream channel.
- (d) Prepare a downstream warning system in the event of an emergency.
- (e) A technical inspection program should be initiated and continued on a yearly basis. Special attention should be given to the condition of the concrete of the spillway and movement of the left wingwall at the outlet of the discharge tunnel.
- (f) Establish a system such that the reservoir level can be monitored during periods of intense rainfall.
- (g) Remove fallen trees along the reservoir shoreline.

#### 7.4 Alternatives

There are no practical elternatives to the recommendations of Sections 7.2 and 7.3.

# APPENDIX A

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# INSPECTION CHECKLIST

VICUAL THE	A-1
VISUAL INS PARTY	ORGANIZATION
PROJECT Storrs Pond(Hanover)	DATE 10/26/79
	TIME 2:00 PM
	WEATHER Cloudy
	W.S. ELEV. 406.34 U.S DN.S
PARTY:	
1. D. LaGatta	6.
2. S. Mazur	7.
3. R. Yarsites	8.
4.	9.
5.	10.
PROJECT FEATURE	INSPECTED BY REMARKS
Dam	Dan LaGatta
2. <u>Spillway, Outlet</u> and	Stan Mazur
3. Downstream Channel	Robert Yarsites
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PERIODIC INSPECTIO	N CHECK LIST A-2	•
PROJECT_Storrs Pond Dam	DATE 10/26/79	
PROJECT FEATURE Embankment Dam	NAME	
DISCIPLINE Geotechnical Engineer	NAME D. P. LaGatta	
	CONDITION	
DAM EMBANKMENT	CONDITION	
Crest Elevation	422.69	
Current Pool Elevation	406.34	
Maximum Impoundment to Date	Unknown.	
Surface Crashs	None observed	•
SUITACE LIACKS	No o grant	•••
Pavement Condition	No pavement.	· · · · ·
Movement or Settlement of Crest	Crest is uneven.	
Lateral Movement		
Vertical Alignment	No misalignment of embankment	
Horizontal Alignment	observed.	
Condition at Abutment and at Concrete Structures	Condition at abutment good.	•
Indications of Movement of Structural Items on Slopes	Wing walls of outlet tunnel portal have moved outward about 2 inches.	
Trespassing on Slopes	Footpath on crest.	
Sloughing or Erosion of Slopes or	None observed.	
Rock Slope Protection - Riprap Failures	Poor. Riprap has been removed in some areas of slope.	
Unusual Movement or Cracking at or near Toes	None observed.	
Unusual Embankment or Downstream Seepage	None observed. Reservoir had been lowered to repair intake structure.	
Piping or Boils	None observed.	
Foundation Drainage Features	None.	
Toe Drains	None.	
Instrumentation System	None.	
Vegetation	Excessive vegetation on crest and downstream slope	

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PERIODIC INSPECT	ION CHECK LIST
PROJECT Storrs Pond	DATE 10/26/79
PROJECT FEATURE Intake Structure	NAME D. LaGatta
DISCIPLINE <u>Geotechnical/Structural</u>	NAME_S. Mazur
AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Intake is a circular concrete drop
Slope Conditions	inlet structure at toe of embankment.
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	Intake structure consists of a celindrical, concrete drop-inlet
Stop Logs and Slots	structure. Considerable concrete deterioration was noted.
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PROJECT Storrs Pond	DATE 10/26/79
PROJECT FEATURE Control Tower	NAME S. Mazur
DISCIPLINE Structural/Hydraulic	NAME R. Yarsites
AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Pond drain structure consists of low inlet located at left side of circular
General Condition	spillway and is operated by gate. The gate is operated from the crest of the
Condition of Joints	spillway. Mechanical controls and gate are very rusty.
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	

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| PERIODIC INSPECTI                     | ION CHECK LIST  | •                                      |
|---------------------------------------|---|--|
| PROJECT Storrs Pond                   | DATE 10/26/79   |  |
| PROJECT FEATURE Pond Drain Structure  | NAME  |  |
| DISCIPLINE Structural/Hydraulic       | NAME  |  |
| AREA EVALUATED                        | CONDITION   |  |
| OUTLET WORKS - TRANSITION AND CONDUIT | The send do dondo has a los deles and                                     |  |
| General Condition of Concrete         | concrete tunnel through the dam. See<br>Figure 1. General condition Fair. | •••                                    |
| Rust or Staining on Concrete          | Rust and stainy.  |  |
| Spalling                              | Spillway-walls and slab of spillway tunnel.                               |  |
| Erosion or Cavitation                 | Erosion of bottom slab and under walls                                    |  |
| Cracking                              | Cracking-walls & slab.  | •                                      |
| Alignment of Monoliths                |   | <b>.</b>                               |
| Alignment of Joints                   |   | •••••••••••••••••••••••••••••••••••••• |
| Numbering of Monoliths                |   |  |
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PROJECT Storrs Pond	DATE10/26/79	
PROJECT FEATURE Spillway Tunnel	NAME R. Yarsites, S. Mazur	
DISCIPLINE Hydraulic, Structural, Geotec	hnical NAME D. LaGatta	
AREA EVALUATED	CONDITION	
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL		
General Condition of Concrete	Fair condition - low inlet and spill- way tunnel.	
Rust or Staining	Staining all walls.	
Spalling	Spalling walls and bottom slab.	
Erosion or Cavitation	Erosion - slab & walls.	
Visible Reinforcing	None noted.	
Any Seepage or Efflorescence	Efflorescence all walls.	. •
Condition at Joints	Good, some spalling.	
Drain Holes	None.	
Channel		•
Loose Rock or Trees Overhanging	Large trees overhanging.	
Channel	Poor. Much debris collected on banks.	
Condition of Discharge Channel		•
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PROJECT Storrs Pond	DATE 10/26/79	
PROJECT FEATURE Spillway Structure	NAME S. Mazur, R. Yarsites	
DISCIPLINE Structural/Hydraulic/Geotech	nical NAME D. LaGatta	<b>-</b>
AREA EVALUATED	CONDITION	
DUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		•••
. Approach Channel	Drop inlet structure passes excessive	•
General Condition	flow.	
Loose Rock Overhanding Channel		
Trees Overhanging Channel		• •
Floor of Approach Channel		
. Weir and Training Walls		
General Condition of Concrete	Fair.	
Rust or Staining	Staining walls.	
Spalling	Spalling walls.	•
Any Visible Reinforcing		
Any Seepage or Efflorescence		
Drain Holes		•
. Discharge Channel	Same as outlet channel.	
General Channel		
Loose Rock Overhanging Channel		. •
Trees Overhanging Channel		
Floor of Channel		
Other Obstructions		
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PERIODIC INSPEC	A-8 CTION CHECK LIST	
PROJECT Storrs Pond	DATE 10/26/79	
PROJECT FEATURE Service Bridge	NAME	
DISCIPLINE	NAME	
AREA EVALUATED	CONDITION	
OUTLET WORKS - SERVICE BRIDGE		
a. Super Structure	This facility has no service bridge.	
Bearings	the dam crest to the spillway riser	
Anchor Bolts	could be seen.	
Bridge Seat		-
Longitudinal Members		
Under Side 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

- 1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS
- 2. PAST INSPECTION REPORTS
- 3. PLAN AND DETAILS

#### AVAILABLE ENGINEERING DATA

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1. A set of drawings (3 sheets), dated November 1934, showing the dam and appurtenant structures is on file at the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire. PAST INSPECTION REPORTS

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Date: November 28, 1978

To: Vernon A. Knowlton, Chief Engineer

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From: Gary L. Kerr, Water Resources Engineer

Subject: Dam Inspection (No. 108.07) Storrs Pond Dam in Hanover Date of Inspection: November 9, 1978

I submit the attached folder with the field inspection report relating to my site visit of November 9, 1978. The following items of maintenance or repair deserve appropriate and timely action to insure stability of the structure:

- 1- Trees and bushes are growing on the embankment and need to be removed to prevent damage to the dam by the root structure or by the tree being entirely uprooted.
- 2- The downstream wingwalls are cracked and spalled and need to be properly repaired to prevent potential failure.
- 3- The exterior surface of the concrete riser (above the present pond level) near the permanent crest has received some maintenance as evidenced by the still attached formwork, but may require more attention as some areas still show areas of spalling.
- 4- The access walkway from the dam embankment out to the concrete riser does not appear to be sturdy enough to support foot traffic as one of its supports is broken near the present waterline.

A letter to the owner indicating that the above items are required maintenance is being sent. This dam is a menace due to the pond storage and the State Highway (Route No. 10). Its discharge then flows into the reservoir behind Wilder Dam.

GLK:paf Enc.

INSPECTION REPORT	
rown: <u>Aprover</u> Dam Number: 1000	
Name of Dam, Stream and/or Water Body: Steph Blue and Charles Pales	2 ° 121 ⊶●
wher: Hand I'm Trans Jos Fry Telephone Number: 643-2403	
Tailing Address: 57 50 MARY HANDIE:	
lax. Height of Dam: 34 Pond Area: 30th Length of Dam: 135th	
POUNDATION: EARSY IND PRECONDUCT LETING	
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DUTLET WORKS:	
3 & MARIN OF MERSK CARE	
10 DEA PRET W/ 4 FLANDAUER	
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ABUTMENTS: NEWC	
MEARKMENT: FRUITA FILL	•
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SHE PAGH+	Location, estimated quantity, etc. <b>0</b> 7
<u>, , , , , , , , , , , , , , , , , , , </u>	B-3
Changes Si	.nce Construction or Last Inspection:
-	GENTLES DEFERINGER PERILES STATE
	MUNCE REPAIRS TO THE CONCERTS
Tail Water	Conditions:
	REC # 10 BALKWARES OF WILLING DEL
Overall Co	ondition of Dam: FRANCE
Overall Co Contact Wi	th Owner:
Overall Co Contact Wi	th Owner: NO spection: J. N: 79 Suggested Reinspection Date
Overall Co Contact Wi Date of Ir Class of I	endition of Dam: FRANK
Overall Co Contact Wi Date of Ir Class of I	endition of Dam: FRAME th Owner: NO aspection: J No. 72 Suggested Reinspection Date Dam: Mproduct
Overall Co Contact Wi Date of Ir Class of I	Signature
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Overall Contact Wi Date of Ir Class of I	andition of Dam: FRAR th Owner: NO aspection: <u>J. No. 78</u> Dam: <u>Markana</u> Signature <u>J. Kerra</u> Date <u>J. Kerra</u>
Overall Co Contact Wi Date of Ir Class of I	andition of Dam: FRAR th Owner: NO aspection: 9 Nov 78 Dam: Marcola 12 Signature Karly Karly Date 9 Mar 78
Overall Co Contact Wi Date of Ir Class of I	andition of Dam:

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-3-Date No. Ĩ B-4 Condition TS: 1) TETTI & French NEW Grander DEN ENGLOCHERDE Ľ 2) OF MERCAN OWN STANDARD OF DIS W NOW MARS 3) CHARGE CHARGEL IS LEW THE CHARGE -THE CONCEPTE HAS PANALLE REALLY AND 4) OUTLON TOAMER WALL HAVE CALLING DELETTS BULUNE OF NO MOST OF THE CLASTICETE JUNITE APP 1 5) FRIELICE OF ROSER APPEND TO THEF MAR ANTRATTA REPLACES (STER PARTS) FUL FRANCE AND 59844146 \_\_\_\_ 6) PORD LEVEL - 6'S FROM THE OF THE 7) DENESS WALKENY DOLES INT APROVA TO BUT SAFE

	INSPECTION REPORT	
Towa: -	Dam Number: 107 CO	
Name of Dam,	Stream and/or Water Body: Stream Part	
Owner:	anout Inprovent Society Telephone Number:	•
Mailing Addro	ess:	
Max. Height	of Dam: $35$ Pond Area: Length of Dam: $145'$	<b>,</b> ●
FOUNDATION:	Faith Foundation	
		•
-		-
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OUTLET WORKS		•
	10 LDin Dropintet spilling,	•
-	3 dua maste Gate	•
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ABUTMENTS:		
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SPILLUAY:	Length: 10' Deck Fre	eboard:	
SEEPAGE: L	ocation, estimated quantity, etc.		0.1
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Manges Sinc			
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fall water C	Sudicions:		ر آب دهه سر بیش ا
	~		
Overall Cond	ition of Dam: $\underline{r}\underline{k}$		
Contact With	Owner:		
Date of Insp	ection: <u>33Min 77</u> Sug	gested Reinspection Date	1930
Class of Dam	: Menace A		]
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te: Give S	zing, Condition and detailed descri	ption for each item, if a	pplicable.

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-3-Dam No.\_\_\_ B-7 CONDENTS: Concrete on Top of Epillanu ć 2. i be repairled. There on Embadant Concitie on intern Floer of discharge tound nee repair . 2.4 . .





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## APPENDIX C

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### PHOTOGRAPHS

## FOR LOCATION OF PHOTOS, SEE FIGURE 1 LOCATED IN APPENDIX B



PHOTO NO. 1 - View of reservoir from dam.

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PHOTO NO. 2 - Upstream face of dam from shoreline opposite dam.



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PHOTO NO. 3 - Upstream face from left abutment. Note areas of missing rip-rap.



PHOTO NO. 4 - Crest as seen from left abutment.



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PHOTO NO. 5 - Downstream face as seen from left abutment.



PHOTO NO. 6 - Rotting tree stump on downstream face 1 to 2 feet below the crest. C-3



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PHOTO NO. 7 - Rotted tree stump on upstream face of dam.



PHOTO NO. 8 - Spillway crest and upper portion of riser.



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PHOTO NO. 9 - Detail of concrete spillway. Note plywood patch forms.



PHOTO NO. 10 - Detail of concrete spillway. Note patch and cracking.



PHOTO NO. 11 - Upstream face of dam as seen from right abutment. Note remains of catwalk to the spillway.



PHOTO NO, 12 - Inside of spillway as seen from invert of discharge tunnel.



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PHOTO NO. 13 - Outlet gate in spillway riser.



PHOTO NO. 14 - Heavy efflorescence on wall of spillway discharge tunnel.

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PHOTO NO. 15 - Downstream portal of spillway discharge tunnel.



PHOTO NO. 16 - Detail of right retaining wall of the tunnel outlet.



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PHOTO NO. 17 - Left wingwall of the tunnel outlet. Note movement of wall.



PHOTO NO. 18 - Spillway and outlet channel viewed from tunnel portal.

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## APPENDIX D

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# HYDROLOGIC AND HYDRAULIC COMPUTATIONS

JTB	Made by RY	Date 1/13/79 JOD NO 5165	.11-15
ID NEEDLES TAMMEN & SERGEND	Checked by HM	Date 20 NOV 79 Sheet No.	/
STORRS POND	DAM	· · · · · · · · · · · · · · · · · · ·	
HYDRAL	ilics & Hydr	ROLOGY	
	· / 4		
DIOFTS Mond Da	is located	along Camp Isrook	$z_{ia}$
in hanner	- Grafton ("	on New Hamishire	
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Classification	Size : Small		
	Hazard: Sign	nficant	
Rasi. Nata	Desinaria Area :	7 74 mil	
	Max Elev. 12	80 FT. HSL	
	Mountainous	300 [t / mi	
$\mathcal{D}_{\cdot}$	A: Zupstream	reservoirs 1.86 by mit	
	Lower K	es.	
Ŧ	Pasimilair : Surl	A-PA 34 2000	
, ,	Chest Elev. 4	2269 60.:520 sere (	
it time of inspec	Spillway w/ Sence": 4	17.14 " 350 acre /	<u>_</u>
	Spillway crest ": 4	15.64 " 300 mer (3	
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Made by HNTB 113/79 JOONO.5965-11-15 26 79 Sheet No. Checked by Date HN Calculation of Test Flood Inflow <u>Step 1</u> Classification size Small Hazard Significant Hydrologic Evaluation Hudeline Recommends 100 yr Frequency Flood to 1/2 PMF for Test Flood clufton Use 1/2 PMF == size is in upper range of kight class with 34 feet no a maximum range ralue of 40 feet. Whe mountainous curve as there is a steep tributary 300 + fut/mile Stope. There are two dans in the water shed upstream of Stores Pond the lower of the Two: Lower Reservoir Dan hava tributary area of 1.86 mi<sup>2</sup>. This leaves .88 mi directly tributary to Storis Fond The Test flow inflow to Jower Reservor a 2345 4 The Routed test flood outflow w. ..... - 1860cps 2-2 three 2-5 Flow direct to Storrs Fond 1980 :4×2450×.88 = Total Inflow to Storrs Pond 2940:43 D-Z

Vade D 100 No 5265 -11-15 Date 1/2/3 79 Checked by LH Storr Calculation of Surcharge Step 2 Insider: No flow thru poid drain pipe Permanent Flashboards to elev. 417.14 Spillway discharge Crest Control H. 19 & morde crest 417.145 13' & sutside 15 Q= Co 2TT RSH032 Assume Ho= H 5.0'R see attached sheet for Coas determined by Ho/Rs R5=6: Max value considered of H./Rs w 427.7 - +17.14 = 7.56 7.56 = 1.16 Co , to (ET.) //0/Rs Ricest 4.0 -115 1630Ka 3.73 . 431 .31 3.07 . 1003 " .62 .9Z 2.20 - 1320 " 1.23 1525 " 1.55 555 .85 2.33 " 1244 ., Check for control in outlet Tunnel Conduit = 10 foot × 10 foot section under dam 5: 32/1031 = .03074 M= 0.018 high to meluste minor losses Pat crestol dam 1244 efs, win flow D-3 Ze Design of Small Doms by S.C.S.

	Made by RY	Date // 26/79	JOD NO 5965-11-15
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Storrs			·····
heck to see I outle	t will control	il water se	face in
ERVA Z Dam crest 4	22.69 reserv	oir is at the c	rist of dam
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Date 11/12/79 JOO NO 5965-11-13 HNTB Viade by Date V26 75 Sheet No. Checked by 2-2 HOWARD NEEDLES TAMMEN & BERGENDOFF Lower Reservoir For Inflow to Storrs Pond <u>Step 1</u> <u>Calculation of Test Flood Inflow</u>. Classification : Size : Small hazard : Significant Hydrologic Evaluation Hudeline Recommends - 100 yr Frequency flood to 12 PMF for the 1/2 PMF as size is on higher end of classification range. 823 acrest rs. a maximum of 1000 at and a hught of 33 feet us. a maximum of 40 Pt 40 ft. Use mountainous curve as there is a stup trubutory area. As drainage set it outside of the PMF quicke curve envelope use the maximum PMF value of 3000 csm Upper Reservoir has a tributary area. 83 sq. ni of the watershed with 1.03 sq me directly tributary to Lower Reservoir Test flood chillow to dipper Res K×3000×.83=1245cfs Routed test flood outflow - 780chs \* See calculations at the ind of this section of 2-2to 2-5 - Not included in this text. Test flood inflow direct to forver Reservor 1/2×3000×1.03 = 1545 eft Upper Reservoir Outflow 780-fu conflow direct to Jours Riv 1545 43 Total about to Journ Reservoir 2325 cfs D-1

Made by 5955-11-13 Date 1/25/75 Checked by Sheet No. 7-3 TAMMEN & BERGENDOFF LOWER Reservoir for Inflow to Storrs Pond Step 2 Calculation of Surcharge Effect Consider : No significant flow thru the water supply intakes or pond drain. : No Flashboards in place (1.0 St high) Spillway Discharge weir Q=eLH32 2 2=3.25 L= 33' anoes weir crest Dermanient crest elev 708.0 Q=3.25(33)H32 = 107.25H32 Discharge over dam Crest Q= ELH32 C=308 Crest Elev 711.5 L=1023-33= 990ft Q= 3.08(990) (H-3.5)" = 3049.2(H-3.5)" Stage-Discharge see Fig 1 Elev Repulliway Roam Total H O ifs 700 110 cfi 709 1-2 110 300 710 Z 300 560 560 711 3.5 700 700 711.5 730 800 100 efs 711-6 3.6 500 1290 711.8 3.8 790 4.0 712.0 1940 D-X 860 1030 2710 712.2 1790 4.Z 920

Date 11/13/77 JOONO 5965-11-13 Made by HNTE Date 1/20/79 Sheet No. 2-4 Checked by HM HOWARD NEEDLES TAMMEN & SERGENOOFF OWER RESERVOIR For Inflow to Storrs Pond <u>Step 3</u> <u>Calculation of Surcharge Effect</u> Qp = 2325cfs RO = 9.5 inches -Storage above spilling crest vertical prism Jaker Surface 47A Start routing with water surface at spilling crest.  $QP_{z} = QP_{1} \times \left(1 - \frac{5t_{2}}{9.5}\right)$ Storm = <u>Storage - AF × 12in/4</u> = 0.0101 Stor A-F 640 2000 × 1.86mi<sup>2</sup> Routing Curve See Sig ! 37 Storage Storing <u> Rpz</u> Clev 2325 efs 708 0 47 acre ft .47 in 2210 709 .95 2090 710 94 1980 1.42 141 711 1860 1.90 188 712 1740 235 2.37 713 See Fig 1 for out flow 1860 efs Stage 712.0 ft 0.50 pt above dam Spillway 38% of Routed test flood of the D-9




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Ref: Design of Small Dams U.S. Dept. of Interior Bureau of Reclamation

For: Morning Glory Type Drop Inlet

D-11

Made by 14/79 JOONO 5765-11-15 Checked by Date Sheet No. % 19 6 STORRS DOWNSTREAM DAMAGE ASSESSMENT Reservoir Storage <u>Step 1</u> Top of Dam Elev. 422.69 Storage 520 we ft Step2 Breach Outflow Poreach = 8/27 Ug Wo Xo23 Wo= 40% of dam langth at Mid Height Vo = maximum height Top of dam to streamhed Total length 140' max.33.75 4' 121 Ų mid height length 76' Qbreach = 3/27 Vg(40)(76)(34)312 = 10100 cfs As spillway outlet is located in center of dam. It's discharge will be included with the breach wave D-12

Made by Date 11/14/79 JOD NO 5455-11-15 HNT Checked by Date 11/2 TA Sheet NO. 41 Storrs Step 3 Stage Discharge Reach Length 1000 yt The outflow of the downstream reach is controlled by the Route 10 highway embankment. The waterway openning under Route 10 was not visible. It is assumed that the discharge thru this openning would be negligible under breach flow conditions Valley Storage between Storrs Pond Dam and Route 10 is computed with the cross section Shown below. The Route 10 embankment 15 15 ft above the streambed Thus d is equal to H(the Lepth of flow over the toddway 11/2 embankment) + 15 feet 100' Valley X-section Route 10 protile 15' H= water surface upstream embankment rembankment Assume Horizontal weir crest 300' Q=CLH32 C=3.08 Discharge Stage/H 720 48 2600 4800 7400 D-13 10300

Made by Date 11/14/79 JOONO 5965-11-15 Checked by Date 11/24 179 Sheet No. 9 Step 4 Reach Outflow Qp. = 10,100 cfs S = 520 acre ft L= 1000 pt Stage, H=4.92' d=19.92' A= 2590#  $V_{1} = \frac{2590 \times 1000}{43560} = 59.5 an - ft$ QPZ = 10,100 (1 - 520) = 8940 egg Stage, H=4.5' d=19.5' H= 2520 ft Vz = 2520×1000 = 57.9 sereft Vave = 58,70 Qp\_= 10,100(1 - 58.7) = 8960 efs Stage H=4.5 the depth of water above Route 10 D-14



INCH INCH

10x10 TO THE





## APPENDIX E

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## INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS



## END

## FILMED

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